"ABET" is the Accreditation Board for Engineering and Technology, Inc. that accredits the curricula of engineering programs throughout the nation.

The Biomedical Engineering Department at UC Davis is the youngest of the engineering disciplines. The College of Engineering (COE) wanted BME to join the other engineering departments in the ABET-accreditation process to demonstrate the university’s ability to produce a robust group of engineering graduates for the work force.

The BME Department had their first graduating class in 2006. ABET accreditation must be renewed every 6 years, so 2012 was BME’s first year to be evaluated for accreditation.
As a young department, the BME faculty started from scratch to prepare their first ABET report. In 2010, our faculty formed an ABET Committee to gather and assemble the many documents required for the ABET Accreditation process. Binders upon binders of reports consisting of the assignments, exams, lecture slides, and books were generated for all BME classes.

Our faculty became “students once again” in writing reports, fulfilling requirements, and preparing themselves before the big “ABET examination.” Our Vice Chair of Education, Dr. Angelique Louie, was the driving force in preparing for the big exam day and went so far as to quiz faculty on their ABET knowledge! The overall ABET examination consisted of an on-campus site visit, interviews with students, talks with faculty and campus officials, visits to our research laboratories and a literal room-full of reports and binders that our hard-working ABET Committee had prepared for the ABET evaluators to review.

Our department’s journey happily resulted in the Department of Biomedical Engineering to be accredited. Rosalind Christian, BME Undergraduate Advisor and member of the ABET Committee, reminisced about the day they found out the initial “results of the exam” in November 2012. Mrs. Christian remembered the news uplifted the whole department and made them happy that all their hard work had paid off. Speaking for our BME students, we would like to thank the BME Department and the ABET Committee for earning our ABET accreditation!

HEY fellow BME-s! We all know you’ve been longing to join the BME Outreach Committee, but you’ve just been too shy to jump in. So we’ve taken it upon ourselves to do a little reconnaissance on the subject and tell you everything you need to know to start spicing up your quarter! We asked Rachel Gurlin, the fearless Vice-President of the Outreach Committee, to fill us in on what the Outreach Committee does for our community and our club members.

The Outreach Program is an outlet for students to take on leadership roles (to beef up that resume!) and/or to participate in reaching out to our community to change lives, inspire youths, and educate people about what exactly we do as biomedical engineers. BMES club members can approach the committee with an outreach project of their own, or simply volunteer for another club member's project. This allows the program to be fluid and cater to the interests of participating club members in a way that gives back to the community at large.
The Committee’s first outreach project will be in partnership with BESA (the biomedical engineering graduate student association) and will entail a visit to a local school to show kids what exactly biomedical engineers do via presentations and interactive demos.

So what can you expect from the Outreach Committee? The good news is that the sky’s the limit. Since this committee is run by your fellow students, the scope of our outreach will be directly determined by your input. Other committee members can utilized to make your outreach dreams a reality, or you can simply contribute your time and efforts to the outreach dreams of your fellow BME’s.

Still not interested in joining the Outreach Committee? All altruism aside, let us tell you how joining the Outreach Committee will enhance your undergraduate experience. Participating in outreach efforts exercises your communication skills by requiring you to impart sometimes complicated ideas with simple language. Joining the committee also promotes your personal growth as an individual by giving you professional experience and exposing you to a collaborative environment. And if making a difference is not for you, you should at least join the Outreach Committee so that you’re more than just another number-crunching engineer.

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**BME SEMINARS**

**BY: KENNETH CHANG**

The Biomedical Engineering department holds many seminars on various topics and developments currently happening in the field. Called the Distinguished, Departmental and Alumni Seminar Series, these talks are held every Thursday at 4:00 PM in 1005 GBSF.

For the seminar, our speaker was Nancy E. Lane, M.D. Nancy Lane is the Endowed Professor of Medicine of Rheumatology and Aging Research and Director for the Center for Musculoskeletal Health. She is also the Principal Investigator of the NIH backed “Program on Sex Differences in Musculoskeletal Diseases across the Lifespan” here at UC Davis. She is an internationally recognized scientist in the fields of osteoporosis and osteoarthritis. Her work has included defining the role of glucocorticoids in bone fragility, pioneering a clinical trial demonstrating the effectiveness of hormone PTH in reversing glucocorticoid induced osteoporosis, and in developing a novel compound to direct stem cells to grow into new bone.

Nancy E. Lane, M.D.
Her seminar started out with a look at a joint that suffered from osteoarthritis (OA) and Dr. Lane pointing out some interesting information to us, particularly that new bone was forming while cartilage was being destroyed. She also showed data from further x-rays of the knee, and studies that correlated Bone Mass Density with increased risk of OA. Finally, she posed the question that has defined her work: what controls this very interesting process?

