Wisconsin engineer. Volume 104, Number 3 April 2000

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

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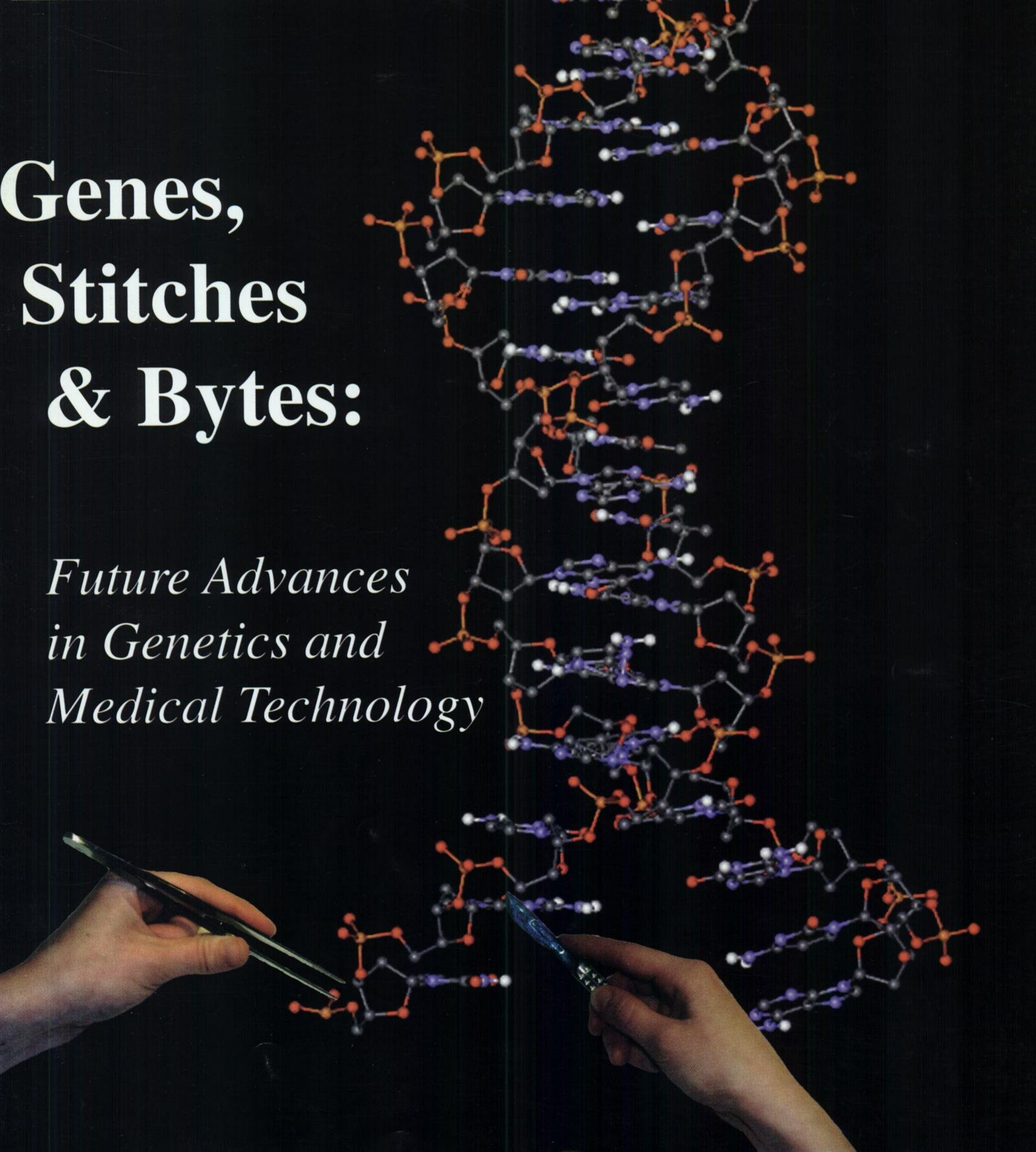
APRIL 2000
VOLUME 104, NUMBER 3

WISCONSIN ENGINEER

Genes, Stitches & Bytes:

Future Advances in Genetics and Medical Technology



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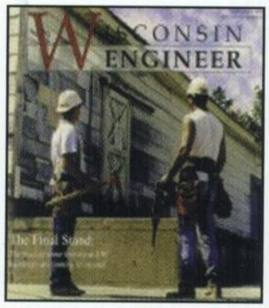

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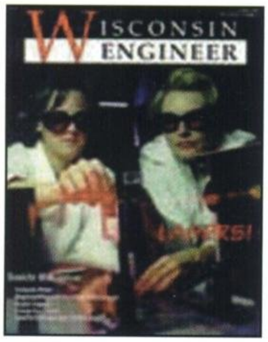

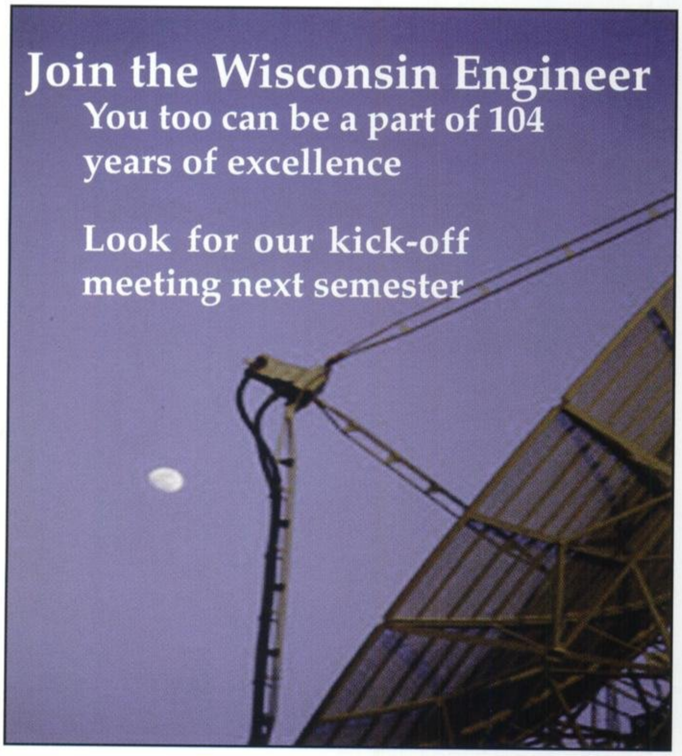

WISCONSIN ENGINEER

Published by the Students of the University of Wisconsin-Madison   VOLUME 104, NUMBER 3   April 2000

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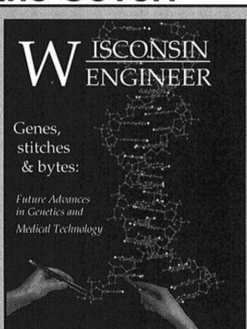


Do Not Alter? Many people wonder how far the human hand should go when dealing with the genetic code. In this issue, we explore some of the areas scientists have already tried their hands at.

Cover designed by Victor Chen
Special thanks go to Christoph Weise

DEPARTMENTS

TO CONTACT THE *WISCONSIN ENGINEER*: 1513 University Avenue, Madison, WI 53706   wiscengr@cae.wisc.edu   http://www.cae.wisc.edu/~wiscengr   608-262-3494

Engineers Learn English

Like oil and water, English majors and engineering majors just don't mix. You can lock up 100 students of each in a room, shake them up all you like, but the end product will be a clean separation of two immiscible majors. The English majors will discuss the finer points of Shakespeare and throw dirty looks at the engineering side, where the characteristics of a lossy transmission line and the impracticality of the studies of English majors will be discussed.

Whatever the topic of discussion is, the fact remains that we don't get along. This might be a problem for me, an electrical engineering major, since I plan to live with an English major next year. Oh, we get along fine, but the moment I try to shine a scientific light on any topic, Beth, the English major, will give me an exasperated look and say "Oh, you engineers" with a derisive tone in her voice. Whenever I talk about the exciting life I lead in Engineering Hall, she'll roll her eyes and sigh.

I realize that when a group of engineers gets together, the discussion might be encrypted in strange words and numbers. It even stands a good chance of being completely boring to everyone else! (Shocking, isn't it?) But the confusing and boring discussion could possibly lead to faster computers, better braking systems in cars, cleaner air and water or less invasive surgery. I'm sure English majors, and everyone else, could benefit from these improvements.

But we engineers don't fully appreciate what English majors have to offer. Who else will read and study the hundreds of thousands of books written in the past few centuries? These books may not lead to faster computers, but they do have something else that is vital to our lives...a history. The books give us a past, a sense of where we started from and most importantly, a culture. English majors also give us coherent ways to present our ideas, a standard to follow when we write about our research. Without these, we would be full of good ideas and have no way to share them. And that is, quite possibly, the most important thing. After all, what good are our ideas if we can't explain why they are important and relevant?

Engineering and English majors both have something to offer the world. It will be hard, but hopefully one day we will realize that one is not more important than the other. Instead of dismissing the studies of English majors as useless, engineerings will admire their ability to read and analyze a piece of literature. It might not seem obvious, but these creative and deductive skills are useful in other applications. And instead of calling the engineers a bunch of geeks, the English majors will appreciate the hard and necessary work that they do. It may be a long way off, but one day we might actually see oil and water mix.

Soma Ghorai

The College of Engineering University of Wisconsin-Madison

ECMA

ASM

UNIVERSITY OF WISCONSIN MADISON

The *Wisconsin Engineer* magazine, a charter member of the Engineering College Magazines Associated, is published by and for engineering students at UW-Madison. Philosophies and opinions expressed in this magazine do not necessarily reflect those of the College of Engineering and its management. All interested students have an equal opportunity to contribute to this publication.
Faculty Advisor: Steve Zwickel **Publisher:** Community Publications, McFarland, WI.
Correspondence: *Wisconsin Engineer* Magazine, Mechanical Engineering Building, 1513 University Ave., Madison, WI 53706. Phone (608) 262-3494.
E-mail: wiscengr@cae.wisc.edu, **Web address**: http://www.cae.wisc.edu/~wiscengr
The *Wisconsin Engineer* is published four times yearly in September, November, February, and April by the Wisconsin Engineering Journal Association. Subscription is $15 for one year and $25 for two years. All material in this publication is copyrighted.

Letters to the Editor

Final Comments From Your Editor-in-Chief – by Jennifer Schultz (February 2000)

- Very good article Jen. It shows people what goes on "behind the scenes" of the magazine and shows how much it has turned around. Thanks Jen.

Is Nuclear Energy Safe? – by Lynn Weinberger (February 2000)

- Physics errors. Not a chemical reaction, cladding is not inkanell (inconel), not a good description of Chernobel or TMI, but the author is very correct in her assessment that nuclear power is far safer than any other form of energy generation.

- You do a nice job of showing evidence on both sides of your title question. You seem to conclude that nuclear power is safer than other energy sources. Why not say that at the beginning? Someone reading only a paragraph or two will get the wrong impression. You also had lots of facts in your article. I noticed a couple of incorrect facts: 1.nuclear energy comes from nuclear reactions, not chemical reactions 2. The spelling of the sheath material is Inconel, not Inkanell. It is a steel alloy. 3. A chernobyl type accident is not just unlikely in the US, it is impossible since we have no graphite moderated power reactors.

- My name is Luis E. Herranz. I was over there for a while 3 years ago and I keep in touch with Madison University. That's the reason why I heard about this article. The article is well structured and quite instructing for non-nuclear guys. I liked it a lot. I think it is one of the best I have ever read. However, I cannot judged its accuracy. For instance, when in the article the neutron-uranion reaction is mentioned, you say it is a CHEMICAL reaction. That is not right, it is a nuclear reaction. The difference is slight and possibly meaningless for those who are not enginneers, but in a chemical reaction electrons surrounding the atomic nucleaus is involved, whereas in fission it is the nucleus itself which is involved. I cannto weigh the importance of this sort of accuracy, but we'd better keep quite accurate because any inaccuracy in our current information releases could be used to regard us as a non-reliable source of information in the best of the cases. Thak you for your article. I consider it quite worthy to be read and I will use it in my classes as Energetic Technology at Spanish University. Thanks again.

- The article contains good information but there are some grammar and spelling problems.

A Magical Mystery Tour: The Best Study Spots on Engineering Campus – by Mike Hsu (February 2000)

- Really neat, I have to check out some of these places

Science at the Speed of Molecular Motion: Ultra-Fast Lasers are Changing the Way We See the Chemical World – by Ryan Sydnor (February 2000)

- More typos and the last sentence seems to be lacking parralelism (and no I don't know how to spell that.)

If you would like to see your thoughts printed in the next issue of the magazine, feel free to make comments on the stories at our website, drop us an email, or send us a letter with your concerns. Note that all comments and concerns were printed as submitted.

Quality Education

By Steve Zwickel

Are you getting a quality education? Or are you getting something that is "just as good as" a high-quality education?

To paraphrase Ford, quality was once "Job #1" in American industry and on the University of Wisconsin-Madison campus. Today it seems to have slipped way down the list. To understand why, you must first know a bit about the rise and fall of the quality assurance movement. Then you can understand why UW-Madison, once a strong proponent of quality education, seems to have abandoned its commitment to it.

After World War II left Japan left in ruins, some Japanese business executives realized that one way they could get back on their feet economically was to emphasize the quality of their products rather than focusing on quantity. It took many years and the help of some clever American statisticians, but Japanese merchandise is now as good as, and sometimes better than, that produced in the United States and Europe.

