SPRING 2006

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COLLEGE OF BIOLOGICAL SCIENCES

Leaders in the Field

DAVID TILMAN, REGENTS PROFESSOR OF ECOLOGY, AND HIS COLLEAGUES USE CEDAR CREEK NATURAL HISTORY AREA AS A LIVING LABORATORY TO LEARN HOW FOSSIL FUELS AND NITROGEN FERTILIZERS ARE CHANGING GLOBAL ECOSYSTEMS. SEE STORY ON PAGE 9.

Biology is bubbling up into other scientific fields

Robert Elde, Dean

BiO

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A REPORT ON THE FUTURE OF SCIENCE AND ENGINEERING AT THE UNIVERSITY OF MINNESOTA CONFIRMS THAT BIOLOGY SUPPORTS A GROWING NUMBER OF FIELDS AND THAT CBS IS WELL POSITIONED TO HELP THE UNIVERSITY ADVANCE ITS RESEARCH GOALS.

The report was issued by the Science and Engineering Task Force, a group of scientists from CBS, the Institute of Technology, and the Medical School who were asked to look at the organizational structure of sciences and engineering across the University to improve connections between biology and physical sciences, engineering, biomedical research, agriculture, and environmental sciences. It's one of more than 30 task forces involved in President Bruininks' effort to transform and reposition the University of Minnesota.

The unique structure of science and engineering at the University provides a strong foundation for collaboration among disciplines, according to the task force, which was chaired by Claudia Neuhauser (Ecology, Evolution, and Behavior), Dave Bernlohr (Biochemistry, Molecular Biology, and Biophysics), and Frank Bates from the Institute of Technology. The group's recommendations focused on ways to strengthen collaboration within the existing structure. Here are some of their key recommendations.

- Seek funding for a Science and Technology Interdisciplinary Research (STIR) Institute
- Focus on three high potential areas for intercollegiate research: materials, energy, and environmental genomics.
- Secure training grants to support graduate programs, especially at the interface of biology and engineering.
- And create an undergraduate minor in biological engineering to be jointly administered by CBS and IT.

These ideas align beautifully with goals we at CBS have been working towards for the past several years and they address serious issues such as energy security and global warming. As an administrator the most important contribution I can make is to bring the right people together in the right place, to address important problems, and then let science take its course. That's what I attempted to do with the 1997 reorganization of biological sciences, planning for the Cargill Building for Microbial and Plant Genomics, and the Initiative for Renewable Energy and the Environment. The task force has taken this approach to the next level. I know that they have made an extraordinary effort and I sincerely thank them for their work.

If you would like to read this report or any others, you may do so at http://www1.umn.edu/systemwide/strategic_positioning/tf_recommendations.html

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Cover photo by Tim Rummelhoff

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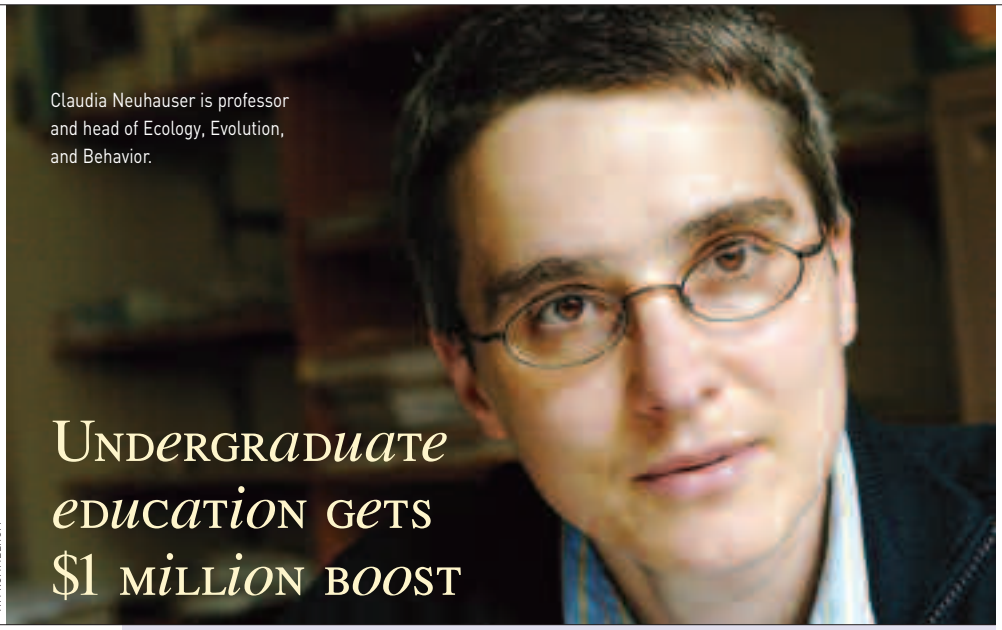