The answer is the WNT signaling pathway, a signal transduction pathway that is involved in a number of processes such as synovial joint formation and the development of cartilage and the skeleton in an embryo. It turns out that expression of the SFRP3 gene specifically codes for these processes, but is also now associated with increased risk of OA.

Dr. Lane also mentioned some limitations about the work they have done. The primary one is that they are not sure yet if the results they found are generalizable to an entire population. Also, the data they studied was collected from older women, but further observations on men must be done before the work can be generalized.

In addition to Dr. Nancy Lane, one of her colleagues, Barton Wise M.D., MSc. also spoke as well. He talked about the Active Shape Modeling techniques he employed to study the shape of the bones in the knees and joints. His work was very interesting as he talked about the mathematical analysis they perform, and what conclusions they can draw from it. For example, one of the results they found was that abnormal hip shape does end up increasing the risk of OA.

The seminar ended with a number of people posing interesting questions, such as whether or not mechanical loading of the skeleton could increase the chance of getting osteoarthritis. Dr. Lane also went over further work they were planning to do, including the new usage of MRI’s to generate 3D active space models, and to examine further variations in bone structure and make up. This is the first time (Active Shape Modeling (ASM) has been applied this widely and on this much data.

Dr. Lane encouraged the audience to study these signaling pathways, like WNT, since not only is this where the exciting science is, but it also contributes greatly to our understanding of the body and health.
As a relatively new field in the world of engineering, biomedical engineering is not as established as the other disciplines. While UC Davis indicates their major as “biomedical engineering,” the majority of universities in California have described their major as simply “bioengineering”. With such a broad field of study, how can one distinguish between the two?

Biomedical Engineering (BME) is the application of medicine and principles of engineering through a top-down or bottom-up approach, as well as the concepts of design, in order to enhance aspects of healthcare such as treatment, diagnosis, and even imaging. On the other hand, “medicine” itself is an applied science aiming at the enhancement, sustainment, and recuperation of the human body through the use of technology. The use of technology is where BME plays an enormous role in medicine. Using engineering knowledge and principles, countless biomedical engineers have created innovative devices, and have gone as far as to dramatically improve these devices to enhance modern medical technologies. At UC Davis alone, we have six principle specializations in BME alone: medical imaging, biomechanics, medical devices, cellular & tissue engineering, systems & synthetic biology, and pre-med (along with a new biocomputational route in planning). In many BME cases, a strong number of medical technologies often seek to analyze, improve, and visualize four main aspects towards the human body: physiology, anatomy, molecular biology, and metabolism.

As a field of study, BME is actually one of many branches of what we call bioengineering (BIOE). This field, like BME, is the application of the engineering principles and design concepts to solve the real-world issues related to forms of life sciences, specifically biology; however, BIOE does not apply solely towards medicine. Because BIOE is such a broad subject, it can also branch out into genetic engineering or bioprocess engineering. Even agricultural engineering seeks to augment, refine, sustain, or even construct products of many biological systems. However, these enhancements are not directed solely towards the human body; BIOE can be implemented to other living organisms. At UC Davis, we have different majors that are very distinguishable in bioengineering aside from BME: biochemical, agricultural and biological systems engineering. Surprisingly, while synthetic & systems biology is a part of the BME specialization, many universities have separated this specialization away from BME.
Specifically, “synthetic biology” is the design and construction of biological systems (not exclusive to the human body) overlapping with both BME and BIOE, whereas “systems biology” is the simultaneous use of biology, technology, and computation models to comprehend cellular organization and cell-cell interactions in a complex network. As mentioned, these two specific studies do not necessarily revolve around medicine, yet they both incorporate great contributions towards both BIOE and BME.

To summarize, we all know that biomedical engineering IS a form of bioengineering, but “bioengineering” itself can refer to many different fields of study. I hope that by knowing the specific differences between the two fields, you can properly decide which path you wish to take. Here, at UC Davis, we have such a wide range of interdisciplinary research by our professors in BME that the amount of experience will be remarkably compelling. In any case, I am certain that both BME and BIOE will offer such significant and magnificent experience!

**CMGI**

**BY: LIZA NGUYEN**

Here at UC Davis, the school boasts its very own center for biomedical imaging. “Biomedical imaging” is the process and techniques in which images of biological systems are taken for research or medical purposes. Named the Center for Molecular Genomic Imaging (CMGI for short), the facility was established due to a demand for access to biomedical imaging by researchers and with the goal that one day UC Davis would independently be able to use biomedical imaging as a translational tool to develop new approaches to study and diagnose human diseases through imaging.