American manufacturers were startled to discover that Japanese products, with their emphasis on quality, were outselling American products, especially in the automotive field. The American response was to jump

Today, however, quality seems to have been replaced by the "just as good as" movement

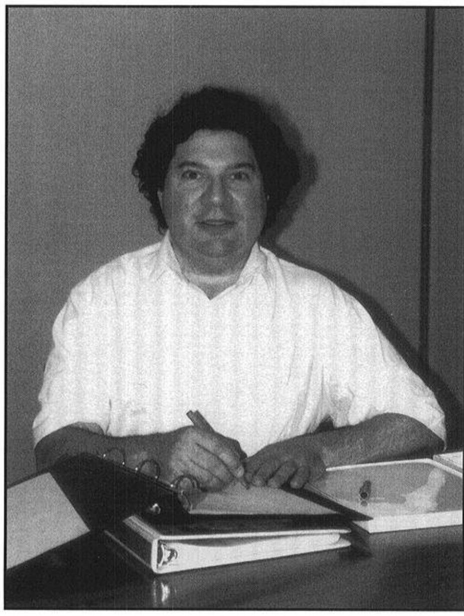
on the total quality management (TQM) bandwagon to try to win back customers. Some American companies went all out, adopting a strong quality assurance ethic and winning certification as compliant with ISO9000—an international set of standards for quality controls. But corporate culture is hard to change and other companies paid lip service to TQM, while continuing to do things the old way. Gradually, through the booms and busts of the 80s and 90s, Americans came back and were once again able to compete with Japan and the European Union.

The quality movement now seems to have run its course. In 1993, the United States entered a period of economic recovery that continues to this present day. Manufacturers discovered that quality management was a good idea in bad times, when people tried to squeeze every bit of value out of their money, but it was not really necessary in boom times, when money flows more freely. Strong opposition to quality management came from managers who found it much too hard to judge success or failure without numbers to back them up. They were reluctant to rely on fuzzy, quality-oriented goals when their careers were at stake. Most of them were never really willing to share power with workers, a basic requirement of TQM.

What really killed the quality movement was the discovery that clever marketing strategies could make quality irrelevant in the minds of consumers. In other words, if you market it just right, even sophisticated customers will buy junk. One example of this is the very machine on which this is being written. In the middle of this great international movement to build quality into products, the computer and software manufacturers not only ignored the trend, they actually headed in the opposite direction. Part of the problem was the need for speed. By the late 1980s, it was impossible to survive in the computer industry unless you could get your wares to market yesterday. Computers and programs were rushed into production without adequate testing, and consumers wound up with shoddy products.

Did customers complain? Did anyone protest against the manufacturers' gall in asking for thousands of dollars for products that didn't work? Nope. Sales never even slowed down!

Instead of offering a quality product, the computer and software companies lowered our expectations. We have learned to accept shoddy, unreliable products, and we are willing to pay top dollar for the latest version of this junk. Instead of raising the roof when our machines crash, we swear, sigh and reboot. We don't expect much and we don't get much.



Source: Victor Chen

Steve Zwickel, the long-time faculty advisor of the *Wisconsin Engineer*, ends his tenure with the magazine this spring.

When I began teaching at UW-Madison in 1992, "quality" was a dominant topic in reports and meetings. Today, however, quality seems to have been replaced by the "just as good as" movement. I have found people in my profession who want to sell students an education that is "just as good as" what we have been doing successfully here at UW-Madison for a long time. But, what they really mean by "just as good as" is "easier for us" or "cheaper." The "just as good as" people see nothing wrong with cramming students into ever larger classes, putting greater distance between teachers and students, replacing face-to-face interactions with flashy communications technology, relying heavily on the Internet as a primary resource and requiring students to buy beautifully designed but badly written textbooks.

What makes things worse is that no obvious advocate for the students here exists. Unless the students themselves hang on to high standards for quality in education, this "just as good as" trend will continue. You, our customers, need to hold us accountable for giving you value for your tuition money.

Don't be fooled by bells and whistles. Meeting face to face in a small group with someone who really knows how to teach and discuss course material has long been shown to be a most effective way to learn. Is a fancy, high-tech lecture with colorful computer graphics and sound effects "just as good" when you are just one of a hundred anonymous faces? How does a live interaction compare to watching an instructor far removed in time and space on video or over the Internet?

We know we can cut costs by cramming more students into labs, classrooms and lecture halls. Is that really "just as good"?

We know we can persuade students that it is better for them if we use more technology (which supposedly makes our jobs easier), but is that really "just as good"?

Instead of having actual books and periodicals (which cost a lot of money) available in our libraries, we know we can have students do research over the Internet. We are not yet at a time when the stuff you find online is "just as good as" peer-reviewed research material found in a real library.

Rather than explaining material to you in class, we know we can make you buy a new, expensive, lavishly illustrated, full-color textbook (Ooooo, wow! It comes with a CD-ROM!) that is not one whit better than the previous edition.

You need to complain, protest and argue to let your college and your professors know that you will not settle for cheap junk. Do not accept these phony "just as good as" explanations. Students must insist on getting a quality education for your money.

Let your teachers know how you feel about getting something "just as good as" an education. Talk to them and, most importantly, take the time to fill in the end-of-semester evaluation forms. If you describe your concerns in writing, there will be less pressure on your professors to substitute "just as good as" for real teaching strategies.

Be smart consumers, demand quality and don't lower your standards. If our customers insist, we will continue to offer you the best education your hard-earned money can buy.

Author Bio: Steven Zwickel has been faculty advisor to the Wisconsin Engineer magazine for five years. He is an instructor in Technical Communications and teaches technical writing, technical presentations, teams and the engineering profession, computer-assisted publishing and professional expression. Both his parents were teachers, so he is pretty sure it's genetic.

From Ghost Story to History and Back

By Nicole Angela Waite

Firelight glimmered in my eyes as I made eye contact with each of the Girl Scouts. "That was 100 years ago tonight. They say that every year, on the anniversary of her death, you can see Nina running, with her hair on fire, down to the river from the ...AAAAUGH!!!" I looked up at the Villa Louis, pointing at the mansion on the hill. There was a girl, with her hair on fire, running to the river. She was screaming, and soon she wasn't the only one.

Earlier that afternoon, I planned this scheme with another day camp counselor. "It's all set, Nickey," she said. "I'm going to sneak away during dinner – the girls won't even notice." It was sleepover evening for Girl Scout Day Camp, and it was up to Amanda and I to keep up a campfire tradition: a marvelous ghost story that hit close to home. I began the story by telling the girls to look up the hill at the Villa Louis, a grandiose mansion and a symbol of great wealth in its day. "Nina Dousman lived in the Villa in the 1890s. She was about your age, and she was invited to go for a carriage ride one day. Of course, she needed to look perfect – it was the Victorian era after all."

Capturing the complete attention of the campers, I went on with the story. Nina placed her curling iron in her hair, and it was so hot, her hair lit on fire. She tried to put out the fire and burned her hands; she became hysterical. She ran down the stairs and out the west doors of the house, screaming, and kept running for 200 yards down the hill to the water's edge. Nina Dousman, a girl of 14, dove into the Mississippi River, trying to put out the flames, and drowned.

At the end of the story, when I screamed and pointed at the house, Amanda ran down the hill, shining a flashlight at the gold tinsel and orange construction paper in her hair. Not one girl slept that night, including me. While the girls talked about what a dirty trick it was for Amanda to pretend to be Nina's ghost, I wondered what really happened to Nina. I vowed to find out the true story behind this Wisconsin legend.

I took a guided tour of Nina's house, enthralled at every turn by the furniture she sat in, the rooms she lived in, the very utensils Nina Dousman used. After the tour, as I wandering the grounds, I felt convinced she really was haunting the house and that our story was true. I started to ride my bike to the Villa every day. I found out everything I could about the family who lived there. Finally, I asked someone what really happened to Nina Dousman.

On August 4, 1894, Mary Nina Dousman (Nina, to her family and friends) went upstairs to get ready for a carriage ride and wanted to curl her hair. She placed her iron in an alcohol lamp to heat and promptly realized the lamp was running out of fuel. She tried to pour alcohol into the lamp without putting out the flame and the jug exploded. An intense fire started on the dresser, the floor and Nina herself – a fire so hot, it melted Nina's silver belt buckle. She went across the hall to where her mother was resting. Rising desperately to help her daughter, Mrs. Dousman tripped on her skirts, but after a time, managed to subdue the hysterical girl with a quilt and smother the flames. Burns covered one-sixth of Nina's body, and she suffered for six weeks until September 14, 1894, when she died at the tender age of 14.

Barely 15 myself, I learned more about Nina and imagined how different her life had been from mine. As I learned about Nina, her house – the Villa Louis – intrigued me more and more. The Dousman family, frontier millionaires, built the Villa Louis in 1870 on a

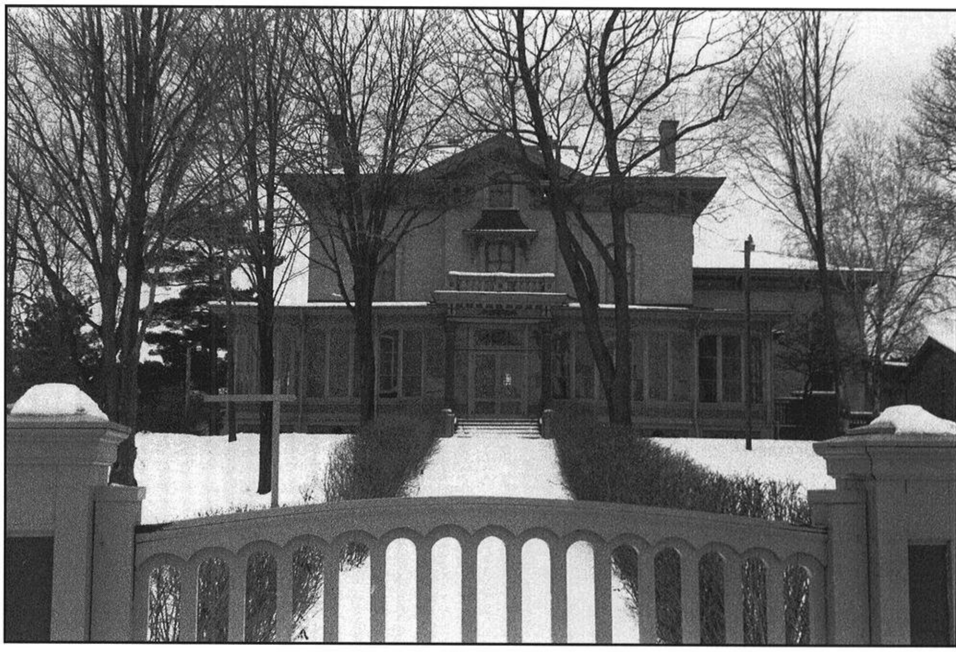
Photo courtesy of the Villa Louis, State Historical Society of Wisconsin

The privileged life of Mary Nina Dousman, daughter of a prominent family, was tragically cut short because of an oil lamp accident.

mound overlooking the Mississippi River. In keeping with the prosperous mood of the Victorian era, the Dousmans decorated their home with extravagant furnishings, many of which are back in the house today.

In the 1930s, Nina's siblings offered the house to the State Historical Society of Wisconsin. It wasn't until April 1952 that the Villa Louis Historic Site opened to the public. The Villa Louis was restored to its 1880s/90s glory. In fact, restoration is still going on today with more historical accuracy than ever before.

I still get chills when I visit the house and eagerly await my next tour of the Villa. Even though I am an engineering major, I have never lost the excitement that comes from learning about the past. With our busy schedules, it's easy to get caught up in school. If you get a moment, try investigating the history around you. A pleasant surprise awaits you.

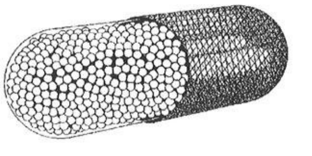


Source: Grayson Harms

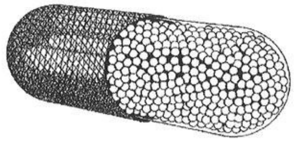
The Villa Louis in Prairie du Chein, Wisconsin, as seen today, restored to its late 1800's glory.

Author Bio: Nicole Angela Waite (twiggy) is a junior majoring (officially!) in chemical engineering. She tells a great ghost story, so if you want to be scared, come visit the Villa with her.

The Antibotic-Resistant



Blues

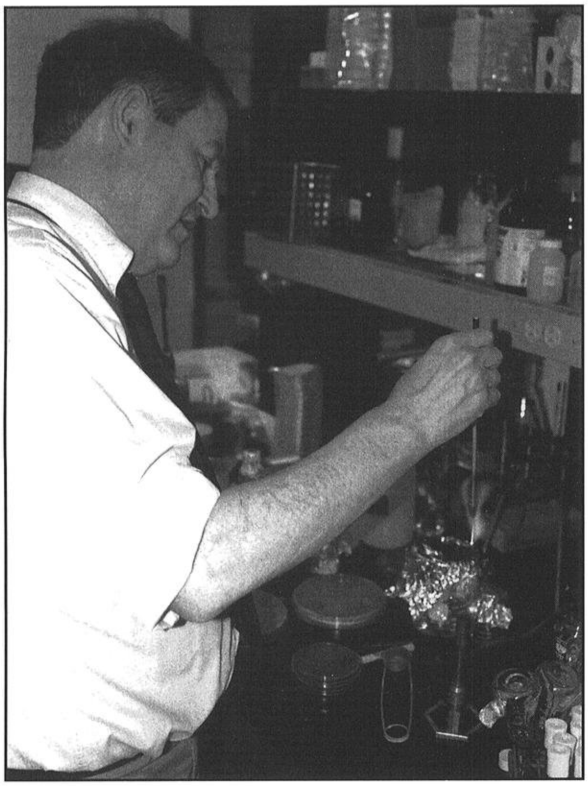


By Dugan Holtey

Let's say your eight-year-old brother is in the hospital for a common tonsillectomy and is forced to stay in the hospital for an extra two weeks due to a bacterial infection he sustained while in the hospital. Those risks are low but are rising yearly for people with weak immune systems. The reason these risks are rising is because pathogen-carrying bacteria are becoming resistant to our strongest antibiotics at an alarming rate.

Antibiotic resistance by disease-spreading bacteria is not a new problem. In 1941, penicillin made its largest debut in Allied armies' hospitals during World War II, saving thousands of Allied soldiers' lives from wound and operation infections. However, in 1945, soon after penicillin was released for usage in civilian hospitals, Staphylococcus aureus (S-aureus), a bacterium that can cause pneumonia and toxic shock syndrome, already developed resistant strains to penicillin. Injecting penicillin was still effective, but dosage use increased significantly.

