Dean’s Message

Dean Joseph Saliba named provost; academic partnerships strengthened in Middle East; manufacturing program focuses on global systems; research aims to extend life of wind turbine blades; and Matt Bolton ’87 and Sheldyn Armstrong ’86 find new ways to stop traffic and save lives.

Alumni News

Health is chief priority for Paul Soskey ’79, a Marianist-educated engineer and African tribal chief.

Features

Sunny day for solar industry
Solar energy may soon have two things it needs to be a power player — federal money and advanced materials.

Body and beyond
We’re more than the levers, electrical circuitry and cellular reactors that make up the human body. So too is the field of bioengineering, which is growing at UD to include disciplines across campus.

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Day at the office
Cody Conner takes a break from his co-op to capture a picture of himself behind a warehouse for an automotive supplier in Hamilton, Ohio. The electronic engineering technology major built a prototype tester for the Valeo climate control products facility. Last academic year, 291 students with an average GPA of 3.23 completed co-op jobs at 113 employers.
Better than recess

Building robots was not the biggest challenge for four senior mechanical engineers. It was the clients: All 16 of them needed hall passes, carried backpacks and counted the minutes until recess.

Last year, the seniors taught math and science concepts to seventh- and eighth-graders at Kiser Middle School in Dayton using robotic Legos. The seniors first developed with Kiser teachers a curriculum that follows Ohio academic standards while also keeping the students' interest with hands-on projects.

“What’s cool about this program is that the teachers didn’t automatically pick the highest-achieving students for this program, but the students who stood to benefit the most,” said Doug Smith, whose group received an engineering school Learn, Lead and Serve grant for the service project.

Every Tuesday and Thursday afternoon, the UD students taught short math or science lessons and then asked challenge questions. These challenge questions required Kiser students to program the Lego robots and apply the concepts presented.

“This problem-based learning taught the students that the solutions are not always clear but are a process of trial and error,” senior Eric Ebbers said.

Kiser is part of the Neighborhood School Centers, which bring together community resources to strengthen Dayton Public Schools. The UD Fitz Center for Leadership in Community administers the program. This fall, another group of engineering students will continue the Lego robot program.

—Anna Gebrosky ’10

Our pride

I am humbled, excited and honored to have been selected to serve as dean of the School of Engineering. I will strive to provide leadership that continues to position us as a national leader in engineering education rooted in our distinctive Catholic, Marianist character. We will continue to build on curricular innovation while ensuring the School welcomes a diverse student and faculty population, providing them the resources needed to grow, thrive, lead and serve.

Though the landscape is changing because of economic challenges, I strongly believe the University of Dayton and our alumni will help us meet the challenges ahead and continue to move the School forward on the road of excellence. Our solid footing owes much to our academically strong student body; a faculty and staff dedicated to excellence in scholarship and service; loyal and generous alumni; and state-of-the-art facilities.

In the fall, we welcome an incoming class that exceeds our expectations in both size and preparation. Among our new offerings is the program in global manufacturing systems, which responds to the increasingly international scope of engineering and the far-reaching interests of our students (see story on Page 5). Graduate studies are also expanding, including the popularity of our new master’s program in clean and renewable energy and expanded offerings in bioengineering (see story on Page 12). The University’s record $96.5 million in sponsored research funding provides all students with hands-on experience in technologies that are improving our world.

On the pages of this magazine, we give you a snapshot of what we are proud of. But our pride comes from more than research dollars, enrollment figures, projects or programs. It comes from the people we touch and who enrich our School. Our students, faculty and staff — along with our alumni, friends and partners — are vital to our continued success. We invite you to connect with your School through the stories in the Dayton Engineer and by engaging with UD in educating the next generation of servant leaders.

Tony Saliba, dean
School of Engineering
Tony Saliba — the Wilke Distinguished Professor, chair of the department of chemical and materials engineering and a three-time University of Dayton graduate — is the new dean of engineering.

President Daniel J. Curran announced the appointment Aug. 13. “Dr. Tony Saliba received strong support from all areas of campus. He’s an excellent relationship builder who’s been able to successfully recruit students and faculty, bring in research dollars and philanthropic support, and build alliances across campus,” Curran said. “He’s a servant-leader who personifies the University of Dayton’s Catholic, Marianist mission. He’s committed to transforming the School of Engineering’s curricula to prepare our graduates for a changing world.”

The School’s former dean, Joseph Saliba, had served as interim provost to the University since July 2008. He was named provost in March 2009 after a national search. Joseph Saliba, also a three-time UD graduate, rose through the ranks of professor, department chair and dean to become the University’s chief academic officer.

Tony and Joseph Saliba are brothers, having first attended the University in the 1970s along with two of their siblings.

As dean, Tony Saliba plans to take a greater leadership role in leveraging the Dayton region’s strengths in engineering innovation. Internally, he will focus on developing flexible curricula and joint accelerated programs such as a five-year bachelor of science in engineering/MBA; marketing areas of excellence in the graduate programs nationally; boosting sponsored research through strategic alliances; increasing diversity; and strengthening the school’s Catholic, Marianist mission of service.

The engineering graduate program is ranked 62nd in the nation, up two places from last year, as ranked by U.S. News & World Report. The program ranks second among Catholic colleges and universities, behind the University of Notre Dame, and is third among Ohio colleges and universities, behind Ohio State University and Case Western Reserve University.

The National Science Foundation awarded UD $650,000 for the ETHOS scholars project, including scholarships primarily for underrepresented minority and female engineering students. Students will live in sustainable innovation learning communities and participate in grant-supported curricular and extracurricular learning, service and research aimed at student retention.

A second new learning-living community — Women in Science and Engineering — will bring together on residence hall floors female students in the STEM disciplines. All first-year students choose learning-living communities based on major and areas of interest.