Claudia Neuhauser is professor and head of Ecology, Evolution, and Behavior.

TIM RUMMELHOFF

Undergraduate education gets $1 million boost

FROM THE HOWARD HUGHES MEDICAL INSTITUTE

The Howard Hughes Medical Institute (HHMI) has awarded Claudia Neuhauser a $1 million professorship to create innovative educational programs for undergraduates at the College of Biological Sciences.

Neuhauser will use the funds to increase the quantitative proficiency of undergraduates by integrating mathematical approaches and statistics into freshman biology laboratory courses, developing a statistics course for biology students, and training faculty to integrate quantitative approaches and statistics into their courses.

"THIS WILL FILL AN IMPORTANT NEED CREATED BY TREMENDOUS CHANGES IN BIOLOGY."

—Claudia Neuhauser

"This will fill an important need created by tremendous changes in biology, particularly at the molecular level where massive amounts of data are now available to ask questions we could only dream about 20 years ago," Neuhauser says.

Neuhauser, professor and head of Ecology, Evolution, and Behavior, is one of 20 science educators nationwide awarded the four-year, $1 million professorships. The grants enable leading researchers to work with undergraduates and develop innovative, laboratory-based models for teaching science. Neuhauser is a mathematician who works at the interface of ecology and evolution. Her research addresses effects of spatial structure on community dynamics.

GRANTS AND AWARDS

Friedrich Srienc (Biotechnology Institute) received a three-year, $700,000 grant from the National Institutes of Health for "Design and Construction of Efficient Reaction Networks." Arkady Khodursky (Biochemistry, Molecular Biology, and Biophysics) is co-principal investigator. This work involves redesigning a metabolism reaction network to operate more efficiently—that is, cells containing these modifications will grow to much higher densities from a given amount of sugars. This study will provide better quantitative understanding as to how the metabolism operates and develop the tools to enhance the efficient production of any metabolite such as ethanol, lactic acid, or protein.

Robin Wright (CBS associate dean) received a grant from the National Science Foundation, Division of Molecular and Cellular Biology, of $459,000 over three years for her research titled "Cold adaptation in yeast: the role of ER-associated degradation and sterol metabolism." Her co-principal investigator is Martin Bard from Indiana University-Purdue University, Indiana. The research will lay the foundation for exploration of the genetics, molecular and cellular biology, and physiology of cold adaptation in yeast. The project also provides training opportunities for students. At least one graduate student and six undergraduate students will be involved.

Pete Snustad

Pete Snustad (Plant Biology) has been elected a fellow of the American Association for the Advancement of Science (AAAS). He was honored for genetic dissection of bacteriophage T4-induced nuclear disruption and host DNA degradation and for molecular analysis of the tubulin gene families of *Arabidopsis thaliana.* Snustad, who has been a CBS faculty member for 37 years, is co-author with Mike Simmons of "Principles of Genetics," a textbook used by universities worldwide. An induction ceremony was held during the AAAS annual meeting, which was held in St. Louis, Missouri, in February.

Jennifer King (Soil, Water, and Climate and EEB) and Sarah Hobbie (Ecology, Evolution, and Behavior) received a $570,000, four-year grant from the National Science Foundation to study photodegradation of plant litter in grassland ecosystems.

