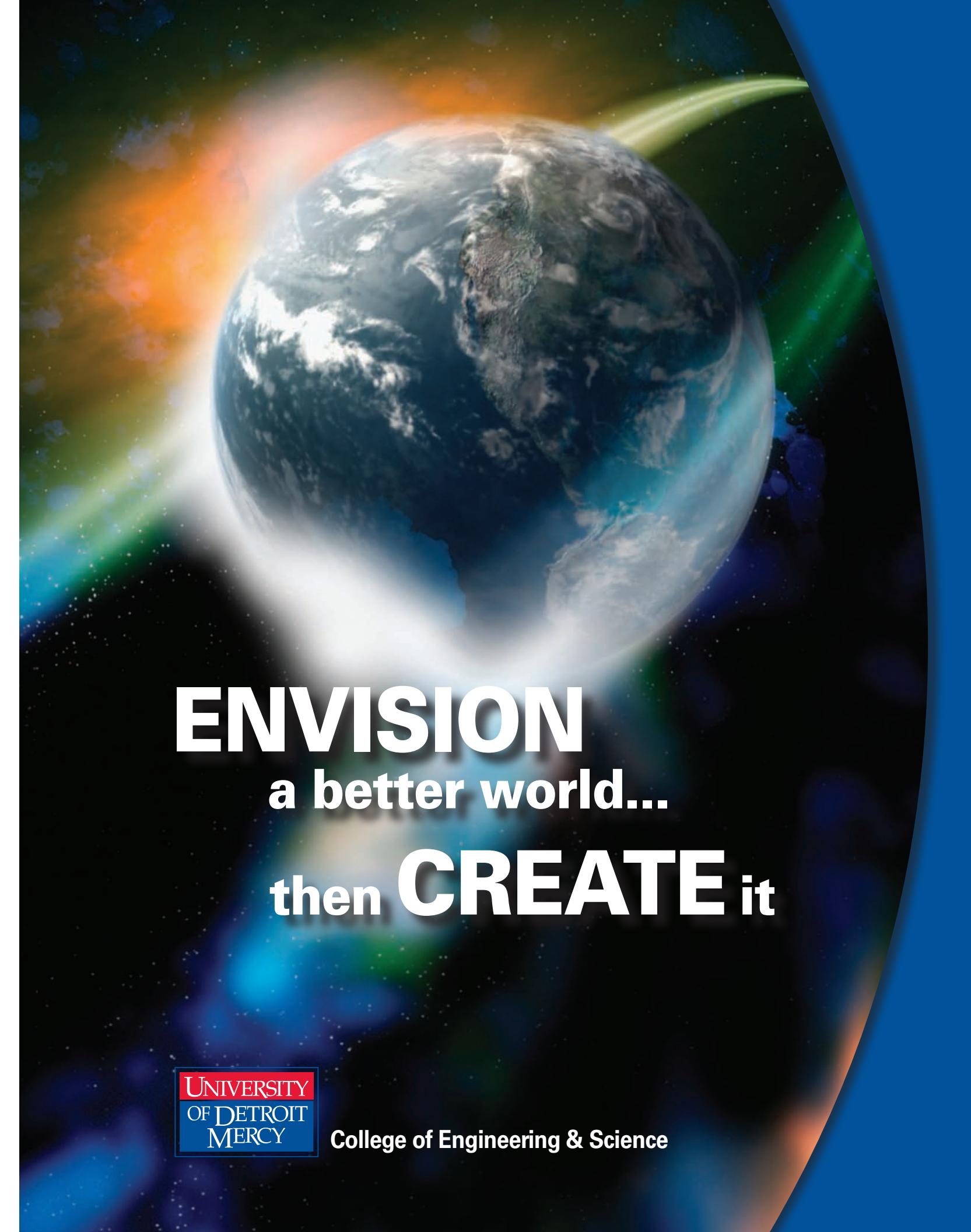


Fast facts:

- 100 percent of UDM engineering graduates had a job offer or had been accepted at a graduate school as of graduation day 2007.
- UDM is among the top schools nationwide receiving 17 NSF Course, Curriculum and Laboratory Improvement (CCLI) grants.
- UDM is in the top 10 percent of all engineering programs nationwide for enrollment of female students (32 percent).
- *U.S. News & World Report* ranks UDM among the top half of engineering schools in our category.
- The College of Engineering & Science has a true multi-disciplinary culture, with seven degree programs offered through collaboration with other colleges.
- E&S students transform innovative concepts into real products and services (e.g. WARM CD/Web program for low-income residents seeking to save on home energy costs, aids to persons with disabilities and systems for the auto industry).
- Our collaboration with industry, foundations and associations provide educational opportunities and address specific society problems. The social impact benefits the urban community in which UDM is located; southeast Michigan, where much of the auto industry and suppliers are based; and in other countries through UDM's international programs.
- UDM celebrates 100 years of Engineering education in 2011.



College of Engineering & Science
4001 W. McNichols Road
Detroit MI 48221-3038
www.udmercy.edu



**ENVISION
a better world...
then CREATE it**



College of Engineering & Science



MINDSET COMPETENCE CONFIDENCE PASSION

Which future?

Many believe that the world's future is flat and rosy, believing the global digital, social and economic integration and acceptance of diversity to be portals for growth. In this vision of the future, American entrepreneurs combine their extraordinary creativity with ubiquitous access to sources, partners and worldwide markets to create and deliver superior products.

In this future, other societies and nations have come together and joined the surging economy of the flat world – creating even larger markets for innovative products. American engineers, having grown up embracing diversity, confidently lead global multicultural technical teams. Citizens of the world accept environmental responsibility and sustainable development. Renewable sources provide for most of the world's energy needs. And, we enjoy better health because our scientists have mined the wealth of the human genome and the world's biological diversity to create new cures for disease.

To ensure that the more positive world future occurs, the charge to American universities is clear: to educate more and better engineers and scientists.

Yet, given the relatively low enrollment in engineering and science compared to other nations, others envision a future that is more menacing than bright. In this bleak future, our nation's scientific and technological leadership has eroded; other nations have far more engineers and scientists, and are taking leadership roles in developing innovative products and processes. These nations dominate the world economy, controlling critical natural resources, especially energy. Other nations have military technology, which is superior to that of the United States. Even worse, the U.S. no longer has the ability to defend itself from increasingly sophisticated terrorist threats. To top it off, global warming is real, creating meteorological catastrophes, wreaking havoc on the sources for food and renewable energy, and plunging entire regions into economic and social chaos.

To ensure that the more positive world future occurs, the charge to American universities is clear: to educate more and better engineers and scientists. In addition to having exceptional technological and scientific competence, traditional hallmarks of American education, they will need new capabilities beyond those commonly developed. They need to be even more creative and innovative. They need to embrace diversity, and truly value and respect all members of global, multicultural technical teams. They need to possess an understanding of business and the entrepreneurial mindset to accurately discern the needs and wants of customers from around the world. Then they must create new products and companies that succeed. These engineers and scientists need to be responsible regarding the environment and sustainable development, and the wise and ethical use of technology. And, most importantly, they need to possess the confidence and passion to change the world. A new model is needed to educate such graduates.

This report describes innovative programs and dedicated faculty that are creating a forward-thinking model as University of Detroit Mercy embarks on our second century of engineering and science education. In this model, our undergraduate and graduate programs integrate elements of engineering and business aimed at product development and entrepreneurship. K-12 outreach programs have increased our ethnic diversity and female participation to levels that lead our state and the nation. Through innovative curriculum development, supported by 17 CCLI grants from the NSF and leadership in major coalitions, UDM's faculty has developed and launched new pedagogical methods for effective teaching and learning.

This model and those faculty members will enable our graduates to develop and implement the technological advances that will lead to a bright future for our nation and the world.



