Spring 2002

Department of Biomedical Engineering

Alumni Newsletter

Recent Awards to Faculty:

Professor Donald P. Gaver has been elected a Fellow of the American Institute for Medical and Biological Engineering and was inducted into the College of Fellows, Class of 2002 on March 1, 2002 at a ceremony at the National Academy of Sciences in Washington DC. This national honor is well deserved recognition of Professor Gaver's achievements in research and education.

Professors Kay C Dee and **Donald P. Gaver** have been awarded a four-year NASA grant for their proposal "Investigations of the Influence of Air-liquid Interfacial Stresses on Pulmonary Epithelial Cells in a Microgravity Environment." The award is funded for $393,650 in total costs.

Professor Paul Nunez, his graduate student **Brett Wingeier**, and Professor Richard Silberstein of the Brain Sciences Institute in Melbourne, Australia authored the article associated with the July 2001 cover of the journal Human Brain Mapping, which pictures the phase structure of human alpha rhythm suggesting brain wave interference patterns.

Professor David A. Rice has been awarded The Freedoms Foundation of Valley Forge 2001 George Washington Award for outstanding achievement over a period of years, reflecting the high ideals of human dignity and fundamental principles of a free society. Previous award recipients include Chief Justice William H. Rehnquist (1998), Dr. Alton Ochsner (1979), and John H. Glenn, Jr. (1963).

Professor Natalia Trayanova has been awarded a four year, $300,000 grant by the American Heart Association for her proposal "Analysis of defibrillation mechanisms in acute ischemia". This grant is an "Established Investigator Award" providing support for Professor Trayanova's efforts aimed at developing a computational model that focuses on unraveling the cause-and-effect relationship between electrophysiologic changes during acute myocardial ischemia and defibrillation shock efficacy. The investigation is based on the new virtual electrode polarization concept of cardiac defibrillation which has provided a deeper understanding of the effects of the shock on the normal myocardium. The present study aims to extend this concept and apply it to the conditions of acute myocardial ischemia.

Professor Cedric F. Walker has been awarded funding from the Brown Foundation for work on two projects in collaboration with Dr. Eckhard Alt, Adjunct Professor of Biomedical Engineering, and Professor of Medicine, Tulane University School of Medicine. The total awarded funds for "Development of a Novel Implant Device for Outpatient Heart Failure Monitoring" and "Development of a Novel Implant Device of a Magnetic Resonance Imaging Compatible Stent" is $840,000, with funds divided between Tulane Health Science Center and the School of Engineering.

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Letter from the Chair

Dear Biomedical Engineering Alumni and Friends:

Once again, I'm happy to be able to bring news about some of our successes in the Department, and let you know that we continue to be dedicated to our mission of providing outstanding opportunities for learning and discovery in Biomedical Engineering.

We had an excellent ABET assessment visit during the Fall as part of the application for our re-accreditation visit. The official results will not be known until the Summer (after the ABET Board meets) but I can tell you that the visit went extremely well. I look forward to the continuous efforts to improve the department that are now a 'built-in' part of the self-assessment process required for ABET-accredited programs. It is thus fitting that this issue of the newsletter continues to focus on the department's recent efforts to determine how to best teach so that our students discover and learn. The spotlight in this issue is upon our use of the improved facilities for laboratory experiences for our undergraduates.

With these new laboratory facilities and our newly revised undergraduate curriculum we are also turning our attention to external issues - in particular, questions about how we can increase our interaction with industry. We would like to provide undergraduate summer internship opportunities for all of our students that want one. Although the majority of our undergraduate students go on to earn advanced degrees, most eventually enter the job market, and we would like to keep students better informed about the jobs and opportunities in biomedical engineering – for students graduating with BS, MS, and PhD degrees. We would like to investigate new 'testing and research' relationships with biomedical engineering companies as a way of not only generating revenue to improve and support our infrastructure, but to give students and faculty more exposure to current issues in industry. These topics and others were discussed at our recent meeting of the Biomedical Engineering Board of Advisors (which was established in 2000, and whose membership and charter may be found on our web page at http://www.bmen.tulane.edu/advisors_board/). I will be writing more about the Board in future newsletters, but for now wanted to take their suggestion to directly solicit our alumni and friends for your help to identify potential summer internship or other employment opportunities. If you have or know of employment opportunities, please e-mail me (rthart@tulane.edu) and I will post it onto our intranet newsgroup, tulane.bmen, for students to see. Perhaps we can build a network of Tulane connections to help our students and alumni.

