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wisconsin engineer

September 2005
VOLUME 109, NUMBER 4

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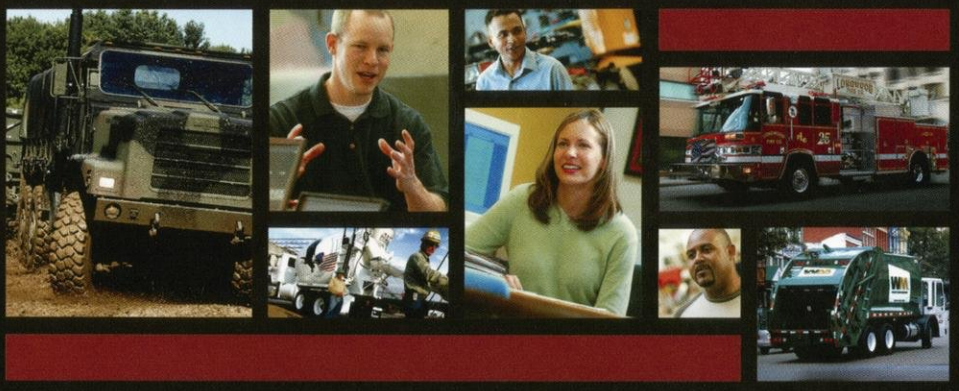

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COVER STORY

Cover photo by Carl Calhoun

FEATURES

COMMENTARY

Kyle Oliver
Writing Editor

Mercy mercy me

I took two courses this summer. The first was Afro-American Studies 156: Black Music and American Cultural History, taught by UW-Madison's Professor Craig Werner. The second was Nonproliferation Issues for Weapons of Mass Destruction, a symposium at the University of Missouri. In retrospect, I'm grateful the order wasn't reversed.

As I have argued in the past, I believe courses from both ends of campus can complement each other in sophisticated ways. For instance, I certainly expected that my year of studying some history of science would have prepared me for a class on WMDs, and it did to a certain extent. Not long after I got to Missouri, though, I found myself much more grateful for my newfound knowledge of black music than for my perhaps more applicable knowledge of Niels Bohr's idea of the complementarity of the atomic bomb or Donald Mackenzie's commentary on the history of weapons testing. That's because, by the end of the first day of the symposium, I was in need more of emotional support than historical or scientific background information.

Dr. Mark Prelas, director of the symposium, spent the first day inundating his audience with the grim realities of the world he's come to know as a state department WMD expert and de facto engineer/political scientist. Interestingly, the details he shared with us that first day had more to do with the looming energy crisis than WMDs per se, but that was definitely by design; Prelas's overriding emphasis for the course is that the demand for oil resources in an increasingly energy-starved world is a central political and economic factor driving WMD proliferation.

It was amazing to see a room full of engineers stricken with silence as the data about oil supplies, population growth, petroleum dependence and the limitations of nuclear and renewable energy poured over us. I felt buried and immobilized by hopelessness, and we hadn't even started talking about WMDs yet.

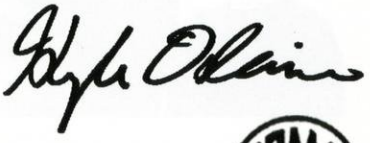
By day two or three, I broke down and asked Prelas the question that had been circulating among the symposium participants. "How do you study all this day after day," I asked, "and not get, you know, clinically depressed?" He answered simply that he's an optimist by nature and that if we get together and work hard, we'll be OK.

At first, that answer wasn't good enough for me, so I turned to my music collection, steeping myself in the soul music that has been my constant companion since my first week in Werner's class. Prelas's contention that everything would be alright carried far less weight with me than the more assured voices of Curtis Mayfield, Aretha Franklin and Marvin Gaye that night--and the subjects they were originally singing about were a lot more burdensome and immediate than anything I was dealing with.

But in some ways, this incident illustrated some shortcomings in my understanding of both Werner and Prelas. The power of soul music, Werner had taught me, comes from the gospel impulse at its core. The assurance in the voices of soul singers reflects the strength they get from sharing their burdens with the community.

But a similar process might give Prelas his assurance, too. As someone who has, for instance, witnessed the terrifying remnants of the Soviet Union's biological weapons program, Prelas's burden is by no means light. But he recognizes the breadth--not just the depth--of the problems he studies. When he said we all needed to get together and work hard to solve the problems he'd been teaching us about, he didn't mean "we Midwestern engineers" or "we American diplomats." He meant people all over the world, nationalities and professions aside. From practicing conservation measures to fostering the kind of tolerance and social justice that may, someday in the distant future, diffuse the threat of WMDs, Prelas made it clear that everyone has a part to play if we're gonna make it through the next thirty years or so.

I have a sneaking suspicion that someday, when I've become desperately frustrated with some part of whatever role I end up playing, I'll think back on his quiet assurance and be renewed by the presence of all the people struggling beside me. Some Marvin Gaye cuts will probably help, too, but now I see how that's pretty much the same thing.



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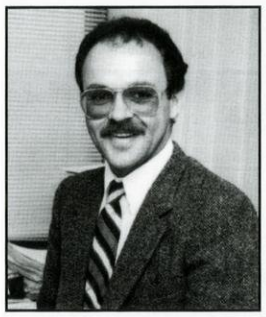


Self discovery, calculated risk and service learning: The unconventional Fred Bradley

By Bradley Groh

Many people have stereotypical views of engineers. They believe engineers are endlessly analytical, but lack skills relating to personal interaction; engineers are strong in math and the physical sciences, but subjects such as philosophy and sociology are completely lost on them; engineers believe in things that can be seen, touched or measured, but put no value in external forces that can not be quantified or observed easily.

Fred Bradley, professor of materials science and engineering, transcends nearly every conceivable engineering stereotype. As an instructor and mentor, Bradley uses many unique techniques to make his teaching more effective and provide enduring lessons to his students.

The concept of personal discovery and learning through risk were important to Bradley from a young age. After dropping out of college his sophomore year, Bradley embarked on what he considers the most influential period of his life. At the age of 19, he traveled to Europe with a couple of friends and began hitchhiking throughout the continent. During this time, he worked in a potato chip factory and in construction. Although his travels proved to be exciting, the ultimate lessons Bradley learned through his European adventure were the virtues of responsibility and self discovery.

"The story of my life has been life-long learning," Bradley says. "If you don't operate on the edge, then you don't know where the edge is." These sentiments echoed through his early development as he renewed his focus in school and attained his Ph.D. in materials science and engineering in 1985. His research in metal casting provided his first opportunity to begin teaching in Madison in 1986. However, after several years of teaching courses in computer tools and applications, Bradley began to realize that something was missing from the classroom experience. So he started refining his role as an educator.

"If you don't operate on the edge, then you don't know where the edge is."
-Fred Bradley

"Up until eight or nine years ago, my teaching was fairly traditional," Bradley admits. "Education should be able to match the times and needs of society."

In this time of uncertainty, Bradley honed in on what he believed was missing from the engineering curriculum in general. An engineering education, in his opinion, should focus on the concepts of calculated risk, personal development and life-long learning skills. Developing an awareness of social issues and character development are, in the end, just as important as learning differential equations or computer programming, according to Bradley.

Bradley's renaissance in college education and societal awareness sparked his interest in leadership training and service learning. After years of research in innovative teaching and learning methodologies, he was able to attain a National Science Foundation grant to implement the Engineering Projects in Community Service (ePICS) program in 2000.

ePICS, offered as materials science and engineering 401, has evolved into a class that pairs students from many different majors with nonprofit organizations, with the goal of learning from and helping each other. Although there have been many changes in the classroom structure of ePICS throughout the years, the core beliefs of learning through community service, personal growth and controlled risk taking have remained constant.

"[Service learning] courses are very difficult to pull off," Bradley says. "Clients have had pervious, not so positive, experiences with students. [Now], we're getting really good at what we do. It's this idea of learning how to be adaptable. Things change every term."

In Bradley's opinion, ePICS differentiates

itself by providing real-world urgency to problems that would have otherwise seemed like arbitrary work.

"You can try to incorporate group work or teamwork, but what's really lacking is the real-world problem solving. That's what makes ePICS great. It fosters a deeper transformational experience for the students."

The transformational experience of ePICS is not limited to the student body, however. Bradley continues to be affected by his unorthodox approach to teaching.

"I don't really consider myself a teacher," Bradley says. "I'm more of a learning facilitator; a guide. Metaphorically, it represents the European life adventure."

On top of coordinating this innovative class, Bradley continues to teach required materials science and engineering courses in computer technology. Although these courses are subject to a stringent set of engineering learning objectives, Bradley finds ways to interject instruction about self awareness and community issues into every class he teaches. For example, Bradley's students may find themselves participating in meditation sessions, watching a video relating to the problem of increasing consumerism in America or hearing from a civil rights activist.