CBS faculty share in collaborative research grants

FROM THE MINNESOTA PARTNERSHIP FOR BIOTECHNOLOGY AND MEDICAL GENOMICS

The Minnesota Partnership for Biotechnology and Medical Genomics has awarded $15 million in state-funded research support to nine research teams and five infrastructure support teams from the University of Minnesota and Mayo Clinic. The $15 million was the second installment of a state commitment to the Partnership.

Applications for the projects in medical research were requested last fall. Each had to be a project that could not be completed by either organization on its own, and co-principal investigators were to be named from each institution. Final selection for the two-year grants was made with input from an outside panel of national experts.

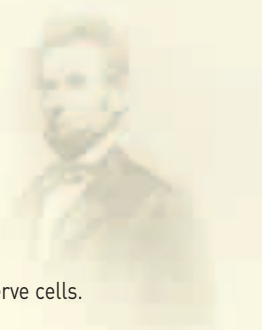
Approximately $9 million will fund research projects in pancreatic cancer, tuberculosis, and brain tumors, as well as cardiovascular, neuromuscular, and autoimmune diseases. Other projects will focus on transplant rejection, drug addiction, and cancer drug development. The remaining $6 million will support equipment, software, and other infrastructure needs to enhance molecular research, genomics, proteomics, and bioinformatics.

David Largaespada (Genetics, Cell Biology, and Development) is co-investigator of a project to better understand malignant glial cell tumors in the brain, with the goal of developing new methods to find cancer genes and design new therapies.

Gary Nelsestuen and Carrie Wilmot (Biochemistry, Molecular Biology, and Biophysics) will participate in teams providing infrastructure support—Nelsestuen in proteomics and bioinformatics; Wilmot in using x-ray crystallography to solve macromolecular structures important to human health and disease.

The Minnesota Partnership for Biotechnology and Medical Genomics is a unique collaborative venture among the Mayo Clinic, University of Minnesota, and State of Minnesota. The partnership seeks to position Minnesota as a world leader in biotechnology and medical genomics applications that will result in important new medical discoveries, thereby improving health care for patients and supporting the development of new business and jobs in Minnesota.

in print



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Laura Ranum (Genetics, Cell Biology, and Development) and colleagues have discovered the gene responsible for a type of ataxia, an incurable neuromuscular disease. This is the first neurodegenerative disease shown to be caused by mutations in a protein called spectrin II that plays an important role in maintaining the health of nerve cells.

Understanding the effects of abnormalities in this protein, which provides internal structure to cells, will clarify how nerve cells die and may provide insight into other diseases, including amyotrophic lateral sclerosis (Lou Gehrig's disease) and Duchenne muscular dystrophy.

The finding also has historical implications—the gene was identified in an 11-generation family descended from the grandparents of President Abraham Lincoln, with the president having had a 25 percent risk of inheriting the mutation.

The research was published in the February print issue of *Nature Genetics,* and posted online January 22, 2006.

TIM RUMMELHOFF

Helene Muller-Landau

Helene Muller-Landau (Ecology, Evolution, and Behavior) is coauthor of a paper published in the January 27, 2006 issue of *Science* showing that nature encourages biodiversity by favoring the growth of rare trees. Muller-Landau contributed quantitative skills for analyzing and interpreting the data. The landmark study, conducted in seven tropical forests worldwide, supports previous research by David Tilman, Regents Professor of Ecology, into the causes and value of biodiversity.

Rare trees may have an advantage because they are less vulnerable to animals, fungi, and microorganisms that prey on common trees and because they don't have the same resource needs as common trees. The new study raises questions about whether other ecosystems, from temperate forests to coral reefs, also select for biodiversity.

Michael Sadowsky (Biotechnology Institute) was featured in an article called "Disease Detectives" in the the March 20, 2006 issue of *Time* magazine. The segment about Sadowsky, called "Keeping Beaches Safe," describes how he uses marker DNA and a robotic system to identify the sources of *E. coli* bacteria that may pose a health hazard at public beaches. "With cities and states across the country spending billions on new water-quality systems, the impact of Sadowsky's work could be huge," according to *Time*.