Next semester we will begin a more formal assessment of our graduate program. The strength of the graduate and research program is crucial for hiring and retaining the best faculty, stimulating opportunities for student learning and discovery, and essential for our reputation. More on that in our next issue!

I hope you enjoy reading about our efforts and successes, that you will take the opportunity to keep current via the network (we will be updating the web site this summer) and e-mail, and that you'll stop by to visit us when you are in town.

Thanks, in advance, for your help and interest in the department - and keep in touch!

Sincerely yours,

Richard T. Hart, Ph.D.
Department Chair

PROFESSOR HART NAMED NEW HOLDER OF ALDEN J. "DOC" LABORDE CHAIR IN ENGINEERING

Professor Richard T. Hart is the new holder of the Alden J. "Doc" Laborde Chair in Engineering. At a ceremony on November 30, 2001, **Dean Nicholas J. Altiero** presided over the investiture. In attendance were **"Doc" Laborde**, his son, **Dr. Monroe Laborde**, and many of Professor Hart's friends, family members and colleagues.

The Alden J. "Doc" Laborde Chair in Engineering was established in 1984 by Ocean Drilling and Exploration Company (ODECO) to recognize and honor the accomplishments of its renowned founder, "Doc" Laborde. Professor Hart becomes the third holder of the chair. Previous holders were Stephen C. Cowin and William C. Van Buskirk.

Incorporating Active Learning into Biomedical Engineering Education

In part one of this article (BME Alumni Newsletter, Fall 2001, http://www.bmen.tulane.edu/news/fall2001.pdf) about learning styles, we outlined a study performed by Professors Kay C Dee, Glen Livesay, Eric Nauman, and David and Janet Rice. This study asked the fundamental question: How do our students learn? The results indicated that Tulane's BME students are slightly more visual and more global in their learning styles than their colleagues at other engineering schools in the United States.
This study also provided another fundamental result – ***our students prefer active and sensing learning styles.***
This result led us to modify some of our teaching approaches.

WHAT IS 'ACTIVE-LEARNING?'

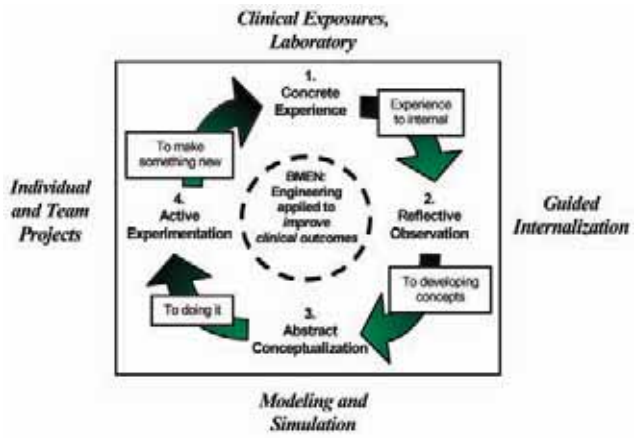
We have followed David Kolb's research *(Experiential learning: experience as the source of learning and development, Prentice Hall, 1984)*, which relates to theories of how individuals think and learn. This theory hypothesizes that learning processes are divided into two orthogonal axes, which are represented in the figure below. In this figure, the vertical axis represents how individuals gather information through either "concrete experience" or "abstract conceptualization." The horizontal axis represents the dichotomy between how individuals process information through "reflective observation" vs. "active experimentation." Stages 2 and 3 are primarily "thinking," while stages 4 and 1 are "active," or "doing." Kolb's learning cycle is based upon the notion that the learning process should be made up of four steps:

Concrete Experience to Reflective Observation - In this quadrant, tangible experiences, possibly from videos, laboratory demonstrations or recollection of common events, lead to reflection as to why an event or process might occur. One benefit from this quadrant is that it motivates further study.

Reflective Observation to Abstract Conceptualization - In this quadrant, a student learns concepts that can be brought to understand the system being studied. This quadrant is commonly the focus of engineering classroom lectures.