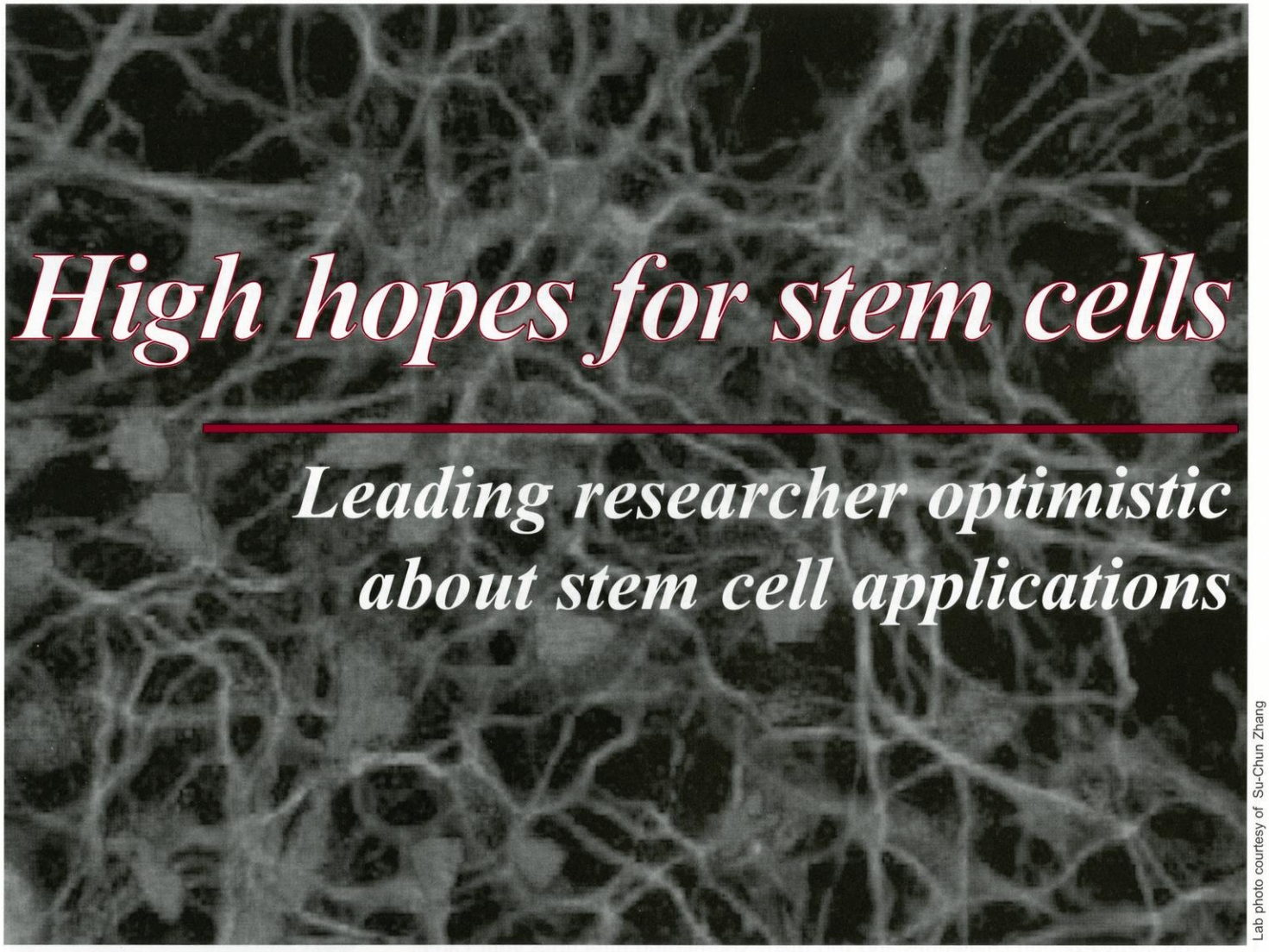
"Education should be able to match the times and needs of society."
-Fred Bradley

"[I stress] this idea of calculated risk; it's all about learning and discovering your limits in a safe way," Bradley says. His students often reflect on their experiences in the form of "self-peer-team" evaluations. Under this format, students reflect on what they were able to accomplish, what they learned and what they plan to do with that knowledge in the future. With this learning approach in all classroom settings, Bradley has been able to emphasize the importance of issues beyond conventional engineering practices.

To Bradley, life has always been about constantly redefining who he is and how he approaches life. Although he may not fit the description of the typical engineer, the contributions he has made to student learning have undoubtedly prepared his pupils for more than just algorithms and material properties.

His teaching style is unconventional. His lectures are unpredictable. His lessons are profound. Fred Bradley is more than just a professor of materials science. He is a professor of life. WE

Author Bio: Bradley Groh is a senior majoring in civil and environmental engineering. He is also a member of the concrete canoe team and has been actively involved in ePICS for the past two semesters.



High hopes for stem cells

Leading researcher optimistic about stem cell applications

Lab photo courtesy of Su-Chun Zhang

By Martin Grasse

Stem cell research has received a great deal of attention from the media, the scientific community and even politicians over the past few years. The discipline is exploding into one of the biggest new fields in biology, and its potential seems to be endless. Here at UW-Madison, university researchers are making breakthroughs that are leading the field around the world.

Most people may not realize that there are many different types of stem cells. They exist in almost every organ of the body as the basic cells that develop into tissue and organs. For example, blood stem cells develop into blood cells, and stem cells in the skin develop into skin cells.

Embryonic stem cells, the subject of most of the public debates, are unique because of their capability to develop into virtually any cell type in the human body. This characteristic is the main reason why scientists are adamant that embryonic stem cells, compared to stem cells taken from adults, have the greatest potential for research.

At the Waisman Center, Zhang researches the mechanism by which neural cells originate, or are "born" in the human nervous system.

Embryonic stem cells are harvested from discarded embryos in the very early stages of development--between five and six days after fertilization--because the cells must be "undifferentiated" to be of value to researchers. Undifferentiated stem cells are those that have not yet begun development into a specialized type of cell.

Here at UW-Madison, stem cell research is receiving more and more attention. There are numerous foundations devoted to stem cell research, including WiCell, which is led by anatomy professor James Thomson, a pioneer in the field of embryonic stem cell research.

Another such organization is the Waisman Center, a complex of research facilities located near the UW Hospital on the west side of campus. The center opened in 1973, and its original mission was to conduct research to further our understanding of neural disorders.

Today, the Center has expanded to include many fields of research, including neuroimaging, genetics, child development and stem cells. The center is dedicated to research that will help us "understand human development, developmental disabilities and neurodegenerative diseases."

Su-Chun Zhang, assistant professor of anatomy and neurology, is a leading researcher at the Waisman Center in the field of stem cell research. Zhang received his M.D. in China at Wenzhou Medical College and his Ph.D. in neurobiology at the University of Saskatchewan in Canada. He has been at UW-Madison for almost nine years and has worked at the Waisman Center for four.

Zhang is very optimistic about how embryonic stem cell research will affect science.

"People already expect that stem cells will invade every field in biology and biotechnology," Zhang says. He adds that the research has applications in everything from understanding human development to deciphering gene functions.

At the Waisman Center, Zhang researches the mechanism by which neural cells originate, or are "born" in the human nervous system. To do this, he uses both primate and rodent embryonic stem cells.

Recently, Zhang developed a way to get human embryonic stem cells to grow into spinal motor neurons, an accomplishment researchers have struggled to achieve for quite some time. These neurons are essential to early fetal development; they are the cells that act as pathways to relay signals and information from the brain to the rest of the body.

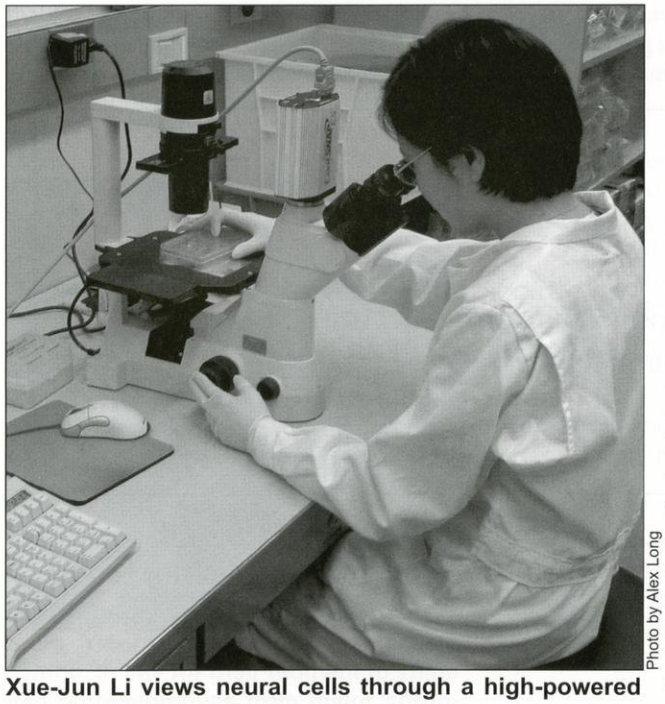


Photo by Alex Long

Xue-Jun Li views neural cells through a high-powered microscope.

