MIT's Biomedical Engineering Society Newsletter

The BioTECH

Volume 2, Issue 1 Friday, August 29, 2003

President's Welcome to BMES

***By Alexis DeSieno**, BMES PRESIDENT*

Welcome to the ninth year of the MIT Biomedical Engineering Society! Since its establishment in 1995, the MIT chapter of BMES has grown from a small, unrecognized campus organization, to one of the leading chapters in the nation.

Over the past nine years, the MIT Biomedical Engineering Society has worked towards its founders' goal by bringing you leading speakers in the field with the EMBS-BMES Distinguished Lecture Series, by hosting industrial site tours of top companies like Merck, by securing exclusive research opportunities only for BMES members, by establishing the Johnson & Johnson Excellence in Bioengineering Award, and most recently, by allocating space in room 56-639 to create a common place for you, the MIT undergraduate, to become active with BMES.

While serving you remains our primary goal, as your President this year I hope to lead the MIT chapter of BMES to a new level that will not only reach out to our members, but also to the Boston community and beyond.

As I stated in my candidacy speech, my personal goal is to increase member involvement within the MIT community. Last year, I founded the "BioTECH," the newsletter you are reading, in order to increase communication between our membership and the executive board and to expose you to the technology being developed today. This year, I want to continue to bring you lectures, internships and newsletters, but I also want you to have the opportunity to take on a more active role in the Society.

> *"This chapter is built upon a firm foundation: a universal passion for our area of study and a strong sense of pride for our home, the Massachusetts Institute of Technology."*
>
> ***BMES Constitution***

You can look forward to more general body meetings, an updated website with lucrative research opportunities, an *opportunity* to take on a leadership role with the creation of new executive offices, and a chance for you to work directly with

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Meet the BMES Exec Board

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The Changing BME Minor

***By Sisi Chen**, VP OF RESEARCH*

The upcoming academic year is a pivotal year for the future of biological and biomedical engineering at the Institute as the Biological Engineering Division (BE) enters an advanced stage of planning for an anticipated SB degree in Biological Engineering.

Since planning first began a few years ago, BE has made much progress on the development of the major – a draft curriculum now exists, and new faculty have been hired in the past 2 years in BE and affiliated departments to teach BE and joint BE/departmental classes. The BE major is anticipated to be available for the class of 2009.

In the meantime, the BME minor will be undergoing some slight changes to its course offerings and curriculum. Freshmen thinking about in BME should pay close attention to the "Special Guide for Freshmen and

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the BMES executive board with the creation of "panel meetings" so that we can address your concerns.

I plan to initiate a "mentor program" between new members and upperclassmen, facilitate "faculty/ student lunches" in Walker dining once a week where faculty and students can discuss the latest in bioengineering at MIT, as well as to create an active community service outreach program which draws upon our passion in biomedical engineering to improve our community.

Lastly, I hope to work with other chapters of BMES and with Nationals, to sponsor joint events and discover ideas about how to better serve you and create an even stronger chapter.

The BMES Constitution states: "This chapter is built upon a firm foundation: a universal passion for our area of study and a strong sense of pride for our home, the Massachusetts Institute of Technology."

I believe that this powerful combination makes anything possible. By establishing connections between you, the faculty, your fellow students, and industry leaders, you will have the opportunity to work directly with some of the world's leading bioengineering researchers and to be at the forefront of some of the most innovative and modern techniques in development today — you may even discover something yourself.

With the leadership of our faculty sponsors, Professor James Sherley and Professor Matthew Lang, and with a talented executive board who has worked hard all summer, you can be sure next year is going to be better than ever. But, the success of the Biomedical Engineering Society at MIT depends on you – on your involvement and active interest.

I urge you to join us, and become one of the fastest growing organizations on campus and in the nation. I hope you will look through this issue of the BioTECH to see just some of the things that the MIT Biomedical Engineering Society has to offer you.

If you have any questions or suggestions at any point this year, please feel free to contact me at alexisd@mit.edu. I'm looking forward to working with you this year!