Abstract Conceptualization to Active Experimentation - Students become actively involved by applying concepts from step 2. Ideally the student is coached in this stage through homework, fieldwork, or controlled laboratory experiences.

Active Experimentation to Concrete Experience - In the final quadrant, a student moves back to Concrete Experience with the enhanced understanding gained from active experimentation. When students return to the Concrete Experience stage, they ideally will be able to create their own experiment or theoretical model, which can be used to motivate a return through the learning cycle.



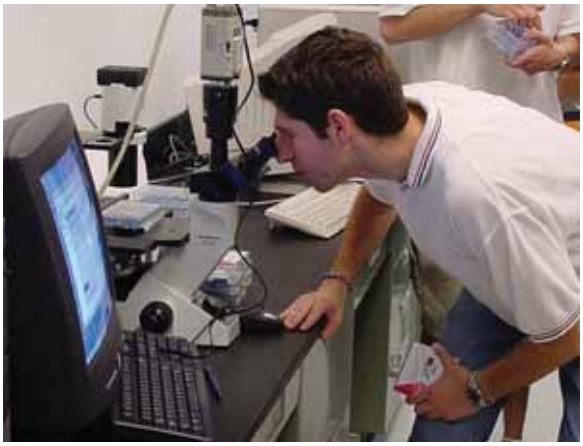
Kolb's Learning Cycle demonstrates the importance of "thinking" and "doing" if one is to optimally learn (or teach) a body of knowledge - independent of the subject matter.

It is this process that we believe defines the active-learning pedagogy that we seek to incorporate in our department.

THE DEVELOPMENT OF A NEW TEACHING LABORATORY

In order to develop active-learning experiences for our classes, we have developed new junior-level 'bridge' courses that interweave fundamental engineering analysis with biomedically-relevant problems. The topics for these courses are Cell and Tissue Engineering, Biomechanics, Biomaterials, and Bioelectricity. In addition, the Department has long offered a course titled 'Biomedical Electronics' that is a bridge-type course. The department successfully applied for funds from the Louisiana Board of Regents (P.I.'s: Gaver and Hart) and the National Science Foundation (P.I.'s Gaver, Dee, Hart, and O'Neal [Psychology]) to develop the laboratory facilities for these courses and evaluate their efficacy. These grants have allowed us to develop a new teaching laboratory that is located in Boggs 241.

This laboratory was skillfully designed by Professor Dee. Kenneth Kuhn, BME Laboratory Supervisor, was able to stretch the budget to extraordinary lengths to meet our goals, and was excellent at overseeing (you know what that means!) the construction work. Lorraine McGinley, the BME Program Coordinator, was responsible for ordering the necessary equipment. Finally, a number of midnight gnomes (Professors Dee and Livesay, Darryl Dickerson, J.B. Raasch, Mike Roberts, Adam Sorkin, Kyle White, and Inchan Youn) added finishing touches to the new lab.



HOW ARE WE INCORPORATING 'ACTIVE-LEARNING' USING THE NEW TEACHING LAB?

The teaching laboratory has been developed over the last year, and already several active-learning exercises have been performed. These are:

BMEN 323, Biomaterials (Professor Bundy): Experiments involve both the chemical and biological sides of the biomaterials field. In the first area, for example, tests are performed to observe crevice corrosion phenomena and characterize conditions where they occur. With regard to biocompatibility, histology slides are microscopically examined to demonstrate favorable and unfavorable tissue reactions to implant materials at the cellular level.

BMEN 330, Biomechanics (Professor Livesay): Students were able to apply their knowledge of kinematics to joint motions obtained from their teammates. Students collected position data for multiple leg positions (digital images) and subsequently determined centers of rotation and angles using two classic techniques (graphical and numerical). They then estimated ligament insertions and origins to determine lengths as a function of motion, conducted error analyses on length and loading estimates, and compared/contrasted the assumptions and limitations of their lab to current 3-D finite element modeling research of the human knee. We hope this unit will help our students make a solid connection between theory and practice, and therefore provide a firm foundation upon which they can build as they move on to positions in experimental/theoretical research in a variety of settings.