Motor neurons are some of the earliest cells to develop in the human body. This, coupled with the fact that there is only a small window of time available in which embryonic stem cells can be directed to develop into the motor neurons, formed the root of the challenge that researchers faced before Zhang's breakthrough.

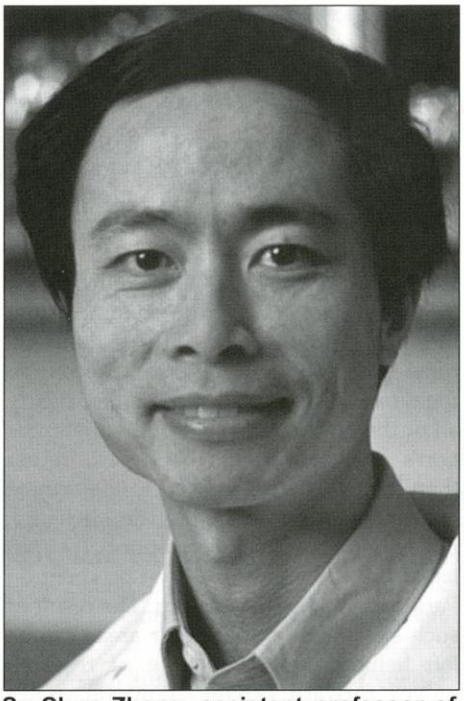
"Embryonic stem cells can differentiate into any kind of cell in the body. The challenge is getting the type of cell that you want."
-Su-Chun Zhang

Through his research and in collaboration with other researchers, Zhang is developing structures of neurons and tissue that are very similar to the early human brain and spinal cord. He hopes to increase understanding about how the nervous system begins development.

The next step is to implant the motor neurons into chicken embryos. Chicken embroys are good hosts for studying the cells because their nervous system develops very quickly--within 24 hours of fertilization. This allows researchers to model the cell development much faster than is possible in other species.

In addition to its speed of development, the chicken embryo is very conducive to this research because it provides a very supportive environment for cell regeneration. This allows cells to keep developing in the foreign environment with a lower risk of rejection.

"Of course, our ultimate goal is to move on to higher species and eventually to human beings, but we have to go one step at a time," says Zhang. He elaborates that animal testing "will never be the same," but that the procedures must be tested and proven to be "safe, effective and efficient" before moving on to human trials.



Lab photo courtesy of Su-Chun Zhang

Su-Chun Zhang, assistant professor of anatomy and neurology, is a leading researcher at the Waisman Center in the field of stem cell research.

Another possible use for embryonic stem cells is that of drug screening to make sure new drugs are safe for use on humans. Zhang provided a very simplified explanation of how the cells can be used for this.

"Researchers could derive neural stem cells, make them sick, and then add compounds and determine which compounds help," he says.

This method of drug screening would be advantageous because it does not involve human subjects, but would effectively assess how safe the drug is for human use. It could also be standardized and computerized for greater efficiency.

Despite the enormous potential embryonic stem cell research holds, federal restrictions on the number of lines, or types of embryonic stem cells, which can be funded with public resources limit researchers' options. Such restrictions are reflective of the great public debate that surrounds the issue. Zhang, however, is optimistic.

"The restrictions are not a big hindrance to research. The federal government does not specifically say that we can't do this, or we can't do that. It just says that taxpayers' money cannot be used to create new lines of stem cells," Zhang says. However, he

continues, "From a scientific standpoint, we need to move on."

In order to "move on," the bulk of funding for new embryonic stem cell research must come from private donations. For example, early in the 2005 spring semester, the Waisman Center received a donation of $1.2 million from the Michael J. Fox Foundation. Zhang was very excited about this large donation, but explained that there is a downside to private funding. Most sources of private funding specify in the terms of the donation that all or nearly all of the money be spent on the organization's particular field of interest, rather than allowing researchers to determine how to allocate the money. The Michael J. Fox Foundation was no exception. It stipulated that the entire donation be spent on Parkinson's Disease research. The result of such specificity is that other areas can be left behind while one area of research moves forward. Zhang, however, notes that researchers can often apply the breakthroughs made in one specific area to other fields of embryonic stem cell research.

Despite of all of the progress being made, Zhang explains that there remain several large challenges to researchers. First among them is the difficulty in getting the cells to differentiate correctly.

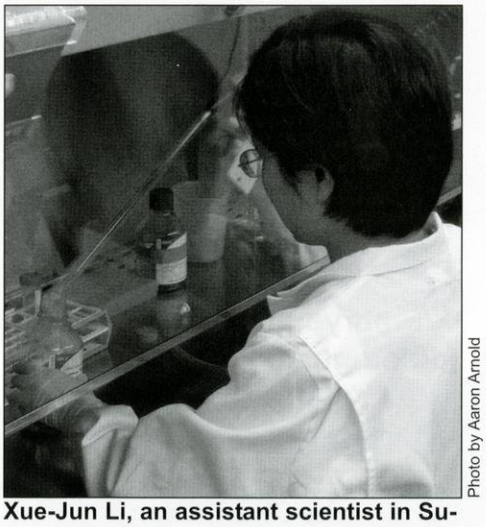


Photo by Aaron Arnold

Xue-Jun Li, an assistant scientist in Su-Chun Zhang's research team at the UW Waisman Center, sits in front of a hood where nutrients are delivered to the developing motor neuron stem cells.

"Embryonic stem cells can differentiate into any kind of cell in the body. The challenge is getting the type of cell that you want," Zhang says. In order to do this, the cells must be exposed to certain chemical mixtures at specific times in their development. Researchers often struggle with timing the sequence perfectly, as well as developing the exact compositions of the chemical mixtures with which the cells are treated.

Another major challenge is what Zhang calls the "immunological issue," or the risk of the immune system rejecting the injected embryonic stem cells. Researchers are working on ways to convince host immune systems to accept the implanted stem cells.

The current progress being made by researchers such as Zhang in embryonic stem cell research only scratches the surface of the huge potential in the field. UW-Madison is fortunate to be leading the way in this area. Indeed, when asked to comment on the breadth of the possibilities that the research holds, Zhang responds simply with, "You name it." We

Author Bio: Marty is a junior from Woodbury, Minnesota majoring in biomedical engineering. He is currently on a co-op assignment at GE Healthcare in Madison.

BACK IN BUSINESS

By Michael Verner

School is back in session and the UW-Madison campus is alive with students bustling to classes. However, for many young would-be engineers, the beginning of the school year is a busy time because of what's happening outside the classroom. The fall career fair is just around the corner, and things are looking up again for UW-Madison engineering students.

In 2000, recruiting on campus was at an all time high. Ninety-five percent of undergraduate engineers were finding employment before graduation. However, with the recession of technology-based jobs in 2002, that number had dropped to as low as 75 percent. We're now climbing back out of that recession and, according to Susan Piacenza, associate director of Engineering Career Services (ECS), the fall of 2004 was the strongest recruiting semester since 2001.

This past spring term, the career fair in January attracted over 100 employers--the largest turnout ever. Companies such as Amazon.com and Google.com came to Madison for the first time, as well as companies that hadn't visited in several years. Ford Motor Company was one of the businesses that had a multiyear hiatus from campus; it was back for the first time since 2002. Ford scheduled over 100 interviews with students for several different positions. One of these was with electrical engineering senior Robert Hejny.

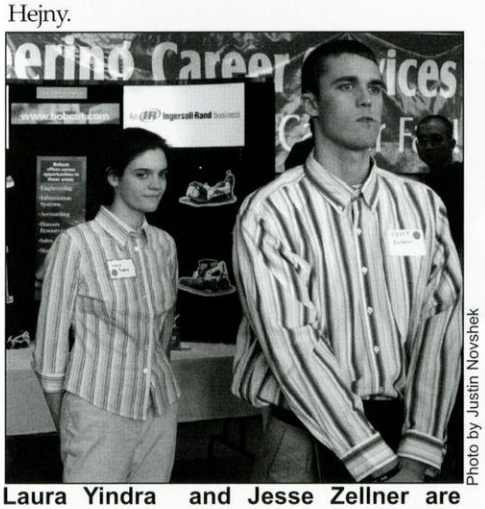


Photo by Justin Novshek

Laura Yindra and Jesse Zellner are waiting in line for their moment to shine with representatives from major corporations.

"Ford was one of several interviews I had this spring," Hejny says. "When I heard back that they were interested, I was ecstatic. They made a very good offer with a lot of perks."

One of these perks was a stipend so that Hejny could find summer housing near their Dearborn, Mich. headquarters. It might be surprising to some that companies are going to such great lengths to hire interns, but Piacenza doesn't see it that way.

"More and more employers are doing more hiring for internship and co-op positions," Piacenza explains. "They see it as an opportunity to have a three-month-long, or longer, interview." Many of these companies will then offer students full-time positions when they graduate. In some instances, companies will even offer to pay for a student's remaining semesters in exchange for his commitment to the corporation when he finishes school.

However, upperclassmen aren't the only ones benefiting from the career fair. Piacenza is also excited by the high freshmen turnout. Many of them have also registered with ECS.

"While they may not get hired as freshmen, they are getting into the system and thus a leg up on the competition next year," says Piacenza.