Upcoming Events: Monthly Lecture Series

***By Mandy Yeung**, VP OF SPECIAL PROGRAMS*

Continuing from a very successful start last year, the 2003-2004 EMBS-BMES Distinguished Lecture Series is looking to be just as promising, with two exciting lecturers already lined up for September and October.

In September, Steven R. Gullans, Chief Scientific Officer of US Genomics and Associate Professor of Harvard Medical School, will present "Single Molecule Biology." He will speak on US Genomics' development of technology that is suitable for analyzing biomolecules using etched silicon devices, microfluidics, and advanced optics.

We are also looking forward to hearing from MIT's very own Professor James Sherley in October. An Associate Professor of Biological Engineering, Sherley has taken a new approach to expanding adult stem cells in culture, which will be presented along with the latest developments in our program for biological engineering adult stem cell production.

The EMBS-BMES Distinguished Lecture Series is a monthly event co-sponsored by the Engineering in Biology and Medicine Society (EMBS) of Boston and the Biomedical Engineering Society (BMES) of MIT.

The lecture series is free and open to the public, and we invite you to join us for our next two lectures on Tuesday, September 23, in room 4-370 at 7pm, and on Wednesday, October 8, in room 1-190 at 7pm. Light refreshments will be served at 6:30 pm, and lectures are estimated to last 45 minutes, followed by a short Q&A session.

Last year we were privileged to have almost a hundred attendees at our lectures, and we hope that you will join us for this upcoming series!

The 2003-2004 EMBS-BMES Distinguished Lecture Series

"Single Molecule Biology"

Steve Gullans
CSO of US Genomics
September 23, 7pm, Rm. 4-370

"Expansion of Adult Stem Cells"

James Sherley
Professor of Biological Engineering at MIT
October 8, 7pm, Rm. 1-190

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Become a member by visiting http://web.mit.edu/bmes/membership.html

Interested in writing for The BioTECH?

Email us at TheBioTECH@mit.edu for more information

New Options for Undergrad Studies in Bio/Medical Engineering

By Judy Yeh, EDITOR

To address the rising student interest in biological and biomedical engineering, several departments are developing new educational programs as options in addition to the currently available biomedical engineering (BME) minor. The new degree offerings include Biological Engineering (BE), Course 10B within the Chemical Engineering (ChE) department, and Course 2A Biotrack within the Mechanical Engineering (ME) department.

Biological Eng. as a Major

The BE Division is currently developing new subjects for the anticipated BE undergraduate major, projected to be available for students entering MIT in fall 2005.

While BME remains a minor as a loosely defined field with diverse applications in clinical medicine, the new BE major, as envisioned by the BE Division, would be grounded as a new discipline with a single set of core fundamentals, like other established engineering disciplines.

"Biological Engineering is a new discipline of engineering based entirely in the science of biology, particularly molecular cell biology," said BE Professor Linda Griffith, also Chair of the BE Undergraduate Program Committee. "MIT is taking a leading role in defining this new discipline at the graduate and undergraduate level, making BE one of the contributing disciplines to the applied field of BME."

The new degree program seeks to address the long-standing student demand for BE as a major, but the BE Division has been very careful in developing an undergraduate curriculum grounded in such a new and evolving field, said ChE and BE Professor Dane Wittrup.

"We don't want to just blindly follow the national trend," he said.

The development of BE as an undergraduate major follows the institution of the BE Division in 1998, the offering of a doctorate degree program starting in 1999, and the subsequent assembly of a five-year program leading to a M. Eng. degree starting in 2000.

The core subjects in the graduate program now provide a basis for the four-year undergraduate curriculum, being developed by the BE Division since 2002 as additional offerings in the BME minor program. Such courses include Introduction to BE (BE.010) and Laboratory Fundamentals in BE (BE.109).

