MASSACHUSETTS INSTITUTE OF TECHNOLOGY

December 2005, Volume 4, Issue 4

# The BioTECH

NEWSLETTER OF THE BIOMEDICAL ENGINEERING SOCIETY AND THE BIOLOGICAL ENGINEERING COMMUNITY

## Undergrad Research Poster Session, First at MIT for Biological Engineering

**By *Ye Ding '08*,**
*OPERATIONS EDITOR*

The BMES-Merck Research Poster Session Competition took place on November 17, 2005 as MIT's first ever undergraduate poster session for biological engineering related research. It was hosted by the MIT Biomedical Engineering Society (BMES), sponsored by Merck & Co., Inc., and spotlighted on the MIT Homepage.

Fifteen presenters participated in the competition, which was held from 5:30 to 9 PM in the Bush Room. Their posters were printed in color on 42" by 30" glossy paper, complimentary of the Biological Engineering (BE) Department. Three presenters were selected as winners to receive certificates as well as monetary prizes: $500 for first place, $300 for second, and $100 for third.

Poster session winners posed with poster session organizers (left to right): **Joshua Katz** '06 (1st Prize), **Heather Pressler** '07 (2nd Prize), **Amreeta Gill** '09 (3rd Prize), George Eng '06 and Julie Tse '06, BMES Co-Presidents.

The idea for the poster session came from BMES executive board members who wanted to create more opportunities to highlight and recognize undergraduate students' contribution to the research scene at MIT, particularly in the field of biological engineering.

"MIT students are proud of their contributions in the lab, but they don't have many opportunities to practice presenting their work and communicating their expertise in novel areas," noted BMES Co-President and Poster Session Organizer Julie Tse. "By inviting undergraduates to participate in the poster session, our chapter hopes to encourage students to share their interests and accomplishments in biological engineering with the rest of the MIT community," said Tse.

> *"By inviting undergraduates to participate in the poster session, our chapter hopes to encourage students to share their interests and accomplishments in biological engineering with the rest of the MIT community."*
>
> ***Julie Tse, BMES Co-President***

During the poster session, each presenter or team of presenters gave a 5-minute overview of their research, followed by a 5-minute Q&A with the judges.

*(Continued on page 6)*

## Bioengineering @ Rice

*A "**Bio + Engineering**' Landscape @ MIT" feature was printed in the September 2004 issue of the BioTECH, and, in response to this coverage, several BMES chapters across the nation have responded with portrayals of the bioengineering landscape at their respective institutions.*

*Here is the second of a mini-series on "Bio" + "Engineering" Landscape @ Other Schools: **Rice**, **Case Western**, and **Drexel**.*

**By *Néha Datta*,**
*RICE BMES PRESIDENT '04-'05*

Greetings, MIT!

As bioengineering emerges at the forefront of technology, we are privileged to witness the birth of a new field. Like LaVoisier and Einstein who witnessed new eras in chemistry and physics, we are on the cusp of a revolution. It has been said that the 19th century was devoted to chemistry and the 20th to physics. Now, in the 21st century, it is our time as bioengineers. Bioengineering is a diverse and expansive area of study that covers many topics, making it rather difficult to define what a bioengineer is.

*(Continued on page 5)*

## Inside this Issue

The BioTECH

MIT Biomedical Engineering Society Publication

**Managing Editor**
*Brian Chase '06*
**Layout Editor**
*Muyinatu Lediju '06*
**Operations Editor**
*Ye Ding '08*
**Features Editor**
*Joao Paulo Mattos '08*
**Assistant Editor**
*Ali Alhassani '08*
**Advising Editor**
*George Eng '06*
*Julie Tse '06*
*Judy Yeh G*

**Contributing Writers**
*Joshua Aronson '04*
*Nancy Benedetti '05*
*Jonathan Coe '02*
*Néha Datta, Rice*
*Alexis DeSieno '05*
*Delbert Green '08*
*Tomo Iida '02*
*Melissa Lambeth Kemp '97, Ph.D.*
*Vincent Leung, Drexel*
*Sarah May, Case Western*
*Lili Peng '05*
*Faisal Reza '03*
*Amy Shi '04*
*Audrey Wang '03*
*Julie Watts '02*
*Yun-Ling Wong '04*
*Mandy Yeung '05*
*David Yin '03*

**Online Webmasters**
*Kenny Yan '08*
*Connie Yee '08*

**Faculty Advisors**
*Bevin P. Engelward, ScD*
*Professor of Biological Eng (BE)*
*Scott R. Manalis, PhD*
*Professor of BE and MechE*
*Linda G. Griffith, PhD*
*Professor of BE and MechE*
*Doug A. Lauffenburger, PhD*
*Professor of BE, ChemE, Biology*

**Contact Us**
*Email: TheBioTECH@mit.edu*
*Website: http://web.mit.edu/bmes/www/thebiotech.html*
*(Check out our website for PDF and html versions of our monthly issues, which are published online in color)*

Novartis site tour participants posed for a group picture with host Dr. Daniel Liberman at the Cambridge facility.

# Novartis site tour showcases research facilities

**By *Ali Alhassani '08*,**
*Assistant Editor*

On the afternoon of Friday, October 21, 18 members of the Biomedical Engineering Society (BMES) were given the privilege to tour the Global Headquarters of Novartis Institutes for Biomedical Research.

Located a mere two blocks down Massachusetts Avenue from MIT, the 500,000 square foot facility is a testament to cutting-edge medical research that Novartis pursues. This state-of-the-art facility houses oncology research, discovery chemistry, functional genomics, human genetics, the models of disease center, and molecular pathways research. It also serves as the command center for all the other Novartis Institutes in New Jersey, Switzerland, the United Kingdom, Austria, and Japan.

The first thing one notices upon entering the building is how organized and spotlessly clean the lab facilities are. Empty boxes left in the hallways are picked up by janitors every hour. The lab benches are all carefully organized; the professional scientists can easily find anything they need. Intricate machinery is maintained round the clock.

The complex also includes a food court replete with myriad lunch options that all employees and guests of Novartis can enjoy. Next to the food court is a truly beautiful auditorium containing only handmade, extremely comfortable seats imported from Germany! Aimed to please potential investors and executives and to hold press conferences, this hall outshines the likes of 10-250, 26-100, and even 32-123.