The spring career fair was so successful that ECS decided to have a second smaller one halfway through the term. This was the first time they had done this. Piacenza said it was easy to put together because companies like Kimberly-Clark and Microsoft were more than willing to come back for a second look at UW-Madison students.

"Companies know our [students] are well-prepared and have a strong work ethic," Piacenza says.

This midsemester career fair benefited students as well. For instance, mechanical engineering junior Andrew Layer found the first career fair frustrating because it was so early in the year.

"I found it hard to get my act together for the first career fair because I was still trying to adjust to a new schedule and a full workload," Layer says. He continues that because he missed out with the recruiters from the first career fair, it was harder to land an interview.

Other students, like electrical engineering senior Greg McMahon, just haven't found the right offer yet. Because so many students were getting multiple offers, they could take their time before making their final decision.

"I've received three offers and I'm waiting to hear about a fourth," McMahon said at press time. "It's nice to have the opportunity to choose based on what kind of work I would be doing for each particular company." However, because of cases like McMahon's, a lot of internship and co-op opportunities are left unfilled.

While the current job market is encouraging to students, there are still things they can do to improve their chances of landing a job, Piacenza suggests. A strong GPA still says a lot, but employers are now looking towards extracurricular activities and leadership positions that can differentiate a student from her peers. Involvement in UW-Madison clubs and organizations can strengthen student resumes. These groups range from hands-on activities like Concrete Canoe and Future Truck to student governing bodies like Polygon.

With all the opportunities UW-Madison offers its students, it's easy to see why they are so highly sought after by engineering firms across the country. With the hi-tech job market back on the rise, it's a good time to be an engineer, and an even better time to be a Badger. WE

Author Bio: Michael Verner is a junior in electrical engineering from Eugene, Oregon.

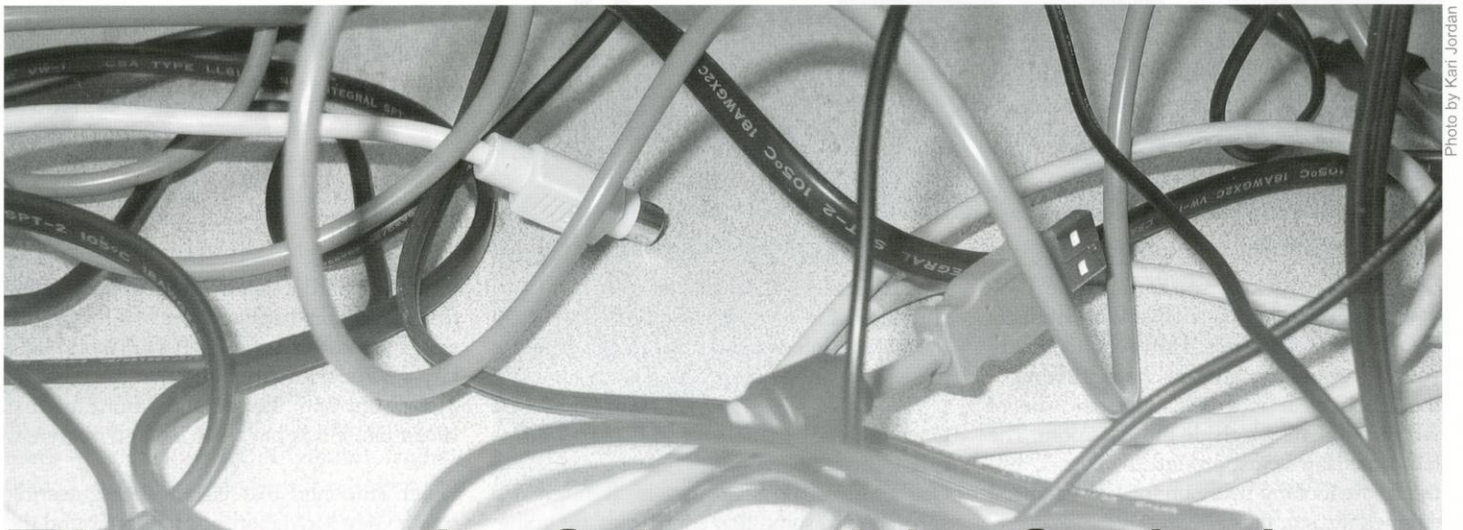


Photo by Kari Jordan

The wonderful world of wireless

By Nate Holton

Just as cellular phones have become as popular as land lines, wireless Internet is on the verge of competing with traditional wire-based Internet. With the rapid spread of wireless availability, it is only a matter of time before finding an Internet signal will be as easy as finding a signal for one's cell phone.

The future is definitely now for UW-Madison. Engineers on campus are working on a new system called the 21st Century Network, which aims to add wireless capabilities to each campus building by the summer of 2006.

Wi-Fi, short for "wireless fidelity," is the system that handles wireless networking. Similar to walkie-talkies, Wi-Fi uses radio signals to send and receive information through the air. The signals are broadcasted from an access point hardwired (physically connected) to a network and travel to any devices that can read the signal.

The current forms of Wi-Fi are 802.11a, 802.11b and 802.11g, all of which were given their lackluster titles by the Institute of Electrical and Electronics Engineers (IEEE). The most widespread form is currently 802.11b, which was the first to hit the market. While 802.11b is the cheapest method available, it is also the slowest version of Wi-Fi networking. This type of communication uses signals that transmit at 2.4 GHz and can transfer 11 megabits of data per second (Mbps).

The next version of Wi-Fi created was 802.11a, which transfers 54 Mbps. However, this form is considerably more expensive then 802.11b because it transmits at 5.0 GHz, more than twice the frequency of its predecessor. Combining the best of both worlds, 802.11g is able to transfer information at the same rate as 802.11a while using the same low frequency as

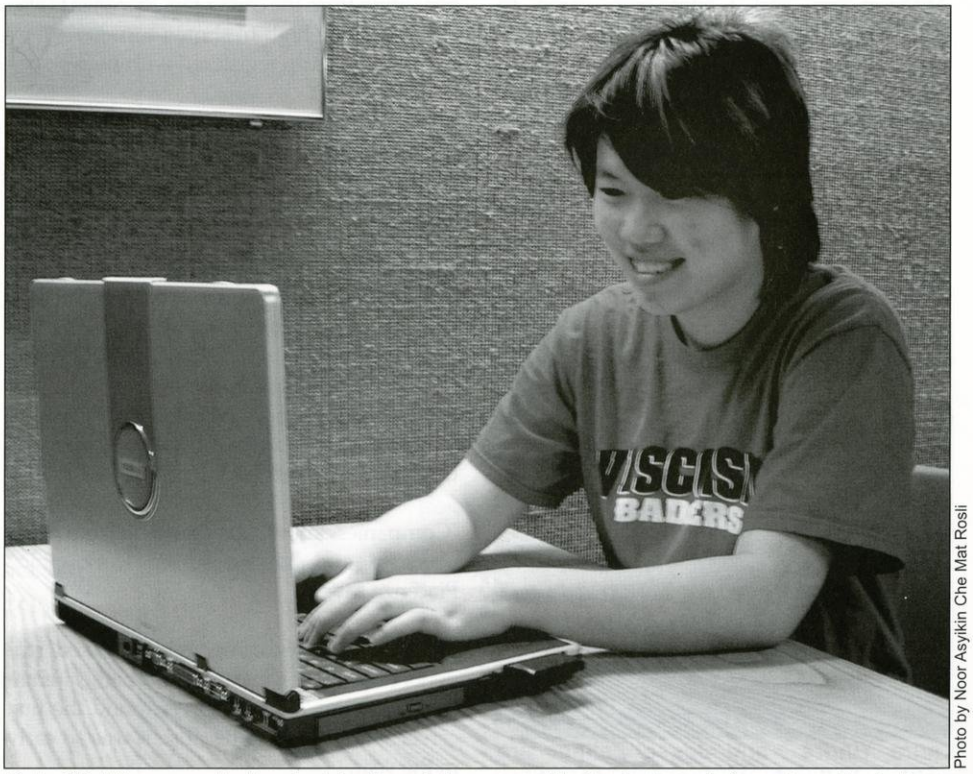


Photo by Noor Asylkin Che Mat Rosli

Poh Kit Wong, majoring in biochemistry, says that wireless Internet really helps her in doing research conveniently anywhere on campus.

802.11b. Though the 802.11b version is still more common, most wireless networks are also compatible with 802.11g.

While Wi-Fi and Bluetooth, another form of wireless networking, have each seen a huge rise in popularity, their roles are separate and clearly defined.

"Wi-Fi tends to be used for Internet access and faster speed networking, while Bluetooth is used more for short range transmissions for things like synching a cell phone with your computer or synching a PDA [personal digital assistant]," says Leo Langheim, a Do-It showroom consultant.

The future is definitely now for UW-Madison. Engineers on campus are working on a new system called the 21st Century Network, which aims to add wireless capabilities to each campus building by the summer of 2006.

Though using Bluetooth to access the Internet is technically possible, it is not worthwhile to do so. Bluetooth transfers data at the tortoise-like rate of 1 megabit per second, and configuring the necessary software and hardware would be a nightmare. While extremely handy in many situations, Bluetooth is no match for Wi-Fi for wireless Internet access.