> *"Biological Engineering is a new discipline of engineering based entirely in the science of biology, particularly molecular cell biology."*
>
> ***Prof. Linda Griffith***

Course 10B Chemical-Biological Engineering

To complement the existing Course 10 and 10C degree programs, the ChE department has developed a proposal to offer Course 10B Chemical-Biological Engineering to reflect the increasing biological focus of its educational program.

"There's been a great deal of discussion and excitement associated with the 10B proposal," said ChE Professor Karen Gleason, also Executive Officer in ChE curriculum development. "We're putting this together as a systematic approach for students who want to see how ChE can be used as a powerful tool in solving biological problems."

While retaining the core ChE subjects of the existing Course 10 degree, the proposed 10B degree requirements will include core biology classes (7.02, 7.03, 7.05 and 7.06) and a new biological engineering laboratory (10.28) offered starting this fall to highlight the application areas of ChE in biochemical processes. Biological transport classes (10.303, 10.304) are being developed as alternatives to the current classes in fluid mechanics and transport processes (10.301, 10.302). In addition, biological applications will be emphasized through selection of relevant modules in the capstone design subjects, Integrated ChE (ICE).

"We want our students to learn undiluted science directly from the scientists, as they know it and teach it best," said Wittrup, who contributed to the design of the 10B curriculum, "and use that as a point of departure where we can launch into rigorous ChE analysis based on a common foundation in biology."

After the proposal is approved by the Institute Committees overseeing undergraduate education, the Course 10B degree will be printed in the MIT Bulletin next spring, at which point it will become available as a major for students to declare. Since the early requirements are similar, undergraduates should have the ability to switch between the 10 and 10B tracks after their sophomore year, said Gleason.

The Course 10B degree will be submitted for certification by the Accreditation Board for Engineering and Technology (ABET) after receiving Institute approval.

Course 2A Biotrack in Mechanical Engineering

To complement the existing ABET accredited 2A degree program, the ME Department has developed the Biotrack to provide additional support for students with a special interest in bioengineering while building a strong ME base.

The Biotrack requires two of the five second-level ME core classes in addition to all the basic cores, freeing 60-66 units for students to pursue an individualized course of study in BE with the guidance of a 2A faculty advisor. The Biotrack curriculum is structured such that it is complementary to the BME minor, and a ME departmental certificate is awarded upon successful completion.

"The program is very student-oriented, and I work with each individual student to configure their curriculum," said ME and BE Professor Peter So, also advisor to all Course 2A Biotrack students.

Specific recommended courses to complement the 2A Biotrack curriculum include Organic Chemistry (5.12), Biochemistry (7.05), Statistical Thermodynamics (BE.011J), and Biomechanics (BE.310).

Of the 300 undergraduates in the ME Department, approximately 65

(BE Options, Continued on page 7)

Challenge for the Newly Arrived: How Can I Find a BME UROP?

By Jeanette Tse, Writer

Why get a BME UROP?

Before discussing how to find BME UROPs, perhaps a better question is what is the point of a BME UROP?

For students looking to go to graduate school for biomedical engineering, UROPs not only give the experience in the laboratory valuable on an application, but more importantly, provide the opportunity to get a taste of what is to come. They require "a whole set of problem-solving skills that don't get utilized in classes," said Professor Hamad-Schifferli.

Not all people who are interested in BME UROPs are absolutely sure what they want to do after their undergraduate years at MIT. For those who are interested in biomedical engineering but are unsure if BME is truly right, UROPs are often a good way of exploring this interest.

Since biomedical engineering is a broad field, there are MIT professors doing research in varied areas from looking at how pathogens attained from the environment cause cancers in humans to using metal nanoparticles to control the activity of biomolecules. Some professors concentrate on the mechanical aspects of biomedical engineering while others on the chemical aspects with still more on the electrical aspects. The exciting part is that these professors are working on some of the biggest questions currently in biomedical engineering, and you could be making contributions to their projects!

No lab experience?

Many UROP labs do expect applicants to have prior laboratory experiences, certain skills, or specific coursework, but there are certain opportunities that require no previous experience, such as those in Professor Schauer's laboratory.