Jim Cotner (Ecology, Evolution, and Behavior) is coauthor of an article titled "Effect of Microbes on Contaminant Transfer in the Lake Superior Food Web" published in the November 9, 2005 issue of *Environmental Science and Technology*. The study shows that bacteria, which are a primary food source for other organisms in Lake Superior, absorb large amounts of PCBs, which are subsequently passed up the food chain. Lead author is Matthew Hudson, environmental biologist with the Great Lakes Indian Fish and Wildlife Commission. Deb Swackhamer (Environmental Health Sciences, School of Public Health) was also a coauthor.

CBS alumnus triples scholarship gift

WITH U OF M, EMPLOYER MATCHES

CBS alumnus Kien Nguyen and his wife, Julie Warren, have created an endowed scholarship for undergraduate students majoring in genetics. The couple's donation was increased more than threefold by matching funds from Johnson & Johnson (their employer), TCF Bank, and the University of Minnesota.

Nguyen and Warren pledged $2,000 a year for five years, for a $10,000 gift. Johnson & Johnson (J&J) matched it two to one, which added $20,000. And Nguyen's first pledge payment was doubled through the TCF match, creating a scholarship endowment of $32,000. The annual endowment payout will be matched by the President's Scholarship Match, making $3,200 available to CBS students each year.

Nguyen graduated from CBS in 1990 with a B.S. in genetics. He earned an M.S. in microbiology from Mankato State University, a Ph.D. in neuroscience from the University of Colorado, and an MBA from Columbia University. Kien, who is global marketing director for BioSurgicals Asia Pacific, a J&J Company, has been with J&J since 2000. Julie studied speech communications at the U of M, 1989-90, and received her B.A. degree from the University of Texas. She has an MBA from St. Thomas.

Julie is an information manager for J&J. The couple lives in Pennsylvania and has a son, Joshua, who is four years old.

Friends may contact Kien at ktnguyen3670@yahoo.com

Kien Nguyen with son Joshua and wife Julie Warren.

Hennen's priorities are raising funds for facilities at Cedar Creek and Itasca field stations and for scholarships and fellowships.

Meet Laurie Hennen

NEW CBS DIRECTOR OF DEVELOPMENT

Laurie Hennen is the new director of development for the College of Biological Sciences. Hennen comes to CBS from Ewald Consulting, an association management firm that operated MNBIO, among other Twin Cities professional associations. At Ewald, she was executive director for three trade associations.

Previously, she held a variety of executive positions with Minnesota Technology, a nonprofit organization that supports economic development of the state's technology industry, where she was employed for nine years. Some of her key accomplishments were developing and writing grant applications, securing funding, developing and implementing strategic legislative plans, and serving on the MNBIO board. Hennen holds a bachelor's degree in business administration. She joined the CBS staff in January. Her priorities are raising funds for new facilities for Cedar Creek Natural History Area and Itasca Biological Station and Laboratories as well as for scholarships and fellowships. Contact her at hennen@umn.edu if you have questions about making a gift to the College.

UEL RECOGNIZED FOR architecture AND COMMUNITY IMPACT

University Enterprise Laboratories (UEL) was honored by University UNITED for architectural excellence and impact on future land use along University Avenue. University UNITED is a coalition of community organizations and business people who work to revitalize the University Avenue corridor through community-based planning and development. The University UNITED Annual Awards are presented to projects that enhance the quality of life along University Avenue.

UEL was designed by Architectural Alliance, with Tom DeAngelo as principal architect.

The University Enterprise Laboratories (UEL) was also featured in an article titled "Getting Started" in the November issue of *Architecture Minnesota.* The article showcases UEL's innovative architecture and laboratory accommodations. Principal architect Thomas DeAngelo describes it as "a kind of laboratory hotel" for fledgling bioscience companies.

Microbial and Plant Genomics Institute

The Plant and Microbial Genetics Institute and the Center for Microbial and Plant Genomics have merged to form the Microbial and Plant Genomics Institute (MPGI). Codirectors are Mike Sadowsky and Neil Olszewski. Sadowsky is a professor of Soil, Water, and Climate and the Biotechnology Institute, and is a member of the Plant Biological Sciences Graduate Program. Olszewski is a professor of Plant Biology and a faculty member in the Plant Biological Sciences Graduate Program. Both are developing ideas to further the institute's mission through enhancing scientific interchange, research, and training opportunities.

