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# Wisconsin engineer

April 2003

VOLUME 107, NUMBER 3

## Scientific Marvels or Myths?

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**What's in Your Water**  
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**Medical Errors**

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# Wisconsin engineer

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VOLUME 107, NUMBER 3

April 2003

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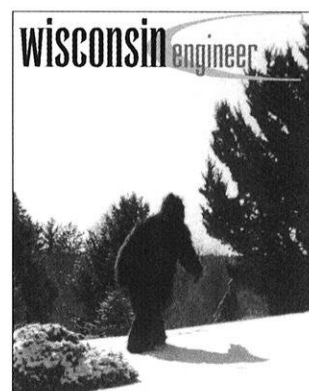
Industrial Engineering Professor Smith earns award for holistic education from students.

By Tom Marmet

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Is it Bigfoot, Sasquatch, or a guy in a gorilla suit? While modern science denies the existence of this elusive beast, there may new evidence to suggest otherwise.

Photo By John Newell

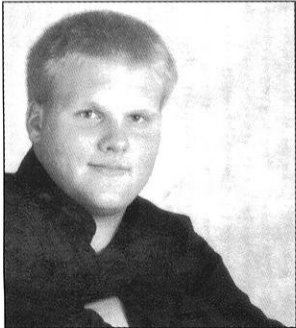


## JUST ONE MORE

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A cartoon by Skye McAllister

# Flying Onward



**Aaron Bock,  
Writing Editor**

Progress does not come without risk. And it certainly does not come without sacrifice.

The Space Shuttle Columbia disaster was shocking to many Americans. It took the lives of seven of our brightest minds and drew serious doubt as to whether manned spaceflight is worth the risk. Following the catastrophic events of Saturday, February 1, many people called for complete and indefinite abandonment of the space program.

Appeals for such an extreme measure are not without merit. Shuttle missions and the research they cater to are by no means cheap. NASA's Human Space Flight program boasts a \$5.5 billion price tag annually and the experiments flown on the Shuttle are the products of years of research and development. Furthermore, their expensiveness is far outweighed by the potential cost of human life. Amplifying all this with a catastrophic failure makes it easy to

vouch for a harsh response. However, failure has never necessarily dictated giving up.

Technological calamities, including those that claim people's lives, are nothing new. Pressing on after one of these calamities is nothing new either. On April 26, 1986, Reactor #4 of the Chernobyl power plant melted down, left 31 people dead and rendered 2800 square kilometers of land uninhabitable. The event triggered worldwide unrest and a strong public outcry for the abolishment of nuclear power. But those who believed in the potential of nuclear energy used the disaster as a learning experience and built upon it. Today, nuclear power is one of the safest and cleanest energy sources available and it accounts for nearly 20% of the world's power consumption.

Members of the Quebec Bridge project refused to be defeated by a catastrophe in the early 1900s. At that time, the Quebec Bridge was on its way to becoming the largest cantilever bridge in the world. While still being constructed it collapsed twice, taking a combined total of 86 workers down with it. Six years after the first collapse, construction of the bridge began anew and was finished in 1917. The completion of the bridge was regarded as one of the greatest feats of engineering at that time. Today, it remains the largest cantilever bridge in the world and serves as a major thoroughfare across the St. Lawrence River.

Now again, we are caught in the wake of a fatal engineering disaster. There are obviously many ways to respond to the events of February 1. For some, it may be difficult to support the space program in the aftermath of a catastrophe of this magnitude. But as so many before us have discovered, it often proves worth it to move beyond a tragedy and forge ahead. There are many things to be learned from the Shuttle disaster, and learning something means little without application of the lesson. All in all, we must accept the risks of spaceflight and press onward with it. The crew of the Columbia would have wanted it that way.



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UNIVERSITY OF WISCONSIN-MADISON**



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# Fewer Lanes, Safer Roads

By Mike Czaplewski

It is Friday after a stressful day of work; one of those days where you cannot wait to get home, kick off your shoes, and plop down on the couch for a few hours. The commute home is unfortunately just as nerve-racking as your day at work because of traffic and dangerously designed streets.

You are almost home, and all you need to do is make a left turn, and the street you are on is a four-lane undivided road. Impatience forces you to slip through a small opening in traffic with your 100 horsepower, 4-cylinder Honda Civic. Devastating consequences could result from that decision. Making the undivided road into three-lanes with a two-way left turn lane in the center is a proven way to increase safety.

The idea for a three-lane road with a two-way left turn lane in the center came about in the 1950's. Roads were designed on a functional basis which meant most were two and four-lane undivided roads—the most dangerous of all. The three-lane road with a two-way left turn lane will reduce the amount of fatalities because people will only have to cross one lane of oncoming traffic to exit the highway. Earlier undivided roads would have a driver crossing as many as two lanes of oncoming traffic, resulting in a large number of automobile crashes.

A study done by the Minnesota Department of Transportation in August 1998 showed the crash rate (crashes per million vehicle miles) for a four-lane undivided highway was 6.75 and 4.96 for a three-lane with a two-way left turn lane.

Road types with a smaller crash rate were four-lane roads with a center median and five-lane roads with a center turn lane. The downside of those types is the large amount of land involved in construction.

According to an article by John McCree of the Illinois Department of Transportation, the cost of obtaining the land, and build-

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**Making the undivided road into three-lanes with a two-way left turn lane in the center is a proven way to increase safety.**

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ing four or five-lane roads, is more expensive than making an existing four-lane undivided road into a three-lane road with a two-way left turn lane. Changing the original road markings converts the four-lane road into a three-lane road. The three-lane road will not need any more land because it uses the dimensions of the existing four-lane undivided road.

The less land required for a three-lane road helps keep residents from becoming irritated and traffic from being congested. Traffic slows on a four-lane undivided highway when a driver needs to make a turn off of the road. The driver who is turning has to wait for oncoming traffic to clear, which causes congestion behind him. The two-way left turn lanes effectively eliminate these problems, because turning drivers are allowed to move off of the main road so that traffic can continue to flow.

As a result of three-lane roads, congestion problems and the number of speeders decrease. Also, the "through" traffic speed

See *Center Lane* on Page 19



Photo By: Tim Miller

The only two-way left turn lane in Madison is along Dayton Street beside the SERF and Kohl Center. Placement of these lanes occurs on an individual basis and is not a blanket improvement.

# Medical Errors

## How can they be reduced?

By Rohan Gavande

**R**ichie Williams's mother knows the dire consequences medical errors can create. In April 1997, 12-year-old Richie was scheduled to receive his last dose of chemotherapy to treat his lymphatic cancer. The nature of the drug made it mandatory to be injected through a vein. But on that fateful day, the drug was injected into Richie's spine by a physician who had never treated him before. Richie died five days later due to the physician's error. The label on the drug was clearly marked "for intravenous (through a vein) use only". Medical errors like this, though not always resulting in death, are a common occurrence in doctor's offices, clinics, hospitals and other medical institutions.

A medical error can occur when a health-care provider chooses an inappropriate method of care. Patients may be adminis-

**A recent report by the Institute of Medicine estimates that medical errors are the eighth leading cause of death among Americans.**

tered certain drugs without knowing they are allergic to it or receive an overdose of medicine. A recent report by the Institute of Medicine (IOM) estimates that medical errors are the eighth leading cause of death among Americans. Fatalities that occur each year in hospitals even exceed those to motor vehicle accidents, breast cancer or AIDS.

Deaths caused by medical errors in the early 1990's proved to be a wake-up call for the Food and Drug Administration (FDA). The FDA was facing tremendous under-reporting of errors from medical institutions. These institutions did not report the

errors they made for fear of being sued. However, feedback from these institutions was critical for preventing the errors from reoccurring.

Some common errors are due to incomplete information about a patient's profile, poor handwriting, confusion between drugs with similar names, misuse of zeroes and decimal points, misunderstanding of dosing units and lack of appropriate labeling. The IOM feels that healthcare professionals should be spared of the blame since, as humans, they can make mistakes. Around the same time, Harvard University conducted a landmark study on medical errors, which led to the recognition that engineers specializing in human factors and health systems are needed to improve the existing system.

The Industrial Engineering Department at UW-Madison has a very strong group of engineers studying health care. Assistant Professor Ben-Tzion Karsh, Emeritus Family Medicine Professor John W. Beasley and industrial engineering graduate student Kamisha Hamilton recently conducted a study on a focus group of participants which involved family medicine doctors, nurses and medical staff.

"Medical errors in hospitals are just the tip of the iceberg and most patients have healthcare encounters outside hospitals," said Karsh. Hence, his research group directed its work on developing systems to reduce the errors occurring outside hospitals.