One of the center's goals is to become a functional part of a “pipeline” within the campus where multiple departments and centers could work together in harmony to analyze a problem, formulate potential solutions, and put those solutions in action to test their potential. Specifically, CMGI's mission is to apply advanced imaging technologies in order to better understand diseases in humans. The

CMGI is the result of the explosion in demand for pre-clinical imaging that has happened over the last ten years. The center includes four imaging suites, where a variety of scans, such as positron emission tomography (PET), x-ray computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound are all offered. While similar centers exist elsewhere, such as within drug companies, CMGI is unique in that it contains all parts
necessary for the imaging modalities to be implemented – the combination of state-of-the-art equipment and methods (some developed in the Department of Biomedical Engineering), trained staff and a diverse array of disease models all come together to distinguish the center from others of its kind. The center also contains its own biomedical cyclotron and is able to synthesize its own radiolabeled compounds for testing.

The CMGI is co-directed by Professor Simon Cherry and Professor Julie Sutcliffe, who work together and oversee the center and its staff. The center currently supports over 70 different researchers at UC Davis and also has done work for other Universities and several companies. The center also provides internship opportunities where students can gain hands-on experience learning to operate the equipment used in the imaging field and analyze data. Additionally, personnel at CMGI have received many grants to bring in new technologies and improve its services to the scientific community. When asked about the decade of service the center has done here at UC Davis, Professor Cherry replied “We've spent the last ten years working to get money in to build the equipment and infrastructure, and develop an expert staff to operate it – but now that we've got a good grasp on that, we're moving on to bigger things that incorporate CMGI’s preclinical imaging with a broader vision of a translational imaging center at UC Davis.” This concept was recently funded by one of the 11 grants given out by the Office of Research as part of its Research Investment in Science and Engineering program.

Since its founding, the Center for Molecular Imaging and Genomic Imaging has been a great boon for the school, making new advanced imaging technologies available to the research community. With eager anticipation, UC Davis can look forward to even more opportunities from this one-of-a-kind facility as it enters its second decade.

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**BME WORLD NEWS**

**BY: JON CHEN**

**Biomechanics**

In this day and age, one would think that human anatomy is a field that has been explored in its entirety. Think again! Two Belgian surgeons at University Hospital Leuvens identified a new ligament in the human knee. The ligament was first hypothesized in 1879 by a French surgeon who thought an extra ligament existed in the anterior of the knee. Based off of this theory, the Belgians, who were researching ACL injuries, dissected the knees of human cadavers and found proof of its existence in all but one of the cadavers. They have recently published their findings of what is
now called the anterolateral ligament (ALL). Until now, a modern medical mystery was the “pivot shifts” that still bother patients who had had their ACL successfully repaired. The surgeons concluded based off of follow-up research to their finding that injury to the ALL is what causes these pivot shifts. This discovery could signal a major medical breakthrough in treating patients with serious ACL injuries. The surgeons are currently working on a surgical technique to correct ALL injuries, but their results will not be ready for several years.


**Cell & Tissue**

Bone regeneration may no longer be just science fiction. Researchers at the University of Iowa have created a bio patch that allows localized regeneration of bone tissue. The patch consists of a collagen scaffold that is seeded with synthetic plasmids that contain the genetic instructions for producing bone tissue. Polymers shrink the plasmids into a compact, particle size and add a positive charge that makes them easier to be absorbed by bone cells. When the scaffold is placed at the wound site, the plasmids are implanted into nearby cells, which absorb the information and begin coding for PDGF-B, a growth factor that helps enhance bone regeneration.

This technique is unique in that bone-producing instructions are directly delivered to the existing bone cells in vivo. This way is much more efficient than current methods for bone regeneration, which require repeated injections of the proteins in order to maintain the required dosage. The bio patch, on the other hand, is applied directly to the wound area and maintains a continuous supply over a long period of time. In addition, the method is non-viral, meaning there will be no undesired immune response. When tested on animals who were missing portions of their skull, the patch grew 44 times more bone and soft tissue in four weeks than with just a scaffold alone, enough to completely cover the wound area. In other lab experiments, it also stimulated new growth in human bone marrow stromal cells.

Since the scaffold can be shaped for different application sites, the patch could also be useful in dentistry. Bone growth can help patients who don’t have enough bone for dental implants. It can also repair birth defects in the head or face. In addition to all of these applications, the researchers are also hoping to create a bio platform that promotes blood vessel growth, which goes hand-in-hand with bone.