Joint career center serves CBS and the Institute of Technology

CBS and the Institute of Technology have merged career centers to better serve students, alumni, and employers. Sharing resources will allow staff to devote more time to developing relationships with employers that could benefit both colleges. The joint office, called the Career Center for Science and Engineering, is located in 50 Lind Hall on the East Bank campus. Services include career counseling and exploration, resume-writing workshops, job postings, and on-campus interviewing. For details, go to www.it.umn.edu/career/index.html. Mark Sorenson-Wagner is director. For more information, call 612-624-4090 or send an e-mail to ccse@umn.edu.

People

Mohamed Abdihalim (B.S. in biochemistry, 2005) is the first U of M student to receive the Jack Kent Cook Scholarship, a national award that provides generous support for high achieving students with financial need. Abdihalim, who is now a student at the U of M Medical School, plans to practice medicine in the U.S. and his native Somalia, specializing in treating and conducting research on infectious diseases such as HIV/AIDS.


Mohamed Abdihalim

Marc von Keitz has been promoted to associate director of the Biotechnology Institute (BTI). Von Keitz has served as program director for the Biotechnology Resource Center (BRC) and managed the BTI Incubator Laboratories. During his tenure, the BRC has been upgraded to a state-of-the-art facility and the incubator laboratories have evolved to become University Enterprise Laboratories.

Cathy Wong Kipper is the new coordinator of multicultural programs for CBS. She will provide leadership for developing a comprehensive approach to multicultural student services within CBS, coordinate programs that promote an appreciation for cultural diversity, and support the enrollment, retention, and academic success of underrepresented students. She is a CBS graduate.

Tony Starfield (Ecology, Evolution, and Behavior) is retiring this year. Starfield received his Ph.D. from the University of Witwatersrand, Johannesburg, in 1965 and then joined the CBS faculty. His research has focused on mathematical modeling for populations and ecosystems. He applied this to look at how decisions are made in conservation biology to develop new paradigms for modeling ecosystem dynamics. Subjects have ranged from the Hawaiian monk seal to Minnesota forests to the effects of global warming on Alaskan tundra.

Three CBS students win Goldwater Scholarships

Kimberly VanderWaal, a CBS honors student majoring in Ecology, Evolution, and Behavior, has been selected to receive a 2006 Goldwater Scholarship. VanderWaal, who works with EEB professor Craig Packer, plans to teach at the university level and study mammalian social behavior.


Kimberly VanderWaal

Two of the other U of M recipients have double majors in the Institute of Technology and CBS. They are Akash Kumar (Chemical Engineering and Biochemistry) and Eman S. Haidari (Chemistry and Genetics, Cell Biology, and Development). Both Kamar and Haidari plan careers in medical research and education.

The scholarships recognize outstanding U.S. sophomores and juniors in science, engineering, and math who plan to pursue graduate studies and research-oriented careers.

TIM RUMMELHOFF

Having trouble with biochemistry? Don't worry. Dr. Anderson's visual aids will show you how all those molecules snap together.

It's a Wonderful Life in the Neighborhood

JOHN ANDERSON IS RETIRING AFTER 39 YEARS AT THE COLLEGE OF BIOLOGICAL SCIENCES

"MY APPROACH HAS ALWAYS BEEN TO MEET STUDENTS WHERE THEY ARE AND BRING THEM ALONG WITH ME."

—John Anderson

John Anderson is a little like George Bailey and a little like Fred Rogers. Like George Bailey, he's always looking out for other people. And his students know that, like Mr. Rogers, he likes them just the way they are.

Those qualities make him one of the best-liked people at CBS. So when he retires at the end of this year, we will wish him well but also wish, a little selfishly, that he weren't leaving.

John arrived at the College of Biological Sciences in October of 1967. Many people don't know that he came here from Oxford University, where he had studied with Francis Crick, who shared the Nobel Prize with James Watson for determining the structure of DNA. (He's not one to brag.)

He was born in Nebraska and grew up on a farm. His father had only an eighth-grade education, but his mother had a bachelor's degree from the University of Nebraska and a master's degree in humanities from Columbia University. "That was quite unusual at the time," he recalls.