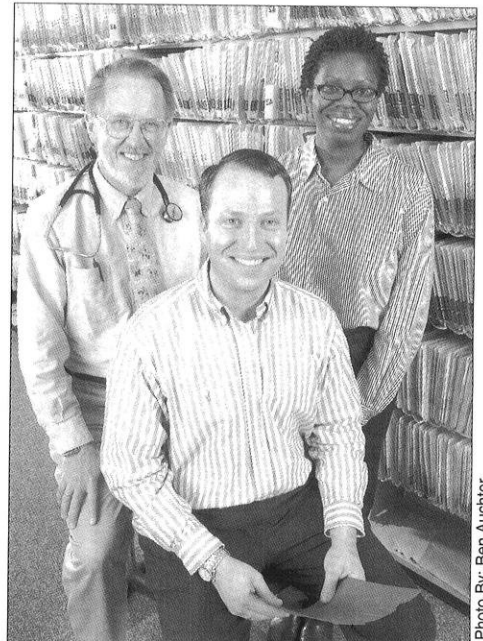
Operations and emergencies are high-pressure situations in which doctors and medical staff have to keep track of multiple tasks simultaneously. Karsh views both the medical staff and patients to be customers of the new error reporting system and gives prime importance to a user-centered system with flexible design to fit in the work flow.

In recent years there have been attempts to

develop hi-tech web-based systems to collect data on medical errors. "The situation can be considered similar to the manufacturing industry 20 years ago, when everyone thought that technology would solve everything," said Karsh.

As it turned out, the medical error reporting systems had a low success rate since some of the designs were intrinsically flawed and users were not comfortable working with them. The new error reporting system the UW-Madison research group is working on aims to provide real-time feedback and a database of lessons learned.

Hamilton interviewed 14 participants from rural and urban areas to understand the problems they were facing and the needs of the new system. The identity of the people interviewed was guarded to foster candid responses. The researchers formulated 87



**From Left: Emeritus Family Medicine Professor John W. Beasley, Assistant Professor Ben-Tzion Karsh, Industrial engineering graduate student Kamisha Hamilton.**

Photo By: Ben Auchter

major themes from the interviews. Focus group concerns included ownership of the new error reporting system, its operation, the kind of data that would be reported and its implications. Some of the potential users were comfortable submitting paper reports while others preferred using computers.

The nurses and medical staff wanted the new error reporting system to be quick and easy without any tedious paperwork or phone calls. The data, which would be entered into the system, would be pertinent to the specific error that occurred and would have very little patient-specific information. "For this to work, we couldn't have many required fields," Karsh commented. "We would have to leave it, at least in the very beginning stages, to allow the people who are reporting to report as much information as they felt comfortable reporting."

Software design is one of the alternatives the research group is working on. The software system would be designed to provide quick answers and useful data that will not omit any important information. Algorithms of the software would allow



Photo By: Ben Auchter

Poor prescription handwriting could cause a patient to receive the wrong pills.

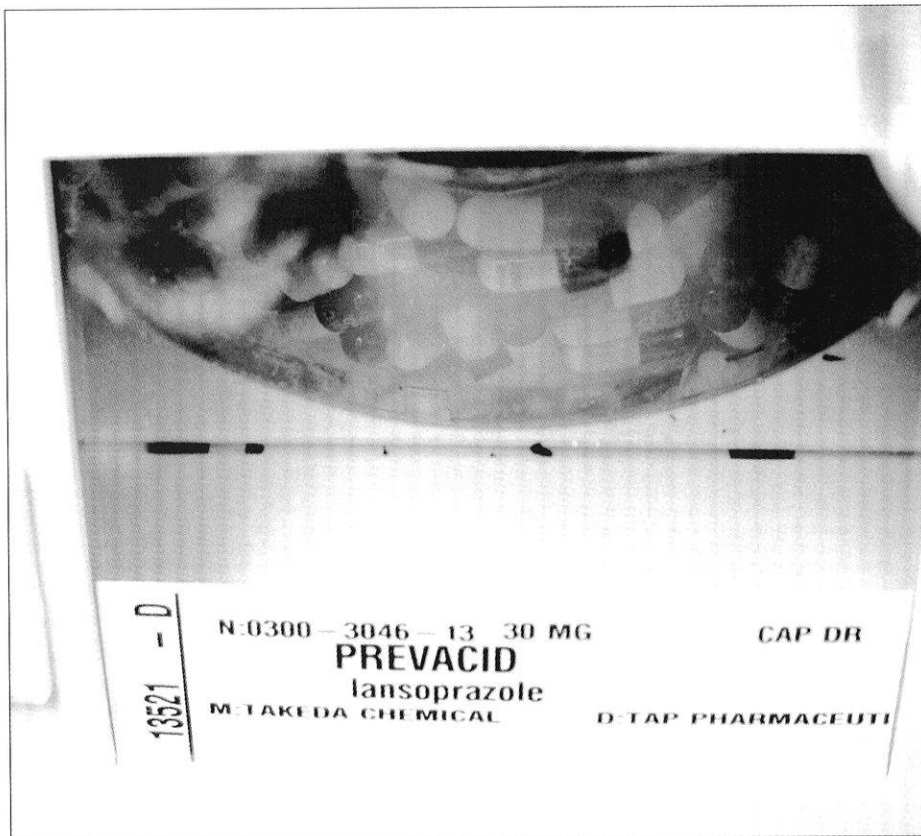


Photo By: Ben Auchter

Entering the wrong quantity into an automatic pill dispenser could result in a patient not getting enough medication.

potential users to easily filter data based on standard classifications. The data generated by these error reports can then be shared with other medical institutions through a suitable agency by means of regular newsletters or emails.

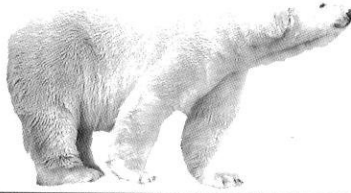
The UW-Madison researchers are currently validating their data from interviews and writing reports to be submitted to state legislators and medical associations. The research group expects that their study will lead to short-term and long-term benefits. Expected short-term benefits of this study will help them understand the design of an error reporting system that will contribute to the safety of patients throughout Wisconsin. Expected long-term benefits will enable them to design error reporting systems that health care providers can use for providing high-quality and appropriate care.

WE

**Author Bio:** Rohan Gavande is a graduate student in Industrial Engineering and a project assistant in the Astronomy department. He is an avid cricket fan and follows the game all over the world.



# Winter Coats in July



By Hideki Nakazono

**T**ry this. Throw on a winter coat, designed to keep you warm, and lay on the beach of Lake Mendota for a hot summer afternoon. Only then will you know how polar bears at Madison's Henry Vilas Zoo must feel underneath their layers of fur designed for life in the Arctic. It raises an interesting question: how do polar bears survive a summer in Madison area zoos?

Intuitively, Wisconsin does seem like an ideal place to keep polar bears, which are typically native to regions of Northern and Western Alaska, the Hudson Bay area, Greenland, and icy Siberia. If you have ever seen a post-November Packer game, you might agree that Lambeau Field, with a negative 25-degree wind chill, looks quite a bit like the northern tip of Siberia (minus the stadium and the lunatics standing in



Photo By: Wiviek Juliean Tjondro

Nanuq, pondering on whether to take a dip in the icy water.

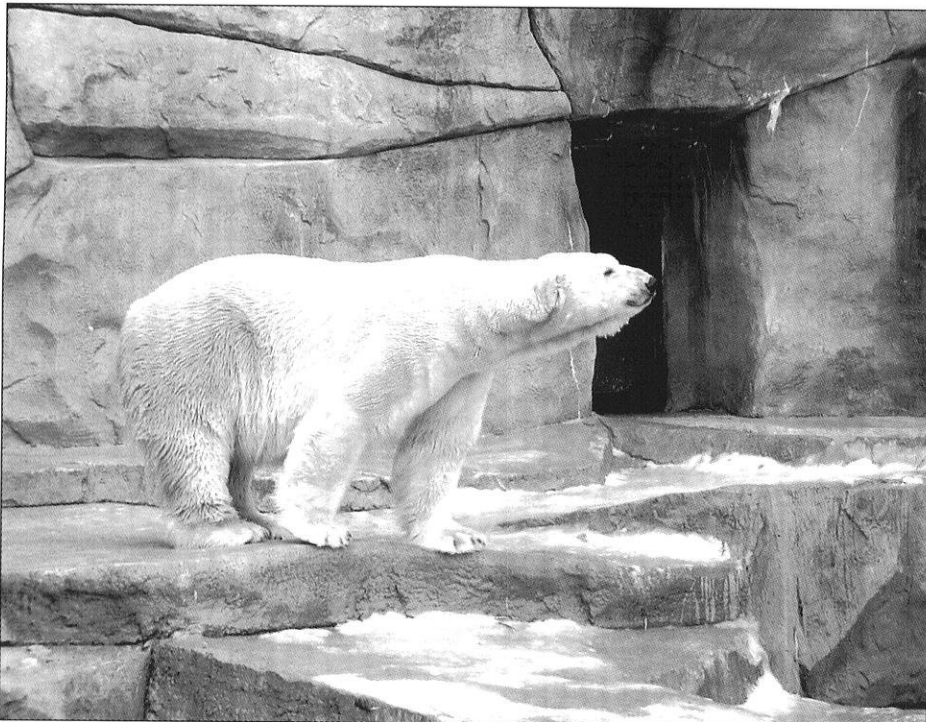


Photo By: Alan Ng

Nanuq, one of the polar bears at the Henry Vilas Zoo, stretches after a nap.

the cold wearing nothing but cheese on their heads). Madison has a summer however. In those few months the temperature in the city can reach 100 degrees Fahrenheit.