In 1960, doctors attacked penicillin-resistant bacteria with a more powerful and easily swallowed antibiotic called methicillin, only to discover one year later that the bacteria developed resistant strains to methicillin as well. During the 1980s, it was flouroquinolones' turn to combat a methicillin-resistant S-aureus (MRSA) strain. Flouroquinolones lasted even fewer years than methicillin against quickly mutating bacteria.



Source: Scott Hackel

Dr. Bernard Weisblum works in his lab growing bacteria to find the right formula to outsmart the latest strains of harmful bacteria.

This leads us to what we are now using to combat antibiotic-resistant bacterium. This "last resort" drug is named vancomycin. Vancomycin is an extremely potent antibiotic used to treat infectious bacteria commonly found lurking in hospitals around the world. The two most threatening bacteria in hospitals are Enterococcus and S-aureus. Both bacterium cause blood and surgical wound infections, with S-aureus also causing pneumonia.

Since the late 1980s, Enterococcus strains resistant to vancomycin have been thriving, only to be treated by compounds and higher dosages of vancomycin. One of the biggest fears in hospitals is over a S-aureus strain of bacteria now gaining resistance to vancomycin. With this upsurge in antibiotic resistance, scientists are trying to create new antibiotics to replace vancomycin. For example, newly released Synercid is capable of destroying some vancomycin-resistant bacteria.[1]

As scientists try to discover new antibiotics like Synercid, they are also trying to think of new ways to reduce the time over which bacteria become resistant to new antibiotics.

Many scientists and skeptics are worried antibiotic misuse will not allow researchers to keep pace with new strains of disease-causing bacteria. In fact, some feel that we are already on the brink of an epidemic

Trying to lengthen that time period is difficult since the source of the problem lies less in the laboratory and more within our own society. The number-one reason bacteria become resistant to antibiotics is society's neglible and gross overuse of antibiotics.

How does overuse of antibiotics increase the resistance of bacteria to newly created antibiotics? To answer that question, it would first help to understand the mechanisms bacteria use to resist antibiotics. First of all, bacteria are intrinsically capable of fending off particular antibiotics and then reproducing their natural resistance. The second way bacteria resist antibiotics is through mutation, in which bacteria somehow change structurally so the antibiotic targets are no longer recognized. Then the bacteria can reproduce themselves with mutational resistance to antibiotics. Lastly, bacteria are able to pick up antibiotic-resistant DNA from other bacterium and incorporate that DNA into their own chromosomal structure, thus becoming resistant as well.

The overuse of antibiotics is a big reason why bacteria begin to become resistant to them. This can happen in one of two ways. First of all, bacteria may begin to mutate and become resistant to the antibiotic. When the antibiotic is used again, it will not kill these bacteria. The mutated bacteria, therefore, will have no competition and will thrive.

Another way antibiotics promote resistance is by affecting non-disease-carrying, or benign, bacteria. Because antibiotics are not selective, they also kill the benign bacteria that limit the growth of malignant (disease-carrying) bacteria. Therefore, more malignant bacteria will survive. At the same time, the benign bacteria that are resistant to the antibiotics proliferate. These antibiotic-resistant benign bacteria have the potential of mutating to become malignant. This process increases resistant traits among the surviving bacteria and heightens the odds that the resistant traits will be spread to other pathogens.

How does society promote these mechanisms of resistance? It is estimated that roughly 50% of antibiotic usage by humans and agriculture is questionable. Centers for Disease Control and Prevention recently estimated 50 million of the 150 million outpatient prescriptions are not needed.[2] Patients are mistakenly taking antibiotics for colds, which are caused by viruses, even though antibiotics only treat bacterial diseases. Also, patients are stopping usage of antibiotics as soon as they feel better, when they should be finishing the full prescription to eradicate the harmful bacteria completely. In-home use of antibacterial hand soaps and general cleaners needs to be reduced as well. Many scientists and skeptics are worried antibiotic misuse will not allow researchers to keep pace with new strains of disease- causing bacteria. In fact, some feel that we are already on the brink of an epidemic.

Bernard Weisblum and Charles Hutchinson, who research antibiotics at the University of Wisconsin-Madison's department of pharmacology, agree that antibiotic usage is out of control and needs to be regulated. However, they are not inclined to agree that society is on the verge of a major epidemic because of antibiotic resistance. Both scientists are optimistic that today's new methods of discovering antibiotics will significantly enhance ways of dealing with pathogens. For example, the recently emerging technology of genomics (the study of genes and their functions) is allowing scientists to "reveal thousands of new biological targets for the development of drugs."[3] Genomics, also has the potential to establish gene therapy to rid the body of pathogens.

There are also many natural cures to bacterial illnesses yet to be put into the market that have the potential to hinder bacterial resistance better than synthesized antibiotics. For example, Magainin (from the Hebrew word meaning "protector") is a drug developed from the African clawed toad's skin. The skin of the toad was noticed to fend off infection in surgical wounds. Other natural examples for possible antibiotics include goldenseal herb and Australian tea tree oil.

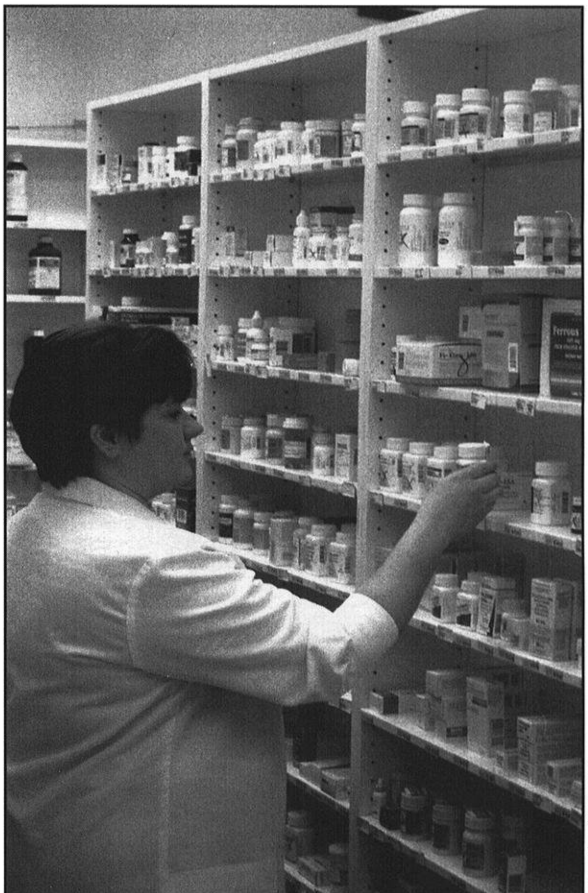
Yes, antibiotic use is out of control, but if a true epidemic is to occur, it will be at the front lines in the war against bacteria, in the hospitals. Here people with weakened immune systems share close quarters and therefore can be exposed to different kinds of germs. Whatever type of cure or technology is used to hinder the seemingly never-ending phenomenon of antibiotic resistance, many believe research is getting done and cures will be found. And, as Hutchinson believes, sometimes "just in time."

[1]Mayo Clinic, *http://www.mayohealth.org/mayo/9812/htm/superbugs.htm.*

[2]Levy, Stuart, "The Challenge of Antibiotic Resistance," *http://www.sciam.com/.*

[3]PhRMA foundation, *http://www.phrma.org/genomics/lexicon/g.html.*

Author Bio: Dugan Holtey graduated from the civil engineering department last semester and now is working on completing the technical communications certificate.



Source: Scott Hackel

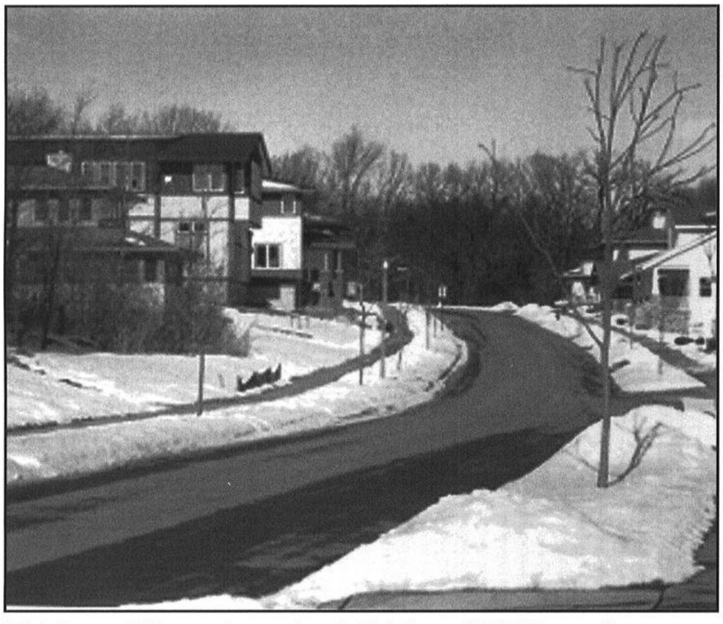
As a manager for the downtown Walgreen's pharmacy, Linda Ballweg is busy getting the right antibiotics to cure her customers' sicknesses, a cure which wouldn't be possible without antibiotic research.

Living for the Future: Sustainable Development

By Katherine Friedrich and Dan Lewison

Imagine the day when we run out of fossil fuels. The cost of producing electricity makes it unaffordable to most people, leaving us without light, refrigeration or air conditioning. We are isolated in suburbs and small towns, unable to afford to put fuel in our cars. The world is at a standstill, and there is nothing we can do about it.

This is not the future that most people envision, but as the world population explodes to six billion people and continues to skyrocket, experts have realized that economic development cannot continue in the direction that it is presently going. Our natural resource usage is too high, and as a result, they will someday be depleted. An article by Hardin Tibbs points out that if China were to consume gasoline at the rate at which its more developed neighbor South Korea does, it would be using all the crude oil on the world market today.[1]



Source: Bill Ketterhagen

Middleton Hills, a planned subdivision of Middleton, is an attempt to return a sense of community to neighborhoods. The subdivision features short setbacks, generous green space and open areas.

How are we going to deal with the fact that our resources are limited? In small towns and large cities all over the globe, people are initiating a new pattern of living, which is based in nature and community-oriented development. People are implementing sustainable development here in our country and across the world.

What is sustainable development, and why should we be interested in it? Sustainable development is a way of saving the environment for the next generation while leaving them with a good economy and standard of living. People are starting to take a more integrated approach, like in Chicago neighborhoods where economic, cultural and natural programs are beginning and also in Hidden Springs, Idaho, where local rural atmosphere and ecology preservation are being initiated. "We need to ask ourselves," says Tom Benvenuto, former sustainable agriculture worker for Pastoral de la Tierra, "what is the real purpose of development? It should be about making people happy and bringing people together."

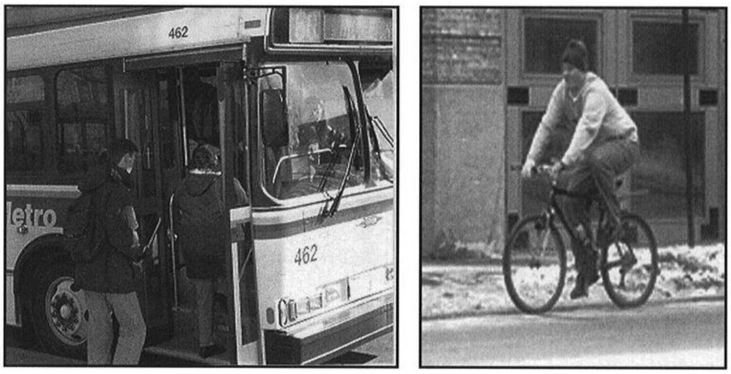
On a basic level, sustainable development is a wiser way to use resources. As Randy Haselow, who worked for the Peace Corps in the Dominican Republic, describes it, "You're creating a way of life that can persist indefinitely, not undermining the environment, relying on renewable resources, not looking at short- term profit but rather a way of life that will be available to your great-great-grandchildren and will not destroy their quality of life."

The key to sensibly using the resources is to streamline our use of them and use technology in ways that make sense in the long term. We can alter our lifestyles and the choices we make in order to provide for future generations, improve our well-being and reduce pollution-related health problems. Since many of the resources we use today are nonrenewable, we need to start finding renewable resources to replace them, while maintaining the economic efficiency they provide. Until we find the proper resources to achieve this, we need to conserve energy by making the way we do things more energy efficient.

The U.S. Department of Energy's Center of Excellence for Sustainable Development (CESD) believes that these methods are important to a resource friendly environment: mixed-use development spaced closely together to minimize commuting, transportation alternatives to highway use, energy-efficient buildings and eco-conscious business. The CESD website showcases sustainable communities, including the community of Civano, Arizona. Civano is a pedestrian-friendly community that combines homes, workplace, schools and recreation. It uses many new solar and fiber-optic technologies, as well as innovative methods of irrigation.

For existing neighborhoods, sustainable development includes community revitalization, efficient mass transportation, improved housing and environmental cleanup. Cities work together with the Environmental Protection Agency to redevelop "brownfields," areas that have been polluted by local industry or by dumping. Existing homes can be made more energy efficient by improving their insulation and wiring. Community organizations and local companies also take part in the revitalization of city neighborhoods.

Many companies are working to become more sustainable. In his article "Industrial Ecology; An Environmental Agenda for Industry," Hardin Tibbs describes industrial ecology principles to include cooperation between industries to reuse each other's



Source: Bill Ketterhagen

Utilizing city buses and other forms of transportation reduce pollution and traffic congestion. Bicycling and walking are effective forms of transportation that do not consume gasoline or pollute the environment.

scrap material, the use of renewable energy and the redesign of their production processes. Eco-industrial parks, characterized by recycling facilities and energy-efficient design, have been developed nationwide.

Closer to home, sustainable development influences designs at the University of Wisconsin-Madison's College of Engineering. From the FutureCar team's regenerative braking designs for electric vehicles to the household water-saving devices currently being designed by students in the mechanical engineering senior design course, students at UW-Madison have many ideas that can be turned into useful projects. Nat Blaz is currently working on the water-saving device, a greywater filtration unit for use in a four-person household. The project will collect water from washing machines, showers and bathroom sinks and will filter out bacteria, particulate matter and viruses so that the water can be reused in certain appliances. "In doing this," he says, "we will probably save somewhere between 40-50% of home water usage."

