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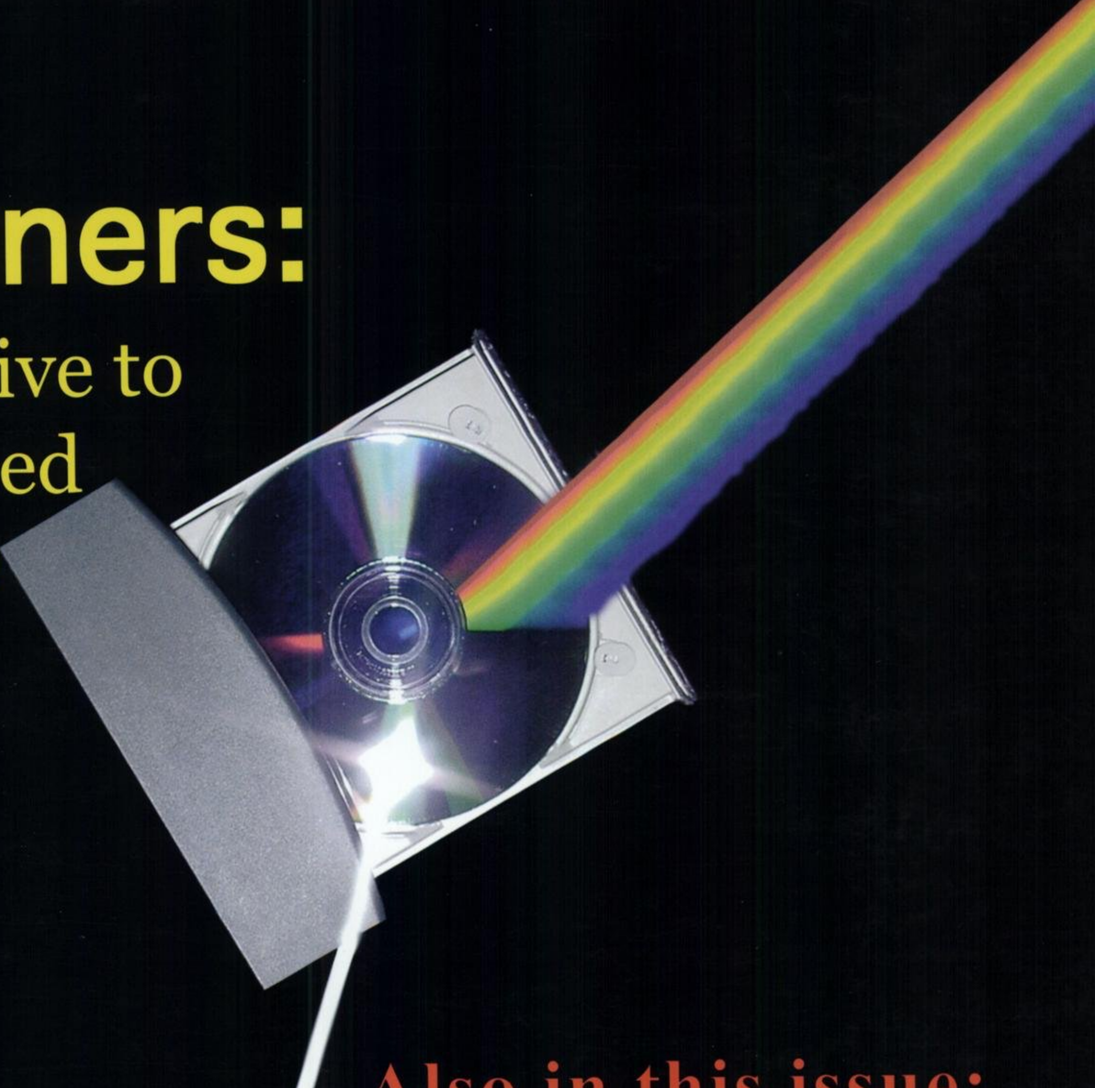
FEBRUARY 2002
VOLUME 106, NUMBER 2

WISCONSIN ENGINEER

CD Burners:

The alternative to getting burned at the music store



Also in this issue:

Nanotechnology

Energy Conference

Neuroscience

Transgenic Monkeys

5 generations of Engineers

Mechanical Engineering Building
1513 University Ave.
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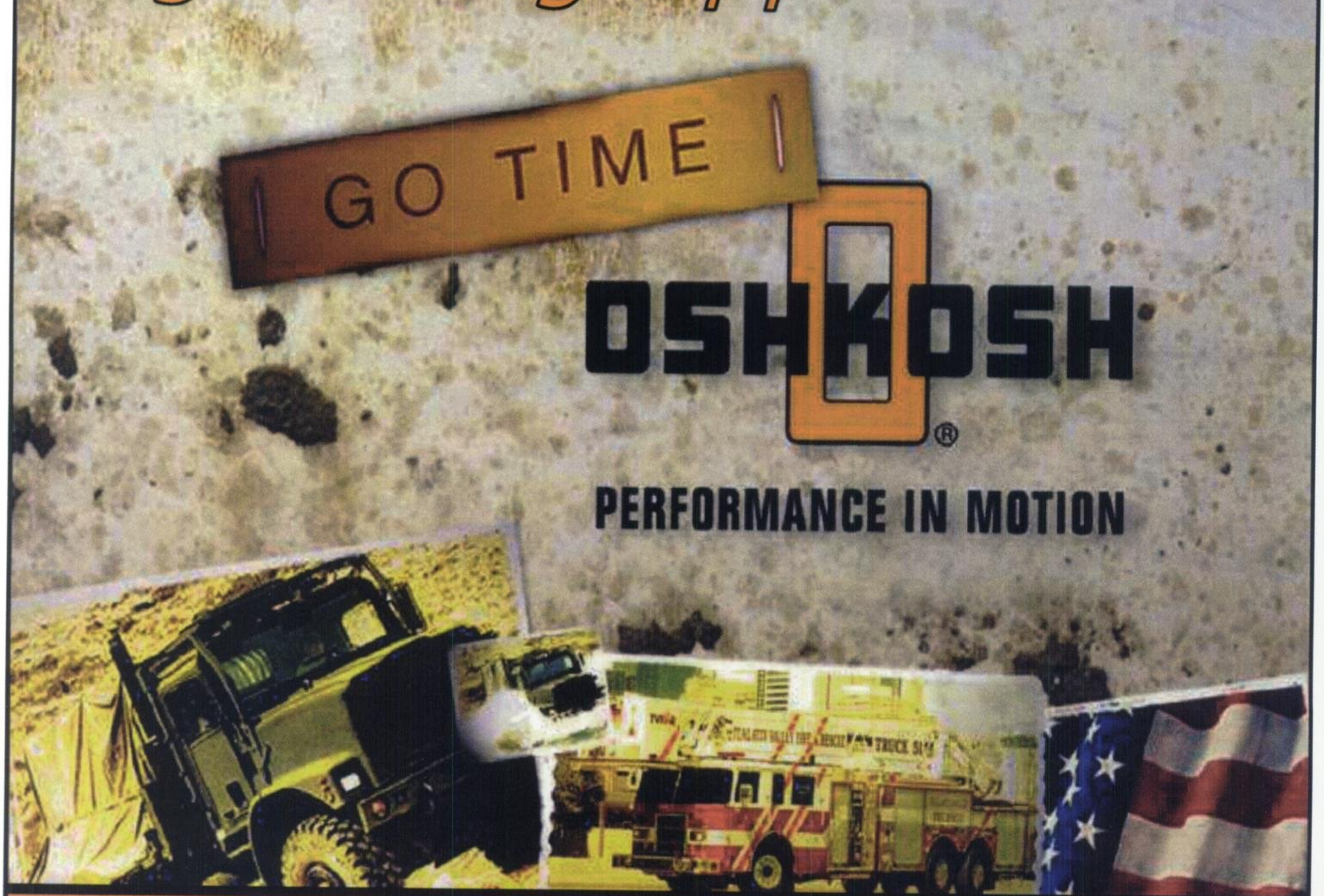
Engineering Opportunities



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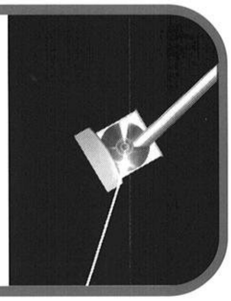
Published by the Students of the University of Wisconsin-Madison VOLUME 106, NUMBER 2 February 2002

FEATURES

DEPARTMENTS

On the Cover:

CD Burners, wow.
I'd like to have a new one.
The old one is broke.
-a Haiku by Bruce Blunt



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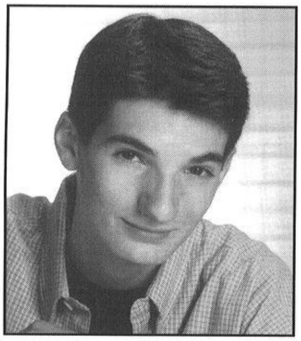
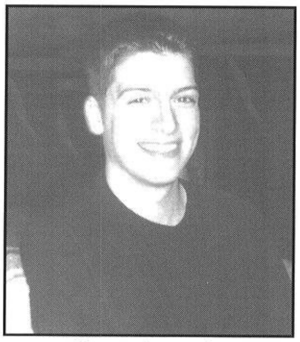
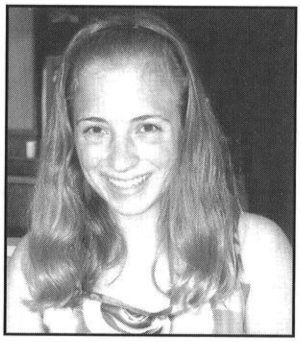
Professional Junk Engineers: Working to Frustrate Us, Day After Day, Or Upholding a Tradition of Mediocrity?