So how do these cold weather natives survive the intense heat? Well, when we are not complaining about how hot it is, we like to spend as much time as possible playing in Lake Mendota with friends. As it turns out, the Polar Bears do pretty much the same thing.

**As odd as the idea of housing a polar bear during the summer might seem, it has been done for over 2000 years.**

"Actually, the polar bears are able to handle the heat a lot better than you might think. If anything, they sometimes start



Photo By: Raymond Kwok

**Polar bears in Wisconsin enjoy the cool temperatures in winter.**

grumbling when it is really hot," according to Sarah Johnson, a zookeeper at Madison's

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### **Hollow polar bear hairs act like fiber optics ensuring the maximum amount of heat absorption from the sun.**

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Henry Vilas Zoo. Johnson said that on such a day, the polar bear Nanuq and his life mate Mishka deal with the heat by simply staying in their jelly bean-shaped pool that varies between depths of three and ten feet. The water itself, which is the same as from any cold water faucet, remains cool through its constant circulation in and out of the bear's tank. In addition to the pool, the zoo provides a large sprinkler that keeps temperatures in the bears' environment down.

As odd as the idea of housing a polar bear during the summer might seem, it has been done for over 2,000 years. In fact the very first known polar bear held in captivity was kept in the private zoo of Ptolemy II, the king of Egypt from 285-246 B.C. It is likely that the early Romans kept polar bears as well. In 57 A.D., Calpurnius wrote about polar bears that fought against seals in a flooded amphitheatre.

The entire time these animals have been documented in zoos, few reports have noted negative biological effects caused by heat. One effect that has been a problem is the thinning of the polar bear's fur. This usually occurs in extended periods of

intense heat, much longer that you would expect the summer to last in Madison. "The summers aren't long enough here to cause any hair loss. Our bears have never had a problem with that sort of thing," Johnson confirms.

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### **"The summers aren't long enough [in Madison] to cause any hair loss."**

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Although uncommon, another reported effect of long spans of heat on polar bears is gaining a green tint in their fur. Hollow polar bear hairs act like fiber optics ensuring the maximum amount of heat absorption from the sun. Scientists have found that these hollow hairs can serve as a home to algae when kept in warm and humid climates.

However, neither of these symptoms occur frequently, and in Henry Vilas Zoo's case not at all, to endanger the polar bears. Although they may not love hot weather, polar bears are able to survive in the summer heat. As a last resort, the bears have a cave in their enclosure that remains cool, making summer life for them seem quite bearable! **WE**

**Author Bio:** Hideki Nakazono, born in Santa Fe, NM, is a junior majoring in English at the University of Wisconsin.



Photo By: Wiviek Juliane Tjondro

**After a short nap, Nanuq is ready for lunch.**

# Dreams of Hearing Come True: Cochlear Implants

By Amanda Mancheski

**H**ave you ever wondered what it would be like to hear?

Many people take their hearing for granted. Until the early 1980's deaf and hearing-impaired people have only dreamt about the hearing world. Cochlear implants are now making those dreams come true.

Understanding how cochlear implants work is best explained by first considering how normal hearing works and what problems cause deafness.

"In normal hearing, sound waves travel along the external ear canal and cause the tympanic membrane (ear drum) to vibrate.

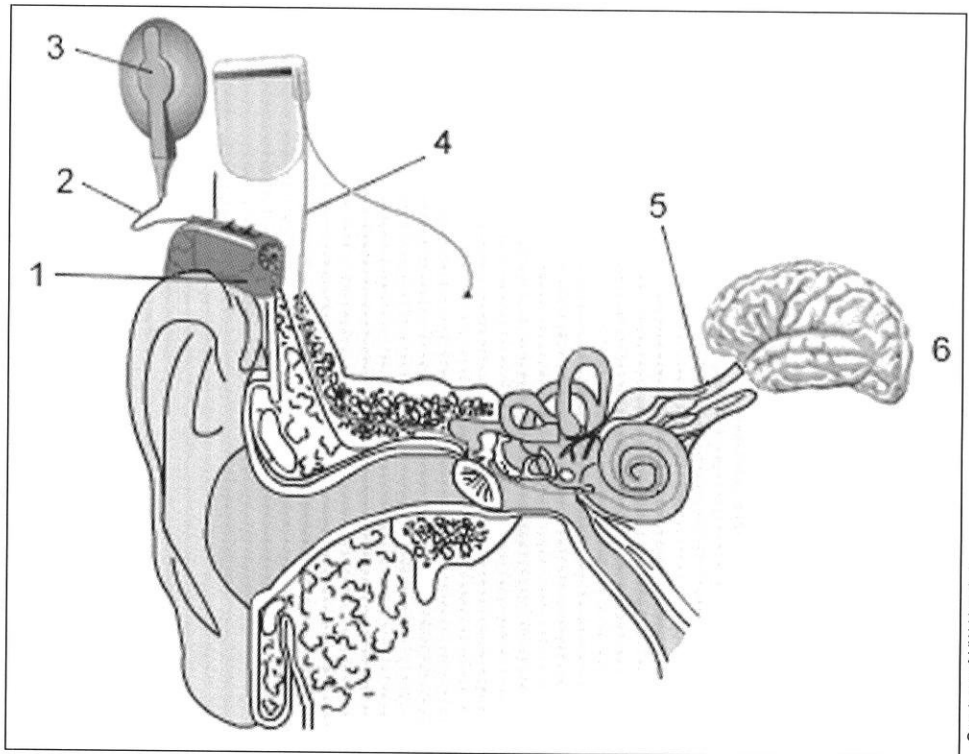
The three small bones of the middle ear (malleus, incus and stapes) conduct these vibrations to the cochlea," according to Donald K. Eddington, Ph.D and Michael L. Pierschalla. The cochlea is the spiral-shaped cavity of the inner ear that contains nerve endings essential for hearing.

Cochlear hair cells translate the acoustic energy of sound into electrical signals, which is carried to the brain by auditory nerve fibers. Damage to these hair cells results in sensory nerve hearing loss-deafness.

Cochlear implants bypass damaged hair cells by directly stimulating the auditory nerve fibers in the cochlea (inner ear.)

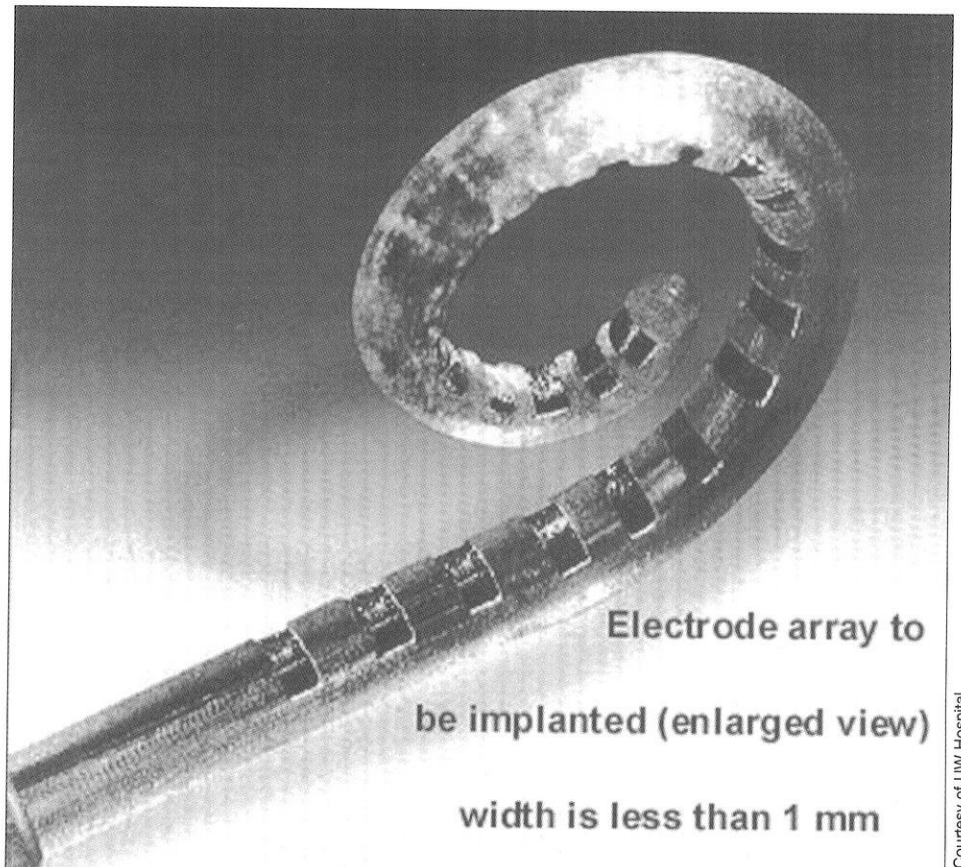
In the surgical procedure, an array of electrodes is implanted into the cochlea. It is attached to a small, directional microphone located in the headset (a casing resembling a hearing-aid) wrapped around the ear. This microphone receives sound that is transferred to the attached speech processor.