Original Article: [http://now.uiowa.edu/2013/10/bio-patch-can-regrow-bone](http://now.uiowa.edu/2013/10/bio-patch-can-regrow-bone)

**Medical Devices**

It’s well known that light-sensitive cells react in specific ways when exposed to light. Scientists have been attempting to utilize these types of cells to trigger reactions in the body, like production of specific proteins. Another application is to have cells emit light for imaging or diagnostic purposes. The main challenge is the fact that light has trouble passing through skin, muscle, fat, and other tissues to reach the targeted areas of the body. Researchers at Harvard and Korea Advanced Institute of Science and Technology have just published a study that could help.

guiding hydrogel to solve this problem.

The hydrogel consists of water, biopolymers, and cell media that support bioengineered cells that perform specific activities when exposed to light or emit light in response to certain biological conditions. The hydrogel is implanted in the targeted area of the body and a fiber optic cable is fed through the skin to the implant. Researchers can use the cable to feed light directly to the engineered cells, allowing for a rapid response.

The researchers demonstrated the implant by using it to control blood glucose levels in mice. They had the cells produce proteins that promote insulin formation when exposed to blue light. In another demonstration, they injected certain toxins into mice, which caused the cells to emit green light as a response, which was seen by using the optic cable in reverse. They hope that they can improve the structure and functionality of the hydrogel, which would allow for better monitoring of disease or detection of certain chemicals in patients.


### Systems & Synthetic

An MIT research team demonstrated that they can turn genes on or off inside human and yeast cells using a new method for controlling transcription. The new method is based on a system of viral proteins, called CRISPR, which has been used to edit genomes in bacterial and human cells. CRISPR has two components: a protein called Cas9 that binds to and slices DNA, and a short RNA strand that guides the protein to a certain part of a genome or synthetic circuit. It is usually used to remove or replace genes, but the researchers decided to use it to control transcription of mRNA. To do so, they modified the system to act as a transcription factor, so that it binds to a promoter region without snipping it, and added a protein segment that activates or represses gene expression.

Once inside the cell, the Cas9 protein and RNA guide were able to accurately target the correct genes and turn on transcription. To the surprise of the researchers, the same complex could also bind to a different part of the gene and turn off transcription. This flexibility and level of control might allow synthetic biologists to create larger, more complex circuits. Unlike other transcription-control systems, this new method is easier to use and doesn’t waste time assembling many expensive proteins; it only requires the engineer to change the sequence of the RNA guide. This technology has many applications, including areas in genetic engineering and synthetic biology, and can also be used to study the functions of naturally occurring genes. The researchers also modified the RNA guide strand so that it can be regulated by certain small molecules, adding even more levels of control to the transcription system. The team hopes to use this technology to build the most complex synthetic circuits ever built in yeast and mammalian cells.

Imaging

Multiple sclerosis is an acquired autoimmune disease that damages myelin, the membrane that protects nerves, in the central nervous system. Damaged myelin inhibits nerves’ ability to transmit electrical signals, causing issues in cognition and mobility. There is no cure, so physicians can only rely on therapies to modify the symptoms; however, physical symptoms take time to show themselves, so it is extremely difficult for MS to be diagnosed.

For the first time, researchers have developed a way to examine myelin damage from MS. Scientists at Case Western Reserve University School of Medicine have recently developed a new molecular probe, called MeDAS, that can be detected via PET imaging. Injected intravenously, MeDAS only seeks out and binds to myelin in the central nervous system. A positron-emitting radioisotope label allows a PET scanner to detect the targets and measure their intensity. The new marker offers the first ever non-invasive visualization of myelin integrity in the entire spinal cord at the same time.

This type of imaging is the first of its kind and has major implications in treating patients suffering from MS. Previous imaging techniques involved using MRI to detect lesions in the brain and spinal cord, which are not myelin-specific and provide no useful information about the disease’s progression. By directly monitoring myelin integrity, clinical diagnoses can be made in a matter of hours rather than months or years. In addition, this imaging tool also opens doors for developing myelin-repairing drugs, since there is now a quantitative way to measure the effectiveness of a therapy. Hopefully this new imaging tool will be put to good use and MS diagnoses will be made earlier.

Source: http://www.sciencedaily.com/releases/2013/09/130923123825.htm
Nothing takes one’s mind off of midterm season like a good old fashioned scavenger hunt. BMES and the Bioinformatics Club jointly hosted a scavenger hunt that sent teams across campus looking for items worth various points. The team with the most points in the end would receive the prize of prizes: a $20 Yoloberry gift card. We had to take a picture of one of our group members with each item in order to earn points. Things on our list included an egghead, a cow, the inside of a Unitrans Bus, and having a dance off contest with a stranger. To find each item, we had to literally travel across the entire length of the campus. As exhaustive as it may sound, the event gave freshmen and transfer students an opportunity to explore the campus in a fun and exciting way, while meeting other BMEs in the process. Unfortunately my team fell short of winning the prize, but I met many new friends and even got some good exercise out of it.