Students on the tour recognized a tangible difference between academic and industrial research. Novartis does however collaborate closely with MIT and the Broad Institute. With such an amazing place so close to MIT, one thing is certain: if anyone is looking for a summer internship at a biotech company specializing in drug discovery, Novartis is a great place to start.

*This site tour was organized by Ling Xu '07, BMES VP of Industrial Relations, and kindly hosted by Dr. Daniel Liberman of Novartis. Our thanks also go to J.-F. Hamel and Prof. Linda Griffith for facilitating the logistics of this visit.*

*For an online virtual tour of the Cambridge facility of Novartis, visit www.nibr.norvartis.com.* ■

# Interview with Professor Peter Dedon

## Insights into what Biological Engineering means to scientists vs. engineers

**Prof. Peter Dedon**

**Dr. Peter Dedon** is the Associate Director of the MIT Biological Engineering (BE) Division and Professor of Toxicology and Biological Engineering.

His research is focused on cellular responses to chemical, physical, and biological agents, the chemistry and biology of DNA damage and inflammation, and biochemical approaches to studying DNA torsion.

*In response to the September 2004 Issue of the BioTECH last fall, Prof. Dedon wrote, "As usual, the BioTECH is outstanding. Very professional layout and excellent stories. This is a very good way to disseminate information about Biological and Biomedical Engineering at MIT to not only undergraduate students but also graduate students and faculty. I like the way you included viewpoints about scientists learning about engineering, since that's my perspective."*

*In this issue, BioTECH Features Editor Joao Paulo Mattos interviewed Prof. Dedon to follow up on his comments and his views on what Biological Engineering means to scientists vs. engineers.*

**By *Joao Paulo Mattos '08*,**
*FEATURES EDITOR*

**BioTECH:** In your feedback to our issue last fall, you wrote, "I like the way you included viewpoints about scientists learning about engineering, since that's my perspective." Could you please elaborate on what you meant?

**Prof. Dedon:** The whole notion of Biological Engineering (BE) is the interface between biology and engineering. Some people would view it as engineering applied to biological systems. Other people view it as quantitative biology, if you will. I'm a scientist; a chemist by training and an MD, so I come from an interdisciplinary research realm. I tend to view this as quantitative biology.

Being one of the original members of the division back when it was formed in 1998, I found that there were those of us who were scientists and those who were more engineering-oriented. It's hard to distinguish between the two now. Once we get real biological engineering faculty in here (that is, junior faculty who come from a biological engineering background), it's going to be really hard to tell the difference.

> "We make BE accessible to a lot of different people . . . [MIT BE] embraces people, students and faculty, from all disciplines."
>
> ***Prof. Peter Dedon***

I've always viewed it as a nice education for scientists in terms of the applications of math, models, and other quantitative facets to biology. I've always been quantitative — we quantify things. We don't do modeling, the kinds of mathematical models that many people do.

**BioTECH:** What do you think are the unique strengths scientists bring to the table when they learn about engineering? Challenges?

**Dedon:** The biggest challenge for most scientists is the math. There are only so many hours in a day and so many years in an education. If you're focusing on the science side of the equation you do that on the expense of something else, which in this case is math and engineering.

That's why being in this division is fantastic. In terms of having collaborators who are adept at building machines, doing mathematical models, and doing the engineering side, all of us have fabulous collaborations with each other. The most difficult but most attractive thing is to take our scientific mindset and move into a mathematical, engineering-oriented approach to problems.

**BioTECH:** How does the MIT BE Division make Biological Engineering accessible to people of different backgrounds -- those who have been trained as scientists vs. those who have been trained as engineers?

**Dedon:** Well, our new major now—obviously that's an engineering major—opens the door to any undergraduate coming to MIT. Hopefully in the future we'll have a class size large enough to accommodate anyone who is interested. Right now, of course, we're so new, we don't have all the space and resources to do that.

Clearly, with something like the BME minor, we make BE accessible to a lot of different people. That's one of the attractive features of the division — you can explore it without devoting an entire major to it through the minor program. I think that's one of the great strengths of the division: it embraces people, students, and faculty, from all disciplines.

**BioTECH:** Do you think BME should be a major?

**Dedon:** Well, first I want to ask how does it differ from a BE major? What's the goal of that program? I think that it, philosophically, isn't much different from a BE major. I would like it to stay a minor to allow access to biological

*(Continued on page 4)*

# **Interview with Dedon**: perspective on how MIT BE is unique

*(Continued from page 3)*
engineering as a discipline to undergraduates of all fields. I'd like the BME minor to be preserved and expanded to be accessible to all kinds of people on campus.

**BioTECH:** Do you think MIT was late in having a Biological Engineering major? Why or why not?

**Prof. Dedon:** Oh no, I don't think so. There are a lot of schools that have cobbled together undergraduate educational programs that they'll call biological engineering. It tends to be standard engineering classes — and that's not an insult — with biology classes on the side.

The BE program at MIT is clearly established so that the biology is fused with the engineering. Engineering issues are applied to biological problems in the same class setting. It's a serious BE program, and probably the first.

I think the fact that we create subjects that are clearly new to a discipline called BE, rather than taking Mechanical, Electrical, and Nuclear Engineering subjects and having some extra biology on the side makes us unique. And we're not late at all; I think we might be early. Sure a lot of other schools have a BME program, but I don't think they have the substance in terms of the core subjects that BE does.

**BioTECH:** Are there disadvantages to getting a major in a undefined and ever changing field?

**Dedon:** There are always disadvantages to trying something new. There are always disadvantages to committing a 4-year education to something that's evolving.

On the other hand, getting in on the ground floor is a fabulous opportunity. In 10, 15 years, when BE is so clearly established and defined as a discipline, I think people will be thankful that they invested in this early.

Sure, there are going to be some bugs in the major. You know, you'll have classes that are oversubscribed, labs that you'll be lotteried out of, and so on. But the classes will evolve. Right now they have a very strong BE vision. Yes, there might be some risks, but I think the benefits far outweigh the risks in venturing into this new area.