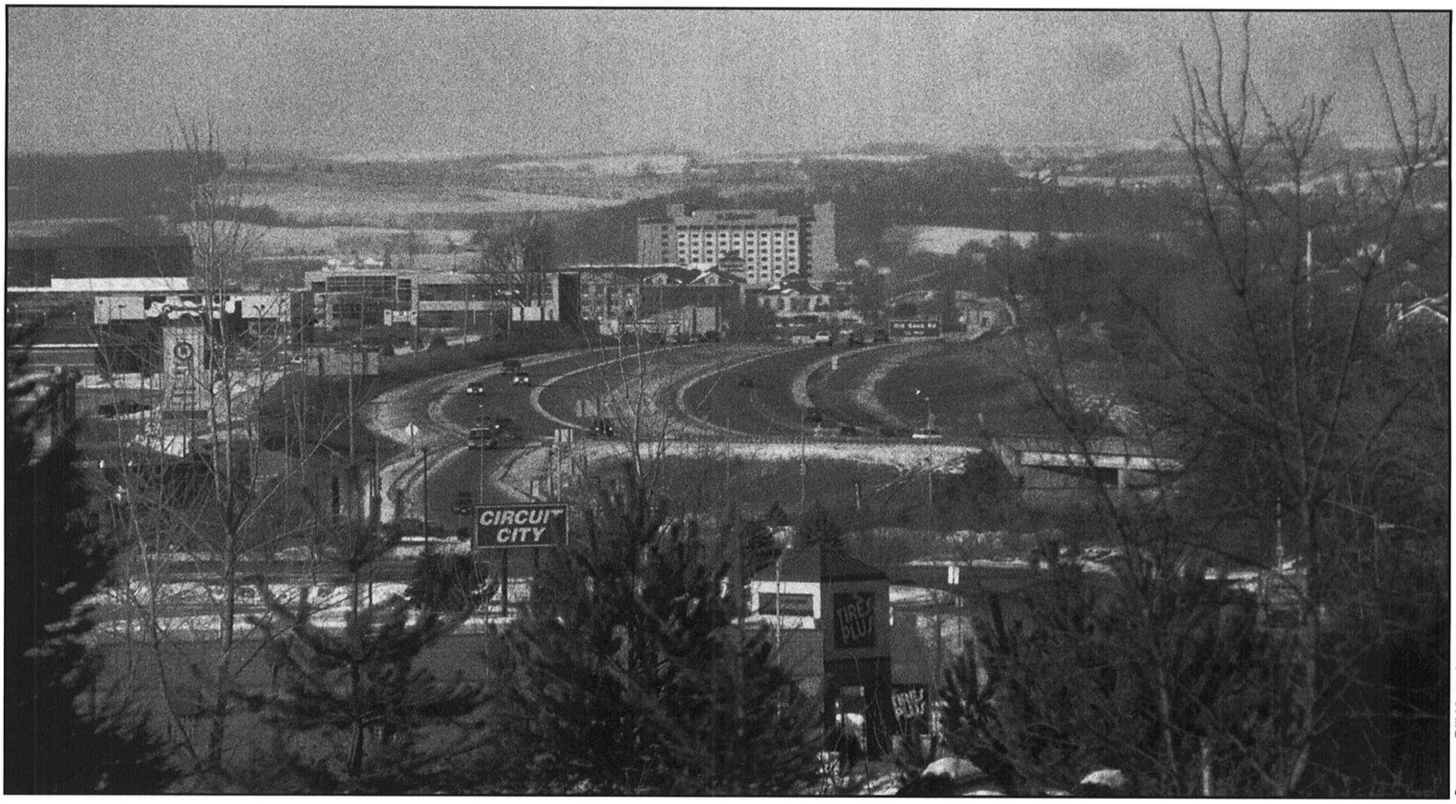
A number of job opportunities are available in sustainable development. Some of them involve working with people in other cultures. Volunteer organizations such as Concern America, the Mennonite Central Committee and the Brethren Volunteer Service give people the opportunity to work in developing nations. Tom Benvenuto, a former volunteer, worked with women in Guatemala to improve designs for wood stoves and to recreate "food forests," which provide food and medicine for a community.

For people who are interested in this kind of work, Tom Benvenuto says, the most important thing is to take a long time to get to know the community that you will be working with and to find out what they want, rather than imposing your views on them. "The rule of thumb is that you have to ask what people need in terms of development... Typically, it's the people with the problems who are going to come up with the best solutions."

For those of us who would like to do something "sustainable" in our everyday lives, there are many things that we can do. We can reconsider making purchases that we will not use, try to reduce our consumption of gas and energy, and recycle items such as computers, batteries and motor oil. We can also choose to live in communities where what we need is within walking distance. There are many things that we can do to help sustain our world for the next generation.

[1]*http://www.sustainable.doe.gov.html*

Author Bios: Katherine Friedrich is about to get her degree in mechanical engineering. She wants to combine engineering with her interest in nature and the arts. Dan Lewison is a freshman who is enjoying the transition from rural Wisconsin to Madison. He is currently undecided on his major.



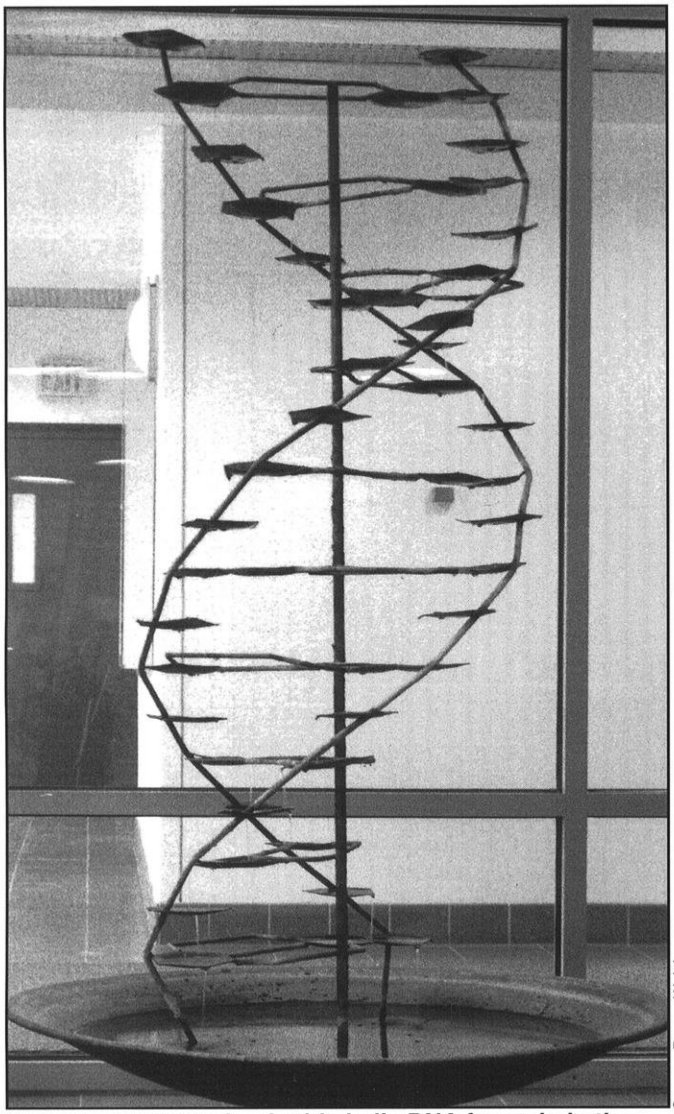
Source: Bill Ketterhagen

Urban sprawl, the haphazard development of undeveloped land, is prevalent on the outskirts of Madison.

Whose Genes Are They Anyway?

By Katie Maloney

Any day now, the first draft of the genetic blueprint of humankind will be complete. Scientists will have isolated and identified 90 percent of the approximately 100,000 genes in the human body, concluding the first stage of the Human Genome Project. However, some of this information may come with a price tag attached.



Source: Renee Weinberger

Water flows down the double helix DNA fountain in the Biotechnology building.

As the mapping of human DNA draws to a close, the question arises, "To whom do these isolated genes belong?" Do they belong to the scientists who discovered them, or do they belong to all of us?

The Human Genome Project, located at the National Institutes of Health (NIH) in Bethesda, Md., began in 1989 as a three billion dollar, international effort to create a map of humanity's genetic programming. The project seeks to isolate all genes contained in every human cell. Proposed utilities for isolated genes include improved diagnosis of diseases, earlier detection of genetic predispositions to disease, drug design and gene therapy. Products created from isolated genes may treat, cure or prevent disease.

The rough draft of the human genome sequence is due either this spring or summer. Over the next three years, the remaining gaps will be closed. Scientists predict the entire genome will be complete by 2003, coinciding with the 50th anniversary of the discovery of the double helix.

Solving the genetic puzzle of human DNA is surrounded by an argument concerning who profits from the information. Once a gene is isolated, it is considered an invention and may be patented. "If the hand of man is involved in isolating a gene, it is considered an invention," says Paulanne Chelf, an intellectual property coordinator at the Wisconsin Alumni Research Foundation (WARF), an agency that administers patents for the University of Wisconsin-Madison.

The patenting of human genes has become an issue as the Human Genome Project accelerates. Scientists involved in the Human Genome Project have promised to make genetic information (patented or otherwise) available to the public, as they must since they are federally funded. If a federally funded scientist holds a patent for a human gene, he or she is allowed to charge royalties but may not exclude anyone from access to that genetic information. However, scientists working independently of the Human Genome Project, who also isolate and patent human genes, do not have to share their "inventions" with the general public.

Common public reaction to gene patents is usually one of surprise. People seem to have difficulty adjusting to the fact that other people may patent parts of the human body. Dr. Deborah Leonard, director of the molecular pathology laboratory at the University of Pennsylvania, described her husband's reaction to the patenting of human genes in an article in the Chicago Tribune. "The first time I had this conversation with my husband he said, 'You mean that there is something in my body that if I wanted it to be tested, I couldn't have it tested unless I went to this one person? I have something in my body that's patented by somebody else?' I said you bet. That's exactly right."

"I think what gets to people is the 'ew, yuck' factor of it all," says Stuart Kim, a research analyst for the National Bioethics Advisory Commission. "There is something yucky about someone having rights over something we all own."

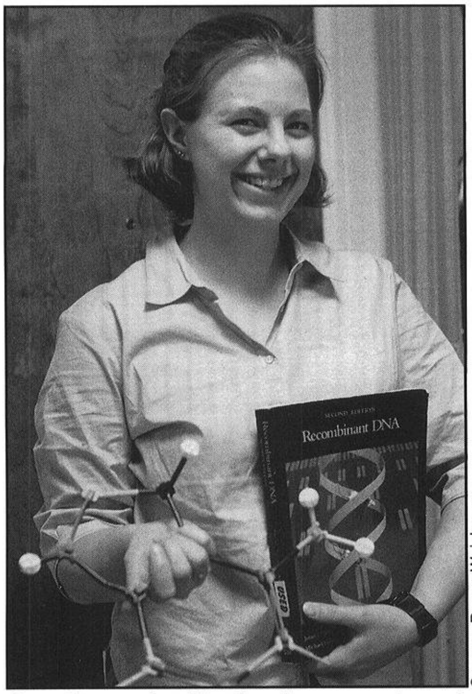
In the 1980 decision of Diamond v. Chakrabarty, the Supreme Court ruled that if an isolated gene fulfills the three requirements of patent law, the gene is patentable. According to Paulanne Chelf, those three requirements are novelty, utility and non-obviousness.

Chelf says the patent office looks for novelty in an invention to acknowledge that the inventor produced something new. Utility requires that the inventor's idea may be turned into a product, and non-obviousness ensures the invention is not obvious to someone of ordinary skill working in the same field as the inventor. Only if a gene has been altered from its original environment (isolated from the DNA strand) and the inventor has a specific product in mind does it fit into the rules laid down by patent law.

"After we issue a patent, we try to get someone to develop a product from the patent," explains Bryan Renk, a licensing associate for WARF. "We license them the right to use the patent." In return for a license, the product developer must pay license fees, or royalties, to the patent holder.

In the case of gene patents, researchers often pay license fees to the inventor simply to use a gene in research. "The inventor owns the right to prevent others from using what he or she claims," Renk says.

Dan Bellissimo, director of the molecular diagnostic lab for the Southeastern Blood Center in Milwaukee, deals with the effects of gene patents daily. "There really is a potential for limiting access to genetic testing," explains Bellissimo, explaining that some patent holders have been able to exclude laboratories from performing certain genetic tests.



Source: Renee Weinberger

Genetics major Monica Awe, wonders at the complexity of the gene patent issue.

For example, Bellissimo is unable to perform a portion of a genetic test for Duchenne Becker Muscular Dystrophy, a disease affecting all voluntary muscles and resulting in death for affected people as early as their late twenties. Originally, a company in Boston held the patent for this genetic test. In the beginning, they did only exclusive testing. Since then, the rights for the test have been sold to only one other group. "Basically, the company is saying 'you don't have a license, so you have to send the testing to us,'" Bellissimo says. "I can't offer this test to families myself, but have to send it elsewhere and pay the company to perform the test."

"I have problems with patenting human genes ... DNA [is] naturally occurring, so how can [it] be patented?" Bellissimo questions. "Your DNA is your property, so how can someone else claim it?"

On the other side of the debate are those people who argue that patents create an incentive for scientists to continue researching new scientific advances. If researchers do not apply for a patent, there is also the fear that some other researcher may steal their information. "I think traditionally science has been the pursuit of knowledge, in which scientists contributed knowledge through academic discourse. What has changed is the commercial application of biomedical research," Stuart Kim explains. "It is difficult because we should recognize the public benefit along with rewarding inventors."

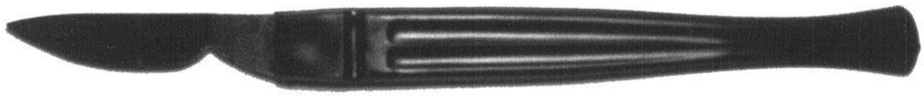
Further complicating the issue of human gene patenting are private companies racing against the Human Genome Project to be the first to map the human genome. Dr. Craig Venter, founder of a genetics company called Celera Genomics Group and former employee of the National Institutes of Health, discovered a method that may enable his company to map the human genome more rapidly than the federal government is. If this happens, Kim explains, Venter will be able to patent all those genes not already patented by private researchers, restricting public access to that information.