The brain interprets the coded signals from the speech processor—a powerful miniature



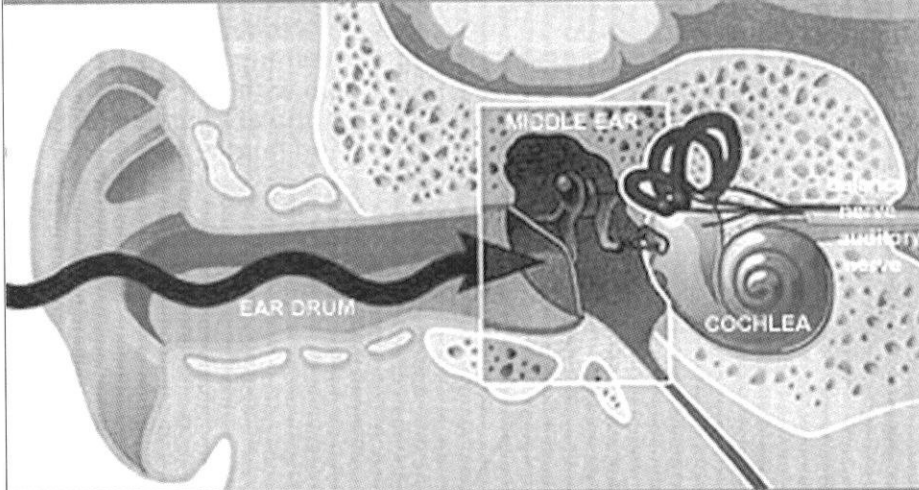
1. Headset 2. Cable to speech processor 3. Microphone 4. Implant 5. Auditory Nerve 6. Brain

Courtesy of UW Hospital



Courtesy of UW Hospital

## NORMAL PATHWAY OF SOUND




Sound passes thru ear drum and middle ear into cochlea then into auditory and balance nerves

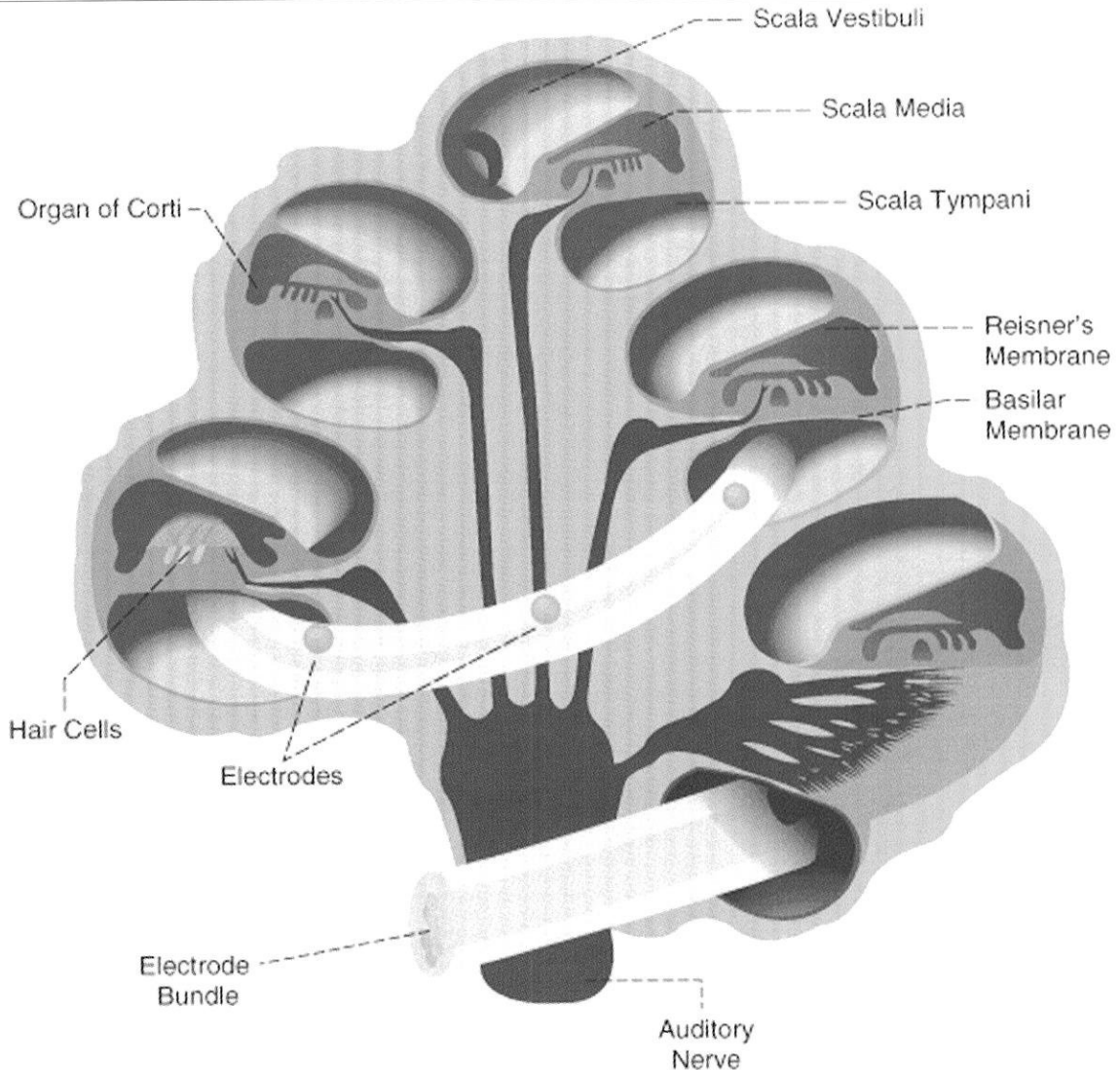
Courtesy of UW Hospital

computer that filters, analyzes, and digitalizes sounds into coded signals. The speech processor is the size of a portable cassette player and is worn on a belt or carried in a pocket.

The coded signals are sent to the transmitting coil where they are passed along as FM radio signals to the cochlear implant located just under the skin. Electrical energy is then delivered to the implanted electrodes, stimulating the auditory nerve fibers. Finally, sound is transmitted to the auditory system for the brain to interpret.

Over 30,000 individuals have benefited from cochlear implants, fulfilling their dreams of hearing. 

**Author Bio:** Amanda Mancheski is a junior studying Agricultural Journalism with a Genetics emphasis.



Courtesy of UW Hospital

This figure represents how the cochlear electrode array wraps around the cochlea to simulate auditory nerve fibers.



# Myth Match- Scientists weigh in on supernatural theories

By Kyle Oliver

After an encounter with a female bar patron in the opening scenes of *The Muppet Movie*, Kermit the Frog is confronted by her overprotective boyfriend. "Uch! Go wash," the man scolds her. "You'll get warts."

Kermit, ever the seeker of truth, responds, "No, that's just a myth."

Mistaking Kermit's words, he says, "Yeah, but she's my 'myth.'"

"No, a myth, myth," Kermit repeats. At this point (to complete the pun) thinking she's being called, a lispng waitress appears: "Yeth?"

The "fact" that contact with a frog can cause warts is one of countless dubious statements about nature commonly considered to be a myth. Myths, often relegated to the realm of religion, superstition or "the supernatural," usually defy explanation. It is appropriate that *The Muppet Movie*'s reference to myths is a joke; most scientists would say, like a joke, myths are not to be taken seriously.

"You're sort of on the fringe" says Dane Morgan, materials science and engineering research associate at the Massachusetts Institute of Technology, speaking of unconventional scientists who are not so quick to dismiss stories of the strange. Morgan, for whom the topic is "just a hobby," gave a class for MIT's middle and high school Splash Program entitled "The Meeting of Science and the Supernatural."

One of the points he tries to make is the disparity between scientific and supernatural explanations for various phenomena, such as the opposing theories of evolution and creation. However, he goes on to describe research that has been done in what serves as a "boundary region"

between these extremes. Scientific studies of presumably supernatural phenomena include ESP research at Duke University, a study on alien abduction at Harvard University and a paper on "therapeutic touch" in the *Journal of the American Medical Association*.

## Small but dedicated groups of researchers are scouring nature for signs of Nessie and Sasquatch.

There have also been recent attempts to find scientific explanations for two of the world's most popular and sensational myths: the Loch Ness monster and Sasquatch (Big Foot). These two mythical creatures have a lot in common. Both originate in ancient cultural tales—"Nessie" as a great beast supposedly slain by St.

Columba in the sixth century and Sasquatch as a sort of human/animal hybrid out of Northwestern Native American traditions. Both have proven to be difficult to catch in photos or on film, and the authenticity of what little has been captured is the subject of much debate. Of course, they are also both said to be enormous-appropriate enough for tall tales, many skeptics would add.

Some scientists are not willing to give up on the existence of these legends. Small but dedicated groups of researchers are scouring nature for signs of Nessie and Sasquatch. New technology is facilitating the evaluation of collected evidence and even the search for the creatures themselves.

The PBS television series *Nova* ran a special in 1999 called "The Beast of Loch Ness." It chronicled the efforts of a team of



Photo By: Jon Newell

Missing link or elaborate hoax?



Photo By: Jon Newell

**How closely do they resemble humans?**

researchers led by Bob Rines and Charles Wyckoff, who have been investigating the Loch Ness mystery for 30 years. After supposedly seeing the monster in 1972, Rines set up a sonar-activated camera, complete with a strobe light serving as an underwater flash.