Ryan Sydnor


Greg Joseph


Karen Mandl

Ryan: Let me share with you something I often find myself pondering. Undergraduate design courses see engineering students doing something they don't do in other engineering courses: engineering things. It's a brilliant concept, and I think the design courses complement the "non-engineering" engineering courses quite nicely.

Anyone who has taken one of these design courses knows that merely completing a prototype—let alone a prototype that works—is an extraordinary achievement. Almost unheard of. You do your best to stumble through the design process as a pseudo-engineer, spending a large portion of your time trying to find real engineers to help you make something better than a Lego model. Although you may have no idea what you're doing, you take comfort in the fact that you're being trained to become a "real" engineer—i.e., one who knows how to engineer things.

Unfortunately, however, there are clearly many "real" engineers out there who don't know how to engineer things any better than do the fumbling undergraduates. Not to debase the field, but the world is teeming with the creations of engineers who managed to get hired despite the fact that they can't even use a ruler correctly. Take the average public restroom as an example. Since no one could figure out how to make an effective towel dispenser, they came up with the innovative electric hand dryer. Not only does this engineering marvel fail to completely dry your hands, but it forces you to wait patiently to not have your hands dried. If you're like me, you also love it when a gob of soap falls to the floor after you remove your hand from beneath the dispenser. And if you ever intend to get more than one piece of one-ply toilet paper at a time, you might as well just give up on going to the bathroom altogether. I could rant about restroom technology for pages, but I think you get my point. Do Journalism majors think about stuff like that in the bathroom?

Greg: Ah, no. I'm usually too busy wondering what's wrong with the guy staring at the hand dryer or the soap dispenser muttering about design flaws and whatnot. Actually, I hate electric dryers – if there's no paper towel available, I just end up wiping my hands on my shirt. I suppose if I were a good engineer (or an engineer at all, for that matter), I could fashion some kind of hamster-powered artificially intelligent hand-drying device that would seat four, comfortably. But I can't, so it's the damp shirt for me.

Speaking of design flaws, I was waiting in the spittle-freezing cold one morning with a dozen or so of my peers at a bus stop, and once, twice, and then for a third time a Metro bus went by, full. I suppose I could have walked, but there remained that sliver of hope that a bus would soon appear from around the corner, warm and empty. Eventually one did come, but of course I was already late. It's just so frustrating that they can't alter their bus routes or add a bus or two to alleviate this problem. Oh, and when you wait thirty minutes at night for a bus only to have three busses, all going to the same place, come at the same time – that's just wonderful. Too bad Metro has a monopoly on the bus market – a little competition could do them some good.

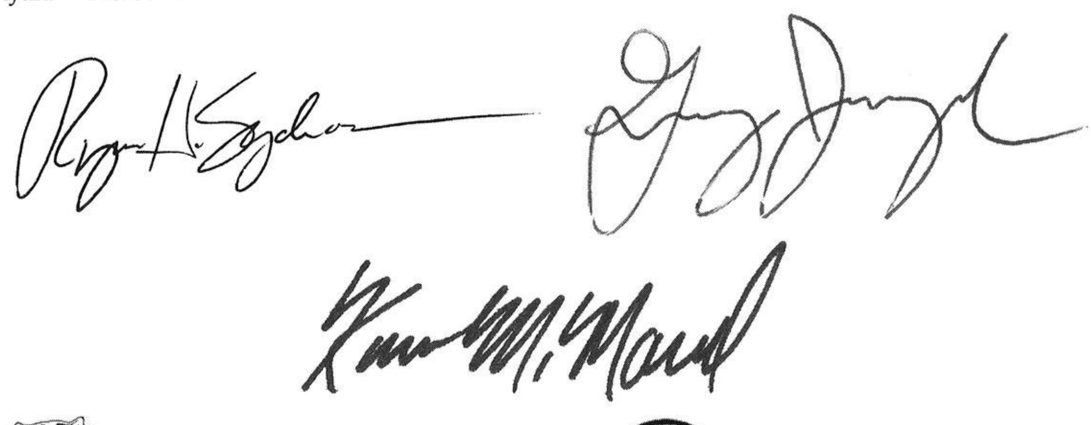
On another note, of course the school is going to produce some people who are grossly under qualified for their jobs. At least in the classes I've taken, your grade is determined more by your skills in getting things in on time than your grasp of the subject. It seems somewhat different in engineering, but at least for me, I'm being convinced more and more that the real learning is done once you graduate or through extracurricular activities. But then again, that was the impression I had in high school – that I was just preparing myself to really learn in college. Perhaps it will soon change for the better. I still have some time here, yet. What about you, Karen – has college treated you as you had expected?

Karen: I don't think anyone expects the kind of problem sets I have received so far in my college career. But they will help me be a good engineer, right? Well…

One of the things I was told in my freshman pre-engineering course was that being an engineering student teaches you nothing about being an actual engineer. We are not being told the solutions to problems; we are being taught how to solve problems with hopes that we will solve the world's problems later in life. Although there is some satisfaction in finally arriving at the same answer that is in the back of the book, the most rewarding experiences for me have been when I am able to apply my knowledge, and I end up learning even more in the process.

For example, I would have laughed hysterically if my boss at my internship this summer had handed me a list of equations and variables on the first day. Instead, I was told a problem the department was having with a process and asked if I could figure out a way to fix it. Even though I did reference a textbook to see how temperature affected the flow of the process and if certain bacteria grew under specified conditions, it was not the textbook that helped me solve the problem. It was critical thinking skills. And while those engineering courses can help you get started, it is our out of class experiences that fine-tune those skills. It kind of makes me wonder if I really want to spend all that time on those crazy problem sets. Maybe I should work on designing better bathroom technology instead.

Ryan: Please do.



The College of Engineering
University of Wisconsin-Madison

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LARGE Advances on a SMALL Scale

By Sam Strom

It seems that everything today is either getting larger or smaller. We have 100-inch televisions and pocketsized computers. One field of study is getting larger but consists of very small things: nanotechnology.

For everyone who forgot their prefixes of the powers of ten, nano- signifies 10^9. Nanotechnology works with structures on the nanometric scale. This is not a new field. In 1959, physicist Richard Feynman gave a talk on the subject of miniaturization. In his speech he noted, "The principles of physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom." Though people have been hinting at nanotechnology for decades, it has not been an active field since scientists have not taken full advantage of the tools provided through advanced engineering. Today, scientists are using the tools and nanotechnology is booming.

Nanotechnology is becoming so popular that some people are suggesting it should have its own major at universities. Others feel the subject is too broad to be narrowed down to a specific curriculum. Nanotechnology includes areas from physics, engineering, biology, and chemistry. Some think taking all of these individual fields and condensing them into one major would be an arduous task.

Associate Professor David Beebe of the UW-Madison Biomedical Engineering Department conducts research in nanotechnology. "[The] lab mainly works at the interface between the micro and nano worlds using microfluidics." Beebe studies the nanoscale events contained within microfluids by running fluids through pipes with the diameter of a human hair. This has significance because there are certain things that work at this scale but do not work at the human scale. One example of this is capillary action.

To take you back to chemistry class, capillary action is a property of water. It involves putting a small diameter glass tube into water. Because of the water's attraction for the glass and the desire of the water to minimize its surface area, there are two forces pulling on the water. These opposing forces cause the water to creep up the side of the tube creating a "U" shape called the meniscus. Keep in mind that this is true with tubes visible to the human eye. Using a pipe with a diameter of nanometers would only increase the capillary effect.

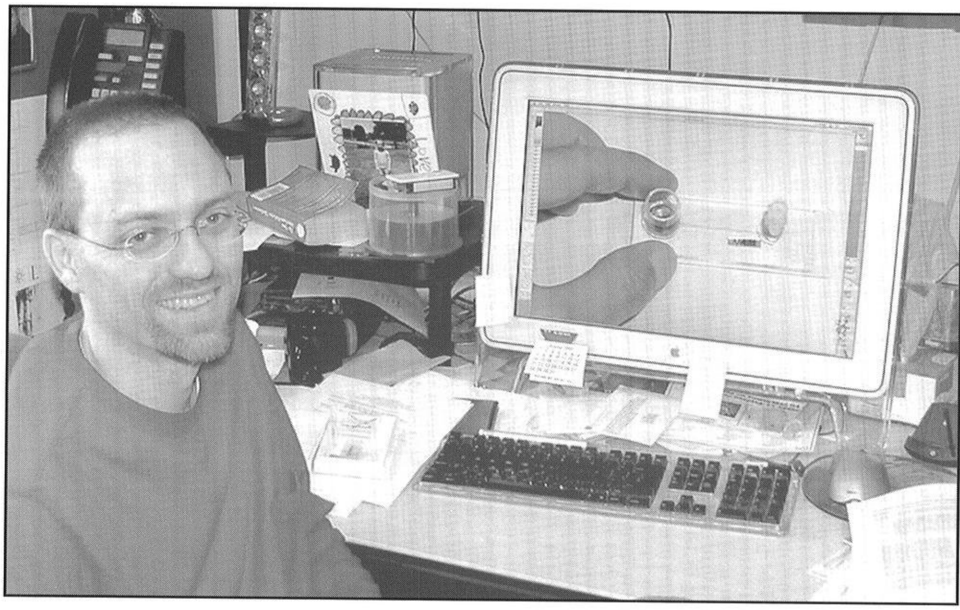
Beebe has collaborated with colleagues at the University of Illinois at Urbana-Champaign to publish nine papers on their findings. One was published in *Science magazine*. The research involved a pathway constructed of two regular walls and two "virtual walls." They studied the effects of different pressures by the virtual walls and various liquid-gas reactions on the flow. They have developed a way to pattern the top and bottom of microchannels, which allows them to direct fluid anywhere in the channel – even when not in contact with the real walls. Hence, they call the resultant liquid-gas contact virtual walls.