> *"Research is an exceptionally helpful way to see how concepts in coursework play out in practice – especially at the leading edge of knowledge and technology creation."*
>
> ***Prof. Doug Lauffenburger***

In his lab, which researches the pathogenesis or the mechanism of disease of bacteria, laboratory experience and classes in molecular biology and microbiology are helpful. However, he mentions, "But for students interested in infectious diseases who are willing to learn 'on the job,' previous lab experience is not absolutely necessary."

For labs that ask for applicants with a long list of skills or classes, lacking one or two of these does not necessarily mean don't bother applying. In these cases, contact the professor expressing your interest and highlighting the skills you have, while acknowledging the skills you do not but are willing to learn.

Sometimes when lacking experience, skills, and classes necessary to be attractive to BME labs, waiting another semester to get the necessary background is wise. If you are extremely interested in a particular lab, some labs have a position for autoclaving and restocking supplies. These positions allow you to explore what the lab works on while demonstrating that you are responsible and fascinated with the work they are doing.

For freshmen, the pre-UROP program during IAP (http://web.mit.edu/UROP/preuropapp.html) allows inexperienced students go to a lab and learn skills needed to be a UROP in that lab as well as getting a look into the work the lab is doing. There are some BME labs that are involved with this program.

How to find a UROP?

The first thing to do is to identify what types of problems under the large umbrella of biomedical engineering are interesting to you and to determine what skills you already have. Doing this self-exploration prior to launching a UROP search will save time by eliminating positions you probably will not fit because either you will not find them interesting or you will not have fitting qualifications.

Just a few positions currently open in different labs are listed at the end of this article to get you started. Read through them, paying special attention to those that fit the profile created earlier with your preferences and qualifications.

Another method of finding available UROPs is to check the UROP website, **http://web.mit.edu/UROP/index.html**. However, many professors do not list their opportunities so talk to other people

RESEARCH PUBLICATION OPPORTUNITY

In each of the following issues of The BioTECH, we will be featuring an undergraduate student's research in biomedical engineering (BME). This is a great opportunity to help prepare for the Johnson & Johnson Excellence in Biomedical Engineering Research Award!

Guidelines for Submission:

1. Original research in a BME-related field
2. A concise and informative description of research in 500 words
3. Jargon-free language accessible to the general MIT community
4. Approval from mentor if research is UROP-based, or clearance from employer if research is industry-based.

For further information, please email TheBioTECH@mit.edu.

involved in BME UROPs. In addition, check the biomedical engineering faculty website, **http://web.mit.edu/be/fact.html** and read through the profiles of BME professors. Pick out professors whose work you find interesting.

The search for a BME UROP can take a while so it is prudent to begin reading up two months before you want to start working in the lab. This will give you time to also work out details regarding work schedule, goals, and responsibilities.

Applying for the Position

With a list of professors whose work interests you and whose requirements match your qualifications, it is time to contact those professors.

Emailing or calling professors generally allows you to reach more professors than you would by going in person. However, especially with email, ignoring what you have to say is fairly easy. Some people recommend simply showing up around the professor's office or lab to talk about the position. Going in person does show a seriousness that lets the professor know that they're probably not just one of the tens of professors that you've contacted. It is also harder to say no to someone sitting in his or her office than to someone who emails.

Many professors prefer to take on new UROPs during IAP or the summer since this allows students to spend more time in the lab so they are able to really make progress on their projects and learn any skills they have to learn.

Most of all, be persistent and look for opportunities that you'll really enjoy. Good luck in your search!

Selected BME UROP opportunities (look on the BME website for more info)

Lab of Professor Yaffe

Description: UROP position available in the fall for someone interested in bioinformatics and cell signaling.

Qualifications: Previous experience with C programming, Perl, HTML, and possibly some MySQL; 7.05 or equivalent.