Danny Eylon, director of the materials engineering graduate program, was elected a member of the European Academy of Sciences. Robert Mott, professor emeritus of engineering technology, published Statics and Strength of Materials (Pearson/Prentice Hall), his fourth book.

The engineering technology department’s recruiting video — now posted on the department’s Facebook page — is appealing to an even wider audience. A version with Chinese subtitles is already up, with versions in Spanish and Arabic in the works. Other online videos highlight careers and opportunities in engineering technology.

The 2009 Minority STEM Summer Bridge program received $15,000 from the Virginia W. Kettering Foundation and $20,000 from Messer Construction. The program offers minority first-year students a head start on their first semester with one week of math and science courses and campus orientation. The program develops relationships between students, faculty and staff and improves student academic performance and retention.
A good handshake with an old friend means a lot.

For UD, it meant re-engaging Kuwait and re-establishing itself as an educational partner in the Middle East.

“They have seen the quality of our students, and they are starting to come,” said assistant dean Riad Alakkad.

Two years ago, UD officials traveled to Kuwait to discuss Dayton being added to Kuwait’s list of partner institutions. There, Alakkad shook hands with friend Hassan Nassrallah, Kuwait’s cultural attaché. Nassrallah was so impressed with UD that he transferred his son into UD’s electronic engineering technology program. The military attaché also transferred his child to UD from the University of Arizona.

Those two have today grown to 20; by the fall more than 35 Kuwaitis will be on campus studying engineering, business and education.

During a March trip, President Daniel J. Curran signed initial agreements with the Public Authority for Applied Education and Training, a two-year technical school in Kuwait. The school is interested in undergraduate completion programs, faculty exchanges and graduate education.

In the 1970s, UD annually taught more than 400 students from Kuwait, Jordan, Lebanon, Saudi Arabia, United Arab Emirates, Syria, Turkey, Egypt, Libya, India and China. Alakkad was one of them, transferring into UD’s civil engineering program; he never left.

Today, while the total number is just more than 100 from Kuwait, Saudi Arabia and Lebanon, the quality of a UD education is again attracting attention. “This is the future of higher education,” Curran said. “It will be much more global than in the past.”

Such partnerships add to campus diversity while retaining scholarship dollars; the Kuwaiti government provides full funding for its students. In May, Curran and provost Joe Saliba traveled to Lebanon to foster similar relationships.

“Our name is already out,” said Alakkad, who points to the power of Middle Eastern word-of-mouth in growing the University’s reputation. “Whatever the University wants to reach, it can reach.”

Above: Riad Alakkad (center) visits with Kuwaiti students during an international student celebration in Kennedy Union.

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**ETHOS expands** This summer, senior Mark Ewalt took two students back to Cameroon to construct a water pipeline for a second African village, building on students’ success last year in Barombi. They are among the 25 students who headed to nine countries for ETHOS technical service and immersion programs, including first-time projects in Togo, Bangladesh and India.

Also new this year: the first domestic ETHOS placements. Two mechanical engineering students are constructing energy-efficient buildings and alternative energy systems at the Long Branch Environmental Education Center near Asheville, N.C.
You’d need a scorecard to keep track of the 26 UD graduates in the families of Michael Soller ’86 and Joan Pierson Soller ’87. Michael, senior project manager at Bowen Engineering Corp. in Indianapolis, gives a family briefing.

What is it like having 26 relatives from UD? Having relatives from UD made college and growing into adulthood a comfortable experience. As the first grandchild to come to UD after Grandpa, Dad and his siblings, I didn’t know a soul. But many Marianist brothers and professors knew my grandpa and took me in. When my three siblings followed, we used to run into each other on campus between classes. It was comforting to see familiar faces, know we shared a common experience and realize we had a relative nearby to call for support.

Do you tell tales at family reunions? Christmas on Campus, the Celebration show choir, volunteering at the homeless shelter, running movie nights — Soller family reunions are full of UD stories. We still discuss my wife Joanie’s family dinners on K Street and laugh about how Grandpa would hound us with questions about our classes.

Was your educational fate predetermined? No. My dad and grandfather encouraged me to find (a university) that would teach me to be a better human being, academically and spiritually. They found UD, but instructed me to make my own decision. What brings joy to my heart is I chose UD on my own, and so, too, have all my relatives. We all found UD to be the best fit, but not because of family tradition.

Does your family stay connected to campus? Certainly. I’m a volunteer recruiter for UD and am on campus often. My brother-in-law, Matt Pierson ’90, works at the UD Research Institute, and my two nephews and niece currently live on campus. I’m guessing the 26 family count will continue to grow, as the Sollers and Piersons have many youngsters who have yet to choose their college.

—Rachael Bade ’10

Michael Soller

UD family tree

How do you say “fluid dynamics” in Chinese? In German?

“The job market demands our students will work in an international environment and most go into some form of product development or manufacturing,” said associate professor Sean Falkowski about the new global manufacturing systems program in engineering technology. It replaces the existing manufacturing program — which attracted few incoming students and graduated only 10 a year, mostly transfers — to address global economic changes, interests of students and needs of employers. The new program includes the school’s first language competency requirement, so students become comfortable communicating in new ways. It also adds a sustainable manufacturing course — including energy efficiency and recyclability — and a required international assignment — international co-op, U.S. co-op on an international project, study abroad or immersion.

Eight years ago, when Falkowski was assigned to a Mexican Delphi facility, co-workers considered it near treasonous. Today’s understanding of shifts in manufacturing — and where American strengths lie — is different, he said.

“If you start losing jobs because (other countries) are technologically superior, we’re in trouble,” he said. “The United States has to make sure students who come out of a university are technically ready, and if they are going to be working in a plant in China or India, they have to be culturally ready.”