Industry now is recognizing this BE discipline and is beginning to embrace it in terms of the development of drugs and devices. They see the need for strong engineers who have a great feeling for biological systems and problems. The risk is that when you graduate, what are you going to do for a job? That's the risk for any major. The benefit of BE is that if you give this thing a few years, there's going to be a big demand.

> "A lot of my colleagues at other schools look at us and they're jealous. They're jealous of the fact that we have such low barriers to collaboration."
>
> ***Prof. Peter Dedon***

**BioTECH:** Do you think the collaboration among different departments at MIT is unique? Do you see it often in other schools and other places?

**Dedon:** A lot of my colleagues at other schools look at us and they're jealous. They're jealous of the fact that we have such low barriers to collaboration. They see the power in being able to have access to people who can build machines, who can master twenty differential equations for a mathematical model. There are many places where scientists and engineers collaborate, but here such collaboration is so commonplace that I think it's unique of MIT.

**BioTECH:** What are some of the biggest challenges facing the field of Biological Engineering these days, be they political, financial, or ethical challenges. How do we face such challenges?

**Dedon:** I don't think there are many financial problems because the National Institutes of Health now recognize BE as an important approach to solving medical problems. The challenge for us is to elevate the visibility of biological engineering as a discipline.

How do undergraduates know what it is when they come to MIT? Everyone has a different definition for BE. Undergrads aren't quite sure what it is, and that's our challenge. To clarify this and present it in a way that is immediately obvious to everyone; not just to undergraduates but also to graduate students and to the public. That's coming along. A clearly defined vision for the definition of BE is already out there, and the fog is clearing. ■

**********

## BME @ Drexel

*(Continued from page 5)*
course, general knowledge in human physiology, ethics, and proficiency in the use of engineering instruments is required for all students.

The most distinctive feature of Drexel is probably its co-operative education program. Six-month internships allow students to spend enough time on their jobs to gain real industrial experiences and better tailor their coursework towards their interests when they return to school. From their job experiences, some students conclude that they would prefer getting their graduate degrees before they leave Drexel, while others make plans for professional schools.

Last year's BMES Annual Conference in Philadelphia was a blast for us, and the Drexel students were very excited to learn about the chapters and student activities at other universities. We are glad to have extended our interaction with the MIT chapter, and we certainly hope that such interaction will prove positive and mutually beneficial for all of us. ■

# "Bio" + "Engineering" Landscapes @ Rice, Case Western, Drexel

*(Continued from page 1)*

**Rice**

At Rice University, students are offered a Bioengineering degree (BS) with track electives in the cellular, mechanical, and instrumentation areas. Collaboration with institutions in the adjacent Texas Medical Center (the world's largest medical complex) and NASA's Johnson Space Center allows for a dynamic medium for collaborative growth and learning.

What separates Rice bioengineers from biologists and engineers is their interdisciplinary skills that cover a range from biological sciences to modern materials science, systems modeling, computer science, instrumentation, and design. Thus, Rice's "Bio + Eng" landscape is defined by acknowledging the different areas of study that may arise in the biotechnological field.

The BMES chapter at Rice is dedicated to unifying the broad interests of bioengineers, to channel their energies into looking to the future of biotech. Our chapter at Rice plays an active role in promoting the social and professional development of students interested in the biomedical field.

Workshops to help students select the right graduate programs and post-baccalaureate career options are offered. We sponsor keynote events where notable speakers from various professional backgrounds discuss career options with students. Our small and friendly campus allows for one-on-one interaction between faculty and students at coffee breaks and other study breaks throughout the year.

We are fortunate to have such a close-knit family at Rice, and integral to this family has been our faculty sponsor, Dr. Kyriacos Athanasiou. Together we have been able to bolster student awareness of what it means to be a bioengineer and develop closer industry ties.

In the coming year, we hope to continue this path, increasing student membership and service. One greatly anticipated event is a trip to NASA's biomedical labs, where we will have a chance to learn about space medicine and biotechnology.

I trust our continued collaboration with one another will lead to fruitful innovations for both BMES and the biomedical engineering community as a whole. We hold so much potential in our hands — let's do something amazing!

**Case Western**

**By *Sarah May*, *Case Western BMES President '04–'05***

At Case Western Reserve University, BME Specialty Sequences provide students with a solid background in a well-defined area in biomedical engineering. Each Specialty Sequence includes essential coursework to establish a foundation in a specialty area, and also includes technical electives to provide flexibility to meet specific educational needs.

A customized Specialty Sequence may also be developed with advisor consultation and faculty approval. Our sequences include Bioelectric Engineering, Tissue Engineering, Biomechanics, Imaging and Computing, Instrumentation, Orthopedic Biomaterials, Polymeric Biomaterials, and Systems and Control. Each sequence provides a broad overview of biomedical knowledge as well as a specific focus in certain areas.

To better explain this, take for example the Tissue Engineering sequence: it is a biomedical engineering major with a focus in chemical engineering. Polymeric Biomaterials is a focus in macular molecular engineering, while Imaging and Computing is a focus in computer engineering.

The use of sequences is actually thought highly of by the students here at Case Western. Most students in the biomedical engineering department are very interested in a certain aspect of research, and the choice of sequences allows them to gear their education around their interests.

In addition to Specialty Sequences, we also have an engineering core and a biomedical engineering core to complete. The engineering core is a set of required classes that all engineering majors must complete, such as Thermodynamics, Circuits, and Computer Programming.

The biomedical engineering core is a set of classes that is geared towards giving every student an overview of the knowledge taught in the different sequences, including biomaterials, biomechanics, and others that cover the spectrum of the other sequences.

Overall Case students are being taught on three different levels: we learn fundamental engineering skills; we learn the broad knowledge of a biomedical engineer; and we learn the specific knowledge in the area that interests us the most.