Another article published in *Nature magazine* dealt with hydrogel structures acting as both sensors and controllers that automatically route fluids based on their chemical properties. This article describes the finding that hydrogel structures react faster in tiny channels than in macroscopic channels.

Beebe is also a co-founder of the company Vitae, founded in 2000 and located in Madison. Vitae uses micro-scale engineering to

"The biological cell is the Holy Grail"

produce products for use with cells and embryos. These devices provide alternatives to growing and maintaining female eggs and embryos in petri dishes. This new technology



Soure: Gene Chyou

Assistant Professor David Beebe has published numerous papers on nanotechnology and co-founded the Madison-based company Vitae.

yields a higher success rate than the conventional petri dish method. Vitae has already garnered awards for its advances.

Early in 2000, President Clinton announced the creation of the National Nanotechnology Initiative (NNI). The importance of this initiative is evident in the $450 million budget allotted for it. Professor Beebe was recently appointed to the National Research Council (NRC) NNI Review Panel. This is a group of 12 to 16 people who review the field of nanotechnology in the United States.

Early in 2000, President Clinton announced the creation of the National Nanotechnology Initiative (NNI). The importance of this initiative is evident in the $450 million budget allotted for it.

The NRC is in charge of overseeing this initiative for the White House and Congress. They review such issues as ethics, money distribution, and safety. One scientific issue they are concerned with is the biological cell. The biological cell is an artificial cell with all of the capabilities of a regular cell, the most significant of which is self-replication.

The idea of a self-replicating machine like the biological cell has aroused fear in many. Last year, Bill Joy, chief scientist for Sun Microsystems, expressed his concern with nano-robots. With their ability to self-replicate, he felt these robots might have the capacity to take over the world. He suggested we halt development of nanotechnology for this reason.

Many believe halting the development of nanotechnology would be a big mistake. Nanotechnology is useful due to its large capabilities on such a small, normally inaccessible scale. The biological cell could change the face of science itself. As Beebe put it, "The biological cell is the Holy Grail."

Nanotechnology deals with interesting and possibly revolutionary topics. Everything from miniature robots to artificial cells could be created. With its broad scope, all of the capabilities of nanotechnology are not yet known. We have only had a glimpse of what working at such a small scale can do for us.

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Interview, David Beebe conducted over the phone on 10/12/01.

Author Bio: This is the second article in the Wisconsin Engineer magazine for Sam Strom. Sam is a freshman at UW-Madison and is currently in the Pre-Engineering program. He is planning to pursue a bachelor's degree in Computer Engineering.

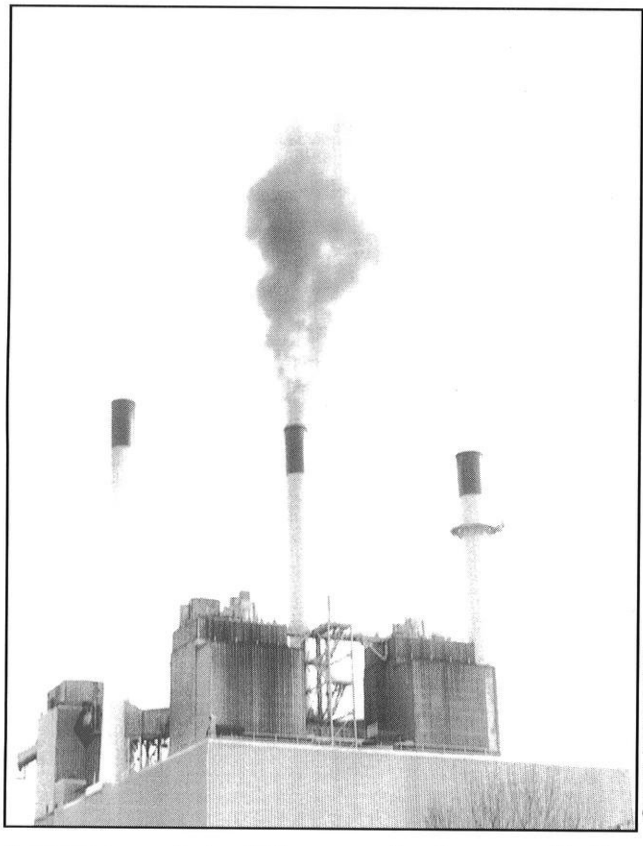
Providing Powerful Solutions to a Powerful Problem

By Shana Scheiber

Have you ever wondered if there is a chance of an energy shortage here in Wisconsin? Or if we could ever have roaming blackouts like California? If you have ever contemplated these questions or been interested in learning about energy sources Wisconsin uses or plans on using, you would have thoroughly enjoyed *Powering Wisconsin*, a conference hosted by We the People/Wisconsin at Monona Terrace on September 24, 2001.

Powering Wisconsin focused on making sure Wisconsin has an adequate, reliable, affordable and environmentally safe supply of energy. The conference did this through both panel discussions between topic experts and audience interaction with a computer simulation. The simulation mathematically took into account each of the four above-mentioned concerns.

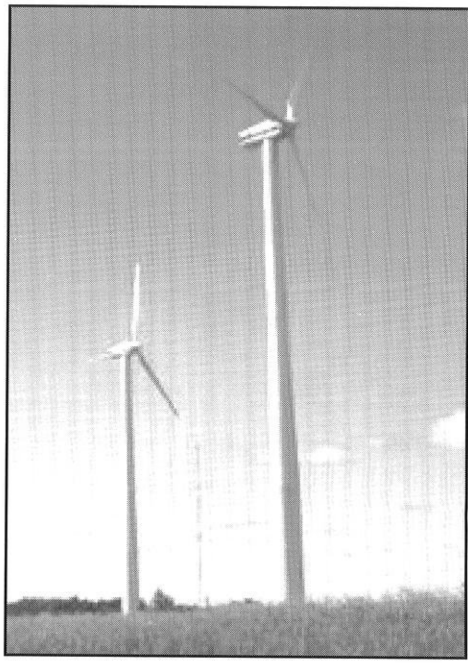
The conference also discussed the pros and cons of all feasible energy sources and how each of them correlated with the four major concerns. Energy sources Wisconsin is already utilizing include: conventional coal, natural gas, nuclear, hydroelectric, wind turbines and solar photovoltaic. Clean coal combustion and biomass are two potential future energy sources. Clean coal combustion is a new way to burn coal more efficiently with fewer emissions. Biomass-produced energy uses organic materials such as sawdust to produce energy without emitting any net carbon dioxide, a harmful greenhouse gas.


Source: Justin Novshek

A coal-powered plant billows smoke. Can more Madison residents get powered by alternative sources?

Tom Stills, President of We the People/Wisconsin and Associate Editor of the *Wisconsin State Journal*, conceived *Powering Wisconsin* in November 2000. He wanted to give the people of Wisconsin the chance to actively learn about the choices and challenges the state will face in the near future. The mission of the conference was "...to spark a statewide discussion about Wisconsin's energy future with the help of a computer simulator that gave people a range of choices to balance," stated Stills.

We the People/Wisconsin normally hosts around four conferences a year, with topics ranging from politics to public health care. Stills also stated that the 250 conference attendees at *Powering Wisconsin* made it the second largest conference in the organization's history.