Dr. Leo E. Hanifin
Dean, College of Engineering & Science
University of Detroit Mercy



Getting engineering students on board the TE-ship

Engineering students are moving beyond their traditional disciplines to learn technological entrepreneurship (TE-ship). This encompasses not only how to design and manufacture products, but also how to assess the market and position their products to sell. This represents a major shift in the way engineering is taught. The University of Detroit Mercy (UDM) has launched innovative, multi-disciplinary curricula and experiences that bring together engineering students, business students and those from other disciplines to learn what it takes to turn a promising technical idea into a marketable product.

Through multi-disciplinary courses, case studies and projects, students will develop the competence and confidence to build new products and companies from their technical knowledge. They will also bring an entrepreneurial mindset and milieu to Detroit, helping to revive Detroit as a world leader in innovation.

While engineering students aren't expected to handle all the myriad details involved with getting their products to market, they are becoming educated about what will sell and how to get those products into the marketplace — from concept and manufacturing to sales and distribution. Curriculum innovation that blends engineering and business principles has led to the development of two programs — a Master's in Product Development (MPD) and a new undergraduate minor in entrepreneurship.

Derrick Kuzak, Group Vice President for Global Product Development at Ford Motor Co., agrees that engineering graduates need more than technological capabilities, stating, "The challenge of innovating and commercializing new technologies requires additional skills of engineering graduates. The best engineers will be the ones who can think in terms of systems as opposed to just components, engineers who can think 'total value chain' as opposed to 'piece cost', engineers who



can understand customer wants and optimize systems to best meet those needs in regional, national and international markets. UDM hit the mark with its Master's in Product Development; I am pleased that UDM will also integrate business competence, along with enhanced innovative capabilities, in its undergraduate entrepreneurship minor."

This emerging sequence of multi-disciplinary undergraduate courses focuses on identifying needs for products and streamlined processes in today's global economy. Engineers and other students work in teams with an entrepreneurial attitude and aptitude to bring technical ideas to fruition.

"The severe challenges faced by the companies in our region are forcing institutions and individuals to change our strategies and fuel greater innovation. Engineering graduates realize that the days of being entitled to work for one company for an entire career are over. Our graduates are now empowered to employ technical and business knowledge to create new products, services, businesses and companies," says Leo E. Hanifin, dean, College of Engineering & Science.

Learning how to think like an entrepreneur is key. To foster this mindset, students will study short entrepreneurship (E-ship) case studies that are inserted into early science, math and engineering science courses that are required of all engineering students. Becoming familiar with those who've employed their fundamental understanding of science and technology to revolutionize products and systems serves as an inspiration and a guide. As juniors, students can begin to take the courses that will develop the competencies to create products and companies that generate jobs and wealth.

"There is a call from industry for more collaboration between engineering and business. But academe has not made such collaboration as prevalent as it should be. A few premier academic institutions like MIT and Stanford have responded by creating collaborative programs. UDM also is among leading institutions when it comes to collaboration between Business and Engineering colleges

and industry," says College of Business Administration Dean Hossein Nivi, who came to UDM after a career at Ford Motor Co. "There's a tremendous amount of untapped potential. These programs are badly needed by business enterprises."

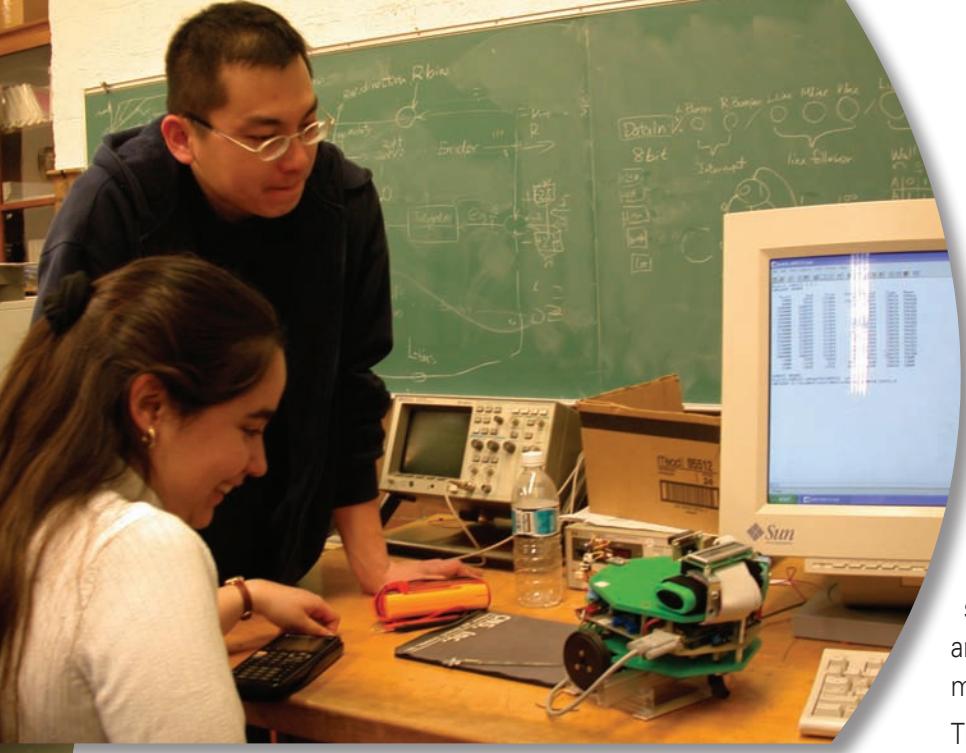
Paving the way with IDEAS

One such course that links engineering, business and other academic disciplines is IDEAS, which stands for interdisciplinary design, entrepreneurship and service. In 2005, UDM faculty from architecture, business administration, digital media, engineering and psychology developed and piloted this course. The pilot project was to design systems to enable a local nonprofit, WARM, to help clients make their homes more energy efficient. This focus was a natural fit for UDM's mission-based philosophy. Detroit-based organizations often tap the University for its expertise and commitment to the city and its residents.

The students in the IDEAS course designed an interactive digital model that could be accessed on the Web or viewed on a DVD player. The virtual



"The new businesses that engineers will help create will be more like the Googles of the world and not just another restaurant or retail shop."
Nassif Rayess, associate professor of Mechanical Engineering



In the product entrepreneurship course, teams of seniors in engineering and business create a product, perform market analysis and develop a business plan.

students influenced the design to maximize the degree of behavior modification.

The successful completion of the pilot project taught students essential skills in collaboration and strategy. For example, engineering students learned from architecture students how to interview clients to determine their needs. And they learned from business students about payback calculations and the business plan.

"Business students take a critical view of new products, yet have a good sense of what's marketable," says Nassif Rayess, associate professor of Mechanical Engineering. "Engineering students use this insight to create products and processes that solve a

problem or bridge a gap in services. Both disciplines bring unique skills to the project."

Since the initial IDEAS course was launched, three other new courses have been piloted by engineering and business faculty. These focus on innovation and creativity, the front end of innovation, and product entrepreneurship.

The innovation and creativity course is open to juniors and seniors from any discipline, and explores how to apply concepts, theories and strategies to the development of new products and services. It is co-taught by engineering and marketing faculty.

The front end of innovation emphasizes the tools and techniques that can lead to breakthrough new products and how to refine the product development process. The second part of the course focuses on the back end of innovation: prototype testing, advertising testing, test marketing, business forecasting and business plan writing. Throughout the dual course, students gain analytical skills, develop rigorous testing methods and use the diverse skills of multi-disciplinary teams to refine the final product or service.

In the product entrepreneurship course, teams of seniors in engineering and business create a product, perform market analysis and develop a business plan. Course work includes the exploration of best new products and failed products, so students can discern differences between what works and what doesn't.