SPEAKING THE LANGUAGE

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Is UD in your family tree?
Share your story at daytonengineer@udayton.edu.
Empenhar-se  
(Applying himself)

Shawn Stout was looking for small-business experience. The senior computer engineering major never predicted his startup would serve 300,000 Internet users daily in South America.

Stout created a software application for Internet service providers in February 2008. With his link embedded in social networking sites such as Facebook, users click and access Stout’s application to organize their favorite games, music, chat rooms and other Web sites on a single page.

Now his link appears on social networks in three countries. Company advertisements on his template bring in up to $300 per day, allowing Stout to further invest in and expand his applications’ content. He hopes to include a greater variety of links, games and music for users to add to their favorites list.

“Eventually I’d like to have my own Web site, not go through other social networks or other providers,” Stout said.

But first he has to find a translator, he said. Brazilians seem to use his application the most, and Stout doesn’t speak Portuguese. He also plans to import comics and design new marketing techniques for his business this summer.

—Rachael Bade ’10

See some of Stout’s content at http://stoutfiles.com.

Strong wind

To see 3-megawatt wind turbines with blades sweeping an acre of vertical airspace is awe-inspiring. To envision their repair is daunting.

Steve Donaldson ’87, assistant professor of civil engineering, is looking to extend their 20- to 30-year lifespan by adding nanoscale reinforcements to the resin-infused fiberglass blades. The goal: stronger, stiffer, more fracture-resistant blades and more jobs for Ohio manufacturers.

Donaldson and composites research engineer Jared Stonecash are testing the strength of selective reinforcement in the ply-drop region — the area where a fiberglass layer stops and resin accumulates to fill in gaps. A given blade could have dozens of layers and as many potential fracture points.

“You have this incredibly strong glass fiber with a weak link,” he said. “The question is, how can you take advantage of composites to maintain the glass fiber strength?”

He is using glass fiber from Owens Corning and nanofibers from Applied Sciences — both are Ohio companies — as part of an effort to create Ohio jobs through wind turbine component manufacturing. His research is funded through the UD Research Institute as part of an $8 million grant from Ohio’s Third Frontier Project.

“We can leverage our work for the Air Force and Department of Defense and transition it to help the nation’s drive for renewable energy,” said Brian Rice ’90, head of UDRI’s multiscale composites and polymers division, who sees a UD wind research center as well-positioned to compete for state and federal stimulus grants.

Donaldson said his basic research could be applied to blades of any size. The question will be whether the increased cost of adding nanofibers will extend blade life enough to make financial sense.

As a co-op student at NASA Lewis Research Center in the 1970s, Donaldson worked on the world’s largest wind turbines — at the time, 200 kilowatts. The U.S. is again looking to wind; in May, Ohio passed a 12.5 percent renewable energy standard by 2025. The U.S. Department of Energy reported wind power could provide 20 percent of the nation’s energy needs by 2030.

“Wind energy is coming, and it’s coming big, so we love being players in this,” Donaldson said.

For information on “medium wind” — the wind energy most available in Ohio — visit http://Ohiowind.org and http://awea.org.
Save a life, start a business

It was 1995. A local police officer had been killed while standing in the street directing traffic. Former lab partners Matt Bolton ’87 and Sheldyn Armstrong ’86 — friends of the officer — created a way to prevent similar tragedies.

“We were surprised that for 100 years, the police had never had a device that would help them direct traffic,” Armstrong said. Together, they invented a portable traffic light that keeps officers out of the intersection.

In an unstable economy, Bolton and Armstrong’s company, IST International, is thriving. Here’s their advice for whether an idea should get the green light:

1. **Finances.** Though they began working on the company in 1995, the men did not quit their day jobs until 2001, after the financial backing was in place.

2. **Research.** And, Bolton adds, not just the fun stuff — but the boring accounting, quality management. “If you get those things squared away ahead of time, your life will be easier down the road.”

3. **Prepare** for hard times and be adaptable. When the traffic light sales began to slow, the two branched into hazardous materials gear for the military. “Adapting to the world or market events, then trying to offer the best product you can, makes a huge difference,” Armstrong said.

4. **Commitment.** “You live and breathe it, wake up at night writing things down,” Armstrong said.

Bolton added that their level of commitment was derived from personal investment. “You put your house on the line to make sure your employees and vendors are getting paid. That changes your commitment to the product,” he said.

And at a time when the job market is at an all-time low, Armstrong said IST International in Cincinnati is hiring. “We’re definitely looking for a few good engineers, so look us up, send a résumé.”

—Laura Edwards ’09
Here comes the **SUN**

Solar energy may soon have the two things it needs to be a real power player — federal money and advanced materials.
Since the early 19th century, scientists have known that certain substances produce electricity when they are struck by sunlight. In 1954, Bell Labs parlayed that discovery into the first photovoltaic device that yielded a usable amount of electric power.

But even after decades of tinkering, electricity from photovoltaics has remained a niche player, often confined to use in regions the power grid doesn’t reach — space, for instance. Solar power is still two to three times the cost of fossil-fuel power, according to solar-industry estimates.

However, the solar-power industry may be poised for a boom. An expansion in federal subsidies for alternative energy, coupled with cutting-edge research at the University of Dayton and other...
research centers, may help drive already falling prices for PV devices even lower.

“I think solar energy will have to become a big part of our energy resources,” said Qiwen Zhan, associate professor of electro-optics, who is working on optical strategies to create a new class of PV materials. “I can envision that every home will have at least some solar energy to supplement the power we draw from the electric grid. Solar energy could heat hot water for showers, dishwashers or washing machines, or run a laptop.”

Last year, the U.S. solar-power industry added 342 megawatts of electrical-generating capacity — a record. In the same period, the U.S. wind-power industry added 8,500 megawatts of new generating capacity, enough to serve more than 2 million homes.