Source: Justin Novshek

Wind power is a viable alternative to non-renewable power sources

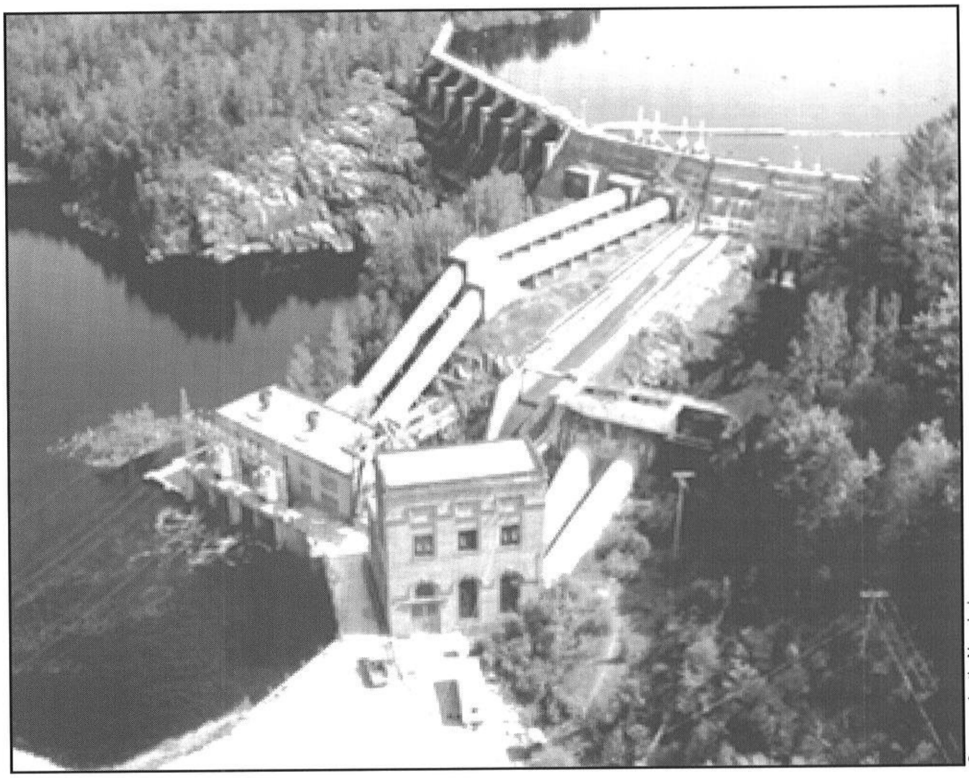
Throughout the morning of the conference, people attended informational sessions to familiarize themselves with potential challenges and solutions concerning the ever-increasing energy demands of Wisconsin. The two morning presentations included "How the System Works" by Roy Thilly of Wisconsin Public Power and "Power Sources" by Susan Stratton of Wisconsin Public Utility Institute. There was a panel discussion with the audience after each presentation. During lunch, there was an interesting presentation entitled "Resources from Space: A Universe of Energy Potential," given by Harrison Schmitt, Professor at UW-Madison, former astronaut and researcher of helium-3 (a potential energy source found on the moon).

In the afternoon, attendees broke up into small groups and participated in Citizens' Choice—a computer simulation based on a governor-issued energy plan for Wisconsin involving a predicted 3% growth in electricity demand over the next 15 years.

The exercise gave everyone at the conference a chance to come up with his or her own solutions to significant future energy problems. The goal of the computer simulation, programmed by Paul Meier, a Ph.D. student at the Institute for Environmental Studies, was "to become a tool which facilitates public evolvement in state's electricity decisions and educates the public on Wisconsin's electricity system." Meier's program took into account the public's desires for affordable energy with a low level of pollutants.

The *Powering Wisconsin* conference successfully educated people on each of its initial goals: making sure Wisconsin has an adequate, reliable, affordable and environmentally safe supply of energy.

Author Bio: Shana Scheiber is a graduating senior majoring in Mechanical Engineering. She would like to note that electric utilities in Wisconsin are projecting a zero probability for power blackouts in upcoming years.



Source: Justin Novshek

Hydroelectric dams like this one indeed are low emission but nevertheless can destroy aquatic ecosystems.

Keck Lab Links Emotion to Science

By Joel Wagner

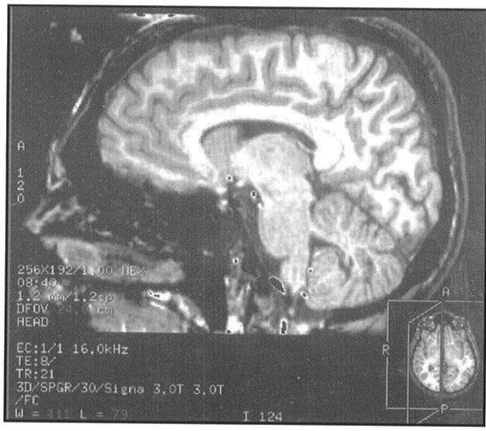
Neuroscience is undergoing a bit of a revolution. Over the past 15 years, neuroscientists have begun to see brain processes not only as cognitive processes, but also as significant emotional processes.[1] Researchers at the W. M. Keck Lab for Functional Brain Imaging and Behavior, located in the Waisman Center, are adding to the revolution by studying the impact of emotions on brain function.

The emotional perspective

Tom Johnstone, Ph.D. in Psychology, is a postdoctoral researcher at the Keck Lab. Dr. Johnstone explains, "We've come to the realization over the last 15 years in particular that emotions and emotional processes, what are called affective processes, play a much greater role in our mental lives than previously thought. We're not just driven by dry cognitive processes—rational thinking as people call it—but really a lot of our decisions in life and the way we behave are governed by our emotions." Johnstone summarizes, "We're interested in understanding better what the neural and brain mechanisms are underlying our emotions... emotional decisions... [and] emotional judgment."

"...in the next 20 or 30 years there's going to be an explosion of understanding of how the brain works"

Through this research, the Keck Lab also has a role helping individuals with specific emotion related disorders, ranging from anxiety disorder to autism.[2] By examining the mental processes associated with these clinical conditions, the researchers hope to provide better diagnoses and treatment for people suffering from them.

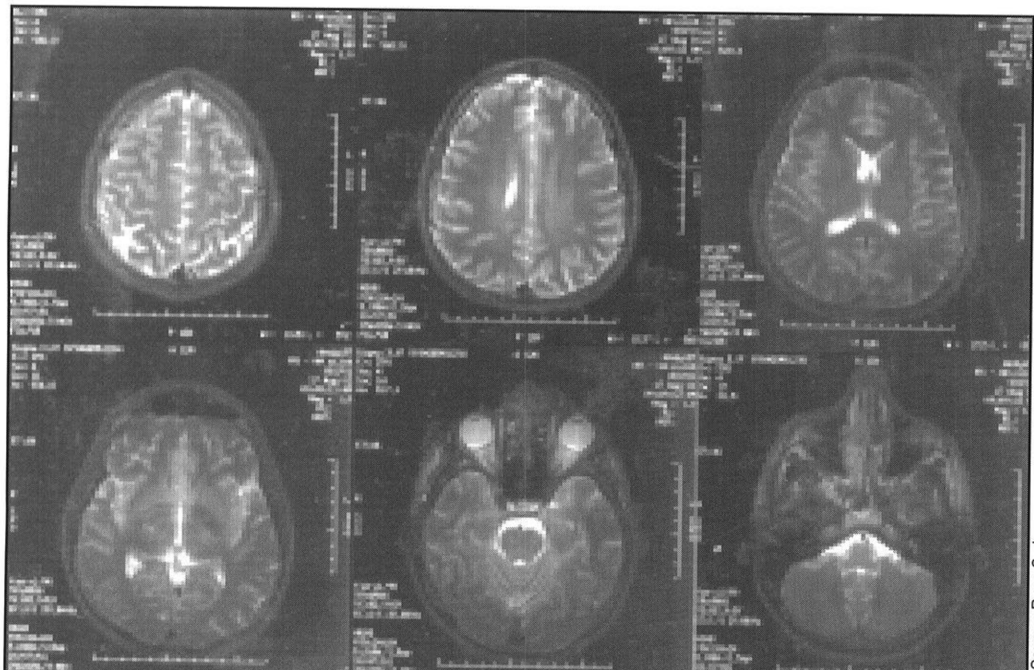


Source: Ryan Sydnor

A side view of a MRI scan.

One current project involves studying the neural mechanisms of individuals' resilience in the face of adversity. They measure brain activity with the magnetic resonance imaging (MRI) scanner and electroencephalogram (EEG) equipment during exposure to affective stimuli. These methods allow researchers to see the difference between the functional and structural makeup of the brains of resilient versus less resilient individuals. Another study focuses on the sources of anxiety disorders. This involves observation of which portions of the patient's brain are activated by stimuli before and after treatment. In many of their analyses, researchers have individuals do the same tasks with both EEG and MRI in order to unite the best aspects of the two methods.[1]

How is the research done?



Source: Ryan Sydnor

A portion of a full MRI scan from the top (upper left) to the bottom of the brain (lower right) of the writing editor, Ryan Sydnor .

The Keck Lab has three primary research devices: the magnetic resonance imaging (MRI) scanner where functional MRI is performed, the positron emission tomography (PET) scanner and electroencephalogram (EEG) equipment.

The key component of the MRI scanner is the huge, ring-shaped magnet that surrounds the individual as he or she is rolled on a platform into the scanner. The magnet generates a magnetic field with a force of three Teslas, or about 30,000 times the earth's magnetic field.[1]

The MRI measures brain activity through magnetism. The blood surrounding the brain is what interests the researchers. The magnetic properties of blood molecules change with the amount of oxygen present. After the magnetic field of the scanner aligns all of the magnetic molecules in the same direction, the time required for blood molecules to return to their original positions depends on whether or not they are bound to oxygen. The MRI detects these differences to form an image of neural activity. By first taking an anatomical scan of the brain and then superimposing scans of neural activity, researchers are able to create a comprehensive image of the brain. Since active portions of the brain require more oxygenated blood, researchers can detect which portions of the brain are activated by certain stimuli.[1]

The Keck MRI scanner is used exclusively for research, whereas the PET scanner is used for both clinical diagnoses and research. The PET scanner detects minute levels of radioactive isotopes that are introduced into the body intravenously or inhaled as a gas. Although more invasive than MRI, the PET scanner can provide detailed information about the biochemistry of the brain. The Keck Lab is especially unique because it has its own particle accelerator that creates the isotopes for the PET procedure.[1]

The EEG lab is used to obtain high-resolution electrical information that complements data obtained from the MRI and PET scans.[2] A net-like cap of 256 electrodes, each of which has a small piece of foam that makes direct contact to the patient's head, is used to detect neural activity.[1]

Each of these three methods measures brain activity in a unique way. Researchers are working to combine the advantages of each method to more accurately examine the intricacies of neural functioning. This three-pronged approach is the most significant attribute of the Keck Lab. Heather Urry, Ph.D. in Clinical Psychology, is a postdoctoral fellow with the Department of Psychology. She explains, "We have multiple methods that all get at different things which we can use in combination. MRI gives great spatial resolution and relies on the inherent magnetic properties of our tissues. PET gives us an absolute measure of metabolic rate in exchange for its more invasive nature. EEG affords us the ability to resolve very fast processes, and, with source localization techniques, can provide reasonable spatial resolution too. I think it's great that we can actually use all three of those methods to really get at the different properties of the brain that we're interested in."