When combined with a wireless card, now typically built into the machine, portable devices such as laptops and PDAs can link to the Internet through an 802.11 radio connection. Areas that offer these wireless connections are called hotspots. The demand for hotspots on campus is rising due to a large increase in the number of students who own portable devices.

"We've seen a huge increase in the amount of people buying laptops versus desktops. You used to see probably 60 or 70 percent of students buying desktops. But now that laptops are getting into a more reasonable price range, we actually found that last year the amount of laptops sold during the back-to-school period was higher than the amount of desktops," Langheim says.

Laptops are still generally more expensive and less powerful than desktops. However, the ability to work on one's own computer and use the Internet anywhere there is a wireless hotspot has proven to be a big advantage. The freedom of a laptop will often entice students to ignore the price and speed differences.

"I've recently purchased both a PDA and a laptop, and being able to do things like check my e-mail and access class Web sites at almost any time or place that I want has just been an enormous benefit," UW-Madison senior Patrick Hill says.

UW-Madison already offers many hotspots, all of which are within a five minute walk from any place on campus. But with the increased demand in mind, UW-Madison engineers are systematically going through the process of adding wireless capabilities to each building in order to complete the 21st Century Network.

To make a building wireless, engineers first do a site survey. They place test access points throughout the area in order to determine where permanent access points will need to be. This ensures the entire building is covered.

Of course, no two buildings are alike. Each is unique and needs a custom network to establish an acceptable signal throughout the area. The materials that the buildings are made out of make a big difference in how engineers design the network. For example, higher density walls can impede the signal and force the engineers to install more access points. All in all, it is an arduous process.

"It's a fairly complex process for each building, requiring engineering, site surveys, equipment configuration, equipment installation, electrical work, testing and monitoring," UW-Madison engineer Rusty Smith says.

While the procedure of making a building or an outdoor area wireless takes a lot of work, more and more communities around the country are seeing the value of wireless networking. Philadelphia is currently in the process of making their city wireless. In Madison, city officials are planning on building access points that will service the area within a one-and-a-half mile radius of the Capitol. Also, the Dane County Regional Airport will soon feature wireless Internet service provided by the city.

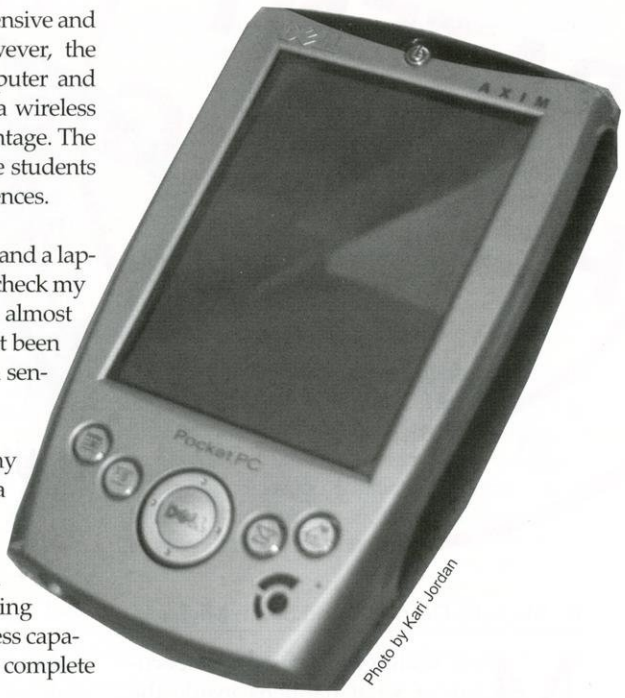


Photo by Kari Jordan

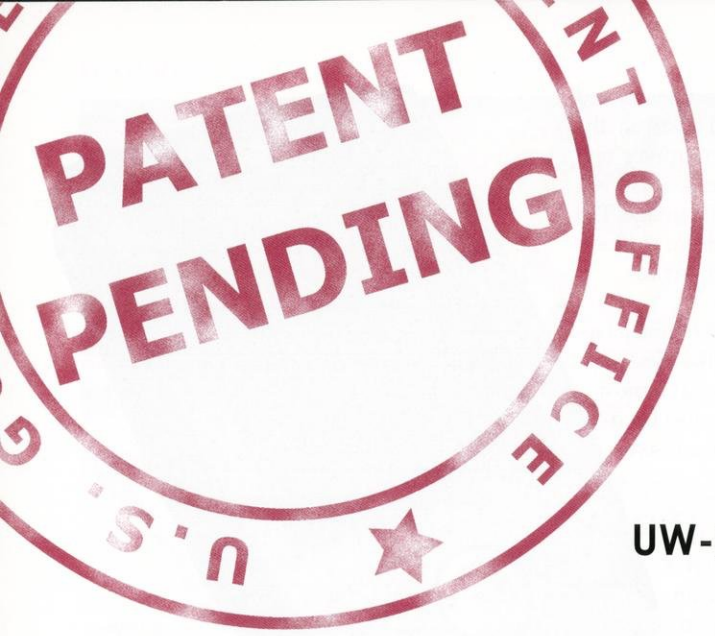
Many Personal Digital Assistants are incorporating Bluetooth and 802.11 connections. These connections, paired with the proper software, can allow a user to browse the Internet and check e-mail. Will the PDA become the ultimate portable computer?

The future is bright and the possibilities are limitless for wireless Internet. Someday soon, one will be able to access the internet from virtually anywhere. Though wire-based Internet revolutionized the way information is spread and gathered, wireless Internet truly has the ability to take it to another level. WE

Author Bio: Nate Holton is a senior majoring in philosophy and mechanical engineering. Upon graduation, he plans to attend law school. Though originally from Milwaukee, he is an avid 49ers fan.

To access wireless Wiscworld, login at **https://wireless.wisc.edu**

Wireless Wiscworld: **http://www.doit.wisc.edu/network/wireless/**
Engineering campus wireless: **http://www.cae.wisc.edu/site/public/?title=fswireless**
sites include login information and campus locations.



WARF
Wisconsin Alumni Research Foundation

How one organization is helping UW-Madison researchers patent their ideas and give back to the community

By Michelle Desnoyer and Sarah Michaels

Most undergraduates only speculate at what happens inside the tall building that shadows the west side of campus. The answer to this enigma is that the monolith houses the Wisconsin Alumni Research Foundation (WARF), a front-runner in the patenting process at UW-Madison.

"The last three chancellors have said that WARF funds provide UW-Madison with a margin of excellence," says Andy Cohn, Government and public relations manager at WARF. In fact, since its founding in 1925, WARF has given $750 million back to UW-Madison to support new research. During 2003-2004 alone, WARF provided $50 million to UW-Madison research.

WARF serves a pivotal role in the patenting of ideas and inventions of many UW-Madison professors, staff researchers and students. In 1923, UW-Madison professor Harry Steenbock discovered the benefits of irradiating food with ultraviolet light to increase vitamin-D content. This discovery made possible the prevention and elimination of rickets, a bone disease that affected children.

But to protect against the misuse of his work, Steenbock paid for his own patent and refused any personal profit. Instead he insisted UW-Madison establish a patent management agency that would be able to reinvest any profits from the patent back into research at the university. Several administrators then created WARF, and Steenbock's patent was the first to be licensed to commercial companies.

Eighty years later, WARF continues the cycle of helping UW-Madison researchers patent their work and recycle a percentage of the profits back to the university. Because of this, WARF received the National Medal of Technology on March 14, 2005. This award, given by President Bush, recognizes the benefits from technology to the country's economy, environment and social well being.

"The award recognizes WARF's many contributions to the field of university technology transfer, a process that is central to delivering to the public the benefits of university research," says Madeline Fisher, editor and writer for WARF.

Typically, when researchers want to patent intellectual property or new technologies, they have to go through years of costly legalities. This process could potentially expose the technology to the public, robbing the researchers of their right to market the technology as they wish.

WARF makes the patenting process easier for scientists and engineers by paying all the patenting costs and navigating the entire legal process that can be overwhelming for lone researchers. National patents cost up to $25,000, and foreign patents often exceed $100,000. Covering these expenses is a big help to researchers who have already had to deal with the costs of research and prototype production.

WARF has been responsible for patenting many advances that have had a major impact on the world, including its first patent which helped to eliminate the disease of rickets.

Not only does WARF cover the costs for patents, it also helps researchers start their own companies. WARF has contributed to many start-up companies including GenTel BioSurfaces, ioGenetics and Lifegen Technologies. In supporting these companies, WARF fosters the local hi-tech market.