Lab of Professor Fox

Description: Interested in environmentally acquired pathogens and the differences in genome and gene expression in a particular strain of mice that are and are not infected with one such pathogen *H. hepaticus,* which, when injected into these mice, causes dysplasia.

Lab of Professor Lauffenburger

Description: Projects focus on bringing quantitative engineering approaches to bear on understanding how cell functions are governed by receptor-mediated signals. Work typically involves a biochemistry and cell biology experiment, often in combination with mathematical modeling and computational analysis. Lab studies cell proliferation, differentiation, death, and migration, relevant to wound healing, cancer, immune and inflammatory system operation, including applications in molecular/cell therapeutics discovery and development as well as biomaterials and tissue engineering.

> *"Students are often surprised at how the nitty gritty of research actually happens since it's so different from what you do in class."*
>
> ***Prof. Kim Hamad-Schifferli***

Lab of Professor Hamad-Schifferli

Description: Interested in developing nanoscale interfaces to biomolecules for control of activity. To this end, they are using metal nanoparticles as antennas which control the activity of a linked biomolecule. One currently open research project is the construction of a fluorescent optical imaging setup compatible with RF magnetic fields involving design and machining, construction of electronic circuits, and some optics.

Qualifications: Looking for highly motivated UROPs with interests and experience in biology, engineering, materials science, physics, and chemistry. For the particular project mentioned, previous experience in building experimental setups is a must; a familiarity with fluorescence imaging of biological systems is also helpful.

Lab of Professor Dedon

Description: Interested in understanding the basis for so-called spontaneous mutations in humans, with an emphasis on the abundance of DNA damage that occurs simply because humans live on an oxygen-rich planet. Also study the damage to cellular macromolecules caused by different kinds of free radicals and the effect of mechanical manipulations of DNA on its structure, function, and susceptibility to damage.

Qualifications: Best preparation is a firm grounding in biology, chemistry, and biochemistry since all the projects rely heavily on techniques drawn from these fields.

Lab of Professor Engelward

Description: UROP position available to work on a project aimed at revealing the relative susceptibility of different cell types to homologous recombination events. They have already developed one strain of "recombomice" in which recombinant cells within tissues can be detected by a fluorescent signal.

Their goal is to develop technology to be able to visualize such recombinant cells within intact tissues of mice. Various approaches will be tested, including fluorescence microscopy, two-photon microscopy, confocal microscopy, and scanning laser cytometry.

Qualifications: Interested UROP students will need to have taken biology and chemistry, and ideally genetics as well. Previous UROP experience in molecular biology or credit in 7.02 is a plus.

Lab of Professor Schauer

Description: There are opportunities to work in this lab for credit or for pay doing a UROP. Research in this lab focuses on pathogenesis – mechanism of disease – of bacteria.

Qualifications: Having had classes in molecular biology and microbiology is helpful, as is laboratory experience.

BME Minor Subjects Added, Retired, Shifted, Restricted

(BME Minor, Continued from page 1)
Sophomores" to plan their courses for the next two years, and then watch for updates on new courses coming on line.

The list of course offerings for the 2005-2006 year (when current freshmen would begin taking BME minor BME cores and electives) is not yet firmly established, although we anticipate that there will be more courses available overall.

Upperclassmen in choosing courses for the 2003-2004 year should note that most BME core classes will be offered in the spring this year; the schedules may change again next year (2004-2005), but updates will be provided.

One major change in the curriculum is that *Cell and Tissue Engineering* (BE.360J), a BME core class, might be discontinued, with part of its subject matter integrated into *Molecular and Engineering Aspects of Biotechnology* (BE.361J). These two classes had been offered in alternate years, and the faculty are considering offering BE.361 every year although no final decision has yet been made.

Course 3 majors should be happy to hear that a Biomaterials course (3.051J, formerly 3.071) might be offered as a new BME core class starting this coming spring. The class is already part of the course 3 curriculum and the BME minor as a restricted elective.