In 1975, his camera took pictures of what looked like a six-foot flipper after NASA's Jet Propulsion Laboratory helped enhance the image. Subsequent studies of the loch in later years by other groups, though not necessarily focused on looking for the beast, have turned up unexplainable sonar targets.

The expedition chronicled in "The Beast of Loch Ness" made use of an impressive array of technology. While the search boat was equipped with simple fish-finding sonar, it also pulled sophisticated Sidescan Sonar. This advanced piece of equipment is capable of sending ultrasonic waves in a 180 degree arc, and is more accurate because the transducer, which emits the waves, is not attached to the hull and hence avoids interference associated with boat movement.

A second boat was used to intercept sonar hits using GPS location data and attempt to photograph the monster using a low-light video camera and a car headlight. The five-day expedition did not yield conclusive results. Some sonar hits indicated an object of considerable mass and density-too dense to be a school of fish, according to marine biologist Arnie Carr - but no conclusive photos were taken.

The studies of Richard Smith, a journalist attempting to validate a 1934 photograph of Nessie, also yielded mixed results. Reconstructing the supposed original camera angle based on the distorted shape of circular ripples around the mysterious shape, Smith then took pictures of one- and four-foot Styrofoam models of a head in the water. Smith

and Rines believe the new photos show the 1934 photo must have been taken of a four-foot object. Hence, testimony claiming that the photo had been falsified with a small submarine toy comes into question.

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**"If you don't have an open mind, in my judgment, you're not a scientist."**

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Though admitting that none of this is hard evidence, Rines notes the numerous eyewitness accounts are at least partially corroborated by his consistently unexplainable findings. At the very least, he says, this should certainly raise questions. "If you don't have an open mind," Rines told Nova, "in my judgment, you're not a scientist."

That same attitude keeps Sasquatch researchers hot on its tracks, so to speak. While searching a 24-mile-long lake is a mammoth undertaking, searching hundreds of thousands of square miles of

forests is even more daunting. Hence, research into the Sasquatch myth focuses mostly on evaluating already available evidence. First and foremost among this evidence, says Jeff Meldrum, anatomy professor at Idaho State University, are Sasquatch's tracks.

"A significant number of footprints," he writes, "are not so readily explained away." These prints not only suggest anatomy compatible with the way Sasquatch supposedly walks, they also nearly all exhibit similar "dermal images" (fingerprints) running parallel to the foot, rather than perpendicularly as in humans or diagonally as in all known primates. Additionally, video taken 35 years ago of a supposed Sasquatch has been analyzed by scientists who agree the combination of "leg movements, stride and speed" could not have been produced by a human in a suit or by any known primate. As with Nessie, many tests have been inconclusive, such as acoustic analyses of alleged Sasquatch recordings and DNA testing of hair and stool samples.

The jury is still out on both of these creatures, and scientists can be skeptical jurists. However, as technology continues to improve, inconclusive tests and searches could conceivably be augmented by better methods, and these myths may someday be substantiated.

Morgan does not think society's fascination with other myths is in jeopardy.

"I don't think it's likely that science is going to simply prove these things invalid," Morgan says. "They seem resistant to that. It's very hard to prove a negative in science." *WE*

**Author Bio:** Kyle Oliver is a freshman majoring in nuclear engineering. He edits The Lobby, ASME's monthly newsletter.

*How intelligent are they?*



# UW's Tractor Design Team: Pulling for a win at Nationals

By Jon Oiler

The spirit of competition is alive as UW-Madison's Badger Pulling tractor design team is gearing up for its sixth national competition in East Moline, Illinois. The competition, run by the American Society of Agricultural Engineers, requires each team to design and build a working tractor that is one-fourth the size of an actual tractor. The competition is run as if each team is presenting a proposal to company management. The goal is to get the design approved for commercial manufacturing.

In 1998, the team's first year of competition, they won the National Championship. The team has placed among the top five every year since. This year's team is hoping to bring the gold back to UW-Madison by changing things up a bit with new ideas like using a hybrid electric power train.

"Our biggest goal this year is to get the hybrid electric power train we are using to work effectively and hopefully prove that it can outperform traditional mechanical or hydraulic power train vehicles," said UW-Madison's tractor team co-leader Patrick Uhlenhake.

**"Our biggest goal this year is to get the hybrid electric power train we are using to work effectively"**

Each team is judged in four main categories. They include the written design report, team presentation, individual design judging and performance competition.

In the written design report, the team must provide design details on how the tractor was assembled and a list of parts that comprise the tractor. The report must also



The 2003 UW-Madison Badger Pulling tractor design team.

include a price estimate that explains how much it costs to build the tractor in a real-world industrial setting.

In the team presentation, the group must present their design process as well as the estimated cost in front of a panel of judges. Each team is given a strict time limit of 15 minutes in which they must convince the judges that their tractor is the best.

The individual design is judged on the design specifications and the tractor itself. Points are awarded in areas such as safety and manufacturability. In years past, the UW-Madison team won numerous awards in this overall category, including specific awards in craftsmanship and safety.

The performance competition is where teams show off how powerful the tractors are. Each team's tractor is connected to a weighted sled and must perform in numerous events that test the tractor's power and agility. The UW-Madison team placed sec-

ond in pulling performance for the past two years.

This year's team looks to build upon their successful reputation. The tractor design has been completed and construction is underway. Look for the Badger Pulling Team to have another successful run at the Quarter-Scale Tractor Pull Competition. **WE**

**Author Bio:** Jon is a sophomore in Engineering Mechanics and Astronautics and pursuing a certificate in Technical Communications. Hobby? If you want one it would be basketball...

**For more info on UW-Madison's team visit their website at:**

[www.badgerpulling.org](http://www.badgerpulling.org)

# America the Fat?

## The skinny on fad diets and weight loss

By Andy Mathys

America the beautiful? Or America the fat? Everywhere we look, we are bombarded with signs of America's "fat culture." We see ads for weight-loss programs in print and on TV, and we hear them on the radio. We see weight-loss products in the grocery stores when we shop. It is impossible to find an open exercise bike in the gym for the whole month of January because of the large number of New Year's resolutions to lose weight. And, on top of everything else, most Europeans think Americans are fat.

Is this true? Unfortunately, yes.

Experts estimate that one out of two Americans is overweight, a fact that may

### **There are no gimmicks, freebies or silver bullets that can make you lose weight.**

not come as a surprise given the enormous amount of media hype on the subject. There are literally hundreds of diets out there and every single one of them claims to be the best way to lose weight and get healthy. What is a prospective dieter to do?

According to nutrition experts from UW-Madison's Nutritional Sciences (NS) Department, two fundamental principles must be understood before the pounds can come off. First, there is no silver bullet for weight loss. It takes conviction, dedication and in many cases significant lifestyle changes for people to lose weight-and keep it off. Second, weight loss is not necessarily an indication of good health.

It is far better to shoot for an all-around healthy lifestyle than to focus solely on weight loss. Losing weight is a consequence of good lifestyle habits, so building a good program will result in the desired weight loss.

"It all comes down to thermodynamics," says Pete Anderson, who teaches NS 132 (Nutrition Today) at UW-Madison. "When energy expenditure equals energy intake, your weight will be stable. You need to be in a negative energy balance to lose weight, either by increasing expenditure or decreasing intake-preferably both." Achieving a negative energy balance requires two things: a balanced, low-fat diet and regular exercise. There is no other way.

Authorities attribute America's obesity to three major factors. We eat too much saturated fat (the type often found in fast food). We consume too much refined food (candy, soda and processed white flour are common foods containing lots of processed ingredients). And lastly, we do not eat enough fiber and whole grains.

Each issue presents problems. Dietary fat is bad for the heart and cardiovascular system and is much more easily converted to body fat than carbohydrates. Also, fat contains over twice as many calories as carbohydrates do, so trimming fat consumption is a critical part of reducing energy intake.

Most people would not argue that eating too much candy or drinking too much soda is bad, but most are not aware of the dangers of other processed foods. Processed food is absorbed quickly by the digestive system, providing a short burst of energy. This quick digestion poses a danger because we do not feel "full" for very long even though we have consumed a number of calories. We can (and do) gain weight by eating more in this situation and then not using the extra calories.

Finally, we ought to eat more complex carbohydrates and fiber. Examples of good carbohydrates are fruits, vegetables, whole wheat breads, grains and cereals. These foods take longer to digest and provide

long-lasting energy. Also, they are not easily converted to body fat. So, it is much better to eat 100% whole wheat bread than to grab a piece of white bread.

Talk of reducing calorie consumption may make some people feel like cutting back more than they should in order to lose weight. Kristin Tuttle, a biology major at the Georgia Institute of Technology, says, "Some people, especially girls, start to see food as the 'enemy' if they want to lose weight. It's important to remember that the body is like an engine-it needs fuel to run. Eating regularly is crucial, even if you are on a diet."

UW-Madison Nutritional Science faculty confirm the importance of eating. According to Anderson, most muscle and some organs can burn fat, but the brain needs carbohydrates for energy.

Fat cannot be converted into carbohydrates, so when people do not eat enough the body is forced to break down muscle tissue into carbohydrates to fuel the brain. Therefore, skipping meals causes a loss of muscle, which in turn decreases metabolism. "Paradoxically, by skipping meals



**While the basic salad is one of the more popular diet foods, there are others which are more healthy.**

Photo By: Andy Mathys



you reduce energy expenditure," adds Anderson.