**Drexel**

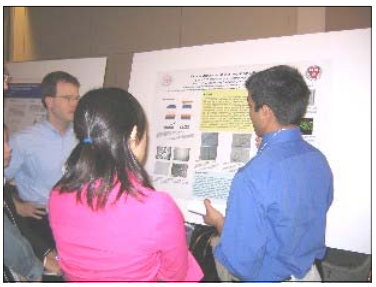
**By *Vincent Leung*, *Drexel BMES President '04–'05***

The BME program offered at Drexel University is interdisciplinary in nature like the BME program described by the MIT BE Division. However, instead of giving its students a crash course in each topic as an elective, Drexel encourages each student to focus on at least one of the biomedical engineering fields as a specialty and take all the related courses.

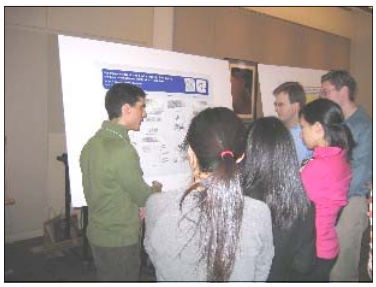
For example, the bioinformatics students would be required to take more classes in programming, computational biology, database structure, and hospital data management, while the neuroengineering students spend more time on psychology, signal processing, biometry, etc. Of

*(Continued on page 4)*

**Chandan Das** MechE '06



**Akash Chandawarkar** '09

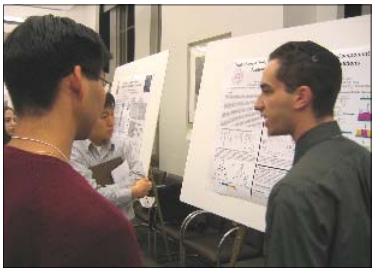


**Sergio Bacallado** Chemistry '07

**Ting Ting Fu** Biology '07
& **Tendai Chizana** Chemistry '06

**Amreeta Gill** '09 and
Prof. Douglas Lauffenburger

**Sophia Kamran** Biology/BE '08
and BE Administrative Assistant
Suzette Clinton



**Joshua Katz** Chemistry '06

# Undergraduate Research Poster Session

*(Continued from page 1)*

The judging panel consisted of BE faculty members, BE Graduate Students Board members, and BMES Executive Board Members, who made rounds in two teams of four, giving each presenter the opportunity to present twice.

In between the two rounds of judging, the presenters often engaged visitors. Professors Douglas Lauffenburger, James Sherley, and Matthew Lang, postdoctoral fellows Jeffrey Karp and Ali Khademhosseini, Dr. Sandra Gaston of Harvard Medical School, as well as friends and other students, were among the many that attended the event.

> *"Ting Ting mentioned that we should practice presentation skills; she asked me to join, and that was how I got involved."*
>
> ***Tendai Chizana '06***

Two presenters, **Sophia Kamran** '08 and **Albert Kwon** '08, had their work featured in previous issues of *The BioTECH* under the "Student Research Spotlight" section and the "MIT Research Highlight" section, respectively.

**Kamran** did her summer research at the Weill Cornell/ Rockefeller/Sloan-Kettering McKinney Lab on *Mycobacterium tuberculosis* (*Mtb*). She examined and identified counter-immune genes that regulate phosphate uptake in *Mtb*. These genes may help the bacterium survive despite host immune response, which often involves the limitation of phosphate.

**Kwon** worked with **Hannah Seong** '08 in Professor Robert Langer's lab at MIT. They experimented with the differentiation of human embryonic stem cells (hESC) into osteogenic cells. By omitting the embryoid body step in the traditional approach, they produced more bone nodules from hESC.

More than a few MIT students had done their research elsewhere.

At Dr. Gaston's Lab in Beth Israel Deaconess Medical Center, **Ting Ting Fu** '07 and **Tendai Chizana** '06 carried out a gene expression profiling method. It involved tissue printing, in which RNA was collected by pressing nitrocellulose gently on top of a tissue specimen and acquiring a layer of cells.

Using Reverse Transcription Polymerase Chain Reaction (RT-PCR) and gel digitization software, **Fu** and **Chizana** evaluated the expression of angiogenic markers and co-regulated genes. They looked for correspondence between gene over-expression and the location of the tumor detected in dynamic contrast enhanced magnetic resonance imaging (MRI).

**Chizana** related why she decided to enter the poster session, "**Ting Ting** mentioned that we should practice presentation skills; she asked me to join, and that was how I got involved."

In the Lavik Lab of Yale's Biomedical Engineering Department, **Sergio Navarro** '08 worked on a project optimizing the encapsulation and release of human recom-

*(Continued on page 7)*

## Faculty Feedback on the BMES-Merck Poster Session

"The poster session was a major success. It was a wonderful opportunity to learn about exciting research from a wide range of programs in biological engineering. Each poster had substantial results, and the presenters did an amazing job at explaining their research to an interdisciplinary audience."

***Prof. Scott Manalis, Biological Engineering and Mechanical Eng.***

"I always felt that undergraduate research should be more actively promoted, since this is one of the unique experiences you can get from an MIT education. The enthusiasm of the participants and the quality of the posters were excellent. With the financial support from Merck, I believe this event could turn into a major competition for all undergraduate student researchers in the future. Desirably, more students should be participating in this event, even if it means longer poster judging hours!"

***Prof. Jongyoon Han, EECS and Biological Engineering***

"The quality and creativity of the research projects presented were tremendously impressive, from freshmen and sophomores to juniors and seniors, and it is very exciting to see the innovative new directions of research arising from our focus on integrating molecular and cellular biosciences with engineering. It is also gratifying to have Merck invest in our BMES student organization efforts encouraging this new biological engineering research. I congratulate our BMES student leaders for their wonderful initiative, and I'll look forward to seeing this terrific event on an annual basis."

***Prof. Doug Lauffenburger, Director, Biological Engineering***

*(Continued from page 6)*

binant vascular endothelial growth factor (hVEGF) from polymer microspheres. Using the method of double emulsion solvent evaporation, biodegradable microspheres containing VEGF and human neurotrophic growth factor (hNT-3) were fabricated.