Renewable-energy supporters see a future in which huge numbers of homes, office buildings, factories and shopping centers will be turned into miniature power plants. “The big market is in transforming building surfaces so they can make electricity,” said Joseph McCabe ’82, vice president for business development at Ascent Solar Technologies, a Colorado-based maker of PV modules.

Theoretically, any surface with sun exposure — an exterior wall, a roof or an overhang — can be adapted to produce power. “We add a thin layer of material, and then you have a high-value electrical-producing surface,” said McCabe, who holds a patent for integrating LED lighting directly into PV surfaces.

A mass market for PV power hasn’t materialized yet; in the meantime, state and federal incentive programs have helped to prop up the industry. Incentives will soon expand, resulting from a $70 billion federal package for renewable energy and energy efficiency passed this year by Congress and signed by President Obama.

In the long term, the solar industry may be able to do without subsidies. “We don’t argue with the subsidies at this point because they help the industry to get going,” said Lou Trippel ’99, a product manager at First Solar, which produces PV modules. “But First Solar’s goal is to be able to get along without them if the subsidies disappear.” This will require PV modules to become both cheaper and more efficient. Manufacturers appear to be on track to achieve this. At First Solar, for instance, the manufacturing cost of producing one watt of PV capacity fell from $1.40 in 2006 to less than $1 today.

One key to these gains is the choice of materials used to make PV modules. Traditionally, silicon has been favored. Its properties are well-understood because it has been used so extensively in the microelectronics industry — computer chips are made of silicon. But silicon is far from ideal, critics say. It is brittle, which limits its uses for applications that require flexibility. It also is expensive, and it is not the best material for converting light into electricity.

Some industry leaders have shifted to other materials. One is cadmium telluride, favored by First Solar. Another is copper-indium-gallium-diselenide, which is used by Ascent Solar. The new materials have helped bring down prices, spurring sales for PV products. Higher sales have allowed the industry to gain an economy of scale that has helped lower prices even further. “As sales go up, you can leverage your suppliers for volume discounts,” Trippel said.

The dream of affordable electricity from sunlight depends on further progress in four areas, said University of Dayton researcher Qiwen Zhan, associate professor of electro-optics.

First, the cost of photovoltaic materials must come down. Next, PV materials must be more flexible, which would allow them to be used on curved surfaces such as automobile bodies.

In addition, PV materials must cut the loss of sunlight from reflection. When light is reflected, it bounces off into space and can’t be converted into power. And last, PV materials must reduce the loss of power that occurs when sunlight is converted into heat rather than electricity.

Zhan is collaborating with colleagues at the University of Florida to create new PV technology that might help solve these problems. The technology would use small, organic molecules such as C60, a form of carbon popularly known as Buckminsterfullerene, in lieu of other PV materials.

Zhan said these small, organic materials are lightweight, inexpensive and flexible. “Potentially, you could make clothes out of them.” To make the material particularly useful for PV applications, Zhan wants to add two types of nanostructured optical coatings. One layer, made of nanoporous silicon oxide, would reduce reflection. A second, made of nanoporous titanium oxide, would reduce the conversion of sunlight into heat.

Zhan received a $10,000 Sustainability, Energy and the Environment seed grant from UD to fund this stage of his research.

“Our numerical model has shown that organic PV cells will benefit greatly from these nanostructured optical films,” he said. “We are building testing devices now. Then we can see if it’s really a winner. If it works, the potential is really huge.”
PRACTICAL PHOTOVOLTAICS
Need to charge your laptop? Just plug it into the sun.
Students of all majors will learn to assemble and test solar panel modules during a Sept. 19 campus workshop. Richard Komp — president of the Maine Solar Energy Association, who has worked to distribute photovoltaic technology in Nicaragua, Mali and Haiti — will teach the workshop.

“I hope students gain an understanding of the principles of appropriate technology,” said Faizan Ahmad ’09, a student in the master’s program for renewable and clean energy. Ahmad interned in 2007 with the Alternative Energy Development Board to maintain photovoltaic systems in remote villages in Pakistan’s Thar Desert. This summer, he is working with Komp in Karachi, Pakistan.

The same phenomenon transformed the early automobile industry. At the turn of the 20th century, cars were something only the rich could afford. But Henry Ford and other pioneers found ways to bring the cost down, which expanded markets and in turn allowed better economies of scale and still lower costs. By the 1920s, cars were part of mainstream American life.

While the solar industry has made great strides in recent years, it is facing a new problem — the global economic downturn. Revenues from solar-module sales are expected to plunge 45 percent in 2009, according to Collins Stewart LLC, a research firm with offices in New York and London. But the firm also predicts revenues will turn around in 2010, surging 31 percent. The projected upturn will be driven by renewable-energy provisions in the economic stimulus packages of the world’s three largest economies — the U.S., China and Japan.

The emphasis on renewable energy in the U.S. represents an about-face in federal policy. The previous administration tended to emphasize fossil-fuel development. But the Obama administration sees renewable energy as a way to combat global warming and to generate large numbers of new, high-wage jobs. Many of these job gains will occur at small companies, which make up much of the industry. Ascent Solar Technology is a case in point. Ascent’s workforce is expected to roughly triple to about 200 by 2012. But these gains should add up. Overall, the stimulus package will create 60,000 jobs in the solar industry in 2009 and a total of 110,000 in the next two years, predicted Rhone Resch, president and CEO of the Solar Energy Industries Association.

Still, more growth is likely when the industry solves its technical and cost issues. But this won’t be easy.

“It’s a very complicated thing,” said UD’s Zhan. “Otherwise it would have happened.”