The last major change is that *Laboratory Fundamentals in Biological Engineering* (BE.109), offered in the spring, will have enrollment limited to 12 students of sophomore standing this year and may have limited enrollment to sophomore standing (with 12 or 24 students) in the 2004-2005 AY. Limitations on enrollment in later years are difficult to predict, as it will be a required course for BE majors and we cannot predict enrollment in the major at this time. We anticipate that it will be offered in the spring and fall terms if the major is approved.

Although it is unfortunate that current undergraduates cannot enroll in the BE major, the development of the major will no doubt result in a much greater course selection for current BME minors.

Already, many new BME electives are being offered this coming year, including *Silicon Biology* (BE.481) and *Computational and Systems Biology* (BE.490). As frontier engineering research turns increasingly towards biological issues, the development of this new major couldn't have come at a better time.

Upperclassmen registered for the BME minor should expect to receive periodic updates on changes in course offerings and the curriculum.

Freshman might have already received the most recent information on the minor at the Academic Midway during Orientation. For those who didn't, this information will be up before Registration Day on the BE Division's website at http://web.mit.edu/be/edpro.html. For specific questions, you can contact Professor Linda Griffith at griff@mit.edu.

Reg Day
BME Minor
Info Session

- Overview of the minor
- Updates on the core and elective courses
- Plans for the BE major

Sept. 2, 2003
3-5 pm, Rm. 56-114

Lander Heads Collaborative Efforts at The Broad Institute

Prof. Eric Lander, Director of Broad Institute courtesy of www.wi.mit.edu

By Muyinatu Lediju, *ASSISTANT EDITOR*

The Broad Institute is a collaboration between MIT, Harvard and its affiliated hospitals, and the Whitehead Institute for Biomedical Research. These institutions are joining forces because they understand that the human genome can have a great impact on clinical medicine as it stands today. They aim to revolutionize clinical medicine through the promise of the human genome.

The mission of the Broad Institute is two-fold: (1) to create comprehensive tools for genomic medicine and make them broadly available to scientists around the world, and (2) to pioneer applications of these tools to the study of disease, in order to propel the understanding, diagnosis, prevention and treatment of disease.

The collaboration of these three institutions will unite experts in the areas of molecular biology, genomics, chemistry and chemical biology, computational science, engineering and medicine. This union of expertise is considered to be the basis for the "comprehensive tools" needed for genomic medicine. In other words, it's the complete set of information, laboratory reagents and analytical methods needed to study human biology and disease processes.

The Broad Institute seeks to empower the next generation of young scientists by providing access to the most powerful concepts and tools of genomics. This information should enable the scientists to tackle a variety of biomedical problems.

Our very own Eric Lander will be the director of The Broad Institute. Lander is a faculty member at MIT and The Whitehead Institute, a member of the MIT Center for Cancer Research, and the founder and director of the Whitehead Institute/MIT Center for Genome Research. In addition to this, Lander is expected to join the faculty of the Harvard Medical School later this year. These numerous appointments have not hindered Lander from accepting the position as director of The Broad Institute.

Subtle Differences Distinguish Each Bio/Medical Eng. Program

(BE Options, Continued from page 3)
are enrolled in the 2A program, and about 20 of which are pursuing the Biotrack. Most Course 2A Biotrack students are also BME minors. A significant growth has been observed in the enrollment for the 2A program, and it is expected that students pursuing the Biotrack will maintain a 1/3 representation as the overall number for 2A is projected to exceed 100, said So.

The Course 2A Biotrack came into existence half a year ago, and it remains an active area of continual development. Interested students should contact Professor So before the end of their sophomore year.

BE vs. 10B vs. 2A ~ What's the Difference?

As biological engineering plays a centerpiece in all three degree offerings – BE, 10B, and 2A Biotrack, faculties in charge of developing these curricula offer their perspectives on the distinction between these educational programs.

The four corner stones of the Course 10B curriculum consist of biological sciences, chemical sciences, ChE sciences, and integrative capstone labs, said Gleason. As with Course 2A, the five fundamentals of ME will be covered in Biotrack: materials and mechanics, control systems, thermal fluids, design, and manufacturing, said So.