"We have been extremely fortunate. We have had several start-ups that have been extremely successful and the majority of the rest it is too early to tell," Cohn says.
In 1999, WARF also started its own non-

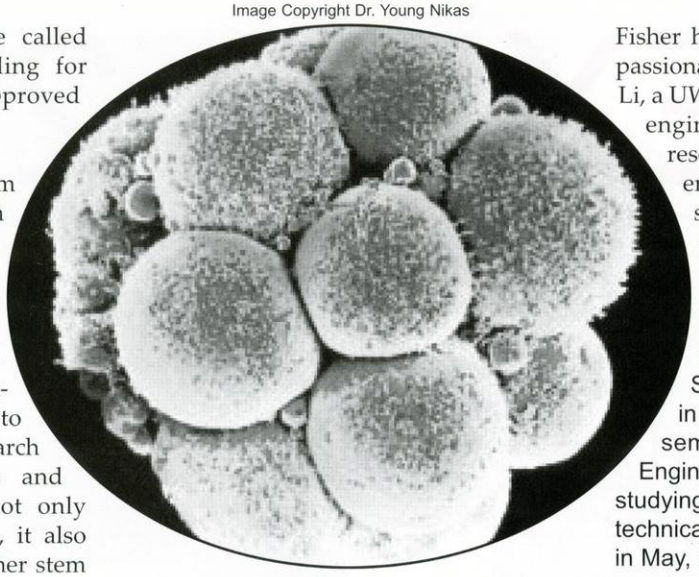
Photo by Erin Jacobs

profit private research institute called WiCell. WiCell provides funding for research with five federally approved embryonic stem cell lines.

Fisher describes the WiCell stem lines as the "gold standard of stem cell lines."

WiCell also provides training for the researchers working with these stem cell lines, which require care to prevent unwanted differentiation. Scientists need to be able to control cell differentiation for research in areas such as Alzheimer's and Parkinson's Disease. WiCell not only grows and maintains these lines, it also distributes them worldwide to other stem cell research firms.

Image Copyright Dr. Young Nikas



Stem cells like these are grown by WiCell, which currently distributes five stem cell lines worldwide.

Fisher has met many professors who are passionate about their research. Xiauchun Li, a UW-Madison professor of mechanical engineering, has done extensive research with lasers and has discovered a way to use them to thinly slice cheese. He is just one of the many researchers WARF aids in the patenting process. We

Author Bios:

Sarah Michaels is a junior majoring in English literature. This is her first semester writing for Wisconsin Engineer. Michelle Desnoyer is a senior studying English, political science, and technical communication. She graduated in May, 2005.

EXPO 2005

Photography by Jonathan Klabacha and Tom Kopriva

Photo by Jonathan Klabacha

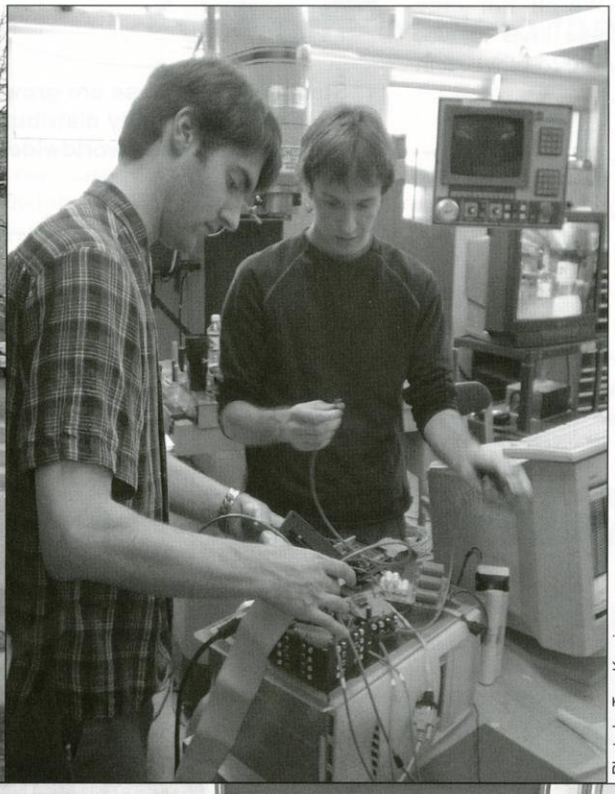


Photo by Tom Kopriva

Left:
Members of the Flying Badgers work on the electronics of their very own UAV (unmanned aerial vehicle) during Expo.

Below:
As people entered the Engineering Centers Building, they were greeted by a large scale Lego model of the engineering campus. Each building was built separately and then merged together to form the large model.

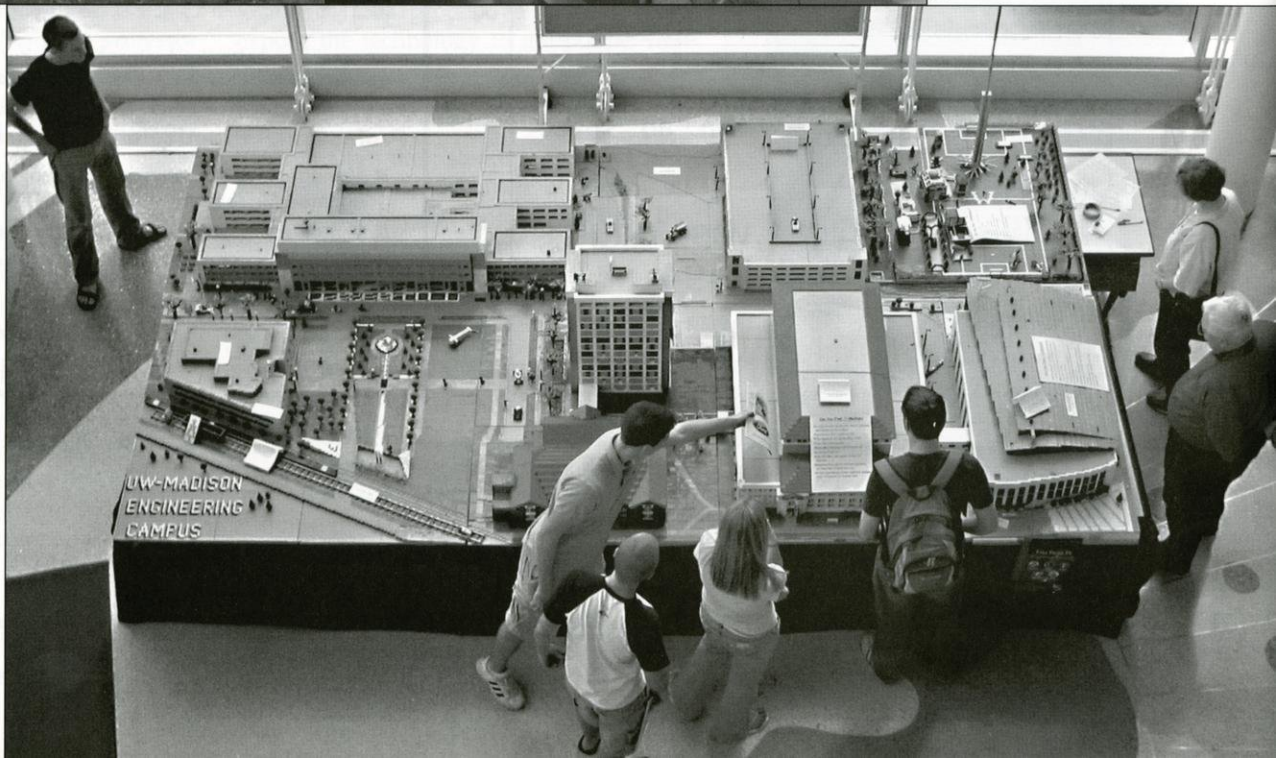


Photo by Jonathan Klabacha

Above:
From left, UW-Madison sophomore Silas Bernardoni and Darlington High School sophomore Eamon Bernardoni stand tall next to their masterpiece. This giant trebuchet can launch bowling balls 100 feet.

From left, seniors Russel Wiltse and Kayla Soucoup show a group of people the process behind making super-absorbant coasters shaped like Bucky.

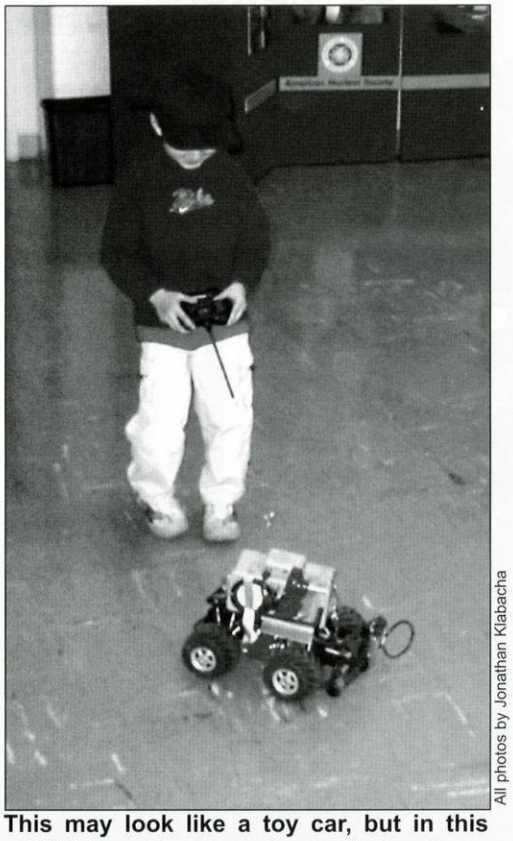
Photos by Jonathan Klabacha

Engineering Expo is an event put on by the students of the College of Engineering at UW-Madison. For each Expo, thousands of people come to see student, faculty, and staff exhibits; compete for prizes in competitions; and see some of the newest technology in industry. Engineering Expo offers an excellent chance to learn about breakthroughs in the many fields of engineering.