The dream of turning sunlight into a boundless source of affordable electricity is an alluring one. If the sun can warm our planet and grow our crops, perhaps one more bit of magic isn’t too much to ask.
Just as human beings are a mix of levers, circuitry, and cellular reactors, bioengineering harnesses interdisciplinary approaches to body and beyond.
Kim Bigelow was sure she was going to throw up.

She lay trapped in a cage, grasping her bed’s rails in a failed effort to right her spinning brain. Wires stretched like hairs from her head and recorded eye movement as warm and cool air was blown into her inner ear. It was the scary last stage of the hourlong medical test meant to determine why, at 30 years old, Bigelow couldn’t keep her balance.

Bigelow, with the body of a distance runner, grabbed doorways as she walked through. She asked others if her extreme leaning might cause her to topple. And she couldn’t demonstrate the simplest procedures to an 80-year-old research subject who came to her for insight into why older people lose balance and fall.

“It gave me a common perspective with these seniors that I could relate to them and that they were intrigued by,” Bigelow said.

The biomechanical engineer, who started teaching at UD last January, points to this — the human interaction, of making lives better — as primary reasons she pursued bioengineering, a field that extends far beyond her mechanical engineering department. With new hires across campus, the University is building expertise in this discipline that includes everything from fall prevention technology to alternative fuels to biological nanosensors. It’s a discipline that could help diversify the undergraduate engineering student body and fill industry needs for truly interdisciplinary problem solvers. And it could help others with balance problems like Bigelow — who was diagnosed with an inner-ear virus and has since recovered — live better lives with less invasive, sickening procedures.
On a March afternoon, Bigelow and Don Comfort sat facing one another near the corner of a 14-foot conference table in a nearly empty room in Kettering Labs. The two new professors — Comfort joined UD last October — discussed the bioengineering field, its elusive definition and its complex skill set.

It was more than a semantic discussion. If properly defined — and, in UD’s case, properly conceptualized as an undergraduate minor and graduate program — the interdisciplinary nature of bioengineering has the power to solve problems that elude single disciplines. Just as human beings are a biological mix of levers, electrical circuitry and cellular reactors, the field of bioengineering harnesses interdisciplinary approaches to complex problems.

Bioengineering and biomedical engineering are terms often used interchangeably by the public, Bigelow said, which leads to confusion over the skill set a “bioengineer” possesses. Do you build prosthetic limbs or investigate tissue regeneration? Or are you like Comfort, whose current research has no direct connection to the human body?

Bioengineering is the large umbrella under which there are a variety of specialties. “It’s very problematic for industry because they don’t know what skills you have,” said Bigelow, assistant professor of mechanical engineering.

In 1997, the National Institutes of Health formed a committee to define bioengineering. Predictably, it had a human health focus: Bioengineering integrates physical, chemical or mathematical sciences and engineering principles for the study of biology, medicine, behavior or health ... for the prevention, diagnosis and treatment of disease, for patient rehabilitation, and for improving health.

Bigelow’s work uses mechanical principles to serve patient needs; she uses a force plate (see photo right) and a computer to record a patient’s stability and a computer model to interpret the data for health care professionals. As a chemical engineer, Comfort has a very different focus: He spent years working on downstream process controls for vaccine production and is now turning his attentions to the intersection of engineering, microbiology and biochemistry by using thermophilic microorganisms, such as bacteria living in hot springs, to aid cellulose degradation for fermentation to bioethanol and other biofuels.

Comfort preferred a stricter bioengineering definition, one of applying math and engineering principles to biological systems not confined to the human body, such as using E. coli cells in bioreactors to produce cellulose-digesting enzymes. The fundamentals taught in undergraduate engineering programs provide the basis for applying additional lessons in anatomy, chemistry and other complementary courses. In his definition, “the traditional disciplines — mechanical, chemical, civil — carry much more weight,” said the assistant professor of chemical engineering.
Another no longer played golf. They had bruises and broken bones and stories of, literally, fallen friends.

Bigelow used a force plate — which looks like a glorified bathroom scale — to record the foot pressure and sway of her subjects as they tried to maintain their balance. Most volunteered because they were intrigued by Bigelow’s research — some wanted to reduce their own fall risk; some hoped her research could help others. Others were more pessimistic: “It can’t be prevented; I fall all the time.”

Bigelow and Comfort join a bioengineering initiative that encompasses faculty and researchers from across the University. In recent years, UD has invested in technology transfer, advanced academic training, state-of-the-art instrumentation and industry collaboration through the Nanoscale Engineering, Science and Technology facility and the Center for Tissue Regeneration and Engineering at Dayton. NEST and TREND make up a portion of the ongoing research at UD in bioscience and bioengineering that totaled nearly $17 million in 2008. Current research by undergraduate and graduate students, faculty and research scientists includes investigation of the toxicity of nanoparticles, viability of a carbon foam bone repair system and genetic circuitry in neurodegenerative symptoms of Alzheimer’s disease.

On the undergraduate level, Introduction to Bioengineering was first taught in 1999. The minor program, first offered in 2003, gives an introduction to engineering principles in biological systems and applications through biology, physiology and genetics. Since 2007, 13 students have earned the minor along with their undergraduate degree. Among the coursework are senior-level introductions to bioengineering. This spring, Bigelow and Comfort each taught one course in their respective departments.

But what to teach?

“We’re jumping fields all the time,” Comfort said. “I have to cherry pick things I’m interested in but also include what I think they should know: pharmacokinetics, cellular reactions, statics, biomaterials.” He decided to let students help drive the course; when asked what they were interested in, 12 students offered six completely different topics.

In an hour devoted to ethics, the students’ discussion of embryonic stem cells encompassed religion, international regulation, greatest good for the greatest number and donor egg (and sperm) compensation. They debated creating chimeric species and introducing terminator genes in crops. One student offered the possibility of genetically engineering humans — smarter, faster, stronger, healthier. What would that mean for poorer segments of society? For the belief that greatness rises from life’s challenges?