We don't have to give up on our favorite foods-or food in general-in order to lose weight. We just need to incorporate lots of natural, healthy foods, minimize fat intake and make sure we burn more calories than we take in. Easy, right?

Nutrition is only half the battle; there is still the problem of making sure we burn more

exercise vigorously for at least 30 minutes a few times per week. Running, biking, swimming, rowing and even walking briskly are good forms of cardiovascular exercise.

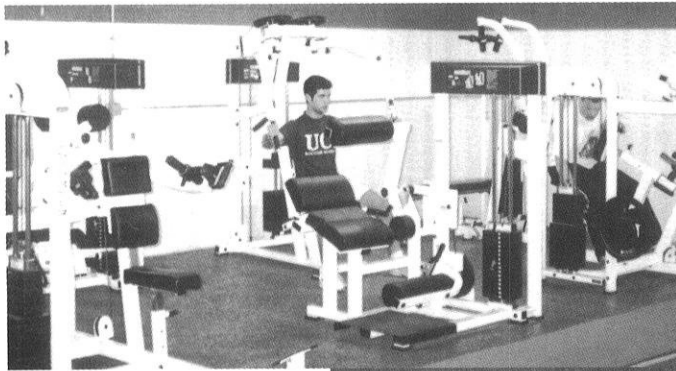
One part of a solid exercise regimen that is often overlooked is weight training. Lifting weights is not just for bodybuilders or athletes; pumping iron can also have significant weight-loss benefits.

It is known that muscle tissue metabolizes faster than other tissues, especially fatty tissues. In terms of a weight-loss program, it boils down to the fact that muscle burns fat-

question that must be answered before starting any diet or weight-loss program.

One of the most popular diets today is the Atkins diet. Designed by Robert C. Atkins, this program claims that participants can eat all the protein and fat they want and still lose weight. The theory is that the body will burn stored fat for fuel-a process called ketosis-if carbohydrates are all but eliminated from the diet. This plan is attractive for many people because weight-loss results can be rapid. Many participants have lost several pounds per week, a rate faster than that observed with most conventional diets.

While nobody denies the results obtainable with the Atkins diet, experts question its feasibility-especially in the long run.



calories than we eat. We do this by exercising. Exercise, especially aerobic exercise, burns calories.

Many workout machines such as bikes, treadmills and cross trainers give the exerciser an idea of how many calories he or she burns in a workout. Most people can burn a few hundred calories-maybe even as many as several hundred-during a workout. Our daily intake is much higher than that. The American Dietetic Association estimates that most Americans consume between 1,500 and 2,500 calories per day.

The remainder (and majority) of calorie burning comes from our metabolism-our body's internal "idle" that runs constantly as we go about our lives. If we want to lose weight, we can learn to increase our metabolism so that our body is a more efficient calorie-burning machine.

Exercise is important not only for the calories we burn while we are working out, but also for the calories we burn while we are not. When we exercise regularly, our metabolism rises overall, making it easier for us to take off stubborn excess pounds. That is why exercise is crucial to health and weight loss. It is recommended that we



so it pays to lift weights. And those who incorporate weights into their lifestyle along with cardiovascular exercise enjoy other benefits besides weight loss. Strength is increased, allowing people to engage in physical activities they could not have before. And weight training can produce a nicer-looking physique, which can lead to a better self-image and increased self-esteem.

Now that we know the "secret" to losing weight, we can evaluate some of the many diet methods and products available today. Most of them promise to have us losing weight and looking great in no time, but whether or not they are reasonable is a



**Top: Modern compound weightlifting machines allow you to work almost any part of your body.**

**Middle: Aerobic exercise offers many health benefits.**

**Bottom: A common trend among males is to pump iron in an effort to bulk up.**

Drawbacks to the Atkins diet (and other high-protein, low-carbohydrate diets) include strained kidneys and elevated LDL levels, the undesirable type of cholesterol.

Some people have a hard time tolerating the Atkins diet because eating so much fat all the time can become uncomfortable. In addition, many sources say that any diet which eliminates entire food groups is not a good long-term solution.

Another regimen that has gained attention

Photos By: Andy Mathys

recently is Body-For-Life (BFL). BFL is more of a program than a diet because it focuses equally on improving diet, increasing cardiovascular capability and developing a good physique through weight training. Developed by Bill Phillips, BFL teaches participants to work out in the most efficient way possible and boasts impressive results for motivated participants. Benefits of the BFL program include weight loss as well as improved cardiovascular and muscular fitness. Also, a better physique can lead to increased self-esteem.

Body-For-Life advocates eating six small meals a day. Each meal includes one food that is a protein and one that is a carbohydrate—the carbohydrate to fuel the body and the protein to help build muscle.

The theory behind this diet is that eating more often allows the body to maintain a constant, high metabolism and ultimately burn more calories. On the other hand, eating only three (or fewer) meals a day causes metabolism to alternately spike and plunge, which puts unwanted stress on the body. In the weight room, Phillips teaches

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**We don't have to give up on our favorite foods-or food in general-in order to lose weight.**

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an intense method of weight training designed to increase muscle mass as quickly as possible.

Body-For-Life is a very active program for overall fitness through which motivated people can achieve great results. Some, though, are intimidated by the intense style and find a more passive approach to weight-loss is better for them.

Countless programs exist for those less ambitious or those not looking to attain a "chiseled" physique. Some of the most well-known are Jenny Craig, Weight Watchers and SlimFast.

Weight Watchers and Jenny Craig are programs that combine well-balanced, low-fat diets with counseling services. Members attend classes and meet with counselors and other participants to share motivational stories and hold each other accountable for sticking to the program. Because these programs advocate the tried-and-true method of calorie reduction, they can

almost guarantee weight loss—but at a cost. The major drawback to these systems is that expenses from classes and special Jenny Craig/Weight Watchers food products can add up quickly. But many people find that even hundreds of dollars per year is a small price to pay for weight loss and a better self-image.

SlimFast works on the same principle as Jenny Craig and Weight Watchers. Users consume SlimFast shakes for breakfast and

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**"You need to be in a negative energy balance to lose weight, either by increasing expenditure or decreasing intake—preferably both."**

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lunch and eat a healthy dinner. Like Jenny Craig and Weight Watchers, the SlimFast diet can virtually assure weight loss due to reduced calorie intake.

Like other plans, SlimFast has drawbacks of its own. SlimFast shakes are not natural; they contain sugars and fillers which are not necessarily healthy. Consuming two shakes a day is expensive. And some health experts caution against diets such as SlimFast because it does not focus on the overall need to develop healthy life habits.

Another strategy for weight loss is nutritional supplements and/or drugs. Metabolife is one such example. Metabolife is a pill that works by increasing metabolism, thus helping aid the weight loss process. Along with reduction in weight, users experience reduced appetite and increased energy.

Some nutrition experts do not endorse supplemental methods because they do not necessarily encourage healthy lifestyles.

They artificially drive metabolism, producing effects similar to those experienced by users of cocaine or amphetamines. This can lead to the habit of depending on Metabolife for energy much as some people depend on caffeine every morning.

Nutritionists have found that the maximum possible rate for sustainable weight loss is about two pounds per week. People who lose weight faster than that (often through fad diets such as Atkins or Metabolife) usually gain it back when they resume their regular lifestyles. Reasonable, "slow-and-steady" approaches are much more likely to lead to success.

There are no gimmicks, freebies or silver bullets that can make you lose weight. People looking to drop excess poundage must create a lifestyle that encourages slimming down. A good routine includes a well-balanced diet that is low in fat and processed foods as well as aerobic and strength training. The goal is to have a healthy relationship with food, exercise and self-image. By keeping these basics in mind, losing weight becomes an attainable goal for all Americans. *WE*

**Author Bio:** Andy Mathys is a sophomore majoring in Mechanical Engineering with a Technical Communications Certificate. Special thanks go to Pete Anderson, Kristin Tuttle, and Keri Sawyer for input on this topic.

**For more information**

<http://www.diet-i.com>

<http://www.bodyforlife.com>

<http://atkinscenter.com>

# What's in Your Water?

By Christine Morris

**H**ow about a glass of water with that arsenic?

Contaminated water isn't just a concern in India, Pakistan, Bangladesh and other developing countries. Parts of the United States, including Wisconsin, have potentially unsafe drinking water.

Arsenic is a poisonous element widely dispersed throughout the Earth's crust. It seeps its way into water through the separation of minerals and ores and as a result of erosion from local rocks. Liquid industrial waste is another source of this metalloid—an element having properties of both metals and nonmetals. Consequently, arsenic can also be found in plants, fish and shellfish.

The health problems associated with human exposure to arsenic can be grotesque if not deadly. Immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain and bloody

diarrhea. Complications relating to long-term exposure include cancer of the skin, lungs, bladder and kidneys. It also has a negative effect on the reproductive system and is linked to black foot disease. Despite these harmful effects, not every country has the means or capital to treat arsenic in water.

"Common treatment technologies used in arsenic removal for piped water supply is costly," said Jim Park, Civil and Environmental Engineering Professor at UW-Madison. "It's estimated at two million dollars of capital cost for each million gallons per day cleansed."