BMEN 340, Introduction to Cell and Tissue Engineering (Professor Dee): A new hands-on laboratory unit was developed where students learned aseptic techniques, how to feed and subculture cells, and quantitatively examined time-dependent cell proliferation on various commercially-available substrates. The students statistically analyzed their cell proliferation data and completed a basic cost/benefit analysis of the various substrates to give a recommendation as to which substrates should be purchased for laboratory experiments in the future. This is the first time we have been able to teach fundamental cell culture skills to our students in any venue other than individual training sessions in research laboratories. We hope this unit will better prepare our students for experimental laboratory research and biotechnology/laboratory manager jobs.

BMEN 643, Cell and Tissue Mechanics (Professors Dee and Livesay): Students performed a series of hands-on experiments on cellular architecture (tensegrity theory), tensile testing protocols, and fiber orientation and alignment in simple fiber/matrix composite materials. These experiments culminated when the students performed tensile tests on specimens of porcine skin and tendon, and analyzed their data assuming that the tissues could be mathematically modeled as a fiber-in-matrix composite material with a predictable distribution of fiber alignments. This linked kinesthetic awareness of materials science and mechanics with the mathematics of composite materials. In addition, the experience of working with real tissues (slimy, hard to grip, hard to isolate a good representative sample from a specimen, etc.) was an important part of biomedical engineering - and is something that a student just can't get from a lecture or a simulation.

Our new teaching laboratory has cell culture facilities, imaging, biomechanics testing, and biomaterials investigations.

Conclusion

Clearly, this new laboratory has greatly improved our educational facilities in the Biomedical Engineering Department. This facility would not have been possible without the generous contributions from state and federal funding agencies, and the hard work of many faculty and staff members in Biomedical Engineering. We are certain that this laboratory will not only enhance our educational mission, but also improve our research program.

We encourage all alumni and friends to visit our department and let us show you these facilities!

Department of Biomedical Engineering
Tulane University
Lindy Boggs Center, Suite 500
New Orleans, LA 70118

Phone: 504-865-5897
Fax: 504-862-8779
Email: bmen@tulane.edu
Web: http://www.bmen.tulane.edu

BMEN STUDENT ACHIEVEMENTS AND RECOGNITION

James Crawford Downs, Jr., Ph.D. candidate in biomedical engineering and holder of three other Tulane degrees: a bachelors in economics (1991) and masters in economics (1992) and biomedical engineering (1998), was selected as the student speaker for Tulane's unified commencement at the Superdome on Saturday, May 18, 2002.

Kathleen L. Rea Fureigh received first place honors at the Graduate Student Poster Competition, Biotechnology category, of the 2002 Louisiana EPSCoR State Conference. Kathleen was selected by Dean Nicholas Altiero to represent the Tulane BoR Fellows, and in April presented her poster entitled "Use of Adult Stem Cells to Generate Neuronal Tissue."

Carol Mullenax has been selected as a finalist for Association for the Advancement of Medical Instrumentation's Young Investigator Competition. At AAMI's annual conference in Minneapolis this June, Carol will give a talk entitled, "An Electrophoretic Method to Deliver Topical Drugs to the Eye". Carol has also been awarded an American Association of University Women Educational Foundation Selected Professions Fellowship for her final year of study. For the 2002-2003 fiscal year, only 43 fellowships were awarded from 296 applications in the eligible fields of architecture, computer science, mathematics/statistics, and engineering. In addition, Carol's paper entitled "If I'm Going To Work In Industry, Why Join ASEE???" has won the best paper award in the Graduate Student Experiences session at the 2002 ASEE Annual Conference and Exposition.

The Society For Biomaterials Ophthalmology Special Interest Group awarded its first Student Recognition Award to **Chris Wallace** on April 26th during the society annual meeting in Tampa, FL. A three member panel judged all ophthalmic student presentations - paper and poster- on scientific content, completeness of presentation and ability of the student to discuss their work. Chris was chosen the winner for his poster entitiled, "Determination of Corneal Epithelial Cell Adhesion Strength to Novel Polymer Surfaces Using A Jet Impingement Technique" by coauthors - Chris D. Wallace, Jingjing Bi, Kirk J. Bundy, and Jean T. Jacob. A $250 cash prize is given to the winner of this award.

We'll continue to update **http://www.bmen.tulane.edu** during the summer, meanwhile
we've added a page for current Independent Research Projects **http://www.bmen.tulane.edu/news/index.html**
and a link to posters recently presented by BME faculty and students at professional society meetings
http://www.bmen.tulane.edu/research_new/index.html