Funding for IDEAS and the entrepreneurship curriculum is provided by grants from the KERN and Lemulsen Foundations, administered by the National Collegiate Inventors and Innovators Alliance (NCIIA), and matched by alumni and corporate contributions.

On the entrepreneurial track

In fall 2007, students began building a model of a rapid transit station in the IDEAS course with the intention of making a technology transfer into the community at the right time. While the details on financing, rail lines and sponsorship are being worked out for the proposed regional transit program, concept developments for efficient and inviting transit stations are well under way at UDM. Funding for this IDEAS project development is provided through the Michigan and Ohio University Transportation Center (MIOH UTC), a coalition of five universities led by UDM.

Adopting this new curriculum has been transformational on many fronts. It has received overwhelming UDM faculty support. Students are excited about gaining entrepreneurial skills to broaden their career options. Industry leaders see the shift in direction of engineering programs as a way to turn corporate technological challenges into learning opportunities. Foundations and grant-making organizations and regional leaders envision the TE-ship curriculum serving to stimulate the economy through new product innovation and synergistic collaboration.

"To establish and grow a company, you need a good business plan with the right funding and operational expertise," Rayess says. "For most engineers, it is acquired knowledge. This is where IDEAS and other TE-ship courses bridge the gap."

"We are giving students a different perspective. But they also must know that they can't do it with engineering alone. If you're innovative but lack business acumen, you'll die poor," he adds.

Engineering and business faculty members are finalizing the courses needed to offer a minor in entrepreneurship, with input from leaders in

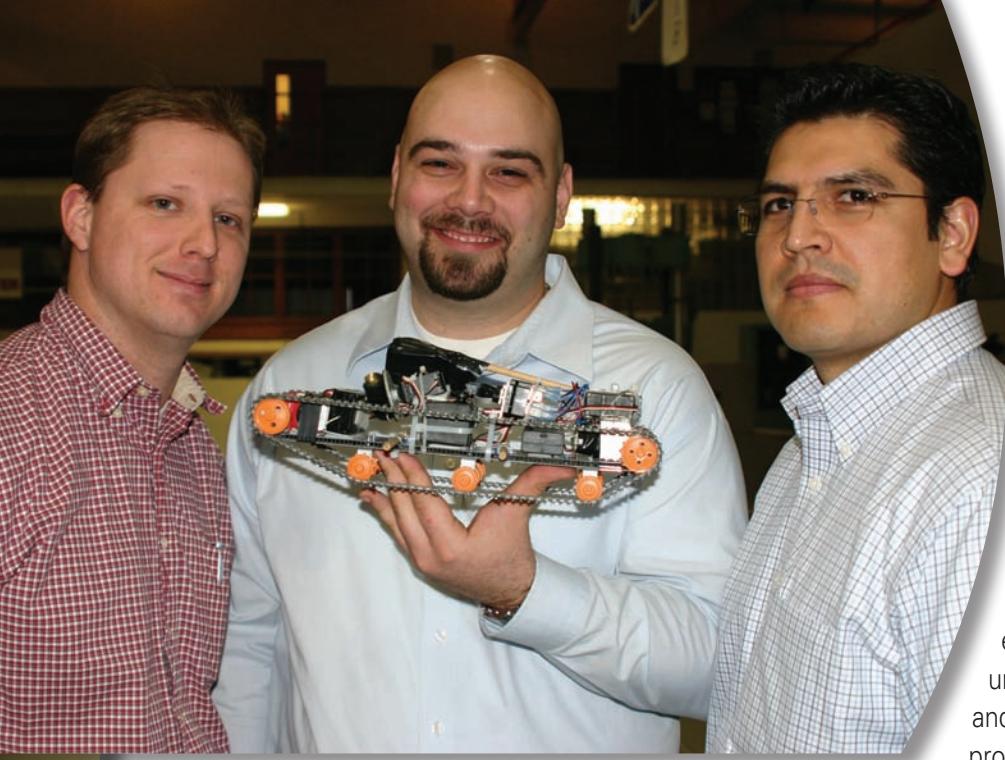
the field. The minor will integrate case studies, courses and projects that center on entrepreneurial skills. While the entrepreneurial hallmarks of vision, passion and persistence can't be taught, they can be sparked and kindled. The UDM faculty has identified methodologies that foster entrepreneurial success. This includes the ability to recognize and act on opportunity, work in teams, gain tolerance for ambiguity, manage risk, communicate clearly, and define and solve problems.

"We're a tightly knit faculty group that serves as a good curriculum incubator," Rayess says. "And our students are so ready for this type of curriculum. Their minds are such fertile ground; all we need to do is give them the tools, teams and challenges."

Engineering-Business graduate program rivals MBA

Ten years ago, engineering and business faculty from UDM, Massachusetts Institute of Technology (MIT), and Rochester Institute of Technology (RIT), and a cohort of industry leaders formed a coalition known as PD-21 (product development leadership in the 21st Century). Initially based on





The goal of MPD is to teach engineers how to truly lead in engineering ... on par with Executive MBA Programs for business students.

MIT's Master of Science in Systems Design and Management (Product Development Track), the coalition developed the Master of Science in Product Development (MPD) program. Their efforts were funded by the National Science Foundation (NSF) with support from Ford, GM, IBM, ITT, Polaroid and Xerox – all members of PD-21.

Through this support and intense discussions with top "PD" leaders, the original MIT program was adapted to the automotive

industry in Detroit, and imaging in Rochester, N.Y. Fulfilling the needs of these Fortune 500 companies led to a unique degree jointly conferred by business and engineering colleges.

Today, the 45-credit hour MPD program still flourishes at UDM. Most students are experienced engineers and sent by their employers to prepare them as the next generation of chief engineers. They gain sophisticated methods and tools for systems engineering, systems architecture and similar complex techno-business challenges.

The program integrates the organizational and management aspects of business with engineering product development principles. It provides the requisite business content and enables students to apply the tools, processes, and management techniques used in industry to bring complex engineered products to the marketplace.

The curriculum is rich in case studies, with the companies in the consortium providing much of the material as well as guest speakers. Key concepts range from team building to understanding the dynamics of global business and technology transfer. A final capstone project provides an opportunity to apply and refine the knowledge gained throughout the MPD program to a real-world problem.

"The goal of MPD is to teach engineers how to truly lead in engineering ... on par with Executive MBA Programs for business students. An MPD takes an engineer on a more direct path to this goal than an MBA would. There's a strong connectivity in how the engineering and business aspects of a company integrate to develop innovative products and bring them to the market," says Jonathan Weaver, associate professor and chair of Mechanical Engineering.



"As a cohort-based program, the MPD courses build upon each other to develop a unique, systems-perspective and deep understanding of the product development process that normally takes years in the company trenches to understand," says Weaver.

Since its launch, over 200 students have earned a MPD degree from UDM. Among recent graduates, one is a published author who contributed to the "Taguchi Quality Engineering Handbook" published by Wylie. Two others were honored as "Outstanding Young Engineer of the Year" by the Engineering Society of Detroit. One capstone project team transformed a Ford Bronco into a high-performance off-road "Sho" vehicle – earning first place awards at national competitions in Michigan, Ohio and Tennessee.

Another measure of success is that leaders in the industry are speaking at the program lecture series. Recent speakers include:

Terence Adderly, Chairman, Kelly Services

George Dettlof, President and CEO, SKF-USA

Hideki Isetani, Executive Director, Global Engineering Processes, General Motors

Bob Sump, Vice President, Component Engineering, Nissan, USA

"Running an enterprise is a holistic, systemic dynamic, and education must follow suit," says Nivi. "Our country's educational system is designed to provide a narrow set of skills in each discipline. We need to provide information about ways to improve the systemic approach. Rather than teaching it in parts, it needs to be whole."

As an example, Nivi notes that integration is a result of the interaction of the parts. "In the automotive industry, the parts won't take you from point A to point B, but the vehicle will. We are trying to teach how to integrate disciplines together to produce results."