While each established engineering discipline is focused on addressing a certain range of biological problems within the scope of tools and approaches of that discipline, BE is the direct fusion of engineering with modern biology, said Griffith.

"Biological Engineering brings to bear on biology the appropriate tools and perspectives from chemical, civil, computer, electrical, materials, mechanical, and nuclear engineering in an integrated way, and all the core subjects blend biology and engineering intimately," said Griffith. "BE is not envisioned as replacing the individual efforts, but rather enhancing them by pushing new frontiers."

While 10B and 2A Biotrack may require or recommend certain biology subjects as part of their curriculum requirement, the BE Division has the addition of strong educational ties with the Biology Department, said Griffith. Several BE faculty members, including the BE Director, Doug Lauffenburger, have appointments in the Biology Department. In addition, all the BE Division faculty (~35) are focused on biological problems in their research and teaching, with about a third of them trained as biologists, said Griffith.

The difference between BE as a major and BE as a focus within another engineering discipline can also be seen as a choice between breadth and depth, said Wittrup.

"BE is broad in that it offers a comprehensive approach on how engineering in general can be used to solve biological problems," said Wittrup. "Course 10B, on the other hand, provides depth with the particular toolkit of ChE, focusing on areas such as reactor design, transport, and bioprocessing, while not incorporating aspects from ME and electrical engineering and computer science (EECS) such as biomechanics, bioinformatics, and electrical instrumentation."

> *"BE is broad in that it offers a comprehensive approach on how engineering in general can be used to solve biological problems . . . Course 10B, on the other hand, provides depth with the particular toolkit of ChE, focusing on areas such as reactor design, transport, and bioprocessing . . ."*
>
> ***Prof. Dane Wittrup***

With Course 2A Biotrack, common areas of focus include biomechanics, biomaterials, bioinstrumentation, and bio-inspired manufacturing. While most engineering disciplines follow a well-defined, predetermined curriculum, the Biotrack distinguishes itself with the flexibility and the student-directed approach, said So.

In terms of outlook on employment, Course 2A Biotrack is ABET accredited, and Course 10B is expected to be a credential at least equivalent to the traditional ChE degree.

"For Course 10B, retention of the full ICE design experience and capstone engineering lab experience should prove valuable to engineers seeking industrial employment immediately upon completion of their SB degree," said Gleason.

Agreeing, Griffith adds that there has long been a desire on the part of companies who hire ChE graduates for more background and training in bioprocessing, and thus the 10B degree fulfills an important need.

For graduates with a BE degree, on the other hand, a precedent has yet to be set.

"The career paths of BE students is expected to be quite different from those of ChE students," said Griffith. "Our industrial partners believe that these students may break new paths for engineers in parts of companies who have not previously hired engineers, and these students will be well prepared to go on to graduate school in Biology."

While it remains to be seen how each of these degree programs will translate into tickets to graduate schools and professional careers, the emerging options for undergraduate studies in biological engineering and biomedical engineering serve an important function in giving students more choices, said Wittrup.

"The faculty are excited to be developing innovative new curricula," said Wittrup. "This is a historic paradigm shift in engineering education, with the integration of biology throughout the disciplines. In the end, the point is to provide to our students a comprehensive spectrum of opportunities in bioengineering."

Come find out more about BME options at the

First BMES Meeting

~ Sept. 24 ~

with company recruiting presentation by Cordis, a J&J company

Perspective in Biomedical Research: Academia vs. Industry

By Lili Peng, *VP OF SPECIAL PROJECTS*

As MIT students, it is likely that we will be involved in some form of scientific research during our undergraduate career. Whether it is a UROP in a biology lab or an internship in the research and development division of a pharmaceutical company, the opportunities for MIT students to do research are endless.

Indeed, working in a research environment is an invaluable experience with great benefits – it gives us insight into graduate school, a head start on potential thesis work, and opportunity to immerse ourselves in cutting-edge science and technology.