Celera is not the only genomics company racing against the Human Genome Project. Many other companies are also involved in the race to cash in on the genetic code. According to an article in the New York Times, Human Genome Sciences, a competing genomics company, claims to already have sequences and patent applications for 95 percent of all human genes. "Any company that wants to be in the business of using genes as drugs has a very high probability of running afoul our patents," Dr. William A. Haseltine, chairman and chief executive of Human Genome Sciences, states in the article. "From a commercial point of view, they are severely constrained – and far more than they realize."

According to the U.S. Patent Office, 1,800 patents have been granted for entire human, animal and plant genes. Another 7,000 applications are being processed. "Things are really heating up in terms of ownership

Author Bio: Katie Maloney is a senior majoring in life science communications. She is graduating in May 2000 and plans to attend graduate school next year at UW-Madison. She intends to continue her studies in the same department. Thanks go out to those six great girls living at 10 Lathrop Street.

Virtual Medicine



Health Care Enters a New Dimension

By Ryan Sydnor

As he floats through the patient's sinuous vascular system, the surgeon thinks to himself, "So this is what it feels like to be a blood cell." He follows a pulmonary vein into the left atrium of the heart, and from there he moves into the left ventricle, examining the walls as they contract with spectacular force. Moving on, the surgeon winds his way along the coronary arteries, searching each branch for a blockage that could lead to a heart attack…

The above description may sound like a weak takeoff of Isaac Asimov's *The Fantastic Voyage*, but it is not entirely science fiction. Such medical fantasies are being realized with virtual reality, a form of computer simulation in which the user is immersed in a realistic, three-dimensional (3-D) environment. While most human-computer interaction is through direct contact with an effector, such as a mouse or a keyboard, virtual reality involves numerous channels of communication. The user receives visual images, sounds and tactile forces, or vibrations, from the computer, while the computer monitors the user's gestures, head movements and even facial expressions. In the virtual environment, the user holds greater control over the surroundings than he or she ever could in the real world.

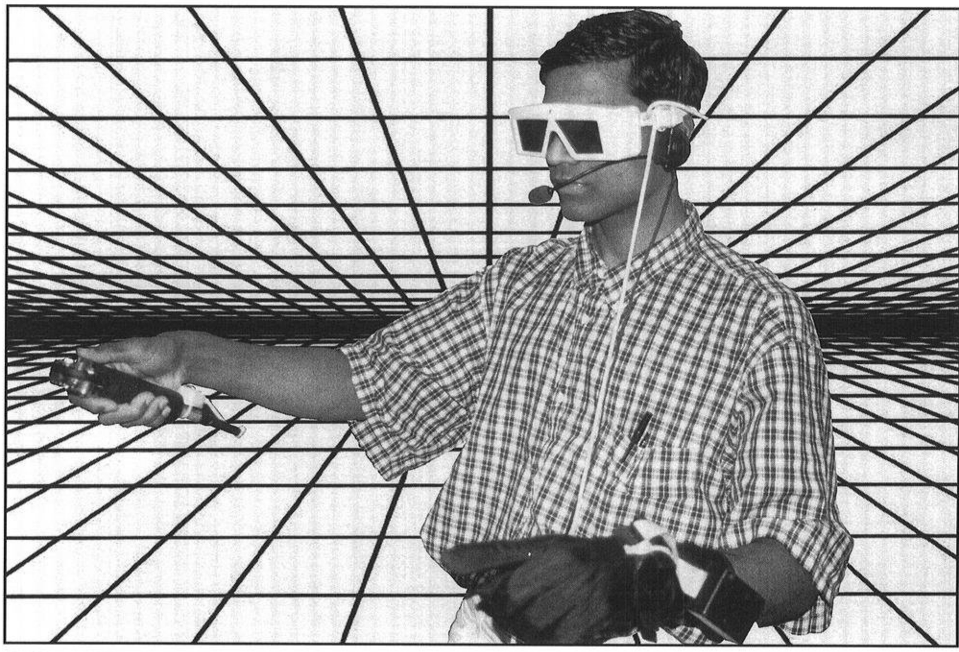
Today, bioengineers are translating the technology of amazing video games and movies into innovative methods of preserving human health and providing doctors with "eyes" that see more and "hands" with unheard of capabilities. With developments ranging from X-ray spectacles to long-distance surgery, virtual medicine promises to revolutionize healthcare in the 21st century.

In *The Fantastic Voyage*, a team of scientists is shrunken to microscopic size and injected into the bloodstream of a dying man. While no one has yet figured out how to fit even *one* scientist into another human being's bloodstream, a technique known as virtual endoscopy offers the next best thing: a virtual tour of a patient's body.

Real endoscopy is by no means a new procedure. For years, doctors have performed close-up, internal examinations of the bronchial tree, colon and arteries by inserting a long, flexible tube equipped with lights, sensors and lenses into the body. While endoscopy offers tremendous benefits, there are countless structures – such as the inner eye and the minute bones of the inner ear – that simply cannot be examined with a real endoscope. Endoscopy also tends to be highly unpleasant for the patient.

Virtual reality allows doctors to circumvent these complications, opening even the remotest of regions to inspection. Systems like that designed at Siemens Corporate Research in Princeton, New Jersey, use computer-aided tomography (CAT) scans to make 3-D computer models of anatomical structures. A CAT scan consists of a series of cross-sectional X-ray images that are combined into a single model. Other systems use magnetic resonance imaging (MRI) and ultrasound data to make 3-D images of internal structures. With this technology, doctors can see far more than they ever could with real endoscopy by probing a virtual model of an actual patient's body. Thanks largely to research directed by doctoral candidate Walter O'Dell at the Johns Hopkins Medical Imaging Laboratory, cardiologists may soon be able to perform a complete heart exam without so much as puncturing the patient's skin.

The more a surgeon knows about what is going on within a patient's body, the more likely any procedure is to be successful. Dr. Ben Carson, the world-renowned director of pediatric neurosurgery at the Johns Hopkins Hospital in Baltimore, offers a powerful testament to the importance of preoperative planning in his book *The Big Picture*. In 1997, Carson used a 3-D visual imaging system to explore the intricate neural structures of a set of craniopagus Siamese twins, twins connected at the top of the head. By looking into a reflective screen with a pair of special 3-D glasses, Carson was able to see every layer of tissue and every blood vessel of the twins' interwoven brains. The program allowed him to erase, magnify, rotate and cut through



Source: Scott Hackel

Raj'arathinam Arangarasan is busy working with the equipment that keep him and his fellow researchers at the forefront of the virtual world.

any region of the brains, giving him insight that would prove invaluable in the actual separation of the twins.

In his book, Carson describes the experience: "I could virtually 'see' inside the heads of two little Siamese twins who were actually lying in a hospital on another continent... This allowed me to isolate even the smallest of blood vessels and follow them along their interior or exterior surface without difficulty or danger of damaging the surrounding tissue. All of which, of course, would be impossible in an actual operating room." With the aid of virtual reality technology, Carson

Telepresence could allow a surgeon to operate on a patient halfway around the globe, deep beneath the ocean or even in outer space

and a team of exceptional surgeons performed the first successful separation of craniopagus Siamese twins in medical history.

Now that doctors like Carson are doing cross-continental examinations, the next big challenge for virtual medicine involves long-distance surgery. Over the past decade, engineers have drawn together numerous forms of expertise in the development of "telepresence," a phenomenon in which robots reproduce the movements of a person working within a virtual environment. Telepresence could allow a surgeon to operate on a patient halfway around the globe, deep beneath the ocean or even in outer space. The surgeon would perform "telesurgery" while looking at a virtual image of a patient's body; a robot operating on the actual patient would mimic his movements with flawless precision.

Telepresence can also be employed in microsurgical procedures, which involve minute structures and incisions. Because motion, forces and images in a virtual environment can be scaled to different dimensions, surgeons can use enhanced virtual images to execute procedures that would otherwise require superhuman hand-eye coordination.

Closely related to virtual reality is augmented reality, which actually melds the real and virtual worlds. In augmented reality, MRI, CAT-scan and ultrasound images are overlaid on the actual patient's body. By gazing at a transparent/reflective screen or donning a pair of liquid crystal display spectacles, the doctor can essentially look directly into the patient's interior. Surgeons will benefit enormously from the ability to see tumors embedded deep within the body before making a single incision.

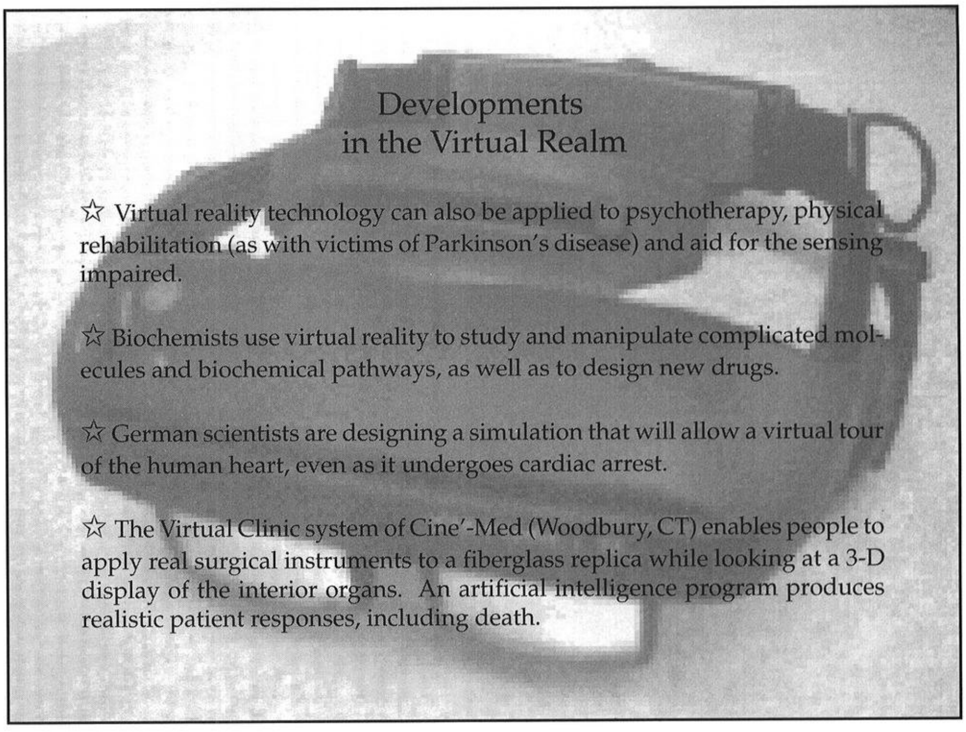
The most immediate impact of virtual medicine technology will be felt in the area of medical education and training. Pilots have long used virtual reality simulations to safely hone their skills; it seems logical that medical students should undergo similar training before taking priceless human lives into their hands. Training is done on cadavers and animals, but such supplies do not exactly grow on trees.

Virtual training also offers a number of advantages over traditional dissection, such as the ability to study magnified images of anatomical structures from every angle. A collaborative team consisting of experts from the Virtual Reality in Medicine Laboratory and the Electronic Visualization Laboratory of the University of Illinois at Chicago has designed several 3-D learning environments that combine teleconferencing, telepresence and virtual reality. Besides learning experience, these systems offer the ability to perform complicated and high-risk procedures safely and repeatedly.

As improvements are made in visual imaging, data processing and force-feedback systems, virtual environments may give closer approximations to the living human body than corpses ever could. Virtual environments also allow students and professors to communicate and cooperate from remote locations; students may even view an operation from the perspective of the professor performing it.

For most of us, virtual reality has long been a futuristic concept, hovering on the border between science and science fiction. Perhaps this is because virtual reality achieves a true fusion of "cyberspace" and our own tangible universe—a feat that seems beyond the realm of possibility. Of course, the wizards of virtual medicine are faced with a number of obstacles, such as the need for faster data processing and improved sensory feedback, but the impact of their work already permeates nearly every facet of healthcare. So, as mankind charges forth into the new millennium, the field of medicine is taking its own fantastic voyage into a world in which "reality" is improved…and anything is possible.

Author Bio: Ryan Sydnor is a freshman planning to declare a major in biomedical engineering this semester. He became interested in the medical sciences while reading Isaac Asimov's *The Fantastic Voyage* in the sixth grade. Call him weird, if you like, but he would find nothing more thrilling than to swim around in somebody else's blood stream. (He would also be fascinated to learn of a land where cadavers *do* grow on trees.)



Developments in the Virtual Realm

☆ Virtual reality technology can also be applied to psychotherapy, physical rehabilitation (as with victims of Parkinson's disease) and aid for the sensing impaired.

☆ Biochemists use virtual reality to study and manipulate complicated molecules and biochemical pathways, as well as to design new drugs.

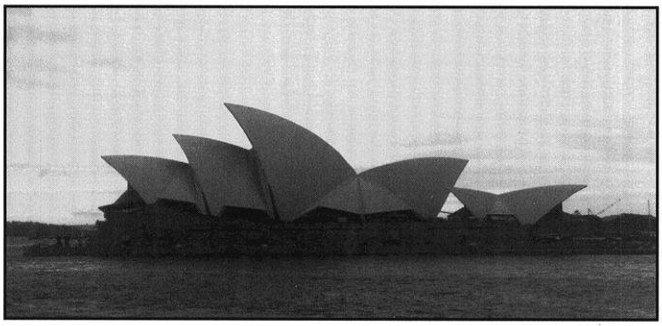
☆ German scientists are designing a simulation that will allow a virtual tour of the human heart, even as it undergoes cardiac arrest.

☆ The Virtual Clinic system of Cine'-Med (Woodbury, CT) enables people to apply real surgical instruments to a fiberglass replica while looking at a 3-D display of the interior organs. An artificial intelligence program produces realistic patient responses, including death.

Go West (or East, or South...) – Just Go!