“Heart disease runs in my family,” said senior Nick Brown, making the conversation personal. “My grandfather died of heart disease, my father died of heart disease, I’ll likely die of heart disease, and if I have a son he’ll likely die of heart disease — it’s inherited. Why not fix it so he’ll not die of heart disease?”

If you change things on a genetic level, you can develop new problems, one student responded.

“We’re creating new problems anyway,” Brown said, pointing to diseases and conditions that have become prominent as we find medical and technological ways to extend life spans.

The students paused, looking down at notebooks. To encourage the conversation, Comfort waited out their silence, knowing ethical discussions are important for those entering a field that’s progressing faster than conversations about possible pitfalls. “It’s not something most of them have thought about,” he said. “For some of them, they haven’t even had a class like that, where you talk about it with no right answers. Usually there’s a value you can solve for, an equation you can apply.”

As the discussion meandered on, senior Annie Van Auker offered her thoughts on bioengineering: “I waver between, ‘It’s all very cool,’ and, ‘We’re approaching the apocalypse.’”

At her former employer Bertec Corp., Bigelow helped develop force-measuring track starting blocks for the Japanese Olympic team. At the senior center outside Columbus, Ohio, she hoped that by measuring the force exerted by a standing patient, she could develop a clinical tool for health care professionals: What is the risk of fall? Is physical therapy decreasing the risk? Is a recent illness or injury increasing the risk?

“I love dealing with a person instead of one client or user,” Bigelow said of her attraction to bioengineering. But working with people also introduces error. Some would clench their toes to try to get a better result. Others would start talking midway through, throwing off their balance concentration. “It’s really a guessing game,” she said of the results, “and of being a bit of a detective, saying, ‘I got these results, but what are some of the unintended effects?’”

Having opportunity to meander and discover is important when contemplating bioengineering, Bigelow said. In her own biomechanics education, she had to seek out the one class or professor or research opportunity that would give her the education and insight to proceed in her discipline.

She wants to change this for her students.

“Your goal here is to help some of those students who have the interest and haven’t been able to explore it,” said Bigelow, who incorporated biomechanics principles in her freshman-level engineering innovation course. “I had a student who was interested in physical therapy and saw [me in a PBS special on biomechanics] and saw she could combine the two. It’s neat to see that end result.”

A more deliberate inclusion of bioengineering will also help draw in nontraditional engineering students, she said. She points to herself as someone who found no appeal in cars or robots. But she had an interest in math, science and helping people: “When you introduce nontraditional fields — not the automotive — you spark interest in nontraditional students.”

Laura Bistrek, director of UD’s minority and women’s engineering programs, agrees. When recruiting for engineers, buzzwords like exploration, creativity and making a difference resonate with many young women. Bioengineering opportunities demonstrate how all the disciplines — mechanical, electri—
cal, electro-optics, civil, chemical — can integrate components of bioengineering to help people and processes.

In Bigelow’s course on biomechanical engineering, students split into groups and designed their own experiments utilizing the force plate. Each member from Group Two took turns balancing on one foot, then the other, to determine which was more stable, the dominant or non-dominant foot. Alex Szewczyk stepped up in a green T-shirt that read, “Nothing tips like a cow,” and teetered on a bare foot, bracing his toes for balance. Chris Korte conveyed their expectation: “We kind of expected the dominant foot to be better ... but sometimes you tend to use your [non-dominant foot] to steady yourself or push off, so we don’t really know.”

Beth Huelskamp — one of three female students in the room — tended to the computer, adding data on Group Two’s test subjects as it recorded their sway. She liked the class, she said, because, “It’s not just a bunch of calculations.” Huelskamp, who worked with the UD Research Institute to test bone cell growth on carbon foam, said her research made her interested in the course. The course reinforced her interest in pursuing graduate school.

Bigelow asked her elderly volunteers about their history of falling and compared it to results the force plate recorded under four conditions: eyes open feet comfortable, eyes closed feet comfortable, eyes open feet together, eyes closed feet together. For all of the testing conditions, she discovered side-to-side sway velocity was most important in differentiating the fallers from the non-fallers. The most predictive condition — eyes closed, comfortable stance — yielded the most complete results when considering together measures of sway velocity, fractal dimensions of side-to-side sway and front-to-back sway, mean frequency, body mass index and age.

The goal was to create a quick clinical tool that could compare the fall risk of anyone with balance issues — because of age, injury, disease or medication — to the general population or to an individual’s baseline.

She also hoped to keep patients from having to undergo the type of testing she endured, called videonystagmography, or VNG; it’s one of the most common, though unsettling, tools to determine the cause of imbalance.

Her next step toward clinical application was verifying the equipment and her equations, which she is doing in UD’s doctor of physical therapy program lab. It’s an important step toward providing care to the deluge of baby boomers who will soon need clinical services, said Kurt Jackson, the program’s neurology coordinator.

Even without a formal graduate degree program, UD students have been receiving a graduate bioengineering education, choosing courses and research in the field but getting advanced degrees in chemical engineering, biology and the like. Courses such as Intro to Bioengineering, Introduction to Biomedical Engineering, and Chemical and Biological Sensors have been offered by the department.
of chemical and materials engineering since the late 1990s.

Now is the time to formalize the master’s program, said Malcolm Daniels as the School’s interim dean. The new program will reflect the strength of our offerings, the interests of our students and the needs of employers, he said.