A broad range of talent

The Keck Lab houses a very wide range of individuals who contribute to the advances made. UW-Madison faculty and other professionals contribute expertise from a range of scientific fields, including neuroscience, psychiatry, psychology, physics, engineering and statistics.[1] In addition to the professional researchers, undergraduate students, graduate students, post-doctoral fellows and clinical interns play important roles in the lab.

Pathway to discovery

By combining incredible facilities with equally amazing individuals in a research field that has much left to be learned, the Keck Lab is on a pathway to discovery. "I think this is really a blossoming area of research.... We're for the first time starting to get a real understanding of how the brain works, and how it governs not only seemingly simple things, like how we see objects, but how we actually understand what those objects are and the relevance of those objects to our lives, and emotion plays a very big part of that," states Johnstone. The future looks promising for neuroscience. In 1990, President George Bush Sr. proclaimed the 90's as the "Decade of the Brain."[3] What was discovered in the 90's was only a piece of the puzzle. As Dr. Johnstone points out, "There's enormous potential, and I think in the next 20 or 30 years there's going to be an explosion of understanding of how the brain works."

"Through this research, the Keck Lab also has a role helping individuals with specific emotion related disorders, ranging from anxiety disorder to autism."

Rather than looking at cognitive processes and emotions as separate entities, neurological research is revealing the interconnectedness of brain activity. This unification of concepts is also reflected in the lab's interdisciplinary atmosphere. Perhaps in the coming years we will see that emotions and the pure sciences are more related than originally thought.

Dr. Richard Davidson, Director of the Keck Lab, concludes, "Research on the integrative functions of the brain and the manner in which the brain subserves higher mental functions is burgeoning today, and I expect that the Keck Lab at Wisconsin will be among the leading laboratories in the world in this important research area."

For more information on affective neuroscience at UW-Madison, visit *http://psyphz.psych.wisc.edu/html/main.htm.*

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Author Bio: Joel Wagner is a freshman majoring in Chemical Engineering and Biochemistry. He has an avid interest in neuroscience, particularly in the biochemistry behind emotions and the development of human thought.

CD Burners: A Hot Commodity

By Aaron Bock

Although compact discs first debuted in the public market in the mid 1980s, CD recording hardware was not available until recently. Since then, CD recorders (commonly known as burners) have become so popular that they are now standard in most new personal computer packages. Despite this new trend of hardware, many people, including those who own them, are unaware of how CD burners work.

The popularity of CD burners can be attributed to several factors. First of all, compact discs hold considerably higher amounts of data than their predecessors. Whereas a 3.5 inch floppy disk holds only 1.44 megabytes (MB) of data, a standard CD holds about 650 MB. Even a normal Zip™ disk holds only 100 MB. The ever-increasing size of files and computer programs severely limits the amount and type of data that can be transferred between computers without using CDs. Many people see CD burners as a convenient way to solve this problem.

In addition, CDs continue to be the most common media for audio data. Owners of CD burners are taking advantage of this by creating their own CDs with their choice of audio tracks. With the added rise of MP3s, music fans are extending their CD libraries to new levels.

A 3.5 inch floppy disk holds only 1.44 megabytes (MB) of data, a standard CD holds about 650 MB. Even a normal Zip™ disk holds only 100 MB.

Another factor promoting the popularity of this hardware is its relative inexpensiveness. Increased demand has driven prices down, and some burners on the market now cost under $200. In addition, blank CDs are readily available for $1-2 each, compared to nearly $10 for a single Zip™ disk.

The variation in cost of blank CDs is due to the fact that two types exist: recordable (CD-R) and rewritable (CD-RW). While the latter are slightly more expensive, they are also more versatile. Rewritable discs can be erased and rewritten after data has been burned to them. When data is burned to a CD-R, however, it remains there permanently. Therefore, while more expensive, CD-RWs are more economic as they allow the 'recycling' of disks.

As the costs of the two types differ slightly, so do their compositions. Compact discs are constructed in layers of several different materials. In a CD-R, the first layer is usually a scratch-resistant coating. The second layer is made of an ultraviolet-cured lacquer. The next layer (about 50-100 nanometers (nm) thick) consists of 24K gold or a silver colored alloy, which accounts for the shiny reflective surface of the disc. Below that lies a layer of organic polymer dye, which contains the actual data. Finally, a layer of polycarbonate substrate (the plastic layer) completes the structure. In CD-RWs, all layers are essentially the same, except that layers of dielectric lie directly above and below the layer of organic polymer dye.

This organic polymer dye is the region where data is stored. A distinct pattern of small raised and lowered areas (called lands and pits) is imprinted on the dye layer. Each pit is between 0.83 and 3.56 μm long, 125 nm deep, and 0.5 μm wide. Not coincidentally, the wavelength of green light is also about 0.5 μm, which accounts for the green colored laser that reads the data on the CD. The pits on the dye layer reflect the laser beam back onto an optical sensor in a series of pulses according to the pattern of pits. The pulse pattern is then sent through a signal amplifier and subsequently an audio speaker.

Source: Josh Worisek

CD burners are more popular than ever, and can be found at electronic stores.

Although all CDs work in this manner, several methods are used to create the lands and pits. Standard audio CDs found in music stores are produced by an injection molding process, where the mold presses the pattern of lands and pits into the disc. In CD burners, a laser is used to burn the pits into the polymer dye in the blank CD. These pits are burned into a pattern according to the desired data to be recorded.

While not presently as popular as their compact disc counterparts, Digital Video Disc (DVD) burners interest media enthusiasts as well. These are analogous to CD burners and work in much the same way. The one major difference between the two is that the laser in a DVD burner uses a lower wavelength (about 635 nm). For this reason, CD burners cannot be used to burn DVDs. DVD burners are not yet commonplace on the market, even though DVDs are quickly overtaking VHS cassettes as the most common media for visual data. DVD burners' present lack of popularity is mainly due to their heavy price tag; a couple thousand dollars. Additionally, DVDs have not yet become popular enough to raise a heavy demand for DVD recording hardware. However, it is speculated that they will become as common as CD burners in the next couple years. By that time, it is likely that CD burners will be as standard as personal computers are now.

CDs continue to be the most common media for audio data. Owners of CD burners are taking advantage of this by creating their own CDs.

Author Bio: Aaron Bock is a first year senior majoring in Engineering Mechanics and Astronautics. He wishes he owned a CD burner, but is presently too poor to purchase one.

Source: Josh Worisek

There are two types of CDs that can be written on: recordable and rewritable.

Professional Engineering Organizations: What Does Your *personal* Professional Ad Say?

By: Ellen Considine

GLE seeking mentor, networking opportunities, professional licensure, scholarships. Interests include landslides, dam safety, shoreline erosion. Long talks about channelization a plus.

If you were to write a professional want ad, would it sound anything like this? If so, you are prime professional engineering organization material. Engineering clubs seem geeky… really geeky. But this isn't your high school physics club.

Why should I join a student engineering society?

Many student engineering groups are affiliated with national organizations like the Society for Women in Engineering (SWE), the American Society of Civil Engineers (ASCE) and the Institute of Electric and Electrical Engineers (IEEE). And they offer more than you thought: volunteering opportunities, professional licensure, continuing education and scholarships, to name a few. You could access all these and more by joining a professional engineering organization.

Your engineering degree from UW-Madison will take you far. But classwork alone doesn't prepare you for the challenges ahead. So write your own professional ad and find the organization that is right for you.

The most practical reason to join? It is a great way to network, and networking is the most effective way to find a job. It also looks good on your resume.

But students who are involved in engineering organizations don't only talk about the contacts they've made or the resumes they've built. The *Wisconsin Engineer Magazine* is a student organization where students have an opportunity to participate in something real. Editors and managers put in long hours without pay, and in some cases, no academic credit. Many keep coming back, semester after semester. Students love what they're learning and how much confidence it gives them.

Is there a professional organization for ME?

There is a professional organization for nearly every field. For example, the American Geological Institute (AGI) is really an association of 37 geoscience societies. If you have a special interest in dams, investigate the Association of State Dam Safety Officials (ASDSO). For dairy goat aficionados, there is even an American Dairy Goat Association (ADGA).

In fact, there are so many organizations out there that you need to beware of acronym homonyms. A.E.G. stands for both the Association of Engineering Geologists and the Association of Exploration Geochemists. Check out the UW-Madison College of Engineering homepage for a list of registered student engineering organizations.

Which group should I join?