By Amy Dohlman

Imagine yourself sitting on a warm beach in Australia with the thought of a cold Wisconsin winter half a world away. Or perhaps you're sitting at a table in a sidewalk café in Denmark, enjoying a cup of joe with newfound friends. The best part? It's a school night, and you have few worries about homework or due dates. Sound too good to be true? Maybe, but for students studying abroad, this scenario is a daily reality. "Yeah, but it's too hard, too expensive, and I just don't have the time," goes the quick rebuttal. Despite what you may think, studying abroad can fit into your schedule of hectic courses and pre-requisites. And it's easier than most students think.



Source: Amy Dohlman

The Sydney House could be a backdrop while you study abroad in Australia.

Aside from the general apprehension accompanying such a grand move, there are some valid arguments that keep students from studying abroad. Many students are concerned that it will not fit into their schedule or that they will not get credit at their home university. Some fear it is simply too expensive to study abroad. Others think studying abroad is a thing reserved for "other people" and is a waste of time when completing a degree. A little research shows that these arguments, while persuasive, should not keep students from travelling outside the mother country.

Both Matt Mayers, the advisor for University of Wisconsin-Madison's Letters and Science Office of International Study-Abroad Programs (OISP), and Marianne Machotka, director of UW-Madison's College of Engineering International Engineering Studies and Programs (IESP), believe that with planning, a semester abroad will fit into any student's course of study. "There's no plan where [studying abroad] absolutely doesn't fit," says Mayers. Machotka agrees but also says that engineering students wishing to study abroad must plan carefully to make a semester abroad fit within the maze of prerequisites and required courses that face these students. Even if they start planning as late as their junior year, students can make room for a semester abroad during their senior year.

Heather Kane, a chemical engineering senior at UW-Madison, who recently returned from a semester in Denmark, advises students to make plenty of time for planning, not only for the student involved but also for any advisors who are helping out. "I wasn't going to leave the country until I knew things would transfer," she states. This planning involves speaking to advisors, professors and directors overseas and working closely with a study abroad advisor, ensuring that classes offered abroad will match with those at home.

One thing students should keep in mind is that studying abroad does not always involve an entire semester away. Mayers says students often forget that programs are also offered during summer and give engineering students a chance to fulfill breadth requirements. Many chemical engineering students at UW-Madison take advantage of the fact that a major senior lab requirement is offered during the summer in both London and Spain, as well as at home, giving them the chance to fit studying abroad into a busy schedule.

Thanks to the exchange program IESP offers under the International Association for the Exchange of Students for Technical Experience (IAESTE), students choosing to study abroad at one of the participating universities are ensured of getting UW-Madison credit for approved courses, quelling fears of not getting credit for a semester abroad. One advantage of this program is that it allows students to take elective courses that may not be offered at UW-Madison. For example, a university in Denmark offers a naval architecture class not available at the UW-Madison. The IAESTE program also makes studying abroad surprisingly affordable as the student pays only UW-Madison tuition. For students a little rusty on their high-school French, some participating universities offer programs in which classes are taught entirely in English. Others provide short, intensive language courses prior to the first day of class for those who want to brush up on their language skills.

For students concerned with the financial side of studying abroad, many scholarships and grants exist to help lighten the load monetarily. Mayers spoke of the National Security Education Program (NSEP) offered by the U.S. government that provides aid to those studying outside Western Europe. Awards of up to $16,000 per year are available for students in the scientific and engineering fields. Universities in places like Japan and Thailand also offer scholarships, enticing students to study in more exotic locations. Various other grant monies are available to qualified students.

"There's no plan where [studying abroad] absolutely doesn't fit," says Mayers

One thing to remember when considering costs is to compare the entire cost of a semester at home to the figure on the cost sheet

Source: Bill Ketterhagen

Heather Kane, a UW-Madison student who recently studied abroad in Denmark, says, "It [studying abroad] really puts life in perspective".

for a semester abroad. "Many students compare cost sheets to only tuition," says Mayers, "and forget about all the extras—living expenses, books, entertainment, all the little costs." Cost sheets attempt to factor in those extras and so can seem more expensive when compared to tuition alone.

Students that believe studying abroad just is not for them might be surprised at how much it can add to their lives. Machotka says that studying abroad is an incredible résumé builder since "so few engineering students have study abroad experience." Kane agrees. She says that experience abroad is rumored to add 5% to a student's hiring worth as these students show they have the ability to work in a variety of situations with many different people in unfamiliar surroundings.

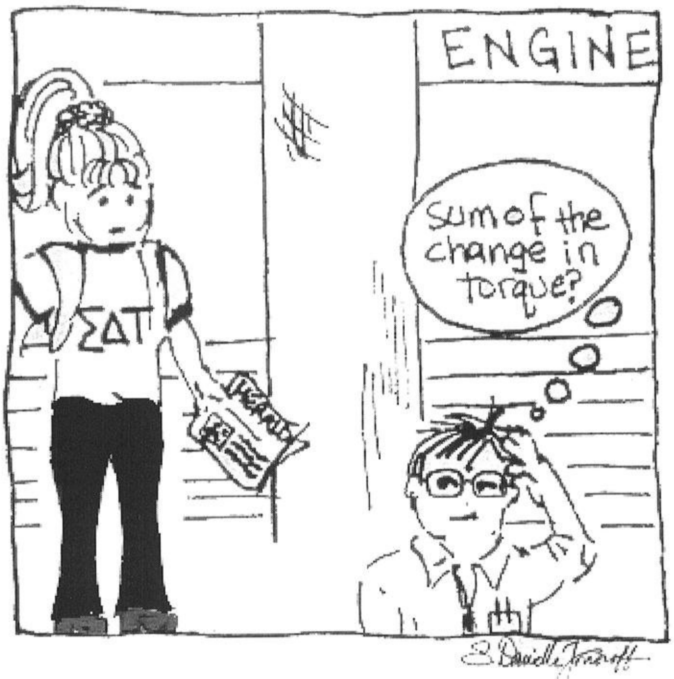
Aside from résumé building, studying abroad also lets students take a break while still working on their degree. Workloads are often lighter with little homework until the final exam. However, this exam can also be worth a large portion of the final grade, so students should not go abroad expecting an entirely easy ride.

Don't let this discourage you, however. Kane says studying abroad was a "blast" as it gave her the chance to travel, meet lots of people and learn how other cultures work and view the United States. Studying abroad is the experience of a lifetime—how else can one touch Ayer's Rock or climb the Eiffel Tower while gaining college credit? For college students, there will never be a better time to gain experiences like these. As Kane says, "It really puts life in perspective." Find out for yourself.

Author Bio: Amy Dohlman is a senior studying English at UW-Madison, and just returned herself from a semester abroad in Perth, Australia. A rabid Vikings fan, she must now readjust to life in a land filled with equally rabid Packer fans. Oh, for Cottesloe beach!

Break Time...

By Dani Fonoroff



Dani's sorority is not interpreted the same way on the engineering campus.

Dani's roommates are Com Arts majors...

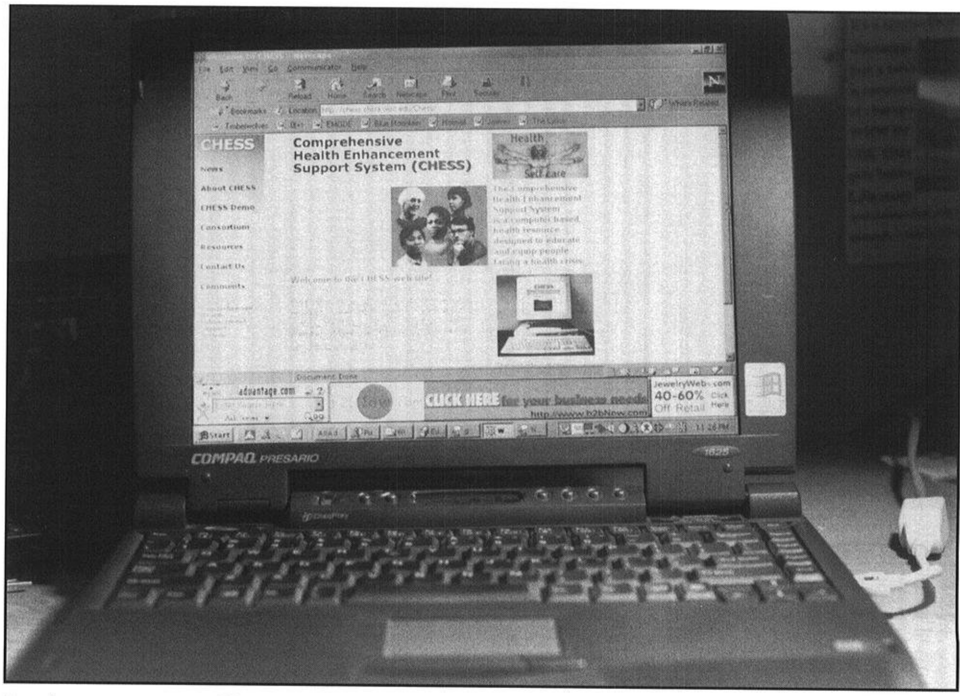
CHESS: A Program to Help Patients Facing a Health Crisis

By Lynn Weinberger

What would you do if you found out you had breast cancer or HIV? One day everything is going along like usual, and the next day you find you have a life-threatening illness. If you are like most patients, you would feel that you had to suffer the pain and anxiety on your own. Your friends, family and health care providers could offer some support, but they cannot be there all the time. They cannot be there at 2:30 in the morning when you are sleeplessly deciding whether you will have chemotherapy or radiation treatment for cancer. This is where the Comprehensive Health Enhancement Support System (CHESS) can really help patients.

CHESS is a computer system that was first proposed in 1973 by Dr. David H. Gustafson, an industrial engineering professor, after studying a group of suicidal patients. Each patient was given a computer to help them through the depression. He or she could use that computer to talk to other patients in similar situations in a chat-room-like setting. Gustafson found that patients were able to speak openly about their feelings and concerns more easily with the anonymity that the computer provided.

The workers at CHESS believe that the most rewarding part was seeing that their everyday work was helping other people



Soruce: Renee Weinberger

Laptop computers like the one shown are given to participants to access the CHESS program.

Since the initial study done in the 1970s, CHESS has focused on trying to help people facing a health crisis. Some of the programs in use today deal with prostate cancer, menopause and beyond, heart disease, breast cancer, asthma, HIV/AIDS and Alzheimer's disease and dementia. CHESS is also currently developing a smoking-cessation program. Part of this program will be aimed toward teenagers, and the other part will be aimed toward adults.

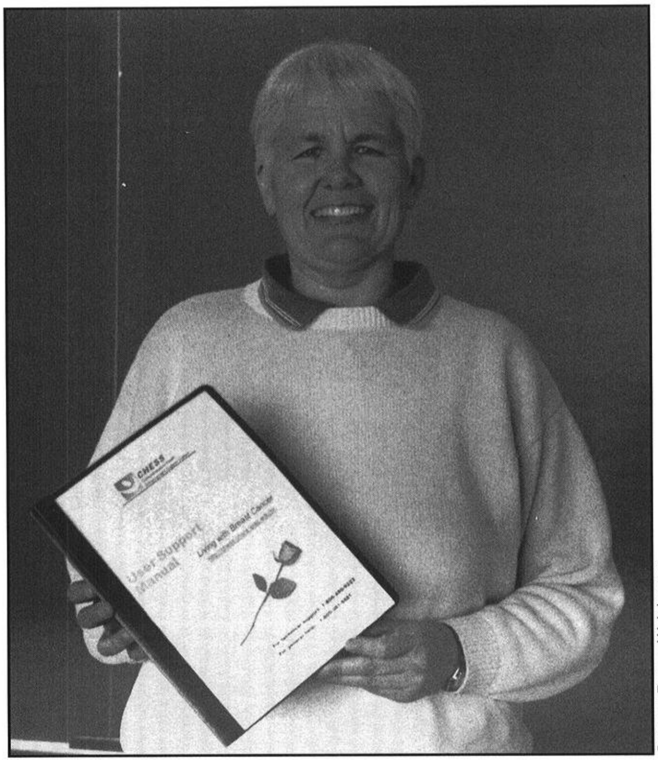
CHESS sets up the patient with a computer and is given access to the CHESS website. The website includes informational pages, such as those describing the nature of the disease and the various treatment options the person can choose. There is also the "Ask an Expert" section where the participant can post a question to a message board, and a doctor can answer the question. In addition to the message board and informational sections, the users also have access to an area that resembles a chat room where they can talk openly about their illness with other people in the study.

One of the advantages to the CHESS study is the level of anonymity that it presents the patients. They can ask any question they want from the privacy of their own home at any time of day or night. All anybody ever knows about them is a code name that they choose for themselves. However, according to Fiona McTavish, the lead developer of the Breast Cancer Module, many patients find that the other patients were so helpful and supportive that they choose to meet each other in person. They develop friendships that expand their network of support.

Often, the patients write letters to the developers of the program thanking them for all the help that CHESS provides. For instance, McTavish keeps a bulletin board in her office, which is covered entirely with pictures of patients and their families who participated in the breast cancer study. The workers at CHESS believe that the most rewarding part was seeing that their everyday work was helping other people.

McTavish says, "I think I have learned many of the lessons without ever having gone through the pain that these women [the breast cancer patients] go through."

Jim Hill, database programmer for CHESS, says, "You work along and think you're just doing a job, and then all of a sudden you hear what the results of that have been on somebody's life which is very rewarding. I



Source: Renee Weinberger

Lead developer of the Breast Cancer Module, Fiona McTavish, shows off the user manual for the program.

mean, when you sit here, you don't always have a chance to think about how these words and documents and computer programs are going to affect people until you hear from someone that it's changed their life. It's gotten them through a part of their life that was very difficult and that they would have had trouble with had they not had this resource, which motivates you to want to do it better and make it available to more people."

In order to make the program better, various studies are being conducted in addition to providing valuable information resources for people. Some of these studies include improving the user interface to make the computer easier to use. This means that fonts are made larger, and some programs actually talk to the user to make it easier for patients who are visually impaired. The ultimate goal is to make a computer system that can help as many people as possible and make it easy for the user.