UDM's continuing business-engineering collaboration

With the right combination of engineering and business skills delivered through effective pedagogy, UDM students will find the path from discovery to implementation easier to navigate, and enterprising engineering graduates will bring more of their inventions to market.

"Curriculum that is not continually evolving is stagnating," says Hanifin. "At UDM, we are on the forefront of curriculum development. The faculties of engineering and business are committed to continuing their collaboration, and most importantly, to providing the undergraduate and graduate education that is needed to sustain Detroit and our nation as the world's leader in entrepreneurship and product development."



A community of teaching scholars

Faculty at UDM's College of Engineering & Science are both scholars in their respective fields and in the pedagogical methods used to teach students. They bring their vast knowledge and experience to the classrooms and labs, teaching core skills while creating new educational techniques to prepare students for the world beyond the University.

These faculty members share their scholarly insight with students by integrating portions of their own research and others' research into coursework, competitions and classroom presentations. The occasional integration of their students' research creates greater motivation and inspiration.

"Our faculty have become true leaders in the development of novel curriculum and pedagogy to teach more effectively," says Engineering & Science Dean Leo Hanifin. "This has a remarkable impact on our students. Together, faculty and students are reaching a higher level as a learning community."

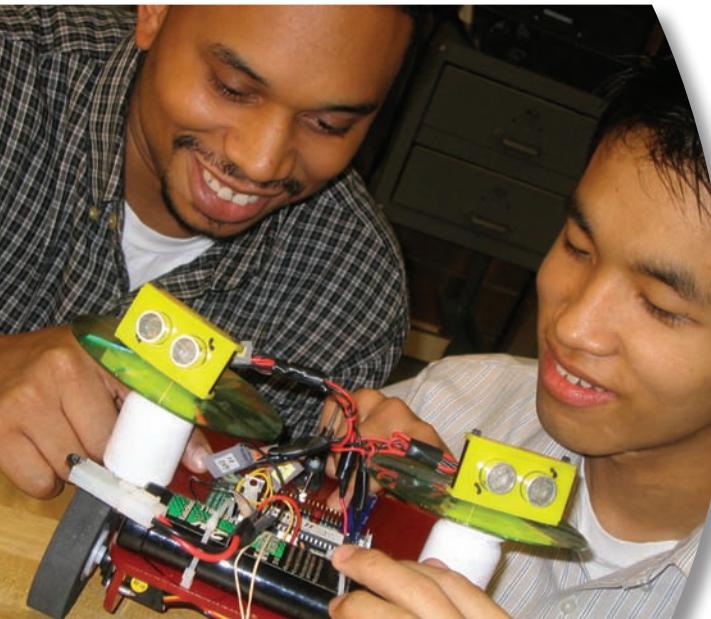
The process of discovery is taught by faculty in stages. Students might be assigned to view slides of brain cells under a microscope and then map results. Or, they may be asked to test sensors with a series of tasks before selecting the best one for use in a robot. Not only do students learn how to collaborate on investigations, they become adept at turning challenges into opportunities. Real-world applications are utilized whenever possible.

Through this contextual approach, faculty members empower students to explore uncharted territory. These investigations take students deeper into their area of interest, whether it's engineering, mathematics, computer science, or the sciences.

Faculty are involved in a broad array of research projects that tap into all E&S disciplines. These include exploring metal foam as a structural element in automotive manufacturing; developing alternative energy systems and alternative fuel along with the simulation of hybrid vehicles; and improving the reliability of army ground vehicles in conjunction with the U.S. Army Tank and Automotive Research Development and Engineering Center (TARDEC).

Recently, students in biology and chemistry collaborated on research studies with students in environmental engineering. Associate Professor of Chemistry Katherine Lanigan led this effort, partnering with Mary Tracy-Bee, associate professor of Biology; and Alexa Rihana-Abdalla, associate professor of Environmental Engineering. In various studies, each faculty member led her class in utilizing the atomic absorption spectrometer to study metal contaminant concentrations in water. The instrument was obtained through a grant from the NSF CCLI (Course,

Having both engineering and science in one college encourages and enables such interdisciplinary education and research.



Curriculum and Laboratory Improvement) Program.

In one study, using water samples from around the state, faculty and students were able to measure the calcium and magnesium concentrations, which allowed them to derive the hardness of water. A poster exhibit was held at UDM for Earth Day 2007, reporting on the test results.

Having both engineering and science in one college encourages and enables such interdisciplinary education and research.

The College's scholarly approach ensures that engineering and science students are steeped in diverse knowledge and perspectives and also acquire deep knowledge in their fields. Students can integrate computer-based applications and computations to drive processes and develop new products. They also have ample experience in presenting their views and findings both in writing and speech. Working in multi-cultural teams that mirror global work teams prepares students for a variety of challenging assignments both at the university and later, on the job. A Catholic University in the Jesuit-Mercy traditions, UDM instills a sense of

responsibility for students and graduates to help others through their coursework or professional work as well as community service. It seeks to integrate the intellectual, spiritual, ethical and social development of students.

Lessons learned in lectures and interactive seminars are put into practice during the semesters when students work at co-op jobs. Performing self-directed lab experiments set higher standards for UDM undergraduate students and provide added value to co-op employers. These co-op employers often are so impressed with the caliber of UDM students that they hire them upon graduation. In fact, 100 percent of engineering graduates had jobs or had been accepted to graduate school upon their graduation in 2007.

UDM engineering graduates possess an impressive set of skills that encompass versatility, social responsibility and knowledge of complex systems. Scholarly teaching prepares them as "citizen engineers" so they can create solutions and lead in innovation.





Awards

Dedicated professors with specific research interests foster an educational emphasis on innovation and exploration. Listed below are some of the recent faculty awards:

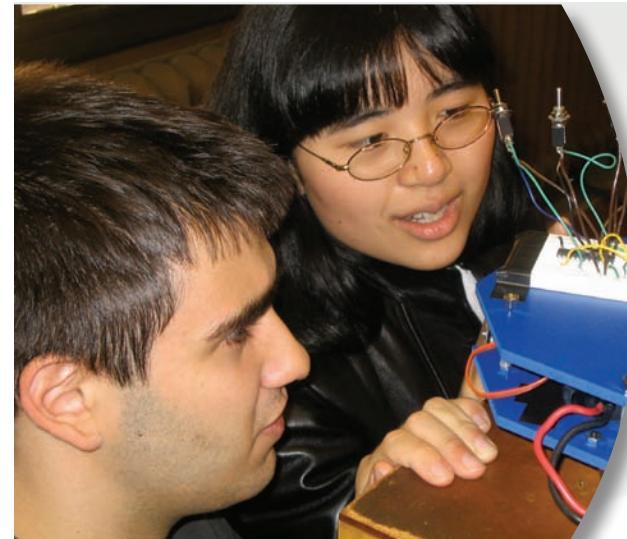
- ASEE Best Engineering Teaching Award (North Central Region)
Shuvra Das, Professor, Mechanical Engineering
- The Fundamentals in Undergraduate Neurosciences (National)
Mary Lou Caspers, Professor, Chemistry/Biochemistry
- Michigan College Science Teacher of the Year, presented by the Michigan Science Teachers Association
Mark Benvenuto, Professor and Chair, Chemistry/Biochemistry
- The Best Paper Award for the Year by the IEEE Transactions on Education (international)
Mark Paulik, Professor and Chair, Electrical & Computer Engineering; and Mohan Krishnan, Professor, Electrical & Computer Engineering
- National Science Foundation, Special Creativity Award, Division of Materials Research
Shulamith Schlick, Professor, Chemistry/Biochemistry

Grants

Our strong track record of funded research projects reflects our ongoing quest for new knowledge. Our leading funding agencies are listed below:

- Kern Foundation, Lemulsen Foundation
Both these foundations provided funding to develop curriculum in entrepreneurship and innovation (2006/2007).
- National Science Foundation (NSF) Project Kaleidoscope
Develop new methods of teaching science, technology, engineering and math as part of a national alliance to identify and exchange best practices in teaching. The focus at UDM is on critical thinking and inquiry-oriented laboratory experiments.
- In recent years UDM College of Engineering & Science has received 17 Course, Curriculum and Laboratory Improvement (CCLI) grants from the National Science Foundation. These grants are funding projects in such areas as:
 - Mechatronics (2)
 - Materials testing
 - Mechanical lab computerization
 - Six spectrometers for chemical analysis
 - Redesign of Electrical & Computer Engineering curriculum
(See sidebar on next page.)