At the Association of Engineering Geologists booth, geological engineering senior Shannon Briscoe shows a group of onlookers the effects of quicksand. This apparatus is filled with sand, allowing her to fill and release water at will.

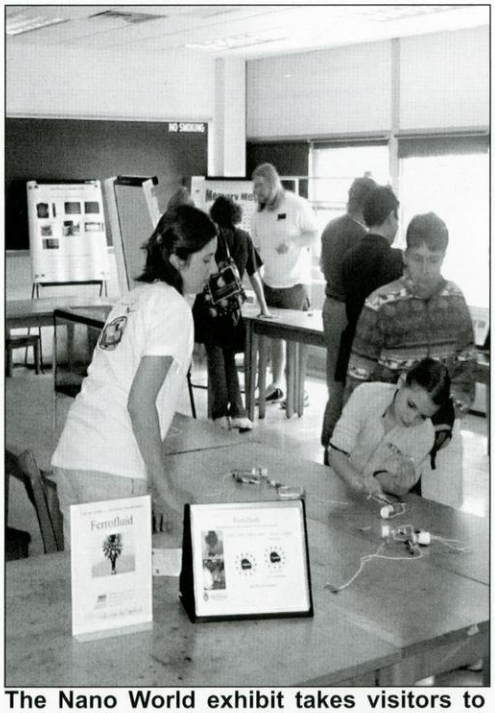
Photos by Tom Kopriva

Bucky takes part in the festivities at the Shell Challenge.



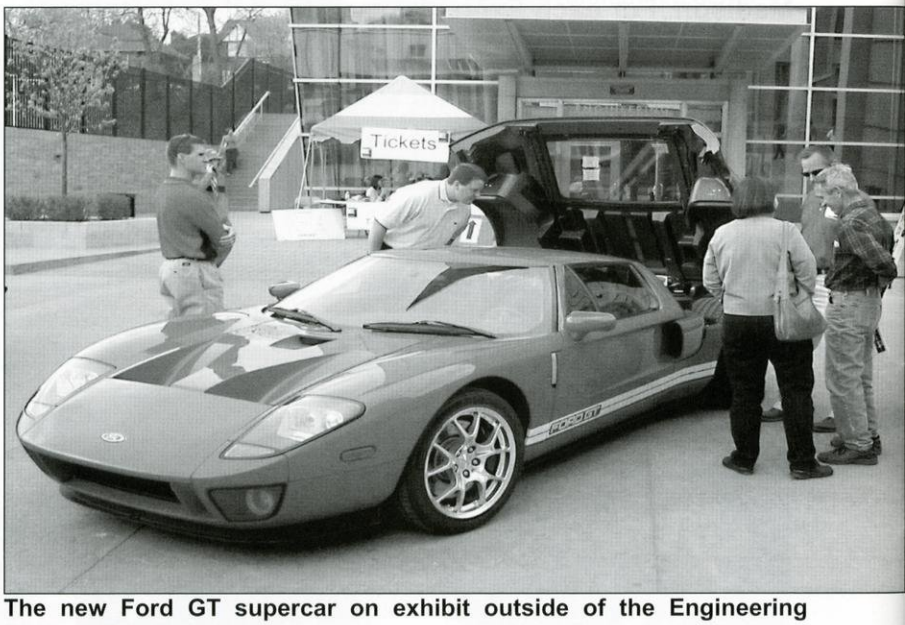
All photos by Jonathan Klabacha

This may look like a toy car, but in this exhibit the driver is trying to find radioactive material. As the car draws near a radioactive sample, a growing clicking noise indicates when the sample is directly below the car. This technology could be applied to finding landmines.

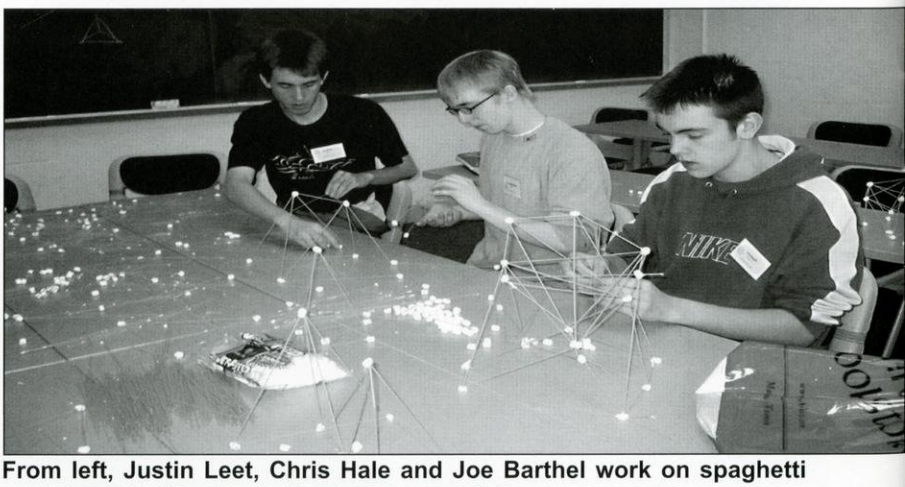


The Nano World exhibit takes visitors to the one-billionth-meter scale, where they explore developments such as memory metal and carbon nanotubes.

Engineers do know how to have fun. Here 2nd-year senior Peter Wilder plays a video game with a future engineer. The game was created by Dan Volk, an electrical engineer at UW-Madison.



The new Ford GT supercar on exhibit outside of the Engineering Centers Building.



From left, Justin Leet, Chris Hale and Joe Barthel work on spaghetti models at the Women in Engineering exhibit.

FUEL FOR THOUGHT

By Emily Niebuhr

Smog tints nearly every city postcard of Los Angeles like an old photograph browning around the edges. Although that city has long been associated with poor air quality, more and more Americans are starting to discover pollution problems in their own backyards. Aside from tarnishing scenic views, the increasing emission of particulate matter poses a serious health risk as the incidence of respiratory illnesses continues to rise across the nation.

The Environmental Protection Agency (EPA) has been working hard to buck pollution trends by targeting emissions from diesel engines, the source of 30 percent to 50 percent of particulate sulfur in cities. To lower diesel pollution, the EPA has mandated that by 2007 all oil refineries must produce cleaner fuels, and all vehicles that use diesel engines must emit sulfur particulates at levels less than or equal to 15 parts per million (ppm).

Not only will the new restrictions allow residents to breathe more easily, but these regulations could also have a significant impact on the types of cars sold in America. Although diesel engines are much more efficient than gas engines, American manufacturers produce many fewer diesel-powered vehicles than gas-powered ones. The higher levels of pollution and the unpleasant odors due to the fuel has cemented the diesel engine's unpopularity in the United States. But the new EPA regulations requiring the manufacture of cleaner, more efficient diesel fuels have the potential to tip the scales.

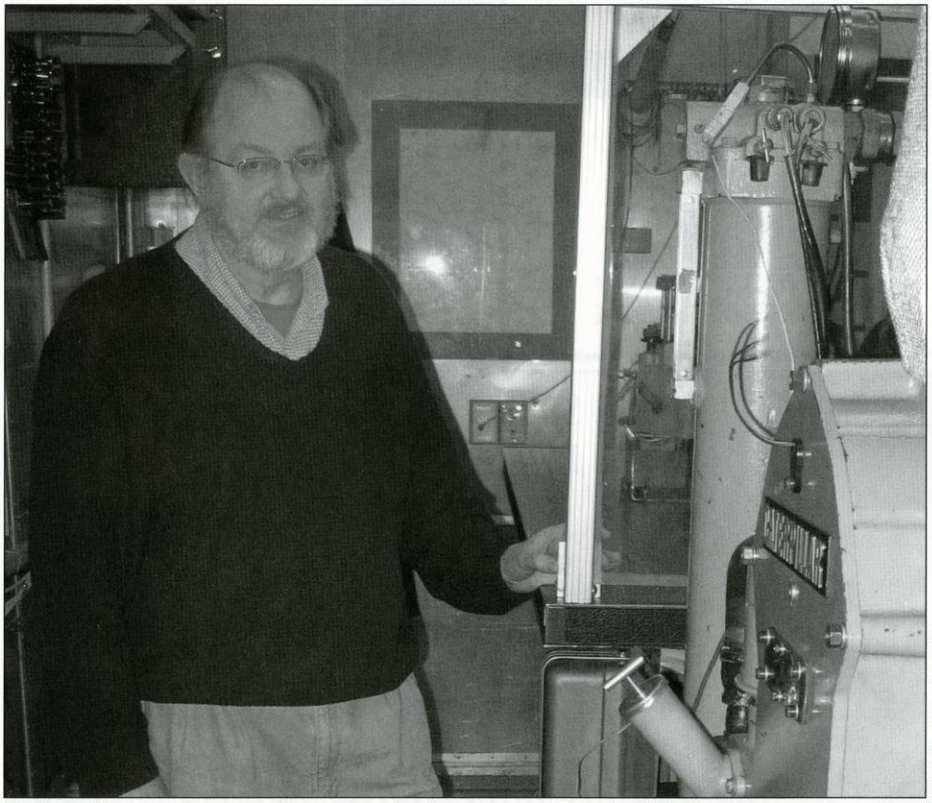


Photo by Philip Karl Micha

Rolf Reitz, professor of mechanical engineering at UW-Madison and part of Wisconsin's Engine Research Center (ERC), is shown here in his laboratory.