Patients range in age from the twenties to the eighties, meaning that CHESS must be accessible across an incredibly wide age span. Many of the patients have never even used a computer before, so one of the challenges is to make a computer system that is easy enough for even the novice users.

In the breast cancer study, patients are recruited into the program upon diagnosis. The doctors work with CHESS to recruit patients into the study. That way, they can receive the most benefits from the study. After diagnosis, patients are often bewildered and feel overwhelmed by the decisions facing them. One patient in the breast cancer study said, "When I was in the decision stage and just diagnosed, I didn't know where to turn to. CHESS provided me with the information I needed at my fingertips to make the right decision that I felt confident about. The Open Discussion Group is a great support system. Not only to myself but also to my 16-year-old daughter. When she needed to talk, she would talk to other breast cancer patients if I wasn't available."[1]

In spite of all the help CHESS provides to patients, there are some drawbacks. McTavish says, "The hardest part is when someone dies, but that goes with the territory." Although the deaths of patients are tragic, at least they had people to talk to and comfort them in their time of need. A disadvantage inherent in the program is that often people get attached to the computer. They do not want to give it up after the three to six month study because of all the relationships they had built over CHESS.

Despite the drawbacks associated with CHESS, the majority of patients find that CHESS helps them. It allows people to talk confidentially about their disease, and it helps people connect and feel less helpless and alone. CHESS is an example of how computers can help people cope with the challenges and stresses of living with life-threatening illness.

[1]Boberg, Eric, "What People Say: Breast Cancer Module," *http://chess.chsra.wisc.edu/Chess/abt_say_bc.html* (Madison: University of Wisconsin, January 2000).

Author Bio: Lynn Weinberger works for CHESS as a computer technician. She sets up the computers that go out into the field studies. She also helps maintain the department computers.

Harvesting Genes

Tradition Meets Technology

Source: Victor Chen

Alvar Carlson, a graduate student working for Dr. Heidi Kaeppler, waters some transgenic oat plants.

By Kari Cox

Who is the most famous literary figure of genetic engineering? Mary Shelley's Dr. Frankenstein, of course. Now what does his creature eat? "Frankenfood!" This may sound like an incredibly lame joke, but "frankenfood" is what many nervous people are calling the offspring of genetically engineered food. Are people's fears of this technology justified, or are they just reactions to something new and foreign to them? No matter what the reason, genetic engineering will soon change how we farm and, more importantly, what we eat.

With the completion of the Human Genome Project on the horizon, genetics has become an extremely important tool in the fields of science and engineering. Its importance has made deoxyribose nucleic acid an everyday term—DNA. DNA can be used to catch a criminal, to aid in identifying the cause of a disease and now to change the food we eat. Genetic engineering involves studying the functions of genes and then inserting genes into plants or animals where the gene is normally not found. It also can involve turning on genes in areas of the organism where the gene is naturally not expressed. Through genetically engineering foods, scientists can improve the nutritional value of crops, increase their yield or make a crop produce substances they naturally do not.

Source: Victor Chen

In the foreground is a corn plant in the early stages of growth. Behind it is a gene gun, which is used to shoot catalyst particles into plant embryo cells.

Agriculture, one of oldest professions and sciences, has been thrown into the forefront of genetic engineering. Heidi Kaeppler, assistant professor of agronomy at the University of Wisconsin-Madison, performs research in small grain breeding, a program that has been in the department since the ealy 1900s. She describes, "It's a program that's been around a long time and has served the public for many, many years, and that's what we are continuing to do as science has progressed." Through cross-breeding types of plants, Kaeppler is able to select for certain traits that will improve the quality of the grain, increase its yield and even make it resistant to disease.

Of course, not all desired traits can be achieved through crossbreeding. This is where genetic engineering comes into play. "We are using genetic engineering as a tool," Kaeppler explains, "to help us better understand plant genes—how they work, where they turn on, where they turn off—to improve crop yield, improve its disease resistance or change the quality which is either better for people when they are eating this as food, or animals as they are eating this as food. What are some ways we can manipulate genes to make the plant more efficient in its uptake in nutrients?"

Genetic engineering aids scientists in improving many traits of agricultural crops. First of all, scientists are able to change the DNA of a plant to increase its nutritional value. Kaeppler gives a hypothetical example saying that we are able to take a gene from one crop that is high in protein and transfer it into a completely different crop to increase its protein content. Genes that are used in such a manner are called transgenes. Plants where these transgenes are used are called transgenic plants.

Another way of increasing the nutritional value of a food in an indirect way is by manipulating the genes to produce natural pesticides. Of course, these pesticides are only harmful to insects, not to humans. Farmers, therefore, no longer need to use as many pesticides on their crops, and the consumers need not worry about consuming chemical toxins. These natural pesticides mean that more of the crop will survive insect attack and will increase the yield.

Increasing the yield of a crop is also achieved through increasing the size and number of the grain. Kaeppler explains that, through changing a gene, a scientist can not only increase the number of kernels in a cob of corn, but also increase the size of the kernels.

Besides nutrition and yield, scientists can also genetically engineer plants and animals to produce substances that it naturally does not but that can serve a practical purpose. For example, mice are currently being made to produce lactose-free milk. A gene created an enzyme in the mammary glands will destroy the lactose in the milk.[1] People who are lactose-intolerant are then able to receive the important nutrients in milk without the threat of getting sick.

One of the most exciting substances that may be produced in food is vaccines. Plants will be genetically engineered to produce edible vaccines. Though still in development, these foods will dramatically decrease the cost of

"We are using genetic engineering as a tool"

vaccinations, especially for people in third world countries.[2] Kaeppler also comments on this technology, saying that a vaccine can be grown in a food as simple as a banana and is administered just by eating it.

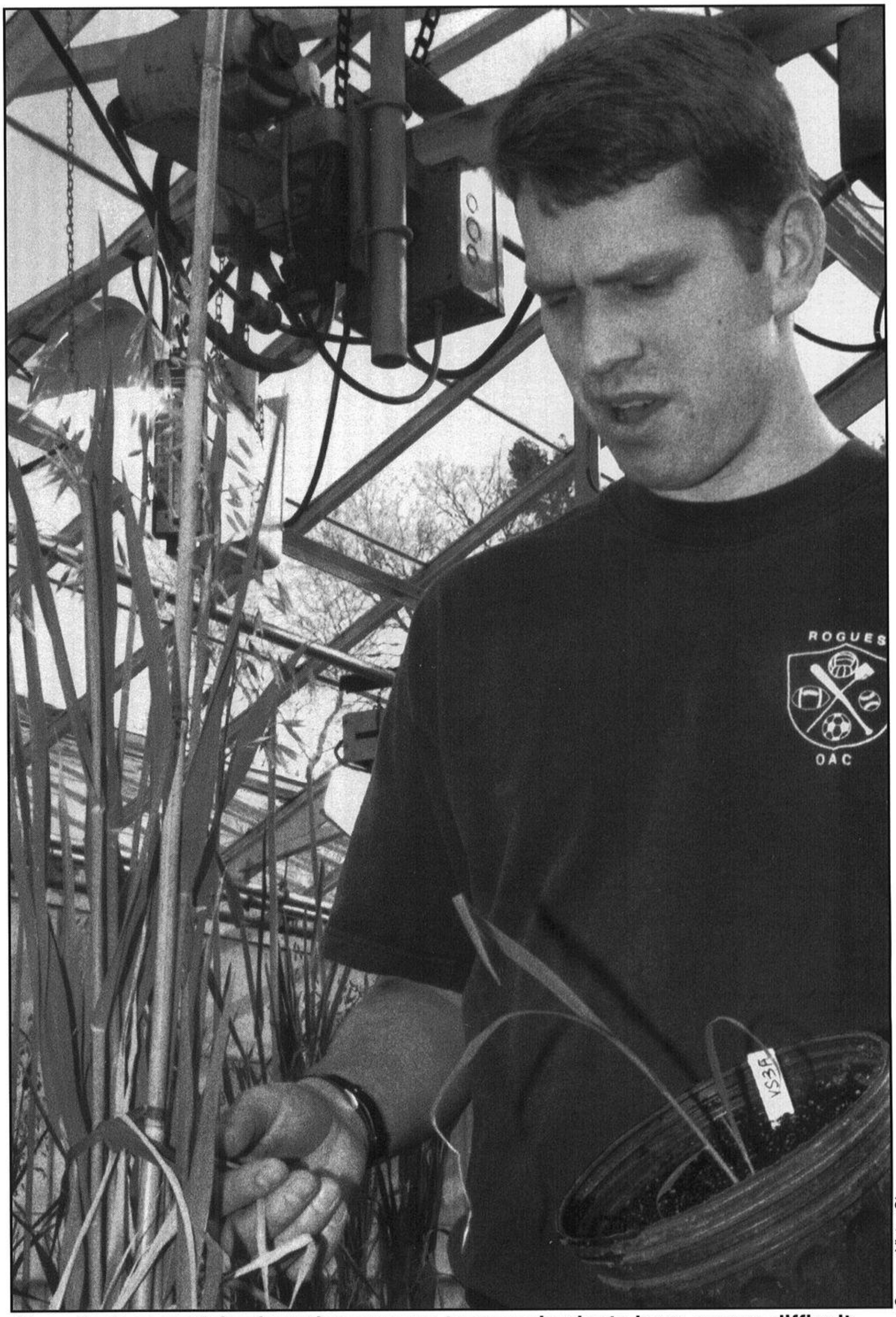
With all of the incredible uses that genetic engineering can provide, the major question and controversy surrounding this technology is "Why do we need this?" Many experts agree that because of the world's rapid population growth, we will very soon need more food to feed everyone. Genetic engineering will help us achieve this. Of course, many others, including the public, disagree, arguing that we have too much food already. "Why can't we rely on 'natural' methods?" they say.

Norman E. Borlaug, president of the Saskawa Africa Association and 1970 Nobel Laureate, has spent 53 years studying food production in developing countries. He sees an incredible need for genetic technology because of the growing population. In fact, he estimates that "to meet the projected food demands...the average yield of all cereals must be increased by 80% between 1990 and the year 2025."[3]

In addition to the growing population, the harvest of cereal grains also faces physical limits. There is only so much land in the world for crops to be grown on, especially if we continue to resort to traditional methods of farming. "I have calculated," Borlaug predicts, "that if the United States attempted to produce the 1990 harvest of the 17 most important crops with the technology and yields that prevailed in 1940, it would have required an additional 188 million hectares of land of similar quality. This theoretically could have been achieved either by plowing up 73% of the nation's permanent pastures and rangelands, or by converting 61% of the forest and woodland area to cropland."

Despite these statistics, though, many still believe that the major problem is with our world's uneven distribution of food. Others believe that humans just should not play around with DNA. Morality is often an important issue surrounding this technology.

(CONTINUED ON PAGE 22)



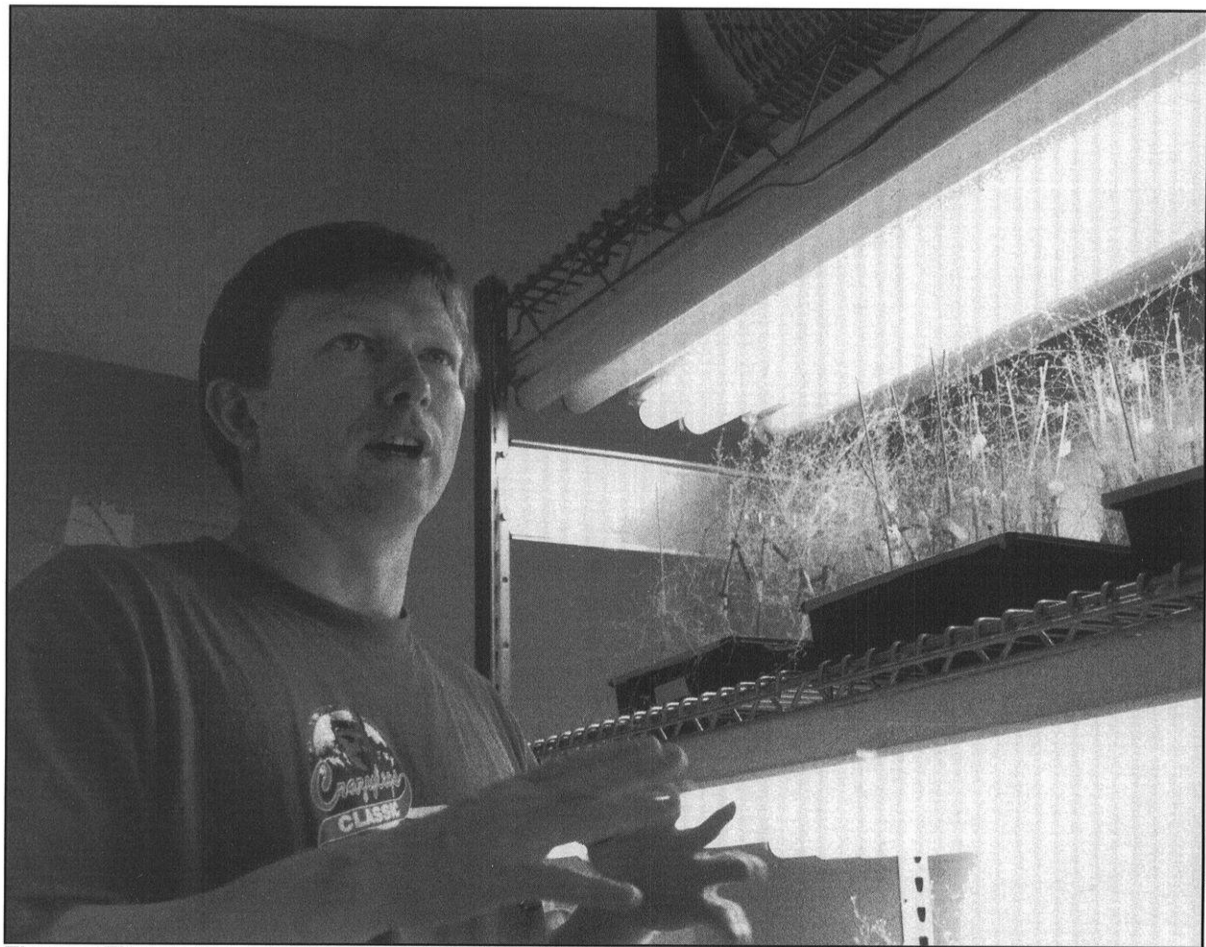
Source: Victor Chen

Alvar Carlson explains how these young transgenic plants have a more difficult time to develop into larger plants because growth begins from a single cell and not a seed.