- The U.S. Department of Transportation created the Michigan Ohio University Transportation Center (MIOH UTC), a coalition of five universities led by UDM. With support from other partners (Michigan DOT, NEXT Energy, Ford, etc.) funding will exceed \$4 million. The coalition focuses on alternative fuels, transportation systems (especially those aimed at congestion mitigation or mass transit) and supply chains. Curriculum has been developed from high school through graduate school levels. One recently funded project at UDM focuses on the performance of Vehicle Infrastructure Integration (VII) Communication Systems (\$120K from USDOT, MDOT and the Center for Automotive Research).
- The Department of Defense has provided over \$1 million for research related to vehicle reliability and vehicle communication/computing systems. Just this year the Tank Automotive Research, Development and Engineering Center (TARDEC) funded three additional projects:
 1. Cooperative Perception in Mobile Robots (\$100K)
 2. Extension of Ongoing Projects in "Condition Based Monitoring of Vehicles" and "Health and Usage Monitoring of Vehicles" (\$100K)
 3. High Mobility Robot System (\$50K)
- The Ford University Grants Program has provided multi-year grants for research into membrane stability in fuel cells and the investigation of metal foams (total >\$300K).



Grant produces new methods of teaching

Through an NSF grant, faculty designed an innovative electrical and computer engineering pedagogy based on three key elements:

1. Spiral-based curriculum

Basic concepts and applications are taught in multiple courses with increasing complexity as students advance in the courses. This ensures that the basics are understood at entry-level courses and are applied consistently throughout advanced courses.

2. Contextual learning

By working with multiple, simultaneous topics in class and project labs, students gain knowledge of how engineered products work as a systems rather than just the components involved.

3. Experiential learning

Students apply concepts learned in the classroom to "hands on" projects through robot and autonomous vehicle projects as well as through paid, co-op education placements.



Sandra Yost, CSJ, Ph.D.: Leading in engineering education

Sandra Yost, CSJ, Ph.D., is on a trajectory to become a nationally recognized leader in engineering education. She's led hundreds of students through undergraduate and graduate programs as an associate professor of Electrical & Computer Engineering at the University of Detroit Mercy (UDM). She has also studied pedagogical methods and learning models with some of the nation's leaders, including Karl Smith, Ruth Streveler and Beth Simon.

Yost embraces technology to advance student learning. As a progressive educator, she has systematically implemented tablet computers into her classroom. In fall 2007, UDM introduced a new student computer program in which all engineering and science students can obtain a tablet computer that contains 2 gigabytes of memory to easily handle the extensive files inherent in engineering design and analysis. Each laptop includes student versions of more than 40 specialized programs for engineering design and analysis.

The tablets enable professors and students to project their calculations and renderings as they create and discuss them in class – similar to a white board – except markers aren't necessary and all the content is saved electronically. Animations and complex system models can be developed and dynamically operated on the tablets. Their flexibility permits experimentation with parameters to explore optimization and boundaries of a solution.

She is excited about how the new tablet computers are transforming course lectures from passive listening and note taking to active sharing that befits a learning community. "I see more heads up listening where I used to see heads down as students took notes," she says.

With the tablets, students can easily review information from the course Web site. Years from now, they may want to retrieve what they've saved when working on real-world problems in industry or academia. By then, tablet computers will have vanquished transparencies and PowerPoint presentations – teaching aids that Yost says she won't miss.

During class, students can show their work as soon as they create it on their tablets. By electronically submitting it, the lesson becomes interactive as the professor quickly reviews the students' work and selects the best answer or most innovative designs to show the class. All this is done in a matter of minutes – nothing needs to be redrawn on the board. The extra class time afforded by the connectivity of these high-tech laptops enable the professor to explore related problems for greater depth of knowledge.

Yost isn't afraid to show her own work on the tablets, even when the problem-solving process leads to a dead-end. When this occurs during lectures, she reworks the problem and may even ask for input from students. What better way to demonstrate teamwork, persistence and the processes in which engineers reach optimal solutions? One of her colleagues said such a teaching style would make him feel too vulnerable; Yost finds the opposite to be true.

"Students need to see that I make mistakes when working on a problem. I don't have all the answers," she notes. "In the workplace, the answers often don't come quickly either. The creative, disciplined, well-taught engineer will find a way to make it work."

Professors as mentors

The traditional role of professor as instructor is time-honored. This attribute combined with the ability to mentor is the hallmark of UDM faculty.

This section profiles two leading faculty to demonstrate how their approach to education and specific research interests are making a difference for students at UDM in engineering and science.

Developing new methods of teaching energizes Yost. Focus groups and surveys are some of the methods used to refine and refocus curriculum. Yost drives advances in education as an active member of the American Society for Engineering Education (ASEE), and other national groups and consortiums.

"Sandy's leadership in the Educational Research and Methods (ERM) Division of ASEE has been instrumental in the success of the Division. She recently assumed responsibility as Program Chair for the 2008 ASEE Annual Conference and Exposition, and has been single-handedly responsible for getting reviewers for eight workshop proposals and about 200 abstracts, and then assigning more than 100 individuals to review more than 120 draft papers for the conference," says Cynthia Finelli, director of Center for Research on Learning and Teaching North at the University of Michigan.

In other educational sessions, Yost has conferred with Professors Beth Simon and Ed Price at the University of California, San Diego on ways to promote active learning using their "Ubiquitous Presenter" software. Yost believes this software will supplant PowerPoint for classroom presentations.

"We're developing new ways to move beyond the lecture mode," Yost says. "We're experimenting with cognitive apprenticeship rather than relying on traditional process-based teaching, where professors take students from point A to point B."

By getting students involved in the learning process rather than the traditional student method of listening to lectures and taking notes, the classroom setting has become much more dynamic.

Building on students' inherent strengths and interests leads to more effective teaching. Yost and other UDM professors have observed that female engineering students are drawn to using their analytical skills to fix social problems and improve people's lives. While the solutions may be mechanical, computerized, sensor-based or electrical, the thrill is in the end result rather than the technology. The faculty has also noted that male engineering students tend to get greater satisfaction from using the tools of engineering. Working in co-ed teams can capitalize on both motives and create greater synergy in using the tools and techniques of engineering to solve real life challenges.

"Engineering is becoming more multi-disciplinary,"

Yost said. "Not only do students need to know the technical material, they need to use their knowledge in a way that makes them a citizen engineer." Yost is mindful of incorporating the objectives of "Educating the Engineer of 2020" into the UDM curriculum. She's leading students toward greater social responsibility.

Yost places ethics at the forefront of a student's education. She covers this ground in class and by example. A Sister of St. Joseph (CSJ) since 1983, Yost lives her order's mission on a daily basis – to love and serve God and humanity and be a protector of all living creatures and a steward of the environment.

"With many gray areas in engineering, having a solid code of ethics should be an ingrained part of my students' skill set," Yost notes.

Being a university professor in Detroit, Yost develops class projects based on applications from industry, especially in robotics. "Right now, my students are working on a robot window washing unit. They are learning how circuits and systems can be integrated to make the robot act on computerized commands."