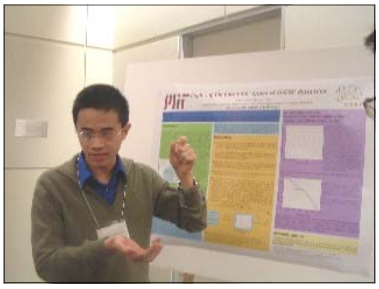
Release of VEGF and NT-3 were quantified using ELISA. **Navarro** found that increasing the concentration of bovine serum albumin (BSA) in the VEGF mixture stabilized the VEGF and promoted its release. On the other hand, the release of NT-3 appeared too low to benefit cell differentiation. Controlled release of encapsulated VEGF may help deliver the growth factor to injured tissues without increasing the chance for tumor growth.

By 8:15 PM, the judges had finished their rounds. After half an hour, they made their decisions: **Joshua Katz** '06 placed first, **Heather Pressler** '07 second, and **Amreeta Gill** '09 third.

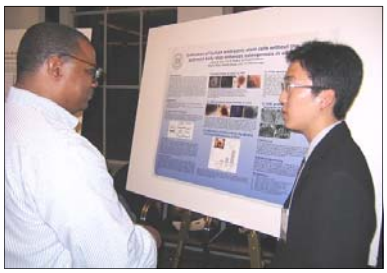
As a part of his UROP project under the guidance of Junsang Doh and Professor Darrell Irvine, **Katz** further developed the chemistry and characterization of the oNBMA-co-MMA-co-PEGMA photoresists, including the use of the 35:0:65 resist as an inverse-tone resist for two component patterning.

**Pressler**'s research was on PHMPA-Mce6-Cortisol and the efficacy of delivering the drug to ovarian cancer cells. Working at the University of Utah's Kopecek

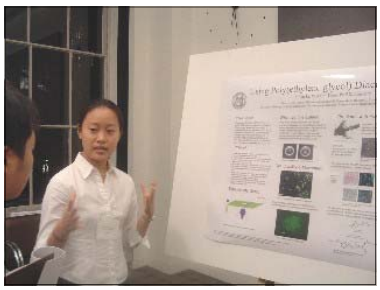
*(Continued on page 8)*



**Joel Yuen** Chemistry '07

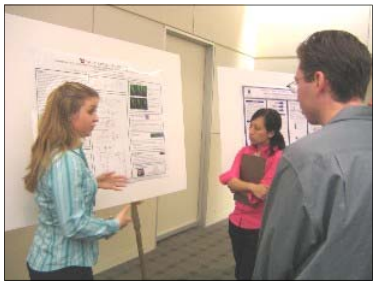


**Albert Kwon** Biology '08 and Prof. James Sherley

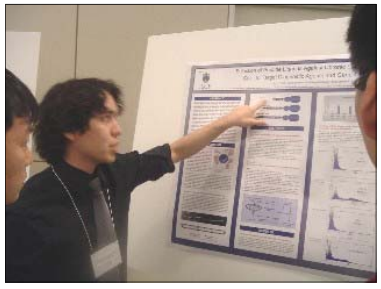


**Chun Li** EECS '08

**Sergio Navarro** MechE '08



**Heather Pressler** Biology & Chemistry '07



**Jerry Trejo** Biology '07

# BMES-Merck Poster Session celebrates undergraduate research

**FIRST PRIZE**
**Joshua Katz**
Chemistry '06
MIT Irvine Lab

*O-Nitrobenzyl protected polymer surfaces for multi-component protein photopatterning under mild, aqueous conditions*

Judges' comments:
Substantive involvement and contribution to research, as evidenced in strong command of material presented and first-author publication in *Langmuir*

**SECOND PRIZE**
**Heather Pressler**
Biology & Chemistry '07
University of Utah Kopecek Lab

*Development and determination of cytotoxicity & nuclear localization for HPMA copolymer-bound mesochlorin as a treatment for ovarian cancer*

Judges' comments:
Especially engaging presentation style and illustrative poster layout; well motivated research and clearly explained methodology

**THIRD PRIZE**
**Amreeta Gill** '09
California State University, Fullerton, Kantardjieff Lab

*Error catastrophe: Using structural genomics to develop therapeutics that inhibit the Mycobacterium tuberculosis 3' exonuclease of DNA polymerase III*

Judges' comments:
Impressive research carried out as a high school student; thoroughly and convincingly delivered presentation

*(Continued from page 7)*

Lab this past summer, she devised purification processes that raised the yield of synthesizing PHMPA-Mce6-Cortisol from 5% to 25%.

Before coming to MIT, **Gill** worked under Dr. Katherine Kantardjieff at the California State University, Fullerton. They constructed homology models for dnaQ, an enzyme that repairs DNA in *Mycobacterium tuberculosis*. These models may be used to identify candidates for the inhibition of dnaQ, and similar approaches may facilitate drug development against other targets. ■

*MIT BMES would like to thank the presenters and the judges for their participation:*

***Presenters***

*Sergio Bacallado*
*Akash Chandawarkar*
*Chandan Das*
*Amreeta Gill*
*Ting Ting Fu*
*& Tendai Chizana*
*Sophia Kamran*
*Joshua Katz*
*Albert Kwon*
*& Hannah Seong*
*Chun Li*
*Sergio Navarro*
*Heather Pressler*
*Jerry Trejo*
*Joel Yuen*

***Judges***

*Prof. Scott Manalis*
*Prof. Jongyoon Han*
*Hyung-Do Kim*
*Jordan Green*
*Jennifer Fang*
*see * below*

***Organizing Committee***

*Julie Tse **
*George Eng **
*Judy Yeh **
*JuneWha Rhee*
*Stephanie Reed*

The Judging Panel prepared to go on rounds (left to right): **George Eng** '06, BMES Co-President; **Hyung-Do Kim**, BE Ph.D. Candidate; Prof. **Jongyoon Han**, EECS and BE; Prof. **Scott Manalis**, BE and MechE; **Jordan Green**, BE Ph.D. Candidate; **Jennifer Fang**, BE M.Eng. Candidate; **Julie Tse** '06, BMES Co-President; **Judy Yeh**, BE M.Eng. Candidate.