An interdisciplinary team of faculty from both the School of Engineering and the College of Arts and Sciences and led by Tony Saliba, chair of chemical and materials engineering, developed the Master of Science proposal, approved in May by UD’s board of trustees. It will next be submitted to the Ohio Board of Regents. The program — with a possible start date of fall 2010 — will be housed in the department of chemical and materials engineering but will be offered collaboratively by the School and College. Faculty from both academic units will work together to teach courses in the program, advise student research and advise the program director on curricular components and admission decisions.

With that in mind, the University is already creating courses and interdisciplinary partnerships to support the program. Comfort’s introduction to bioengineering course is an undergraduate senior elective as well as a graduate program core course. This spring, chemical engineering professor Bob Wilkens and biology professor Carissa Krane team-taught Transport Phenomena in Biological Systems for students from both disciplines. It incorporated physiology, molecular genetics, chemical engineering and fluid flow mechanics.

In the proposed graduate program, students will be able to choose from among four emphasis areas — bioprocesses, biosystems, bioinstrumentation, and biomaterials and biomechanics — and take courses that focus their studies and research. Since the program is designed to draw from science and engineering, the foundational coursework will be different for a chemical engineer versus a biologist. All students will be grounded in chemistry, math, biology and engineering, allowing them to develop a common, interdisciplinary language.

“We’re going to have the scientists, we’re going to have the engineers, and they’ll be separate at first when they take their fundamentals course,” Comfort said. “But after that, they’ll come together and be able to leverage the different thought processes and different expertise of their classmates.”

The proposed program — which will include courses such as biomimetics, bioproduct design and database systems for bioinformatics — will have full-time and part-time options. Comfort said it may be especially attractive to professionals who have seen their job responsibilities shifting toward bioengineering and to those who want to change fields, such as from engineering mechanisms for cars to those for the human body.

The need for bioengineers is documented regionally and nationally. BioOhio, a nonprofit organization that helps develop and promote bioscience industry, research and education, recently stated that Ohio “has emerged as one of the leading bioscience states in the nation” and that bioscience and bioengineering will continue to be critical to Ohio’s future economic development. According to the U.S. Bureau of Labor Statistics, there will be a 21 percent employment growth in biomedical engineers from 2006-16 and that “unlike many other engineering specialties, a graduate degree is recommended or required for many entry-level jobs.”

To gauge interest in the proposed program, UD’s Business Research Group conducted an online survey of alumni with undergraduate degrees in engineering, the physical sciences, computer science and mathematics. More than 25 percent of respondents indicated interest. Respondents in positions to gauge their firms’ hiring needs also indicated high interest. In a survey of UD undergraduate junior and senior science and engineering students, 15 percent indicated that they were “likely” or “very likely” to enroll in such a degree program offered by UD. In addition to serving students and employers, the program will help attract more bioengineering faculty and research dollars and provide more undergraduate research opportunities.

To verify the measurements of the force plate, Bigelow recruited volunteer student research assistants — mechanical, chemical and electrical engineering majors, all freshmen and sophomores. In April, they shared their results at the Stander Symposium. They found negligible drift and total oscillation (called “noise”) of 1.3 and 1.4 mm for each sway direction from center of pressure for readings up to 10 minutes (the average human test takes 30 seconds). Their conclusion: Noise and drift is small suggesting good accuracy of subject tests.

The students also discovered a software glitch. “We showed the manufacturer the data about these two peaks,” said sophomore mechanical engineering major Erin Sutton, pointing to spikes in the data graph. “Since they were symmetrical about the average, there is no way [a patient] could have pushed down and pulled up at the same time.” The Columbus, Ohio-based manufacturer is replacing the force plate with one that corrects the glitch.

Later that semester, Sutton demonstrated like a pro the force plate to seniors and grad students in Bigelow’s biomechanical engineering course, who used it to conduct their own experiments. Next year, Bigelow’s research assistants will work with doctor of physical therapy students in evaluating the balance of multiple sclerosis patients before and after kickboxing or Wii fitness therapies.

Mark Stercay, first-year mechanical engineering major, said his research assistantship helped solidify his interest in helping people through engineering. “If we can bill [the balance plate] as accurate, physical therapists can know their results are accurate and help translate it to help people,” he said.

This may prove to be the research project that helps Stercay on his path to a bioengineering career. But with all the opportunities growing at UD, it won’t be his last.

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Health is chief priority

In Ghana, Paul Soskey learned that whether you’re a Marianist-educated engineer or an African tribal chief, servant leadership is a universal concept.

Soskey was working for BD, a global medical technology company, when he was selected for the company’s 2007 volunteer service trip with Direct Relief International, a medical aid organization. The team spent three weeks in Ghana, upgrading two health care clinics, improving lab capabilities and providing medical outreach to villages.

Soskey, the “general construction guy,” worked at a rural clinic on Lake Volta that’s the only health care resource for nearly 100,000 people. He helped build a satellite clinic and outfit it with a blood bank refrigerator and a generator, the clinic’s first electricity.

Soskey went home to New Jersey “with a different perspective on what’s important,” he said. “Most of the things we say we need are just wants.”

In spring 2008, BD sent a team back to the same sites to install 200 BioSand water filtration systems designed for multiple-household use. Some villagers have access to pumped water, but “the neediest people use surface water that can be filled with diarrhea-causing parasites,” he said. Soskey enjoyed getting to know the villagers and their chief, Nana Bonjah, who invited him to a fall thanksgiving celebration.

Soskey accepted. Last November, he and daughter Ginny returned to Ghana with support from International Volunteer Development Programs, a Christian nonprofit organization. Traveling with a nurse and lab technician to a village accessible only by boat, they brought a “Lab-in-a-Suitcase” outfitted with solar-powered medical instruments. They were able to accurately diagnose and treat children with malaria.

The thanksgiving celebration? It became a daylong ceremony to make Soskey a chief of Nana Bonjah’s community. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. ‘They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village. “They dressed me in my own kente cloth robe, sandals and amulets. They even sacrificed a goat. I became a member of the village.