Club membership takes time and effort, so don't try to join every group that looks interesting. This is where your professional ad becomes important. Decide what is most important to you. If your needs don't match the organization's agenda, you'll be dissatisfied and frustrated. For example, say you're a mechanical engineer who is black and enjoys metal casting on weekends. You can't decide whether to join the American Society of Mechanical Engineers (ASME), the National Society of Black Engineers (NSBE) or the American Foundry Society (AFS).

So read each group's mission statement. Go to a meeting and learn about their goals. Decide where you feel most at home and which group's activities interest you the most.

But I don't know anyone at the club meetings!

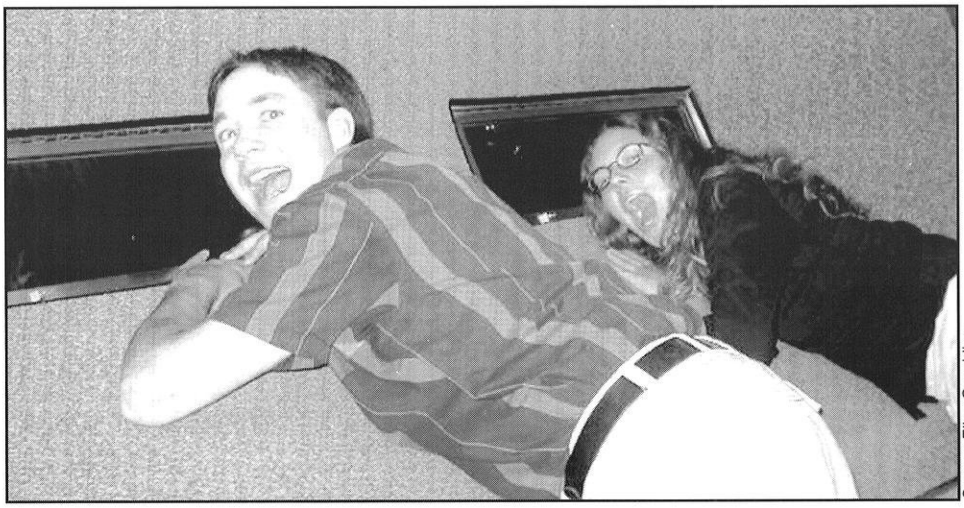
Sure, it seems like a clique that doesn't want strangers. But don't hesitate to introduce

To Join or Not To Join?

The pros and cons of professional affiliation

Cons:
- Member fees
- Time commitment
- That awkward "newcomer" stage

Pros:
- Find jobs jobs jobs jobs
- Build resume
- Volunteer in a setting that suits YOU
- Meet other people with similar interests
- Keep up-to-date in your field
- Make a name for yourself
- Continue learning
- Get free stuff (*binders, pens, levels, rulers, stress balls*)
- Meet role models and mentors
- Attend skill seminars
- Receive discounts on insurance, airfare, and rental cars
- Receive publications (*technical magazines and newsletters*)
- Improve your profession's visibility
- Access equipment and supplies
- Apply for scholarships
- Eases transition from student to professional
- Builds leadership skills
- Gives your homework meaning
- Find jobs jobs jobs jobs



Engineers from the GLE society enjoy the view atop the St. Louis Arch.

yourself to an officer and ask about the group. All leaders want to see their organizations grow, and they will be ecstatic to meet you. Find someone new to talk to, and sign up for club activities. Soon you'll be reaping the rewards of membership.

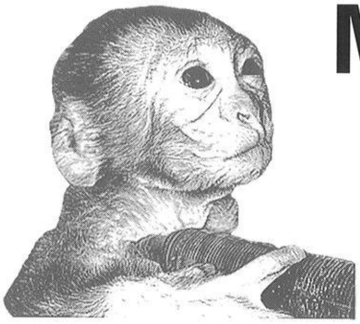
Too good to be true?

Once upon a time the Geological Engineering Society (GLE socitey, a student group not affiliated with a national professional organization) applied for membership to the Association of Engineering Geologists (AEG, a national professional organization). The AEG accepted them, and the young geological engineers were happy.

But they wanted to do more than change their name from GLE Society to UW AEG. So last October they went to the annual AEG conference in St. Louis.

They learned about exciting new techniques in groundwater remediation, landslide analysis, karst mitigation and tunneling. They talked to engineers and owners instead of recruiters. They met other dirt-loving geeks and made new friends from Colorado, Missouri and Mississippi. The young engineers learned how to organize people and plan activities. They met employers, and they gained confidence in their technical skills. Thanks to a professional engineering organization, they were finally prepared to graduate and live happily ever after. True story.

Author Bio: Ellen Considine is a senior majoring in Geological Engineering. She has found happiness with UW AEG and the Wisconsin Engineer.

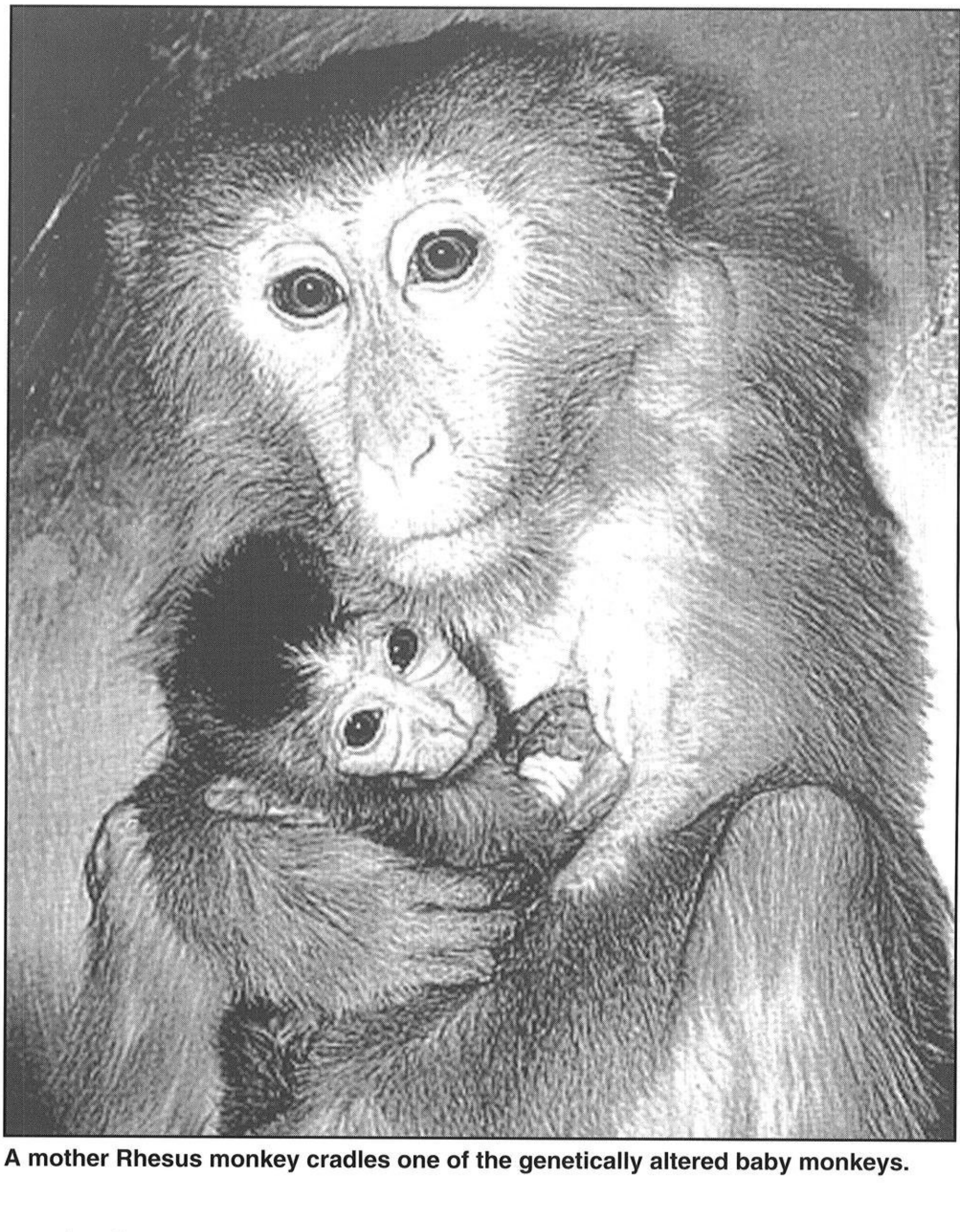


Monkey See, Monkey Glow?

By Eric Vieth

There are two very special rhesus monkey infants roaming about the Wisconsin Regional Primate Research Center. These infants, which are short-tailed monkeys native to southeast Asia (genus Macaca), were born at the UW-Madison facility and are the first genetically modified monkeys to be born with functional transgenic organs.[2] The monkeys have placentas that contain a gene from a jellyfish. This gene, which causes cells to have a green glow, was transferred into the genome of a rhesus embryo and placed into a surrogate mother.

The purpose of producing these hybrid monkeys is to develop a better understanding of genetic diseases in humans. The monkeys are used as models in determining which genes can cause or cure diseases.[3] The jellyfish gene was chosen because it creates a protein that glows green and enables scientists to confirm whether or not the gene is active within the host cell. This experiment, which creates a marker or, "reporter," gene, was performed in order to investigate the practicality of inserting a foreign gene into a non-human primate, as well as studying the interaction of this gene with both the mother and the fetus. The success of this gene transfer will accelerate the development of genetic engineering techniques such as inserting disease-causing genes into monkeys. Scientists could then analyze the effects of these diseases with hopes of creating possible cures.