***Our thanks also go to:***

*Merck Recruiting Coordinator Dr. Brian Phenix for his support; Merck & Co., Inc. for its sponsorship of cash prizes; Ms. Suzette Clinton for assistance with preparing the awards; Mr. Aran Parillo for help with printing the posters; Prof. Lauffenburger, Prof. Griffith, Prof. Engelward, and Prof. Manalis for their guidance to the chapter.*

# BMES Executive Board Alumni Notes: *Life after MIT*

*At the suggestion of Prof. Matthew Lang, former faculty advisor of BMES, we have connected with past officers and invited them to write a blurb on what they have been up to since graduating from MIT. Here's what they have shared with us:*

## '97

**Melissa Lambeth Kemp**, Ph.D.
* S.B. in Nuclear Engineering '97, BME minor
* BMES Co-Founder '96-'97
* Currently a Postdoctoral Associate at Lauffenburger Lab in BE at MIT.
* *Life after MIT*:

Graduate school in Seattle, WA; returned to Cambridge in 2003.

## '02

**Jonathan Coe**
* S.B. in Mechanical Eng. '02
* BMES VP of Publications '01-'02
* Currently a Design Engineer at Ethicon Endo-Surgery (Cincinnati, OH), a Johnson & Johnson Company.
* *Life after MIT*:

MSME at Georgia Tech before starting in industry in 2004.

**Tomo Iida**
* S.B. in Chemical Engineering '02
M.Eng. in Biomedical Eng. '03
* BMES Secretary '01-'02
* Currently a Diplomat in Embassy of Japan in Greece, Ministry of Foreign Affairs of Japan
* *Life after MIT*:

After graduation, I worked at Life Science Laboratory of SONY Corporation in Tokyo as a research engineer developing a DNA disk that could be used for entertainment purpose. (You know, SONY likes to produce something creative and fun, not for medical use.) I liked the job and the environment, but my curiosity for the world outside of science and engineering has emerged enormously soon after I started to work in the real world.

So, I switched my job to become a diplomat. Now I am assigned to Embassy of Japan in Greece and engaged in the facilitation of Japan-Greece economic affairs. Quite a different life, but I love it very much. Indeed, I miss thinking about gene expressions and pipetting once in a while, but I feel great to expand my knowledge and experience to diplomacy and its associated political, economical, and cultural issues.

The best thing I learned from being at MIT is not to be afraid of challenging new things. As Einstein says, curiosity and actions are the driving force to make one's life full. So, I strongly hope that fellow BMES students listen to what their hearts tell them and live happily, whatever career they choose to have. All the best to all of you.

*P.S. Tomo got married this past September!*

**Julie Watts**
* S.B. in Chemical Engineering '02
* BMES VP of Research '01-'02
* Currently a Market Assessment Manager at Clearview Projects (Brisbane, CA)
* *Life after MIT*:

Life has been great in San Francisco! I love working for Clearview Projects, which is a biotech consulting company that also helps biotech companies form partnerships. I'm learning a lot from the team here.

Prior to Clearview, I was working for a tissue engineering start-up company doing project management. It was a great experience, too! There are so many biotech events out here, and it's good to start building a network wherever you live. There is even a group called BioE2E (Entrepreneur to Entrepreneur) that was originally founded by the MITCNC (Club of Northern CA).

In my free time, I race catamarans (small sailboats) with my fiancé, play soccer, and hike. There is a lot to do in the bay area!

## '03

**Faisal Reza**
* S.B. in Physics, Feb. '03
S.B. in Science, Technology, and Society, Feb. '03
Minor in Chemistry
Minor in Biomedical Engineering
* BMES Member-at-large '00-'02
Crufty alum '03-
* Currently remaining in academia, in interdisciplinary research positions at Duke University (Durham, NC) similar to those espoused by MIT BMES:
Doctoral candidate in Computational Biology and Bioinformatics;
Masters candidate (en route) in Biomedical Engineering;
Certificate candidate (en route) in Biomolecular and Tissue Engineering
* *Life after MIT*:

I continued computational biology and bioengineering research and teaching at MIT and Harvard University before pursuing graduate studies at Duke in these disciplines.

My research focuses on synthetic systems bioengineering, at the nexus of these disciplines. I use computational approaches to model and prototype the architecture of existing biological systems and engineering approaches to design and implement synthetic biological systems in a complementary manner. This research is generously supported by a Bioinformatics Award through Duke University and a NIGMS Biotechnology Predoctoral Training Fellowship through the NIH.

MIT's new S.B. in Biological Engineering will be a boon to future undergraduates who find themselves at the crossroads of the basic biosciences, engineering, and technology. Though I miss having such an opportunity when I found myself at these crossroads, such feelings are tempered in knowing that MIT's biological engineering initiatives today exceed those of yesterday.

*(Continued on page 10)*

# BMES Executive Board Alumni Notes: *Life after MIT*

*(Continued from page 9)*

**Audrey Wang**
* S.B. in Biology '03
* BMES VP of Special Programs '02-'03
* Currently a medical student at Harvard Medical School, Harvard-MIT HST Program (Boston, MA)
* *Life after MIT*:

I spent the first year of my life after MIT working abroad as a research intern at a pharmaceutical company through the MIT-Japan Program. Needless to say, it was quite an experience, living on my own so far away from home and everything else I had ever known. I arrived in early August, welcomed by my supervisor as well as the summer heat and humidity of Osaka. Throughout my stay, I sampled various aspects of Japanese culture, cuisine, and company life.

Before I knew it, spring gave way to the summer heat once more, and I found myself back in the US preparing for orientation week at medical school. I did not stray far from MIT, though. I am now a second-year in the Harvard-MIT HST Program, living across the Charles in the heart of the Longwood Medical Area. I currently divide my time among classes, research at the Dana-Farber Cancer Institute, and exploration of Boston.

**David Yin**
* S.B. in Chemical Engineering '03
M.Eng. in Biomedical Engineering '04
* BMES VP of Special Programs '01-'02
* Currently a Product Development Engineer at Clorox (Pleasanton, CA)
* *Life after MIT*:

Life here in San Francisco is going well. I love the city and the lack of snow. Still getting adjusted to the real world and figuring out what I want to do with my life.

While I enjoyed my time at MIT and highly value my engineering education, I don't know that I want to be an engineer long term. After working for Clorox in the consumer goods industry I've found myself very attracted to the business, more specifically marketing, aspects of industry.

