2011 Murphy Society Faculty Funded Projects:

Design for America: Extracurricular Design Based Learning

$35,000

Elizabeth Gerber, Assistant Professor, Segal Design Institute and Mechanical Engineering; Sami Nerenberg, Director of Operations, Segal Design Institute; Jeanne Marie Olson, Lecturer, Segal Design Institute and School of Education and Social Policy

Design for America (DFA), an extracurricular design based learning initiative, prepares students for careers in engineering, design, and innovation by combining service and project based learning. The effort is in alignment with McCormick's commitment to providing innovative, interdisciplinary educational opportunities for students that enable them to apply the fundamentals through experiences that require adaptability, collaboration and analysis and Northwestern University's strategic focus on Design and the advancement of inventive and rigorous models of education that incorporate experiential service learning opportunities. From an innovation perspective, the implementation rate for DFA ideas is equal to or exceeds the rate for professional innovation consultancies. From a learning perspective, analyses of DFA students' diaries, interviews, and surveys show that participation positively impacts 8 of 11 of ABET's educational outcomes for Engineering Education including problem solving, tolerance of ambiguity, collaborating within interdisciplinary teams, and innovation self-efficacy (Gerber, Olson, Komarek, 2011; Gerber, 2010). Further, over 50% of DFA students are from underrepresented groups in engineering.

Hands-On Experience for Students Taking Basic Mechanics Courses

$22,500

Jianmin Qu, Civil & Environmental Engineering

The goals of this project are: (1) to help the students grasp and understand the fundamental concepts and measurements of mechanics; (2) to better meet the ABET student learning outcomes criterion - ability to design and conduct experiments and to analyze and interpret data. The goals are achieved through the use of PASCO (miniature) testing apparatuses, upgrading the existing MTS testing machine, purchase of strain data acquisition equipment, and the fabrication of experimentation and learning models in-house.
**Humanitarian and Non-Profit Logistics Beyond the Classroom**

$27,500

Karen Smilowitz, Associate Professor, Industrial Engineering and Management Sciences; Irina Dolinskaya, Assistant Professor, Industrial Engineering and Management Sciences; Joseph Warfel, Ph.D. candidate, Industrial Engineering and Management Sciences; Lewis Meineke, Humanitarian and Non-Profit Logistics Research Coordinator

Humanitarian and Non-Profit Logistics applies a systems approach to societal issues such as disaster relief, food distribution and health care access. Northwestern University is emerging as a leader in this critical area. The proposed initiative aims to engage IEMS undergraduates in Humanitarian Logistics and train them to be leaders in the field through service learning opportunities for students and equip students with the necessary tools to excel in the field.

**Northwestern University International Genetically Engineered Machines Competition**

$20,000

Joshua Leonard, Michael Jewett, Keith Tyo, Assistant Professors, Dept. of Chemical and Biological Engineering, John Mordacq, Distinguished Senior Lecturer, WCAS Program in Biological Sciences

The International Genetically Engineered Machines (iGEM) competition is an interdisciplinary undergraduate synthetic biology experience that challenges undergraduates to design and build an engineered biological system that addresses a pressing scientific or societal need. This competition presents undergraduates with a unique opportunity to innovate, tackle open-ended problems, and apply their scientific and technical training to tangible problems, while interacting and collaborating with peers across the world. In our first year of support from the Murphy Society (2009-2010), we successfully organized Northwestern's first iGEM team, and with continued support from the Murphy Society, we have improved and expanded the experience for this year's team (2010-2011). The broader project aims to continue developing this activity and organization so that the experience is sustainable and improves from year to year.
**Materials Synthesis and Processing Laboratory**

$23,000

*Yip-Wah Chung and Katherine Faber, Materials Science and Engineering*

We propose to establish a Materials Synthesis and Processing Laboratory to provide hands-on experience to students in MSE 391 (Process Design), a required course for all MSE undergraduate majors. There is a severe shortage of materials synthesis and processing equipment in our teaching laboratory to provide adequate hands-on training to students enrolled in this class. Our stopgap solution is to either use the equipment in existing research facilities, or to design “kitchen chemistry” projects to simulate materials processing. Neither is satisfactory. The proposed Laboratory will address this shortcoming, covering sol gel processing, lithography, thin-film deposition, and computer process control.

**Investigating and Improving Engineering Students’ Mathematical Modeling Abilities in Capstone Design**

$5,000

*Jennifer Cole, Assistant Chair and Lecturer, Department of Chemical and Biological Engineering, Robert Linsenmeier, Professor, Departments of Biomedical Engineering, Neurobiology and Physiology, and Ophthalmology, Matthew Glucksberg, Professor, Dept. of Biomedical Engineering*

This project investigates students’ abilities to generate mathematical models that they can use in the development of innovative design solutions to open-ended problems. In particular, we will continue to study the students’ approach, creation, solution, and interpretation of mathematical models, which our previous work has found to be a difficult part of design. We will continue to analyze student work in capstone design courses in two departments, and analyze the utility of an instructional intervention designed to guide students through the modeling process. The results of this study will lead to recommendations on how to improve instruction in mathematical modeling, a practical skill that students need in engineering careers.