As a junior in chemical engineering, I am also privy to this double-faceted world of scientific research. Like most MIT students, I first experienced real-world research by acquiring a UROP in the Lauffenburger Lab, where I mostly conducted laboratory bench work under the supervision of a graduate student.

When I received an internship at Intel's Biotechnology Research Group this summer, I initially entered the corporate world thinking that bioengineering research would be similar to my UROP: running lab experiments, analyzing the data using computer technology, and writing reports on my conclusions.

Little did I know that research in industry is much different from academic research at MIT. Although both settings gave me the opportunity to experience cutting-edge bioengineering research, I have also witnessed the distinct differences between academia and industry:

Technical Background. It is commonly assumed that the level of technical expertise also varies with the research environment: those with Masters level are more often found in industry, and those with PhD's tend to navigate towards academia. In my situation, I have found this conception to be rather false.

At Intel's Biotech Research Group, every employee has achieved a doctorate level of education; at my UROP, there are graduate students who have just finished their Masters level and are still working towards their Ph.Ds. Perhaps my case is a rare exception, given that Intel's Biotech Research Group research group is relatively small (9 employees) and new (3 years old) compared to bigger and more established biotech companies.

Environment. The environment in my UROP lab was much more open in terms of discussing and exchanging research ideas. I often saw graduate students discussing math equations and concepts openly in the hallway. Such conduct was rare in industry, as the "hard science" was only discussed in private meetings and laboratories. In addition, any information generated in industry was used only internally; that is, it is intellectual property not privy to public disclosure.

Stress. Although research-related stress is prevalent in both settings (of which I was victim myself!), I noticed that the sources for stress were different. At my UROP lab, the stress was more self-induced as graduate students stayed overnight to finish experiments, whereas work-related stress in industry mainly resulted from a project delay or even termination.

Funding and Flexibility. In academia, there is more independence in taking on the role of an independent investigator. While this allows the researcher to pursue any kind of science he wishes, it also sets up the anxiety of writing grants and proposals requesting funding from sources often consisting of anonymous persons. (For me, it was writing and submitting a UROP proposal.) On the other hand, my summer project at Intel was assigned, and although the financial resources were readily available, I did not have the freedom to choose my own project, as I did at MIT.

Publications. The pressure to publish is definitely higher in academia than in industry, as the role of people in academia is to discover and deliver scientific knowledge to the public. Contrariwise, the primary function of a business enterprise is to develop and sell products to other companies and for immediate consumer use by obtaining patents.

Diversity: a quality both worlds share. Despite the differences in bioengineering research in academia and in industry, I did notice one similar element- the *diversity of people* working in the field. This similarity is the biggest distinction of bioengineering research itself.

At both MIT and Intel, researchers from different disciplines (ranging from chemistry to mathematics to mechanical engineering) work towards a common goal in a single research group. Perhaps this heterogeneity of people is correlated to the breadth of the bioengineering field; thus, the need for adaptability and collaboration is manifest.

As my UROP mentor remarks, "While such breadth exists in more classical research and engineering disciplines, it is exceedingly rare that you will find this same diversity in a single research group or research project."

Given the pros and cons of each environment, there is no overall advantage to working in one setting over another. Take into consideration what is ultimately important to you, and I am sure your research experience will be rewarding!

Spotlight

Lili Peng '05, Course 10, BME Minor

Academic Research Experience

Third year UROP student in the Lauffenburger Lab. Conducted quantitative experiments using Western blotting and gel electrophoresis to investigate protein signaling on in-vitro cell membranes for apoptosis (cell life/death decision process) behavior in HT-29 colon carcinoma epithelial cells.

Industrial Research Experience

Technical research intern at Intel's Biotech Research Group. Performed competitive assessment on Intel's biosensor device against competing technologies by compiling and analyzing scientific literature to evaluate sensitivity, specificity, and other theoretical and experimental limitations.