Who knows where the future will take me, though currently the writing on the wall might be business school. I wish the undergrads involved with BMES the best of luck and remember nothing you do now dictates what you have to be in the future. Keep your eyes open and your ears to the ground. You never know what could happen!

## '04

**Joshua Aronson**
* S.B. in Biology '04, Minor in Toxicology
* BMES VP of Information Technology '01-'03
* Currently a medical student at Harvard Medical School, Harvard-MIT HST Program (Boston, MA)
* *Life after MIT*:

After graduating in 2004, I spent the summer before medical school working in Dr. Raphael Bueno's laboratory in the Department of Thoracic Surgery at Brigham and Women's Hospital researching the use of mRNA microarrays to predict candidate oncogenes and tumor suppressor proteins.

As the fall began and medical school started, I moved to the Harvard Medical dorm, Vanderbilt Hall, thus completing my four-plus years in Next House. In the spring, I began my thesis research in Dr. David Scadden's lab at MGH in the Center for Regenerative Medicine. I am researching the role of osteoblasts in the regulation of the haematopoietic stem cell niche, eventually identifying secreted or cell-surface signaling proteins involved with stem cell self-renewal.

During this past summer, I moved to Beacon Hill and spent my time working full-time in the lab. Now, in my second year of medical school, I am finishing my preclinical coursework and preparing to start my clinical rotations in the hospitals.

**Amy Shi**
* S.B. in Chemical Engineering '04
* BMES President '02-'03
* Currently a Ph.D. student in the Harvard-MIT HST Medical Engineering and Medical Physics (MEMP) Program (Boston, MA)
* *Life after MIT*:

After spending the summer traveling with friends around western Europe and the Rockies, I returned to Boston to start my PhD in HST and Materials Science and Engineering.

I chose a thesis lab in the fall (Prof. Angela Belcher's lab), working on a vaccine storage project. After the first year of classes, I took written quals and then spent the summer in Boston (my first!) doing research and exploring more of the Boston that I didn't see as an undergraduate as well as exploring parts of New England and Canada. This term, I'm taking classes over at Harvard Medical School where I have bumped into a few fellow BMES alums who have also decided to stay in the area.

All in all, life as a grad student tends to be more flexible, more self-directed, and is in many ways like a job where they pay you to learn A LOT. Great time so far and looking forward to finishing my oral quals in the spring so I can become an official PhD Candidate and get cruising with the research.

**Yun-Ling Wong**
* S.B. in Chemical Engineering '04; S.B. in Biology '04
* BMES VP of Research '02-'03
* Currently a Ph.D. student in Bioengineering at Harvard University (Boston, MA)
* *Life after MIT*:

Working as a doctoral candidate on pulmonary drug delivery of vaccines for tuberculosis in third world countries.

# BMES Executive Board Alumni Notes: *Life after MIT*

## '05

**Nancy Benedetti**
* S.B. in Biology '05
* BMES VP of Special Projects '02-'03
* Currently a medical student at Stanford University (Stanford, CA)
* *Life after MIT*:

Medical school at Stanford has proven to be much different from MIT, and I'm not just talking about the weather, which, of course, is much more pleasant in California than in Boston. I have spent most of the first quarter adjusting to the new environment, establishing good study habits, and getting to know my classmates.

At MIT, we are tested on problem solving that applies the material taught in class, but in medical school, we are tested almost exclusively on memorization (and a lot of it). Adjusting my study habits for rote memorization definitely took some time. Luckily, not all of my classes are based solely on memorization.

Because Stanford is housed on one campus, we are able to take classes at other schools, so I am taking a business school class on the costs, risks, and benefits of health care. My group project is a cost-effectiveness analysis of anti-malaria drugs in Uganda. It has been great to have a quantitatively focused class and to study something other than biological science. I've always enjoyed learning about the economic side of medicine, and I plan to start a research project in this area soon.

**Alexis DeSieno**
* S.B. in Brain & Cognitive Sci. '05
* BMES President '03-'05, VP of Publicity '02-'03
* Currently a Private Wealth Management Analyst at Morgan Stanley (New York, NY)
* *Life after MIT*:

New York is great! After going through Morgan Stanley's Investment Banking training over the summer, I began working in the Quantitative Strategies and Analysis group in Private Wealth focusing on "ultra high-net worth" clients. One of the things I have been the most surprised about is the type of clients we serve — lots of people from Boston who started pharmaceutical companies!

For me, I've been doing a lot of catching up, since prior to this job I had absolutely no finance background (I worked in bio labs and never took 15.401). I work ridiculous hours trying to learn all of course 15 in 1 month, hoping that I sound like I know what I'm talking about.

Outside of work I'm on the executive board of the MIT Club of NY as Editor of the MIT NY Newsletter, and I'm mentoring a high school student in Brooklyn weekly through iMentor. The future? An MD/MBA program to apply all these business skills to helping people in a medical setting — hospital administration or starting a biotech. We'll see.

New York is completely crazy and intense, and I can't wait to get my first PAID vacation so I can go home to California and chill for a few days!! The main difference from college is that when you work, you have a lot less free time because you're in the office 12+ hours per day. Time is passing so quickly, and I can't believe I've been a real person contributing to society and paying bills (gasp!) for the last 5 months. I really miss MIT, so enjoy it while you still have it!

If you have any questions about switching from science to finance, feel free to contact me: <alexisd @alum.mit.edu>. Good luck this year!

**Lili Peng**
* S.B. in Chemical Engineering '05; BME Minor
* BMES VP of IT '02-'03, VP of Special Programs '03-'04, Student Advisor '04-'05
* Currently a Ph.D. student in Bioengineering at USCD (San Diego, CA)
* *Life after MIT*:

Hi everyone! I'm having a blast out here in southern California! I just started my PhD track at the UCSD Bioengineering Department.

Now that I'm in graduate school, I can truly appreciate how much my undergraduate background in chemical engineering has provided a strong set of skills for graduate school. Experiences such as my previous UROPs, BME internships, and communication-intensive lab courses (10.26) have taught me skills that are crucial to doing cutting-edge research. Even my MIT coursework has made my graduate coursework very manageable — I definitely don't regret my MIT experience.