Source: Jordan Lennon WRPRC

A mother Rhesus monkey cradles one of the genetically altered baby monkeys.

Diseases such as Alzheimer's and cystic fibrosis could possibly be eradicated through genetic engineering

Rhesus monkeys were chosen for these studies because their genome and physiology are very similar to those of humans. Rhesus monkeys are close relatives to humans (DNA differs by just over 1%), and the use of these animals will provide more applicable data and understanding of human diseases. In the past, only mice, sheep and bacteria were genetically engineered – mice being the most commonly used for this type of transgenic research.[1]

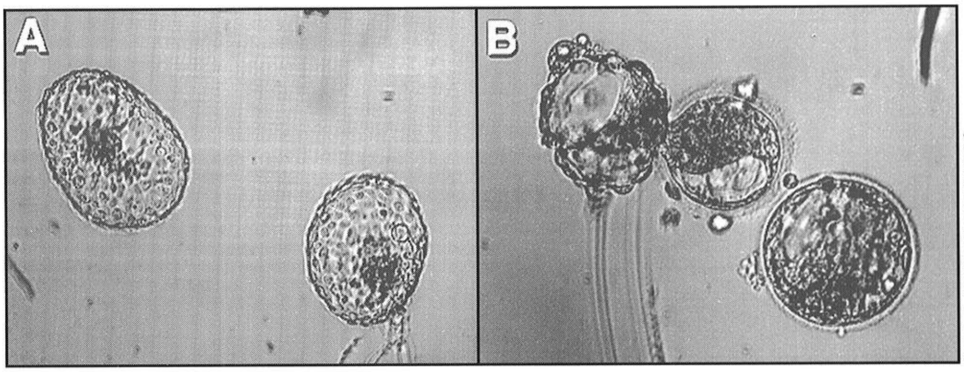
Scientists at the Oregon Regional Primate Research Center (OPRC) were the first to genetically modify a primate in January of 2001.[4] The researchers were successful in engineering the birth of three rhesus monkey infants with a transplanted jellyfish gene. Only one of the three monkeys survived and was named ANDi (backwards for "inserted DNA"). The difference between ANDi and the two UW-Madison monkeys is that the foreign jellyfish gene wasn't active in ANDi. The gene in the UW-Madison monkeys is active and able to function the way it would in a jellyfish. This is significant because it is essential for the mutated gene to be active in transplant experiments.

The two UW-Madison monkeys were born with the active gene in their placental cells.[2] The role of the placenta is to supply nourishment to the fetus during pregnancy. Thus, this experiment is geared towards developing ways to explore problems or defects associated with human reproduction. Problems with the placenta are believed to cause infertility and miscarriages.[3] The way the placenta functions is still somewhat unclear to scientists, and these new transgenic placentas will be valuable in future research related to pregnancy issues.

Using monkeys as human disease models poses a question of ethics. These experiments also pose the risk of permanently altering the gene pools of rhesus monkeys. Many animal rights interest groups, including the British Union for the Abolition of Vivisection (BUAV), are strongly opposed to using these monkeys for scientific research. BUAV spokeswoman Wendy Higgins states, "It's bad enough using rodents, but for scientists to play God with primate genes is morally abhorrent."[1] On the other hand, scientists explain that these experiments are going to be monitored very closely and that a major priority will be to ensure the well being of the animals. Professor Gerald Schatten of the OPRC claims that the number of monkeys used in this type of research will be minimal. Schatten further says, "Our goal isn't to make sick monkeys. Our goal is to eradicate diseases."[1]

They are the first genetically modified monkeys to be born with functional transgenic organs

UW-Madison researchers have brought us one step closer to curing many devastating human diseases. Although the two genetically modified monkeys provide insight into the health of the placenta, many other human diseases are going to be explored through this type of experimentation. In the future, diseases such as Alzheimer's and cystic fibrosis could possibly be eradicated through genetic engineering. For now, we'll just have to put up with a couple playful, glowing monkeys.



Source: Jordan Lennon WRPRC

Above are Early (A) and Late (B) stages in the modified embryo's development.

References:

[1] BBC Online, "GM Monkey First," www.bbc.co.uk , January 2001.

[2] Wolfgang, M. J., Eisele, S. G., Browne, M. A., Schotzko, M. L., Garthwaite , M. A., Durning, M., Ramezani, A., Hawley, R. G., Thomson, J. A., and Golos, T. G., "Rhesus Monkey Placental Transgene Expression After Lentiviral Gene Transfer Into Preimplantation Embryos," Proceedings of the National Academy of Sciences , September 11, 2001.

[3] Marchione, M., "Jellyfish Gene Placed Into Monkey Embryos; UW Work on Functioning Foreign Gene is a First," Milwaukee Journal Sentinel, September 11, 2001.

[4] Bernton, H., "Monkey Gets a Jellyfish's DNA," The Seattle Times Company, January 12, 2001.

Author Bio: Eric Vieth is a junior majoring in Civil Engineering. Eric will be studying abroad for the spring semester in Brisbane, Australia. He'll stay there as long as the surf is up or until the women want him to leave. He could be there a long time.

5 Generations: A UW-Madison Tradition

By Amanda Andrew

Family traditions. Baking cookies, decorating for the holidays, making apple cider as fall turns into winter, attending UW-Madison?

David Shaw has a very unique and interesting family background, one including five generations of UW-Madison graduates. Shaw was born and lived in Renton, WA, before coming to the University. When asked if there was any family pressure to attend UW-Madison, he had a surprising answer. "My mom told us that of course she would like it if one of us decided to attend Madison, but there was never any real pressure to come. I think that it's kind of neat to continue the tradition." While family tradition did play a big part in his decision to attend UW-Madison, the fact that the University is highly reputable was also a deciding factor.

This is Shaw's family attendance at UW-Madison:

- Great-great-grandmother: 1879 to 1881
- Her daughter Helen (Great grandmother): BS in 1919 and MS in 1920
- George Robert Shaw (Great grandfather): Ph. D. in 1920
- John (Grandfather): 1944 with a BS E.E.
- Ann Axness (Grandmother): 1942 to 1945
- John Shaw III (Father): 1972 with a BS E.E.
- Kathleen Beauparlant (Mother): BS

Shaw also has multiple aunts, uncles and cousins who have attended UW-Madison in fields such as Meteorology, Philosophy, Music and Engineering. The father-in-law of one of his uncles, Dr. J. Howard Mathews, actually had the Chemistry building named after him (originally the J. Howard Mathews Chemical Laboratory, now called the Daniels and Mathews Building).

When Shaw's great-great-grandmother attended UW-Madison in 1879, there were only three buildings: Bascom Hall, North Hall, and South Hall. Shaw says that story might be a myth, as he became interested enough in the history to look up some dates. He found that the Red Gym was actually built before 1879 but is unsure of whether or not it was UW property.

When asked if there was anything else he wanted to add about his choice of school, his education or his family background, Shaw replied, "It's just such a great opportunity to carry on this tradition, not a lot of people to get do something like this. It's a nice place, but a big change; it's always a big change when you are somewhere 2500 miles from home, but I like it."

Author Bio: Amanda Andrew is a freshman planning to major in Journalism. She knows next to nothing about engineering and is finding this a very interesting experience.

Source: Gene Chyou

A photo of Helen and Robert Shaw from 1919. It appears the photo was taken atop Bascom Hill overlooking Lake Mendota.

Source: Gene Chyou

Robert Shaw continued the family tradition of attending UW-Madison.

Source: Gene Chyou

Besides attending UW-Madison, many of Shaw's relatives attended church like these women.

Ethics and the Modern Professional

By Andrew Wentland

Say you discover that an office building you helped design a year ago has a flaw that could be devastating. With the building complete and occupied, you face a dilemma. What do you do? What is ethical? What role do ethics play in training and teaching an engineer? These questions are frequently on the minds of engineers, students and professors.

One of the greatest concerns in engineering education is how to teach ethics. Often, teachers' own standards can have an effect on their teaching. Ethics in technology is important due to its impact on human safety.

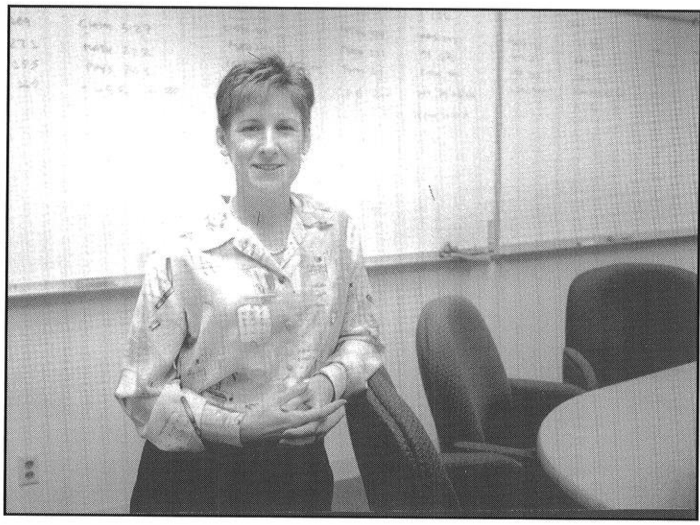
Sarah K.A. Pfatteicher, Ph.D., is an Assistant Dean of Academic Affairs of the College of Engineering at UW-Madison. As a historian of engineering ethics, Pfatteicher understands the roles played by each engineer. She conducted research on ethics with an emphasis on civil engineering disasters.