As a mentor, Yost advises students to follow their heart when deciding on a career. Students with an aptitude for engineering should enjoy the tasks and processes involved to be truly happy in their profession.

Yost's affinity to teach engineering is enhanced by an active involvement in several academic and professional associations. She has served on review panels of the National Science Foundation and held a vice-chair position in the Southeastern Michigan Chapter of the Institute of Electrical & Electronic Engineers (IEEE). She served on the American Society for Engineering Education (ASEE) Board of Directors as chair of Zone II. Yost has recently been nominated to run as ASEE vice president of Member Affairs.

Yost's achievements establish her as a leading faculty member not only at UDM, but also in the national community of engineering educators.





Mary Lou Caspers, Ph.D.: Setting new benchmarks

Conducting basic research into how a certain enzyme is distributed in nerve cells of the brain has brought national recognition to Mary Lou Caspers, a Biochemistry professor at University of Detroit Mercy. For her students, it has sparked their interest in biochemistry research.

Caspers enlists her students to assist in studying frozen slices of an animal brain for traces of the enzyme, sodium-potassium-ATPase. The enzyme maintains an ion balance across the nerve cells; without it, nerve function is impaired. The entire mechanism of how nerves "fire and reload" is impacted by the enzyme, which triggers excess sodium to exit the nerve so it can "re-fire."

This enzyme consumes approximately 40 percent of the energy of the brain and alters its activity in response to changes in the concentration of sodium ions within the nerve cells. Hormones and stress levels also may affect the enzyme's function, based on her investigation.

Caspers has partnered with a fellow researcher at the University of Cincinnati to share laboratory mice – she studies the brain while her colleague studies the heart. A tritium-labeled drug,

which binds specifically to the sodium-potassium ATPase, is used in combination with computer-assisted autoradiography to view the enzyme. Caspers is performing a mapping study to show the enzyme distribution in nerve cells. It appears in some parts of the brain, but not others.

"It's far more complicated than we thought," says Caspers, who began this avenue of research 20 years ago while on sabbatical at the National Institutes of Health. Since then, Caspers has maintained collegial ties to current and former NIH researchers who've gravitated to other research centers and universities.

Her scholarly research attracts both medical doctors and Ph.D.s, and is funded by the NIH and other prestigious organizations. Nationally acclaimed, she was honored as Educator of the Year by the Faculty for Undergraduate Neuroscience in 2004. At UDM, she received the President's Distinguished Faculty Award in 2001 and the 2004 College of Engineering & Science Cornerstone Award for excellence as a teacher and researcher.

"I like to get students excited about science," says Caspers, who has taught at UDM for 30 years. "I want students to become independent thinkers and be able to apply their acquired knowledge to new problems."

Caspers believes the quality of students now is more scholarly than when she first started teaching. Most of them know what career they want to pursue and are on track to become nurses, doctors, dentists or scientists. Using the Internet in the last decade alone has led to an explosion of accessible resources and theories that were hard to find when digging through library materials in the past.

In addition to instilling students with a core set of biochemical principles and research skills, Caspers stresses the ability to be a critical thinker and communicate

Professors as mentors

The traditional role of professor as instructor is time-honored. This attribute combined with the ability to mentor is the hallmark of UDM faculty.

This section profiles two leading faculty to demonstrate how their approach to education and specific research interests are making a difference for students at UDM in engineering and science.

Caspers was honored as Educator of the Year by the Faculty for Undergraduate Neuroscience in 2004.

well – verbally and in writing. She gives students ample opportunities to acquire these skills. During a biochemistry lab

for juniors and seniors, the first half of the semester is spent on assigned experiments. The second half of the course is an open-ended project where students must formulate and test a hypothesis.

Caspers helps students manage their expectations by making sure the scope of the hypothesis is sound and can be tested within six weeks. Students work in teams of three and four on the project. The initial stage involves translating their hypothesis into a written proposal that guides their course of study. Weeks are spent conducting experiments that prove or disprove their hypothesis. Once results are achieved, students produce a poster presentation. Faculty review their work as a group and ask questions about the testing method and results.

"Asking students questions during this presentation forces them to think on their feet," says Caspers. "It's a good way to help them become critical thinkers."

Another of Caspers' favorite classes is senior seminar in which papers detailing current topics involving biochemistry – cloning, stem cells, gene therapy and more – are read and discussed. One student is chosen to lead the discussion on each topic. Ethics are a key part of the class as students delve into the pros and cons of various applied scientific methods.

"Having students from many cultures brings different views to the table. I also discuss how the Catholic faith views key scientific issues that affect society. It's interesting to see where certain cultures agree or disagree on very precise aspects of these matters," says Caspers.

Off campus, she takes delight in gardening and nature. Every spring for the past 21 years, she and a colleague invite eight

accomplished students on a backpacking trip to Shenandoah National Park in Virginia. Caspers and Fr. Gerald Cavanagh, S.J., UDM professor of Management and Charles T. Fisher III chair of Business Ethics, lead the weeklong expedition, viewing spectacular waterfalls and wildflowers as they trek through the scenic park. The undergraduate students who participate in this outing often form a bond that may extend beyond graduation.

Such unique learning and teaching experiences fuel the passion

and excitement that Caspers brings to the study of biochemistry and the field of science. Her experience and depth of knowledge have set the bar higher for academic excellence.

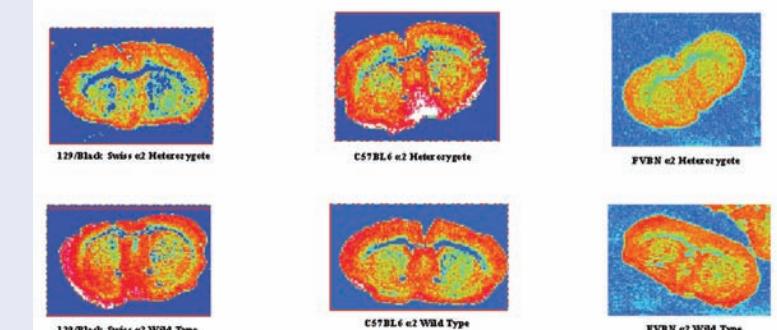
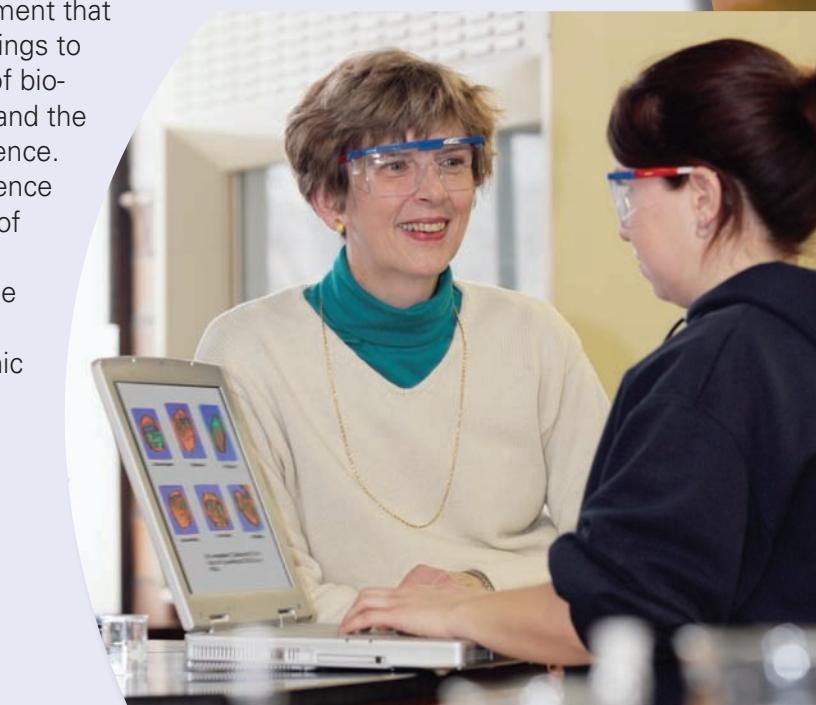