The things that I'm still getting adjusted to are: the lack of snow (not that it's a bad thing!), UCSD's quarterly trimester system (it's a very different pace from MIT's semester system), and living in my first apartment! Last month I also took a weekend trip to the SF Bay area to visit some MIT alumni, including Max Cohen '05. In terms of research, I recently joined a lab in which I will be doing computational modeling of the heart. I will start research rotation this winter, and I am extremely excited about this project!

Feel free to email me at <lilipeng@alum.mit.edu> if you have questions about graduate school or southern California or the like.

**Mandy Yeung**
* S.B. in Biology '05
* BMES VP of Special Programs '03-'04, Secretary '02-'03
* Currently a Consultant at Simon-Kucher & Partners (Boston, MA)
* *Life after MIT*:

Interned at Genentech, traveled to China and Hong Kong, spending quality times with family and friends at home in California. ■

**BE SB Advising Session**

Tuesday, December 13,
4:30-5:30 pm in 56-614
*Provided by Prof. Linda Griffith*
*Tailored for freshmen*

# Student Research Spotlight

## New Model for Investigating Role of *Evi1* in Acute Myeloid Leukemia and Myelodysplastic Syndrome

**Delbert Green**, a sophomore from Opelousas, LA, plans on majoring in Biological Engineering with a minor in Brain and Cognitive Sciences. He has been working in Dr. Fernando Camargo's lab at the Whitehead Institute since January 2005.

**By *Delbert A. Green II '08***

Aberrant expression of different transcription factors in hematopoietic (blood) cells has been implicated in several hematological disorders. In acute myeloid leukemia (AML), anomalous cells accumulate in the bone marrow, replace normal blood cells, and spread to other organs. Myelodysplastic syndrome (MDS) is characterized by the accumulation of genetic abnormalities in the hematopoietic stem cell (HSC).

Anomalous activation of the transcription factor *Evi1* leads to AML and MDS in mice and humans. In the hematopoietic lineage, *Evi1* has been shown to be expressed exclusively in the pluripotent hematopoietic stem cell (HSC), indicating that *Evi1* may play a role in sustaining the pluripotency of HSCs.

In order to determine the role of *Evi1* in adult hematopoiesis, thus defining the role of *Evi1* in AML and MDS, we have created both *in vitro* and *in vivo* models of retroviral infection-induced over expression and ablation of *Evi1* in HSCs.

EMLs, a hematopoietic progenitor cell line, were infected with a retrovirus harboring an siRNA for silencing of *Evi1*. One to two days post-infection, *Evi1*-deficient HSCs show a slowed growth rate and morphology uncharacteristic of the HSC. After several days, most *Evi1*-deficient HSCs have died, though few show the morphology of red blood cells.

Bone marrow-derived HSCs infected with the *Evi1*-siRNA were competitively transplanted into recipient mice. *Evi1*-deficient HSCs are unable to contribute to the blood lineage, indicating a competitive advantage of *Evi1*-positive HSCs in forming the hematopoietic system (Fig. 1).

It is apparent that *Evi1* expression dictates a delicate balance in normal hematopoiesis. *Evi1* seems critical for HSC potential (self-renewal of the HSC population) and potency (ability to form the hematopoietic system), but expression in differentiated hematopoietic cells leads to disease. We are currently working to establish more definitively the importance of *Evi1* in hematopoiesis and to delineate the precise mechanism(s) by which *Evi1* acts. ■

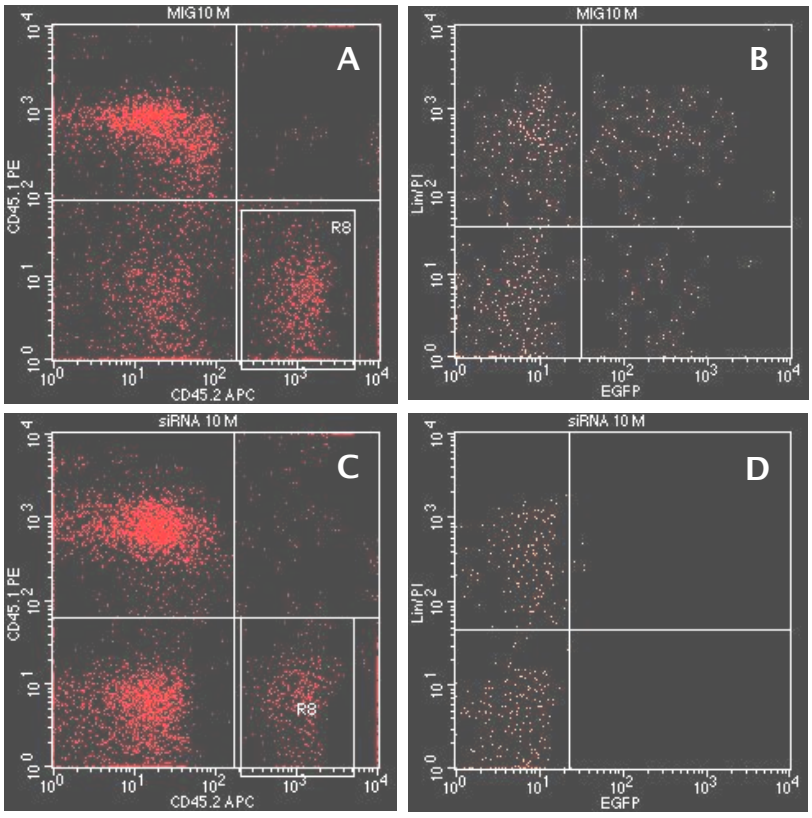



**Figure 1. Peripheral Blood Analysis (FACS).** Lethally irradiated mice were rescued with donor Lin- BM cells. The peripheral blood was analyzed for host/donor blood reconstitution. (A-B) Control: Lin- BM cells infected with pMIG (MSCV-IRES-GFP) virus. (C-D) BM cells infected with *Evi1*-siRNA virus (which includes an IRES-GFP fusion). $GFP^+$ is an indication of viral infection. In 1D, the absence of $GFP^+$ cells indicates that *Evi1*-deficient donor cells did not contribute to the blood of rescued mice.