Can what fills you up fuel your car? A look at the impacts of innovative fuels on the automotive industry.

While few Americans outside of truckers or farmers use diesel fuel, Europeans have relied on diesel as their main fuel source for many years. Fuel prices two to three times higher than the American rates have motivated 60 percent to 70 percent of European car owners to use the more efficient diesel engines. This prevalent use of diesel fuel has encouraged more stringent requirements on fuel emission and manufacturing. Europe has already achieved sulfur emissions of 15 ppm or less for over five years.

While under European governments the diesel engine has flourished, poor govern-

mental planning has limited their availability in America. The government originally regulated the amount of emitted particulates from engines without placing sufficient requirements on oil refineries to make clean fuels. This made it nearly impossible to make a good diesel engine that could meet EPA standards and compete with the cleaner burning, better smelling gasoline engines.

In addition to difficult restrictions, the auto industry also had to tackle the public's negative perception of diesel engines. Poorly designed engines and their reputation for being noisy and dirty have stifled consumer interest in the past.

"The United States has been a very slow market for diesel engines. There hasn't been much interest in them partly because of the bad reputation carried over from some attempts in the '80s and '90s. Despite the potential gain in efficiency, relatively few customers wanted to deal with the lack of refinement when they could opt for a smoother gas engine," according to Ford employee and UW alumnus Brian Sullivan.

But with recent anxiety about depleting oil supplies and the rising prices at the gas pump, Americans are starting to re-think their preconceptions. Diesel engines are attractive to the efficiency-conscious consumer because they can operate in some vehicles at 40 to 50 miles per gallon, a significant increase from the current average in the 20s for cars with gas engines. Also, the introduction of hybrid cars has made Americans more receptive to alternative and more efficient methods of powering vehicles.

UW-Madison is taking a lead in switching its diesel engines to cleaner diesel fuel a year before the EPA law mandates the change. Starting in 2006, the University will use low-sulfur diesel fuel containing 20 percent biodiesel in University vehicles, according to a University news release. The new fuel mix will allow university vehicles to have even better emissions than the law requires, setting a precedent for other diesel consumers.

Although the availability of cleaner fuels will solve many current U.S. diesel engine problems, engineers still face many difficulties in making diesel a viable option for the average consumer. The properties of diesel fuel pose potential challenges for the northern half of the country. As the temperatures drop below freezing, diesel fuel can gel and make starting a vehicle nearly impossible once it has been turned off. However, consumers can solve this problem by plugging their cars into an electric outlet at night, a practice which is already a necessity for some gas consumers in northern states.

"They ran into some issues in the earlier cars where it would smell like you were driving behind a french fryer."
-Brian Sullivan

In addition to low-sulfur fuels, scientists are looking for fuel additives to meet government requirements on particulate emissions. One such additive is biodiesel. Biodiesel already contains oxygen, a necessary component for fuel combustion, so fewer injections of oxygen are needed.

"If the oxygen is already in the fuel, which is the case with biodiesel …a very small amount of oxygen in a fuel goes a long way toward reducing particulates," says Rolf Reitz, professor of mechanical engineering at the UW-Madison.

One appeal of biodiesel is that companies can derive it from a variety of sources ranging from soybeans to recycled products. According to the County of Ventura Environmental & Energy Resources Division Web site, Biodiesel Industries based in Las Vegas has even converted left-over cooking oil from local restaurants and casinos into biodiesel fuel.

Like diesel, biodiesel fuel is still undergoing constant modifications to appeal to the consumer, although biodiesel has had its own unique set of problems.

"They ran into some issues in the earlier cars where it would smell like you were driving behind a french fryer," Sullivan says.

The implications of the EPA's new regulations stretch beyond simply improving air quality. The American Automotive Industry is transforming as these regulations encourage scientists and engineers to experiment with innovative fuel compositions and engine designs.

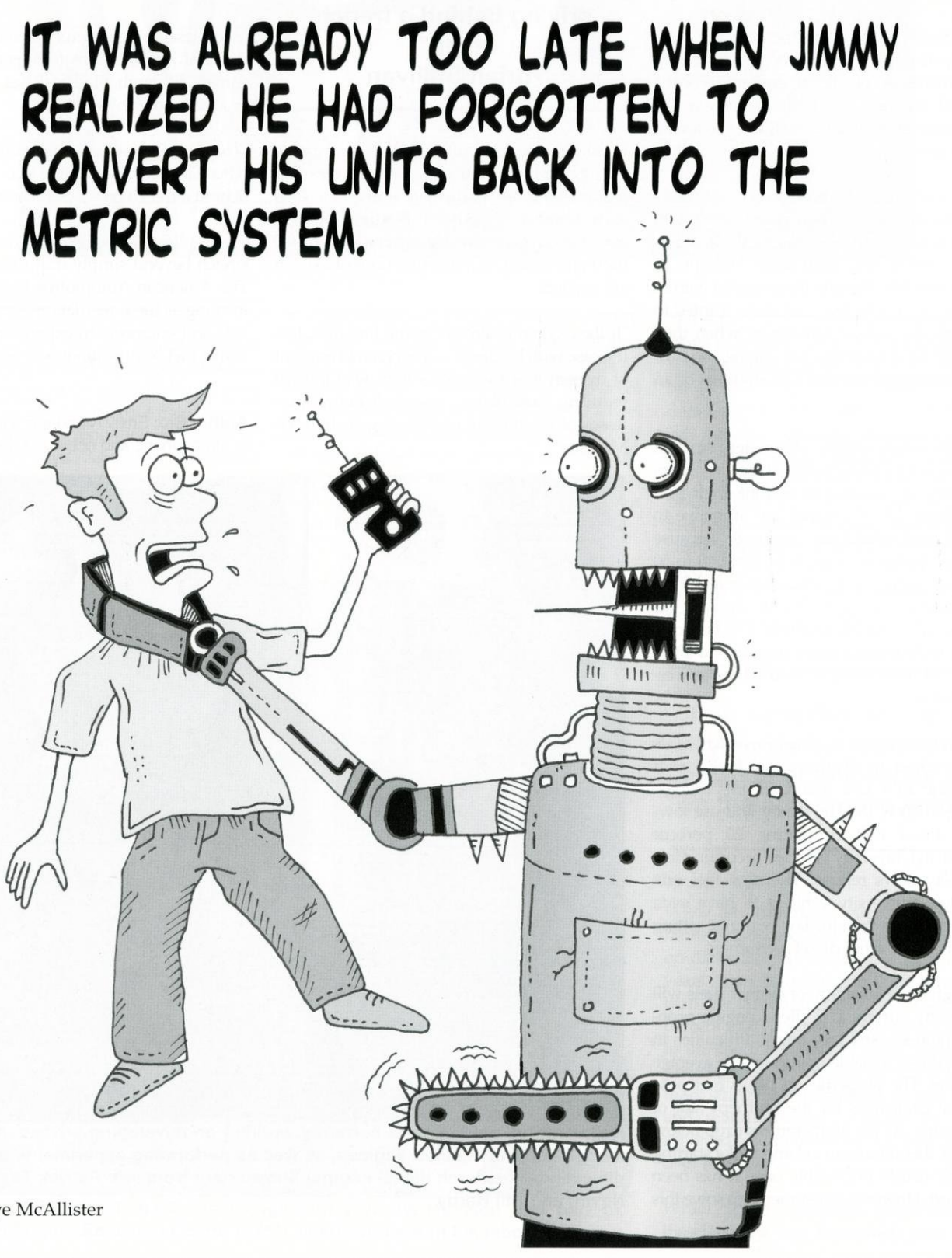
Author Bio: Emily Niebuhr is a junior majoring in atmospheric and oceanic sciences.

Photo by Philip Karl Micha

Reitz and his students are currently working on developing advanced computer models for fuel injected engines, as well as performing experiments using a single cylinder research diesel engine. Shown here from left: Patrick Thomas, Ryan Nevin, and Bill Hardy.

Just One More

The Finest in Eclectic Humor



By Skye McAllister

Welcome Freshmen!

On behalf of *Wisconsin Engineer*, welcome to the University of Wisconsin! The fact that you're here shows your motivation to learn and an insatiable desire to have fun --two qualities our magazine is eagerly seeking. If you are interested in writing, photography, designing lay-outs, or business, and would love to meet fellow students ranging from freshmen to grads, then we would like to invite you to join our staff!

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