Figure 1: Autoradiographic Images of [³H]Ousabain Binding to (Na^+ , K^+)-ATPase in Sections from Wild Type and e2 Heterozygous C57BL/6, 129/Black Swiss and FVB/N Mice



Science education engages students in new ways

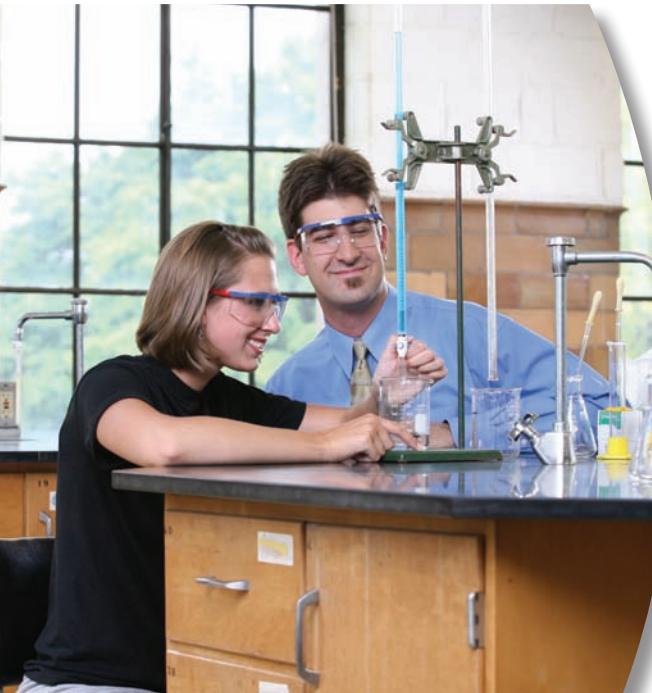
More students are seeking a science degree at University of Detroit Mercy, a trend that reflects a growth in careers with a science base. There is a pressing need for doctors, dentists and other health care professionals. There are also more opportunities for chemists and biologists who can solve pressing problems affecting the environment – whether it's cleaning up toxic waste, containing global warming or maintaining clean drinking water. Another top priority is being able to develop cleaner, safer and more efficient manufacturing processes.

Enrollment in the sciences has increased steadily at UDM over the last five years, from 69 freshmen in 2002 to 191 in 2007. This trend is expected to continue in coming years.

Educational advances

In the classroom, innovation has transformed teaching from a passive, disciplinary mode to an interactive, interdisciplinary one. Clicker technology and tablet computers enable students to weigh in with their opinions and answers during lectures. A "real-time" survey of students can be instantly projected onto the screen based on their clicks. This clicker technology was introduced in several biology classes in fall 2007. Also in fall 2007, UDM introduced a program that allows all science students to obtain a powerful tablet computer with over 30 scientific software programs.

UDM is testing a teaching and learning process known as POGIL: Process Oriented Guided Inquiry Learning, in the freshman general chemistry lecture. This educational method empowers students to think analytically in both classroom and laboratory settings. Developed on a national level by chemistry professors, POGIL has been shown to improve critical thinking and problem



solving in science courses. Conducting courses by guided inquiry and hands-on experimentation results in greater participation, higher test scores and better retention of certain science subjects.

Faculty research aids the environment

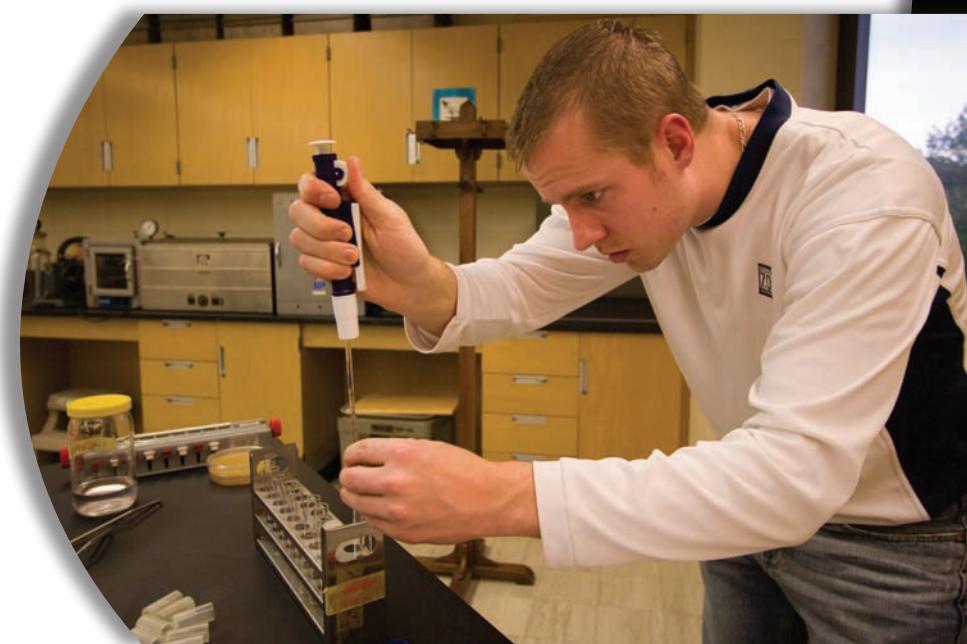
UDM's focus on green chemistry includes water purification courses and research led by Chemistry & Biochemistry Professors Katherine Lanigan and Mark Benvenuto, who is also the department chair. Their research involves methods of removing heavy metals in water and developing photo catalysts for water remediation of hazardous materials (organic or metallic).

About 35 undergraduate students a year work with chemistry faculty members on such research projects – providing an important early educational wedge that will open doors for them in the future – as entrepreneurs, highly skilled employees, scientists, consultants and

university professors. This opportunity for undergraduate research with faculty members sets UDM apart from many other research-based universities, and is often cited by students as one of the strongest indicators for future success. A full 80 percent of UDM science students have significant lab experience before graduation.

Opportunities abound for science graduates

Among UDM science graduates, about 50 percent go on to attend medical, dental or graduate schools. Of the 50 percent who enter the workforce, many are employed by companies where they worked part-time during college. Top employers are BASF; Ford Motor Company (Research & Development); NSF International, a chemical company based in Ann Arbor; and Michigan State Police for forensics work. Small analytical firms also hire many UDM science graduates. With good employment opportunities, most UDM science graduates stay in Michigan.





Leading the way to global multicultural teams

Preparing graduates as leaders and participants on global multicultural teams requires a multicultural student body and experiences designed to explicitly develop requisite attitudes and competencies.

Proactive engagement of minority communities and special pre-college and college programs for women have dramatically increased the diversity of UDM's College of Engineering & Science. The College has among the nation's highest percentage of female engineering students: 32 percent of UDM's full-time undergraduate engineering students are female – compared to the national

average of 17 percent. And 33 percent of UDM's undergraduate engineering students are underrepresented minorities, compared to 15 percent nationally and only 9 percent in Michigan. UDM ranks first in the state among engineering schools with the highest percentage of both female and minority enrollments.

Students from diverse backgrounds and cultural settings bring new insights and opportunities to engineering student teams. This mosaic of diversified talent provides a distinct advantage when developing designs and systems during labs and classroom projects. Innovative ideas are developed in multi-cultural teams that are similar to the composition of multi-national teams of engineers in industry and other settings. Thus UDM engineering students begin to appreciate, value and accept both team members and their ideas that are different from theirs. This reinforces the concept of a global mindset, in which engineers must create solutions to meet unique needs of customers from different cultures and countries.