**Development of Regenerative Engineering Laboratory**

$10,000

*Shu Q. Liu, Professor, Biomedical Engineering Department*

The objective of the proposed project is to develop a new undergraduate laboratory course: BMD ENG 359 Regenerative Engineering Laboratory. Regenerative engineering is the engineering aspect of regenerative medicine, an emerging medical branch for developing cell-based regenerative therapies for human disease. The proposed course covers the fundamental concepts, technologies, and experiments of regenerative engineering, enabling students to understand the principles of designing and developing regenerative therapies.
Refurbishment of the Biomedical Engineering Laboratory

$8,774

John B. Troy PhD, Professor and Chairman, Biomedical Engineering

This request is for funding to refurbish the Biomedical Engineering Department's undergraduate teaching laboratory. The request is to provide funds to replace broken and outdated equipment. The equipment requested is used primarily in the Biomedical Engineering course BMD ENG 307 taken by all Biomedical Engineering undergraduates. Enrollment is typically in the 70-80 student range. While most of the equipment in the laboratory is fully functional and meets needs there are a few pieces that need to be replaced or refurbished. The funds sought are intended to accomplish this.

Laboratory Experience for Undergraduate Students in Colloidal Processing Science

$41,500

Scott Barnett, Professor, and Jiaxing Huang, Assistant Professor, both in Materials Science and Engineering

This proposal is to develop a new set of laboratories in undergraduate classes focused on colloidal materials processing, an area where there is currently very limited lab experience. The proposed instrument, a Zeta potential and particle size analyzer, is a key part state-of-the-art industrial materials processing methods that utilize colloidal suspensions. It is particularly notable that the same method is useful over a broad range of materials applications, including ceramics, metals, biological, and polymeric. As such, the instrument will allow totally new and/or much-enhanced labs in several classes (impacting a large number of students) including MSE 340 Ceramic Processing, MSE 337 Conducting Polymers, MSE 331 Soft Matter, and MSE 301 Introduction To Materials Science.
Translating Capstone Design Projects for the Developing World into commercial medical products.

$25,000

David Kelso, Clinical Professor, Biomedical Engineering

Several innovative, cost-effective medical devices have been designed for resource-limited settings in the Biomedical Engineering capstone design class and the Global Heath Technologies study abroad program over the past six years. They could have a real impact on healthcare in the developing world if they could be continued on through beta prototyping, field testing, pilot manufacturing, regulatory approvals, and market introduction. Once students see that great designs have a path to market and impacting healthcare in resource-limited settings, a number will be inspired to invest more time and effort in mastering the process; and McCormick's engineering program will be recognized as contributing materially to the care of patients in the developing world. Some of this will be accomplished by reaching out to students in other engineering departments, and other schools such as Kellogg and Feinberg. The funds requested will be used to engage professional engineering consultants to develop beta prototypes, and pay for clinical tests in the developing world.

Healthcare Engineering at McCormick

$7,500

Sanjay Mehrotra, Professor, Industrial Engineering and Management Sciences

Healthcare problems are complex and their solutions often require a multi-tiered multi-pronged approach inclusive of a diverse set of stakeholders. Traditionally, Industrial Engineers play the role of "productivity and efficiency" experts capable of handling such problems. There is an increased recognition that a systems approach is required to address healthcare problems. Because of the nature of this problem, decision making in healthcare is different from that in other profit driven industries. For example, there is a stronger socio-psychological component in this decision making and patient safety takes precedence over profit making. IEMS department has recently introduced an undergraduate course "IEMS-385: Introduction to Health Systems Engineering" to better expose interested engineering students for problems in hospital, national, and global healthcare delivery. A goal of this course is help students realize that an optimal blend of quantitative and behavioral science techniques is necessary to arrive at solutions of complex problems.
Collaborative Integration of Heterogeneous Sensing, Actuation and Computing Devices (CIHSAC)

$17,300

Goce Trajcevski, Assistant Chairman/Senior Lecturer, EECS

This proposal seeks funding for three years for the design and development of a laboratory and related materials for courses ranging from: 1) Domain-specific: presenting advanced topics in computers science and engineering to both undergraduate and graduate students. 2) Short-courses and seminars: suitable for entry-level EDC students. 3) General-purpose: oriented towards enabling students from different domains of science and engineering to become knowledgeable about current trends in distributed collaborative sensing and networking, and gain expertise in using the paradigm in their own field(s). The lab environment and courses' materials will ensure that EECS students will have state-of-the art tools for advanced study and research, and that all the students from McCormick School of Engineering and Applied Sciences will have the opportunity to learn about and get hands-on experience with the current trends shaping the computing world. We envision that this will give our students a competitive advantage in their respective disciplines not available at other universities.

Modernizing the Laboratory Component of EECS 307: Communications Systems Using Software-Defined Radios

$13,000

Dongning Guo, Associate Professor, EECS

Programming general-purpose computers or devices to accomplish specific tasks is a theme in the technological transitions seen in the past decade. It is crucial to educate undergraduate students in EECS about the latest physical-layer radio technologies and trends. Thanks to a pilot study funded by the EECS department, the Communications and Networking Laboratory has gained first-hand experience in commercially available software-defined radios (SDR). If funded by the Murphy Society, we plan to acquire 10 sets of SDR devices to populate an EECS teaching laboratory, revise the laboratory assignments, and to use the devices in Fall 2011 when EECS 307 is taught next time.
Online Self-Taught Review on Pre-requisite Topics for Required Mechanics Courses

$10,000

Karen C. Chou, Assistant Chair & Clinical Professor, Civil & Environmental Engineering Department

The highly structured, building block nature of an engineering curriculum requires the learner to build the knowledge upon what was previously learned. Many students usually forget many of the pre-requisite materials after even a quarter. The goal of this proposal is to provide a mean to help the students recall or re-learn the pre-requisite topics so that they will be better prepared to learn the new topics. To meet this goal, we propose to develop a customized online self-taught review courseware that can be accessed through the Northwestern Course Management System. The project will focus on a sequence of mechanics courses from the freshman Gen-Eng 205-2 (EA 2) to the junior/senior Civ-Env 325 (Reinforced Concrete Design).