After three years of research and development, Professor Park and his team of students have created a metal oxides nano-particle impregnated mesoporous silicate absorbent, which has a significantly greater adsorption capacity and rate compared to the commonly used activated alumina. It has a \$600,000 price tag for each million gallons per day purified. This makes it more affordable to developing countries that have not been

able to afford previous treatment.

The way his product works is quite simple. Imagine a large column with nothing but the media substance inside. Groundwater is then pumped into the column. Any arsenic in the water is trapped within the media and the natural water flows through to the drinking water distribution system.

When the media are saturated with arsenic, the natural water is drained from the column, leaving the arsenic-saturated media behind. A solution of sodium

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**The health problems associated with human exposure to arsenic can be grotesque if not deadly.**

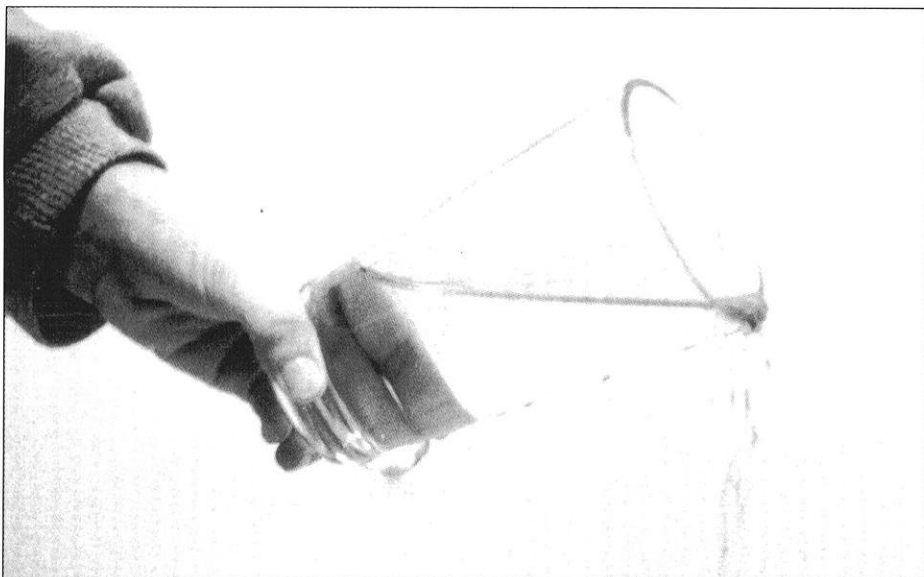
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hydroxide is then poured into the columns, which releases the arsenic from the media. The contaminated solution is then transferred to another container where the liquid is evaporated, leaving a pure arsenic substance on the bottom.

The cleaned media can be used again in the process. Any remaining pure arsenic can be reused as wood preservatives or in production of lead-acid batteries and semiconductors used in computers and electronic applications. The distinctive properties of the media are what make this process efficient and economical.

This novel absorbent has a significantly large surface area of more than 1000 square meters per gram. The large surface area combined with the media's chemical and other physical properties gives it a higher adsorption rate than activated alumina.

Let's assume activated alumina is a basketball. Professor Park's research team erected cans on the surface of the basketball in a highly-ordered fashion, thereby



Even some Wisconsin residents are being forced to pour out their water.

Photos By: Nicholas J. Orf

increasing the surface area significantly. Then, lanthanum oxide was impregnated on the surface. "These treatments allow it to adsorb ten times greater adsorption at 15 times faster rate than activated alumina," stated Professor Park.

It is more efficient because the media are specially formulated to have greater affinity to arsenic particles, whereas the alumina resolvent method removes other minerals and elements as well.

The fact that it can accumulate a larger amount of arsenic in a shorter contact time (ten seconds to one minute) than other methods makes it an economical method of extraction. The amount of arsenic that may pass through the process is well below the future regulatory limits of five to ten parts per billion (ppb).

The U.S. Environmental Protection Agency (EPA) sets the U.S. standard for arsenic in water. Currently it is set at 50 ppb, but by 2006, every drinking water provider must abide to ten ppb. The EPA estimated that the 5 ppb standard would cost \$1.5 billion annually and requires \$14 billion in capital investments, which translates into water bill increases of as much as \$1,900 per customer annually.

Professor Park and his team of students took three years to develop these efficient

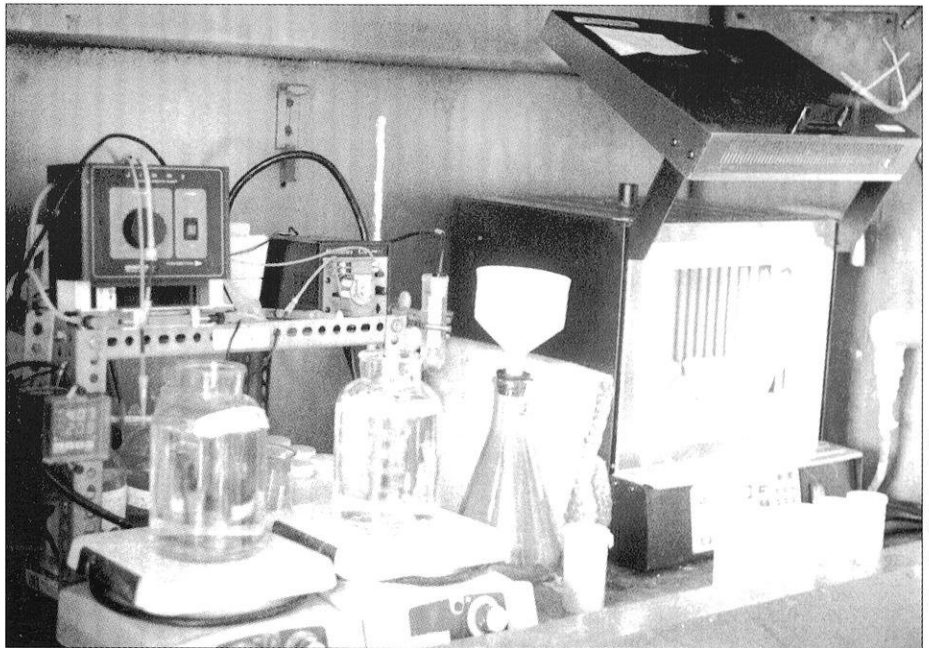


Photo By: Nicholas J. Ort

**Lab apparatus Professor Park's team used to develop and test his new arsenic removal media.**

and economical media for reducing arsenic in water. It has been funded through University Industry Relationship (UIR) and Wisconsin Groundwater Research Council and patented through the Wisconsin Alumni Research Foundation (WARF.) Currently, Professor Park is in the process of working with Clack Corporation in Windsor, Wisconsin to handle the commercial pro-

duction and distribution of the product. It is scheduled to hit the market in two years. *WE*

**Author Bio:** Christine Morris is a junior majoring in Life Sciences Communication. Every Wednesday night she tests for arsenic in her drinking water.

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# Michael J. Smith: Impassioned Professor

By Tom Marmet

Industrial Engineering (IE) Professor Michael J. Smith advises his students to "be passionate about what you do and match your heart with whatever you decide to work on," says former graduate student Maria Brunette. Brunette is of one of the several students who organized a ceremony for Smith last December. Smith was honored with the one-time award, "Excellence in Holistic Education," for his dedication to students.

Born and raised in Madison, Wisconsin, Smith attended UW-Madison and received his BS in Psychology (1968), MS in Industrial Psychology (1970), and finally his PhD in Industrial Psychology (1973).

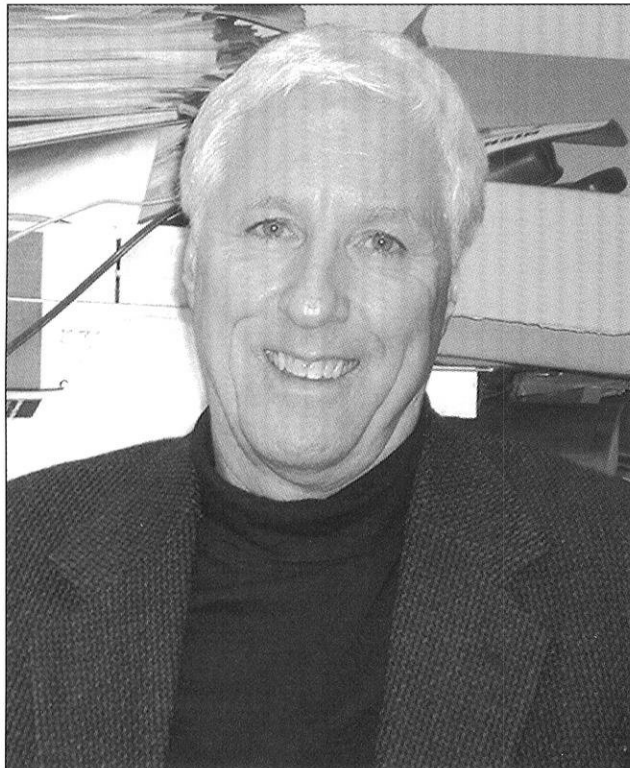


Photo By: Brad Pate

**IE professor Michael Smith was honored with the Excellence in Holistic Education for his dedication to his students.**

Following his studies, he worked at the National Institute for Occupational Safety and Health (NIOSH) for ten years. At NIOSH Smith developed organizational safety programs that were incorporated into federal Occupational Safety and Health Administration (OSHA) guidelines and are still used today. During his time at NIOSH, Smith still found time for one of his other interests: working with students, which he did through teaching at least one class per week in his free time.