UDM's College of Engineering & Science has among the nation's highest percentage of female engineering students.

Outreach efforts make a mark

Years of innovative programs and events have positively impacted the enrollment rate of females and minorities. UDM's College of Engineering & Science offers a dozen outreach programs for K-12 students. For example, the dean, faculty and alumni speak to more than one thousand students annually at 25 high schools during road shows designed to generate excitement and encourage students to study engineering and science. UDM also offers programs that directly prepare students for engineering and science studies. In addition to gaining more students at UDM, other engineering colleges also matriculate students motivated by our outreach efforts. The net result is an increase among female students and minority students who decide on engineering as their major.

"We're pleased to mentor students to develop their aptitude for engineering and discuss how their interests and talents can lead to fulfilling careers," says Leo Hanifin, Engineering & Science dean. "We are doing our part to help stem faltering engineering enrollments. It takes a lot of hard work, but the tide seems to be turning."

One of the most successful outreach programs is **STEPS**, a weeklong summer engineering camp for girls who just completed ninth and 10th grades. A total of 80 girls spend a week on campus (in two sessions of 40) and become immersed in the field of engineering. They participate on projects, attend lectures and labs, watch films and create a functioning

mobile robot. Students gain knowledge of manufacturing techniques, robotic control systems, circuits and sensors. This hard work is balanced with summer fun at a water park, climbing high ropes and watching movies with their new friends. The program is funded by Ford Motor Co., one of UDM's top industry partners, and the Society of Manufacturing Engineers.

The Detroit Area Pre-College Engineering Program (DAPCEP) is a free program comprised of intensive courses and projects that draw students to the UDM campus on Saturdays in the fall and spring. Activities are geared to fourth through 12th graders and delve into principles of engineering, computer science, math, chemistry and biology. It's a dynamic, integrative learning environment with courses such as "Engineering your community" and "Forensic crime stoppers." During the summer, a four-week DAPCEP session draws ninth and 10th graders who take courses in math, computers, writing, speech and physics. Another group of middle school students design/build a full-scale vehicle from cardboard, wood and other materials. High school students acquire a deeper level of education in math and science and learn how to apply those skills to a career in manufacturing or business through the **Ford-UDM Partnership for Advanced Studies (PAS)**. The PAS program provides complete coursework and training for five courses (15 modules). Annually, 600 students take these courses at nine Detroit area high

schools. UDM faculty and staff visit the schools and students come to campus to use advanced scientific equipment and meet with professors. Internet resources are also a key part of the program.

Technology Discovery Day, held each fall, is a field day of exciting exploration for budding engineering and science-minded students. It features 10 competitions that pit students from area high schools against each other with their entries, which are tested or launched at the event. In 2007, the perennial favorite – the egg drop – vied with interest in building toothpick bridges, catapults and Rube Goldberg contraptions. Corporate displays and a chemistry magic show produced by UDM students round out this popular event that draws about 700 students to campus annually.

The FIRST Robotics Competition brings a team from University of Detroit Jesuit High School to campus to use the College's machine shop and the FIRST practice field to build and test their robot.

The MIOH UTC TRANSIT program is a one-week summer program that enables high school students to explore the field of transportation up-close and help them decide if they want to pursue a career in this field. MIOH UTC is the Michigan and Ohio University Transportation Center, a coalition of five universities led by UDM. Students also work on a special project that focuses on intelligent transportation systems, alternative fuels and the mitigation of traffic congestion.

First-year female students majoring in engineering, science, math, architecture and health professions have the support of a unique mentoring and support program known as **WISE (Women in Science and Engineering)**. These students reside on





the same floor of a student residence hall to foster a stronger sense of support that stems from shared interests and ready-made study groups. Female faculty members mentor these students and tutoring is offered. This first-year experience serves as a solid foundation to help ensure success for female students in these fields of study.

UDM's efforts are paying off. These dozen programs are

changing the image of engineering in Detroit – and the makeup of UDM's engineering student body. The first step of creating a diverse student team has been accomplished. Now UDM's faculty have turned their efforts toward enriching and deepening the multicultural engagement and global focus of engineering education.

Years of innovative programs and events have positively impacted the enrollment rate of females and minorities.

Special scholarships for exceptional women

An incentive to succeed

Creating a cycle of success for female students majoring in mathematics, science and engineering is the overarching goal of a prestigious scholarship introduced at UDM in 2005. A grant from the Clare Boothe Luce (CBL) Program is funding four two-year scholarships for students to complete their junior and senior years.

The scholarship covers tuition and room and board. To be eligible, students must achieve at least a 3.25 GPA and be involved in a campus organization. It provides an incentive for freshman and sophomore female students to strive to attain this support and recognition.

Recipients included Elizabeth Hardy, Christina Haviland, Amie Hinshaw and Lindsey Macomber.

Female faculty mentors the scholarship recipients, who, in turn, mentor freshman and sophomore students following in their footsteps. The scholarship recipients and mentoring faculty are also engaged in outreach programs to encourage junior high and high school students to pursue a college degree in the technical field.

CBL Scholars also gain important insights on leadership from top female executives, such as Anne Stevens, the highest ranking woman in the auto industry (photo).

The award exemplifies the spirit of Clare Boothe Luce, a playwright, journalist, U.S. ambassador to Italy, and the first woman elected to Congress. She was the widow of TIME magazine founder Henry R. Luce.

Aware that many women "face obstacles in their chosen professions," she established the scholarship program to help support women pursuing technical careers.



Competitions prove competence

UDM entry ranks high in water purification contest

UDM placed third for its "White lightning" entry as a first-time competitor in the American Society of Mechanical Engineers (ASME) District B Student Design Contest, held in April 2007 in Ann Arbor, Mich.

The college bested some key competitors: large state universities in Michigan, Ohio, West Virginia and parts of Pennsylvania and New York. The contest was developed in the wake of the Katrina flood and its ensuing water shortage to challenge students to create a way to produce clean water with limited resources. Students in the contest had to develop a self-contained mechanism to produce potable water from contaminated water. The UDM students rigged a bicycle wheel to an electric generator, which created electricity using human power. This electricity was used to boil the water and create pure steam, free of impurities, which was drinkable when cooled and condensed in a separate chamber. Students factored in the

equation that using leg power as the lever to turn the wheel of the device was three times more effective than using one's arms.

"The biggest drawback is that users must sweat one liter to purify 200 ml. But it is super cheap and it works. The next generation will feature a vacuum to speed the process," says Nassif Rayees, associate professor of Mechanical Engineering.

More work needs to be done on the invention to make it a practical device, but it will serve as the foundation for UDM students involved in Engineers without Borders, who are also working on self-powered water purification systems.

UDM takes third place in International IGVC contest



A robotic entry by a team of UDM electrical engineering students and faculty placed third overall at the 15th annual Intelligent Ground Vehicle Competition (IGVC) in Rochester, Mich.,

in June 2007. The competition included design and navigation competitions and an autonomous challenge. UDM's team, CAPACITOPS, was one of 37 competitive teams from the U.S., Canada, India and Japan. UDM surpassed such prestigious engineering schools as Georgia Tech and the University of Wisconsin.

The IGVC is an annual international



competition that challenges students to apply cutting-edge design to competition entries, which are judged for design, navigation and an autonomous challenge. The navigation portion tests the ability of each team's vehicle to autonomously travel from a starting point to several target destinations through obstacles and return to home base, guided only by GPS coordinates. The autonomous challenge requires teams to create a fully autonomous, unmanned ground robot that can navigate an outdoor obstacle course within a set time frame and speed limit. This was the second consecutive year that UDM placed in the top three.

"We built a curriculum in the Electrical & Computer Engineering department around a robotics theme," says Mark Paulik, professor of Electrical & Computer Engineering at UDM. "We're proud of our students' performance and the way they've applied academic lessons to create a robot that worked well in competition."