"Ethics helps us think through how to use the information that is available to us," Pfatteicher states. "Ethics is about critical thinking."

If students are taught to think about ethics, according to Pfatteicher, they are more likely to make sound decisions when they are out on their own. "I think of teaching in much the same way that I think of parenting. That at some point I know I am going to have to let these students go, or let this kid go."

Pfatteicher states, "One question is whether you can in fact teach an adult to behave a certain way, to have certain attitudes about engineering and what ought to be done with it." The Accreditation Board for Engineering and Technology (ABET) requires colleges to teach ethics to students. This emphasizes the role that ethics has in education, especially in a college that maintains ABET accreditation.

Pfatteicher had to personally develop her teaching methods to test students on their systematic approach to ethical situations, not on how they feel about a given problem. In her article, she writes, "In our role as teachers, we are charged with evaluating students on their knowledge and skills rather than their values and beliefs. We should strive, then, to teach our students about ethics rather than to teach them to be ethical." The students are graded on how well they think and argue each situation.


Source: Meg Cox

Sarah K. A. Pfatteicher, Ph.D., is an Assistant Dean of Academic Affairs at the UW-Madison College of Engineering.

Since ethics deal with critical thinking, Pfatteicher recommends setting up a classroom to evoke thought from the students. If a student is accustomed to critical thinking, he or she is more likely to be ethical in the real world. Pfatteicher explains that when a product is designed, developers need to take into consideration not only its ability to function properly, but also how it might be used.

Aside from motivating students to think, another challenge Pfatteicher faces is to avoid grading based on her own ethical opinions. She explains, "I am aware of my limitations, that as much as I would like to be objective when I grade, as much as I try to be objective when I grade, grading is an incredibly subjective exercise."

The events of September 11th further complicated the ethical debate. Recently, the ability to freely access the Internet was discussed. Since anyone can go to a library, log onto the Internet, and look up plans for making an atomic bomb, congressmen question the ethics of free access to that type of information. Pfatteicher comments, "One of the lessons of ethics is about how to use information, and I personally believe that access to information is a good thing. Censorship or limiting access generally is not a goal or tactic we should take."

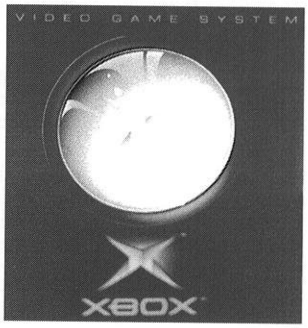
So what steps can we take? Some organizations, such as the American Society of Civil Engineering, have developed codes of ethics over the last century. These set codes of ethics are simply based on organizations' opinions, but one can examine them and see how they argued over what is ethical.

To Pfatteicher, "Ethics goes beyond a code of ethics that you can see in writing, in part because engineering for most people is a career and not a job. To be an engineer is something that goes beyond the job title that you have. If you are an engineer, you are an engineer 24 hours a day. An engineer is your identity and it is not where you go to work. To be an engineer means to involve ethics in all aspects of your life."

Ethics are not solely based on individual opinions. Although a specific code of ethics can be found in each person, society has reached a general consensus as to what is ethical. Many do not realize it, but when a population gasps at a tragedy, those feelings are derived from a standard. Even though one cannot teach someone to be ethical, one can hope that a person will make the correct decisions based on thorough thought.

Author Bio: Andrew Wentland is a freshman in engineering. This is his second article for the Wisconsin Engineer.

Battle for the Video Game Throne



By Carl Edguist

Last December, a war was raging in the video game business. Sony's PlayStation 2, Nintendo's GameCube, and Microsoft's X-Box battled for customers' holiday money.

Source: Carl Edquist

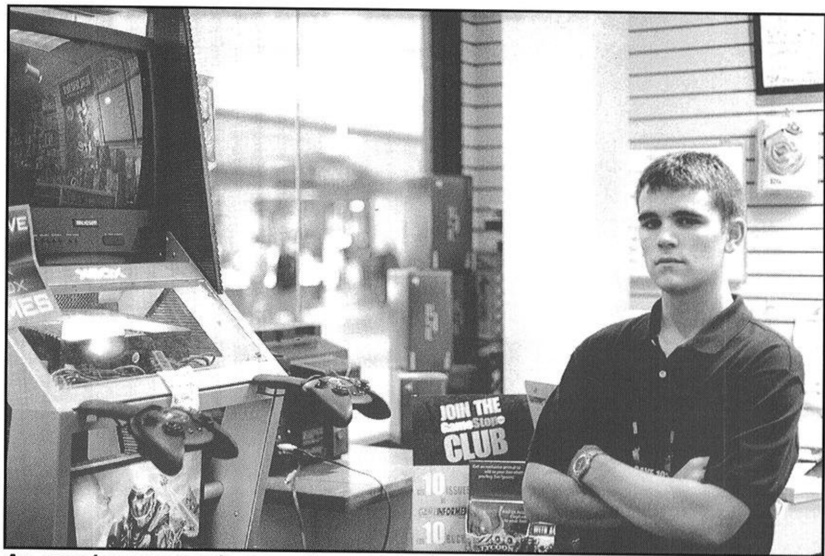
PlayStation 2, which came out almost a year ago, is a major contender because of its ability to play PlayStation 1 games.

Source: Carl Edquist

A customer trys the new X-Box system which is renowned for its quicker speed and glitzier graphics.

Source: Carl Edquist

The X-Box, which debuted last fall, is Microsoft's attempt to get into the video game market.



Source: Carl Edquist

An employee stands proudly next to the *Halo* demo for the X-Box.

Reminiscing About Engineering IV

By Nicholas P. Mueller

This article, the final installment of the "History of Engineering" conference covers a special supplementary session of "pulpit" during which various faculty members have attempted to explain their teaching methods. It was, for this reporter at least, a very revealing experience.

Teaching Advice:

• Always remember that you, as a professor, are not here to teach. You are here to do research and gain tenure. If you are already tenured, you are here to relax.

• Let's get this out of the way first: Do not make the mistake of caring for your students. The sniveling little snots may be the future of the world, but you know any one of them would leap at the chance to stab you in the back and take your job, being those damnable young Turks they are.

• Always remember to find the brightest young Turk in your class right away and ruin his standing amongst his peers by wrecking his class average with tough grading. In fact, ruin all the student's averages. That way, you can instate a large curve and make depressed-sounding comments about how "This is the worst performing class ever" and "My God, what has happened to students since I was in college," etc..

• Never actually learn the material you are teaching in the class, as this is below you (and your advanced research). Gin up a bunch of either really neat or really bad Power Point slides and present them instead of actually teaching. Address all student questions to your TA, and flatly refuse to actually work problems in class unless your TA has ginned up Power Point slides for the question.

• Don't be flustered by student questions if you have not had time to make a TA gin up the answer and slides. Preface any responses in lecture with "Well this is really some difficult material to explain..." and then feel free to write pretty much whatever you want on the board. As long as there is a significant amount of writing and erasing, eventually all your students will give up on writing down the answer and the problem will be solved.

• Alternately, if forced to address student questions one may take this tack: First play a thoughtful look across your face, then morph to confusion. Murmur under your breath to yourself or stroke your chin for maximal effect. All the while, stare directly at the student as if he or she was "that guy" and then dive into a completely different subject.

• Whenever a student starts to say something correct in response to a question, nod your head and murmur statements of agreement. When he or she is finished, then state "Well, yeah, but no. What I really was looking for was ..." then repeat almost exactly what the student's response was. Not only does this make you look really smart, it makes the student look really stupid for giving an incorrect response.

• Always make your questions to the class sound rhetorical. This way, the students will think that you do not want an answer, and then you can play-act frustration with them and yell because "Nobody answers questions in this class, why?"

• Ask a lot of simple questions in class, but do not state them in a rhetorical manner. Then railroad right over the raised hands and the proffered answers with your own responses, embarrassing the students and making them feel dumb.

• Always make sure a sufficient amount of fear, uncertainty and doubt (FUD) revolves around your entire class, especially the exam questions. FUD is your best friend in professorship, as it will undoubtedly cause you to be treated as a wise man of great learning, who can't be bothered by student questions, complaints or problems, which is, of course, really the case anyway.

• Always allow students to get extensions on homework or else a delay on a test for reasons such as health or travel plans. This way, you can delay grading the work of the entire class until that student has turned in or taken the exam. Also, they provide a shield/easy excuse for you when the other students start demanding their work back.

Teaching Assistant Advice:

• Always grab a TA.While they may require some maintenance (e.g., you may actually have to talk with them), they can generally field all questions relating to class material preventing you from having to deal with all those snot-nosed little sycophants who can barely grasp the material.

• Be sure to always check up on your TA in lab or discussion sections. This way, you keep them on their toes and make them very nervous, which is how they should be. Take every opportunity to point out the TA's mistakes in these sections, as it proves how good and smart a professor you really are. It also allows you to keep an eye on that pretty, young freshman who is always batting her eyes at you.

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