(FROM PAGE 21)

In *U.S. Catholic* magazine, author Kevin Clarke states, "The Good Lord gave humankind dominion over the earth, but we bipeds seem unable to draw the distinction between that which we are capable of doing and that which we ought to do."[4]

Another issue concerning genetic technology is the threat of pest-resistant genes spreading into the wild environment. If these genes are present in weeds or other unwanted vegetation, the farmers may have another problem to deal with. The result may be a "superweed" that is resistant to pesticides.



Source: Victor Chen

Thomas Zinnen, the outreach specialist of the Biotechnology Center at UW-Madison, talks about Arabidopsis, a common plant used in testing gene sequences.

The most prevalent concern revolving around genetically engineered foods is the issue of safety. It seems to be human nature to distrust what is new and seemingly "unnatural," especially when it comes to what we eat. Great Britain is in the middle of a huge controversy over the use of genetically modified food. The public there, even notables such as Prince Charles, is having a hard time accepting this technology. The United States, on the other hand, seems to be more accepting. However, the Gerber Co. and Heinz Co. both have publicly stated that they will not use genetically engineered ingredients in their baby foods. This may be to reassure nervous parents who want their babies to have only natural foods. The reasons for this public fear may lie with their trust of their government's food testing procedures.

The World needs this because of its exploding population

Fully aware of the public's concern, the Food and Drug Administration (FDA) has set up specific guidelines for the testing and marketing of genetically engineered foods. These foods are being treated with the same procedures that every new food product undergoes. Of course, only a statistical difference between the genetically modified food and the normal food will require further testing.

What is the solution to this safety concern? One idea is to use labels stating that this product contains genetically modified ingredients. The FDA requires labeling foods that contain ingredients whose nutritional components have drastically changed or may contain a food allergen. Tom Zinnen, outreach specialist with the Biotechnology Center at UW-Madison, points out an important issue revolving around labeling. Labeling must be based on fact and not misleading. For example, a company may proclaim that its product does not contain genetically engineered ingredients, thus implying that genetically engineered ingredients are somehow inferior to natural products. This tactic may intimidate and mislead the consumer to thinking that all foods containing genetically engineered ingredients are bad.

Despite the public's fear, genetic engineering remains in the spotlight as a new and exciting technology of the future. Everyday researchers are finding new ways of using this technology as a tool of creating better nutrition, higher yields and safer growing environments for our crops. Evidence that the world needs this technology because of its exploding population ensures that this technology will thrive even in the face of mistrust. It is amazing how one little gene can cause so much controversy.

[1]Travis, J., "Making Milk Easier on the Stomach," *Science News*, vol. 155, no. 9 (February 29, 1999), p. 139.

[2]Moffat, Anne Simon, "Toting Up the Early Harvest of Transgenic Plants," *Science*, vol. 282, no. 5397 (December 18, 1998), p. 2176.

[3]Borlaug, Norman E., "Feeding a world of 10 billion people: the miracle ahead," *Plant Tissue Culture and Biotechnology*, vol. 3, no. 3 (December 1997).

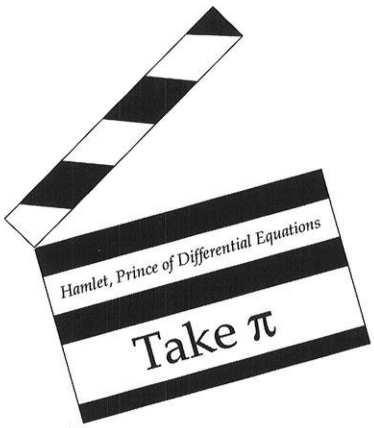
[4]Clarke, Kevin, "Dr. Frankenstein meets Mr. Potato Head," *U.S. Catholic*, vol. 64, no. 1 (January 1999), p. 26.

Author Bio: Kari Cox is a junior majoring in English and Technical Communication. As a former genetics major, she found the research and writing of this article the next best thing to being out in the field herself.

Just One More

Hamlet, the Engineer

By Victor Chen



Hamlet, the freshman:

To do, or not to do: there is no question.
'Tis neither noble for the mind to suffer from a "D" on an exam,
  nor the berating of my professor.
To dig myself into a hole is a foolish action.
Thus, while the workload a moderate level stays,
  grades must climb the mountain.
For when comes the time that a major one must chooseth,
  acceptance to a department is desired.
To do my homework, or not to do my homework:
'Tis not the question ***if*** I will finish it,
  but ***how long*** my homework shall remain unfinsh'd
  before I leave for thy party.

Hamlet, the sophomore:

To be an engineer, or not to be an engineer: that is the question.
Whether 'tis intelligent to enter the College of Engineering
  and subject myself to a lifetime of material balances,
  static forces, Ohm's law, or differential equations;
Or to travel through college trudging through the likes of
  Dante's *Inferno*, Homer's *Odyssey*, or even Shakespeare's *Hamlet*,
Only to ponder my existence in a job
  without the assistance of something called graduate school.
To work on problem sets, rather than to write papers:
  that is the decision I maketh now.

Hamlet, the junior:

To finish, or not to finish: that is the question.
'Twas a tumultuous journey to get this far in my problem set,
  and yet, what an ache that other assignment
  doth give my head!
O foolish me!
What cometh o'er me to choose this major?
And now standeth before me, another three-and-ten hours
  of work to finish by morning morrow.
Behold, my fair lady arrives and wishes me to
  go to the theatre.
"Get thee to a nunnery!" I cried,
  for I am consum'd and overwhelm'd by the
  homework that is before me.
To finish my lab report, or to finish my problem set:
  the answer will be clear when class time arrives.

Hamlet, the first-year senior:

The year repeateth like the last...

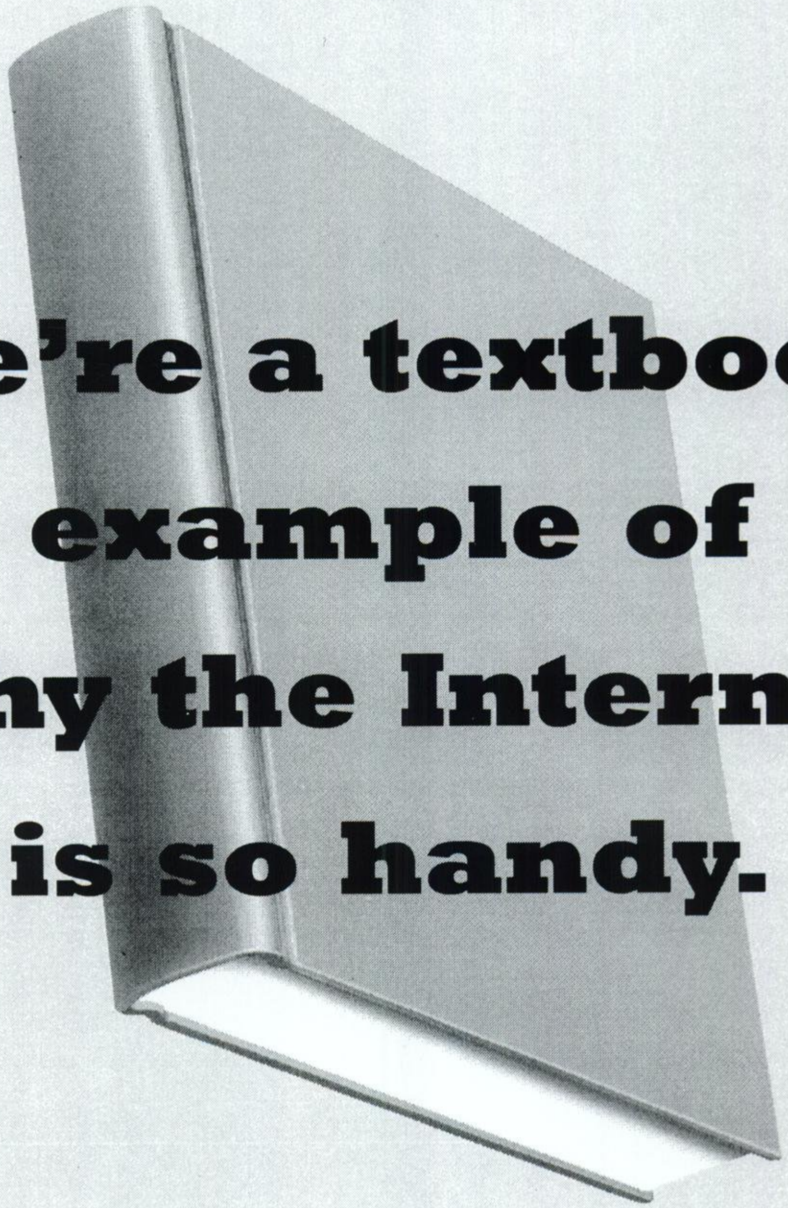
Hamlet, the second-year senior:

To do, or not to do: there is no question.
Whether 'tis nobler to watch football, play sports, go shopping,
  climb trees, yodel to the masses, practice bird calls,
  and write pointless poetry for some magazine,
Or to do homework for my classes...
One holds no sympathy for those who have work to do.
As in my fifth year I commence,
  four years of work doth appear on my transcript.
And neither recruiter nor admissions committee will lay eyes
  upon the efforts (or lack thereof) of my final year.

Alas, "how dost thee pass your classes?" you ponder,
  "for a total lack of effort surely will lead you down
  the depths of sorrow..."
But I tell you, my friend, that 'tis an art learned o'er four years
  to complete a task with effort minimal.
O worry not!
For spellling errrors, misus'd; punctuation and the occasional
  incomplete sentence need not be

To be, or not to be:
'Tis the duty of the senior engineering student to uphold
  the duties of relaxing, slacking, taking a myriad of
  physical education classes...
  and still graduating.

Author Bio: Victor Chen is a fifth-year chemical engineering student that has redefined the term "senior slide." His class schedule this semester includes black music, ballroom dance and kendo. He still plans on graduating in May.



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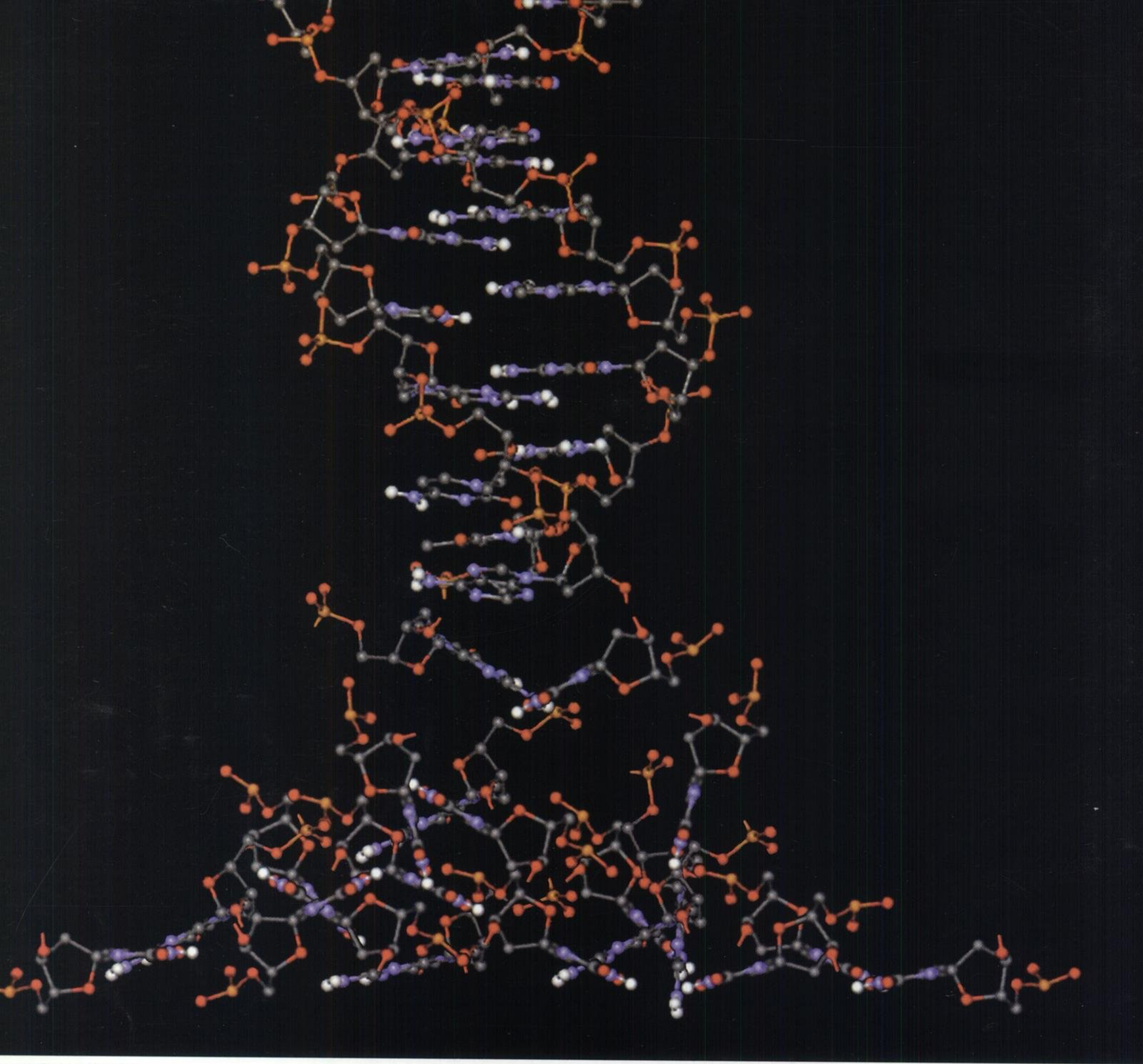

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