Smith says he has always enjoyed being around students, which was one of the main reasons he left NIOSH and came back to Madison to teach. According to Smith, he was called by UW-Madison and asked if he wanted to return to the school to fill a vacant spot in the IE program. Being a professor at UW-Madison has allowed Smith to get to know students better and reacquaint himself with the university.

"There is no other school like Madison," Smith asserts, emphasizing the fact that while UW-Madison is a research giant, it also invests a huge amount of time and money into liberal studies in order to create "better citizens." Smith feels the faculty, staff and students have the unique opportunity to contribute to a college administration that does not simply dictate school policies.

"Madison is a world class university," Smith declares, one that is probably more famous internationally than it is

nationally. UW-Madison's importance in bleeding-edge research and education led Smith to state that any cuts to funding due to the current Wisconsin financial crisis would be a "great disservice to the student body."

In his role as a teacher and researcher, Smith says his job gives him the opportunity to study what he enjoys and "interact with interesting and smart people, especially students." He feels that as a professor his commitment is to be a good teacher, providing relevant information but also respecting his students as human beings.

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**Smith says his job gives him the opportunity to study what he enjoys and "interact with interesting and smart people, especially students."**

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Smith feels that mutual respect is very important, one of the reasons he makes himself available to students even when he doesn't have office hours. He enjoys talking to students about non-academic subjects, feeling that college is a time for students to "learn about life, organize themselves and learn what their values are." Technical skills are not as important, in his opinion, as the self-knowledge gained through the college experience.

Smith is particularly proud of the IE Department on campus. Historically, UW-Madison was one of the pioneers of IE as it emerged from World War II. Smith's advisor during his studies here was Karl U. Smith (no relation), whom he credits with some of his work ethic. Smith also attributes his commitment to working hard to his blue-collar upbringing. Karl U. Smith was a leading force in the development of Human Factors (HF) research. At that time, HF was part of the Psychology department, which explains Smith's PhD in Industrial Psychology.

It wasn't until Gordon Robinson came to Wisconsin in the 1970's that HF was incorporated into the College of Engineering. IE has grown tremendously over the years, and UW-Madison has an incredible faculty, says Smith.

Smith says that IE is currently moving away from the biomechanical aspects of technology and towards the cognitive characteristics. The importance of how people feel about technology is one area that Smith says will become more significant in the future. Technology today is often "cold," he feels, having no relation to the people using it, and needs to be humanized. Smith sees a future where we integrate people with technology at a societal level. People must "relate emotionally" to technology in order for all people to be able to use it effectively. The perfect technology, Smith declares, is one that doesn't "dictate to [the user] the method of operation."

Smith's extracurricular hours are often spent with his family. He enjoys UW-Madison sports, and describes himself as a "dyed-in-the-wool" Badger football fan.

Often Smith does outside consulting work, as his experience and knowledge are highly sought after.

What Smith likes most about Madison is the people and their attitudes. They are "open and friendly," he says, and "civil in how they disagree and agree" with others. The city also satisfies one of Smith's favorite hobbies: eating. Smith feels that Madison has "one of the best diversities of restaurants" in the country.

A pillar of the IE department, Smith teaches several courses each semester. One of his most popular is IE 349: Introduction to Human Factors, which in recent years has been attended by many engineers of all disciplines, not just IE's. Brunette feels students are attracted to Smith because "[his] work ethics, discipline, and integrity have inspired us...towards becoming better human beings." *WE*

**Author Bio:** Tom Marmet is a Junior in IE and Economics. He plans on using these degrees to further his goal of world domination.

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### Center Lane Continued from page 3

and the number of drivers weaving through traffic decreases because all vehicles are moving in a single lane in each direction. Drivers can more easily move into turning lanes and do not feel as tense. According to a report by UW-Madison Professor Keith Knapp, pedestrians and bicyclists are better served by a three-lane road rather than a four-lane undivided road.

The slower and more consistent speeds benefit pedestrians and bicyclists. Even though the width of the road is not changed with a three-lane road conversion, it will be easier for pedestrians to cross the road. The conversion also leaves room for a bicycle lane. The three-lane road with a two-way left turn lane cannot be used in all situations. The two-way left turn lanes should be used where the amount of through traffic is light to moderate, turning traffic is high and commercial driveways is low to moderate.

In addition, the average daily traffic limit should fall between 10,000 and 28,000 vehicles per day. The growth of the surrounding environment should be fairly

stagnant so to keep the traffic on the three-lane roadway fairly moderate. The implementation of the three-lane road with a two-way left turn could have saved that precious 100 horsepower Honda Civic. Although your day at work may still be as hectic, at least the drive home will be less stressful. *WE*

**Author Bio:** Mike Czaplewski is currently a sophomore planning to major in Mechanical Engineering. This is his third Wisconsin Engineer article.

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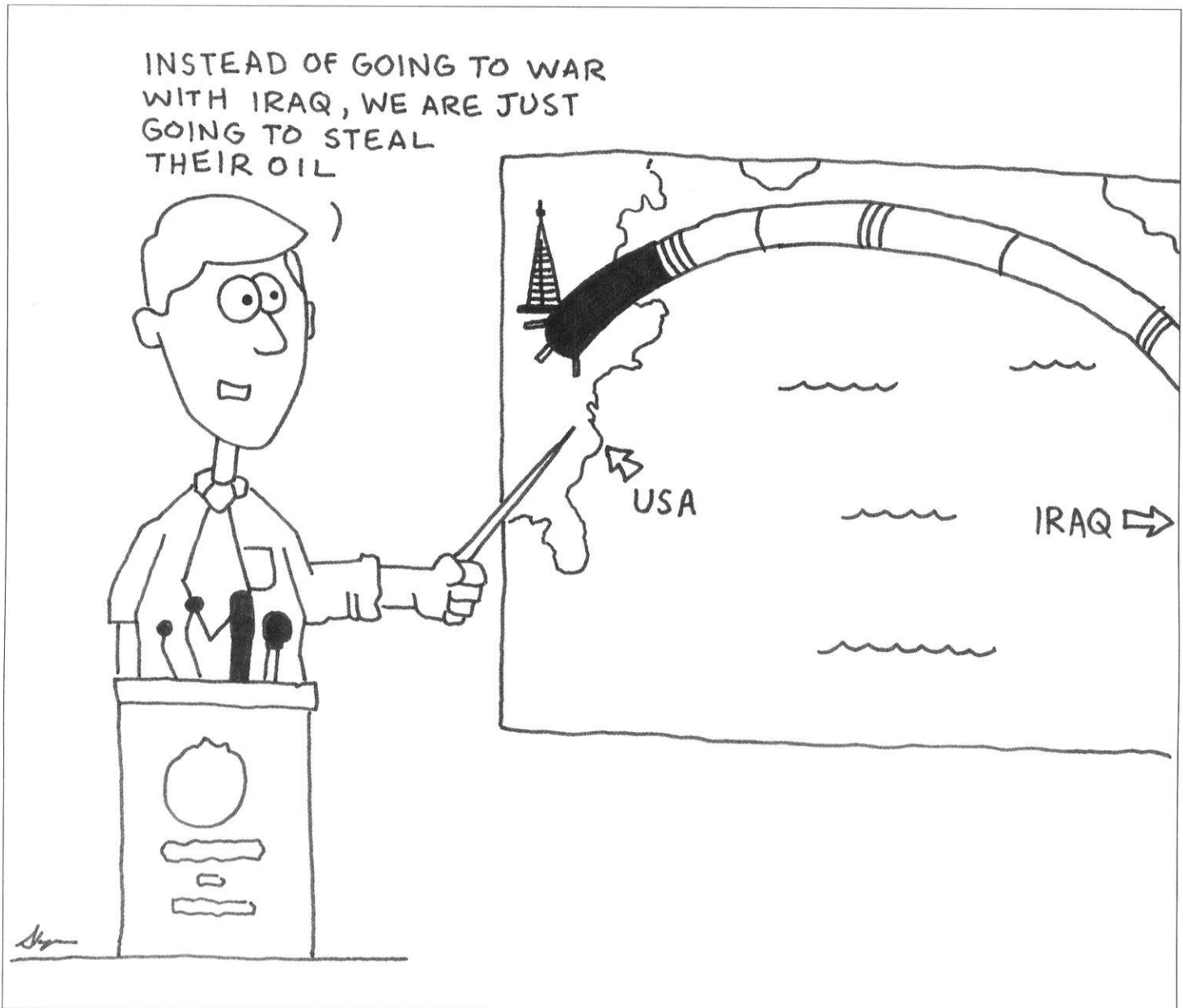


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# If an Engineer Were President

By Skye McAllister

Editor's Note: Skye McAllister does not reflect the opinion of the Wisconsin Engineer Magazine and can be reached at [samcallister@wisc.edu](mailto:samcallister@wisc.edu)



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