Recalling conversations with Nana Bonjah about a leader’s responsibilities to the people he serves, Soskey realized, “We were talking the same language.”

—Deborah McCarty Smith ‘93
People’s advocate

“You’re taught to look at it from UD,” said British Virgin Islands resident Neil Smith. “You’re taught to look at a complex problem and within a short period of time come up with a strategy to solve that problem, to make a breakthrough.”

Smith works to make financial breakthroughs — and good economic sense — in his job as financial secretary for his homeland, made up of 60 islands and cays in the Caribbean.

The British Virgin Islands’ equivalent of the U.S. Treasury Secretary, Smith advises the government on how to best manage the economy, which is more stable than in other countries due in part to steady tourism and financial industries.

And while the job requires the analytical thinking skills he learned at UD, it seems like an unlikely choice for an electrical engineering grad.

Smith worked as an engineer, though, with the British Virgin Islands Electricity Corp. for nearly a decade. After graduation, he started in transmission and distribution — working on power lines — and later worked as a generation engineer responsible for all the power stations on the islands.

In 1999 he earned his MBA from Wright State University. “I needed a higher level of understanding of the managerial aspects of running a utility,” Smith explained. But he received a concentration in finance — “more quantitative and analytical” — rather than in management.

Soon Smith felt his talents could be used in better ways. “I still liked engineering, but you reach a point in most jobs where it almost becomes routine,” he said. “I realized the issues that the British Virgin Islands were dealing with needed someone who could solve problems that seemed unsolvable,” he continued. “I felt the people needed an advocate.”

He became deputy financial secretary in 2003 and was promoted in May 2006.

Now Smith frequently works into the night to ensure a better standard of living for the citizens of the British Virgin Islands.

“It is a fundamental reason why I make any decisions in this office,” he said. “The policies that we implement affect the lives of my personal family and the entire population. It’s quite rewarding.”

—Lauren Pauer
Lisa Robbins Ehrman ’00

“The idea of doing something challenging was really appealing. Luckily, I stumbled into it because it was difficult and that it paid well. “I was very bored in school as a kid,” she recalled. And the challenge is what keeps her going. “I’m working on something that’s truly defensive — something that acts as a deterrent against nuclear war.”

The need for a challenge was also a factor in her choice of electrical engineering. At an earlier age she had been turned off by the science she was learning in school. “I decided that I wanted to study something I liked,” she said, “and I feel like I’m doing what I’m supposed to be doing with my life. I’m working on something that’s truly defensive — something that acts as a deterrent against nuclear war.”

“Even if I could have had a day at the office, I don’t think I would have chosen it,” she said. “I’d be bored. I need to be doing something where I’m using my brain. I need to be thinking.”

Lisa, who works in the Georgia Tech Research Institute, has been working on missile defense systems for over 10 years. She is part of a team of about 100 people who work on a project called the Advanced Technology Demonstration Program. The program is designed to detect, track and destroy enemy missiles, she sticks to the basics.

“We have to figure out what a missile launch has happened, and then you have to figure out where it is going so that you can intercept it,” said Ehrman, who works at the Georgia Tech Research Institute.

While that sounds simple, the science that drives missile defense systems is highly complex. That’s where Ehrman and other Georgia Tech researchers come in. Their role includes making the transition from basic research to the field and providing guidance for systems engineering decisions.

After receiving her bachelor’s in electrical engineering from UD, she went on to get a master’s and doctorate in the same field from Georgia Tech. She now lives in Atlanta with her husband, Brad ’02, and their daughters, Rachael and Julia.

Her work is difficult, but that’s part of its attraction.

“I’m drawn to it in part by the challenge,” she said, “and I feel like I’m doing what I’m supposed to be doing with my life. I’m working on something that’s truly defensive — something that acts as a deterrent against nuclear war.”

The need for a challenge was also a factor in her choice of electrical engineering. At an eighth-grade career fair, she heard that the field involved a lot of abstract math and science, that it was difficult and that it paid well. “I was very bored in school as a kid,” she recalled. “The idea of doing something challenging was really appealing. Luckily, I stumbled into the right field.”

—Doug McInnis
John Gunzburger and Linda Kilian

Gunzburger began their life together as a childhood friends. “Our back yards were a few houses apart,” John said of a relationship that grew to include their 1972 marriage and move to Chicago.

Linda had an ease with people, making a lasting impression on those she touched as a clinical professor and associate dean. “She would remember their names and their children’s names,” he said. “It was amazing, a blessing to be married to her.”

He, an engineer of motor inverter drives, and she, an educator with a passion for helping medical students, talked of developing scholarships at the schools they loved dearly, including her alma mater, the University of Dayton, where she received a bachelor’s degree in education in 1971 and a master’s in education in 1972. Linda earned her doctorate in curriculum evaluation and professional development in 1980 from the University of Chicago.

When Linda passed in 2005, John decided there was no better way to celebrate their love than by fulfilling their dream to help educate others.

The Gunzburger Foundation supports two electrical engineering majors who demonstrate skill, drive and need. The half-tuition scholarships are awarded annually. Their other UD scholarships support students studying education.

Through the Gunzburger Foundation, John will continue to support education, the primary initiative of the Dean’s Fund for Excellence.

Join John today by supporting today’s students and tomorrow’s leaders.

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No clean sweep Mud wasn’t the only obstacle for Lucky, the UD minibaja vehicle that finished 34th out of 100 vehicles in the Society of Automotive Engineers’ four-day Baja Alabama competition. The team survived a broken axle, an unexpected somersault and a broken shock that happened when another vehicle landed on Lucky’s left-front suspension; it took students an hour in the pit to weld the injury. Watch the somersault at http://engineer.udayton.edu.