John's father died while he was in high school. While helping his mother run the farm, he enrolled at Nebraska State College to study agriculture and became interested in biochemistry. When his mother sold the farm, John went on to the University of Nebraska and for a Ph.D. in biochemistry. He did a postdoctoral fellowship at the University of Wisconsin, Madison, before the stint at Oxford University.

In his 39 years at the College of Biological Sciences, he has taught biology and biochemistry at all levels, conducted his own research, and provided leadership for General Biology and other programs.

John has won nearly every award the University offers for excellence in teaching, as well as a "Nobel Prize" from his students. What's his secret? "It's understanding where students are on their educational journey so that I can meet them and take them from there," he says.

Two former students, David Bernlohr and Tim Ebner, attest to Anderson's knack for teaching. Now department heads, they were advised by Anderson when they were CBS undergraduates.

"John is one of the glories of our university," says Bernlohr, who is head of Biochemistry, Molecular Biology, and Biophysics. "Without his influence, I might not be where I am today."

"I trusted John and knew that he cared about his students," says Ebner, who is head of Neuroscience. He tolerated my youthful lack of focus, yet kept me on course to complete my degree on time. He ignored the fact that I had little talent for biochemistry."

Anderson will miss interaction with faculty and students, particularly the one-on-one meetings with students. "It's very fulfilling to work with students individually to help them get over barriers. That's when you really feel like you've made a difference," he says.

His retirement plans include sleeping late, reading books, enjoying long walks, traveling, gardening, and pursuing interests he hasn't had time for, like becoming better acquainted with Minnesota's flora. He also plans to teach a freshman seminar called "Science, Politics, and Religion." Otherwise, he's just going to see what happens.

"I hear from those who have gone over to the other side that time gets used up there, too," he says.

—PEGGY RINARD

TIM RUMMELHOFF

Tony Dean uses biotechnology to understand ancient events in evolutionary history.

Predicting the past

GENES YIELD CLUES TO ANCIENT EVOLUTIONARY PRESSURES

Most prognosticators try to paint pictures of the future.

Antony Dean, associate professor in the Department of Ecology, Evolution, and Behavior and the Biotechnology Institute, predicts the past instead. He and colleagues use molecular-level analysis, genetic engineering, and experimentation to study selection pressures that gave rise to modern-day biochemical traits.

"We've been involved in reconstructing an adaptive event that occurred 3.5 billion years ago," Dean says. "We're finding a way to make historical adaptation an experimental science."

Dean and colleagues study a family of enzymes known as isocitrate dehydrogenases (IDH), which bacteria use to extract energy from glucose. To do their job, these enzymes require a helper molecule, or coenzyme. For most bacteria, the coenzyme is a substance known as NAD. But about 3.5 billion years ago, at least three distinct lines of IDH began using a coenzyme called NADP instead. What was happening, Dean asked, that made a preference for NADP evolve three separate times? And how did IDH change in the process?

To find out, he and colleagues altered the IDH found in *Escherichia coli,* a bacterium that uses the NADP system today but which had evolved from an NAD-using ancestor. The researchers strategically switched six amino acids that shape the cubbyhole in IDH into which NADP normally fits. In the process, they produced an *E. coli* IDH molecule into which NAD fit even better—the equivalent, Dean says, of re-creating the enzyme function as it existed before the mystery conditions caused it to evolve NADP preference.

"WE'RE GOING TO TRY AND RERUN THE TAPE OF LIFE."

—Antony Dean

With both NAD-binding and NADP-binding versions of *E. coli* in hand, Dean set out to test conditions that might favor one or the other. He suspected that an environment in which acetate had to be used for food might favor the NADP-based system. To test that, he grew IDH-NADP *E. coli* and engineered IDH-NAD *E. coli* on acetate and on glucose. As predicted, the NAD-using bacteria grew best on the glucose, while the NADP-using ones grew best on the acetate.

Dean and colleagues also engineered an IDH-like molecule, IMDH, which normally uses NAD as its coenzyme, to use NADP instead. As before, they chose replacement amino acids based on their knowledge of molecular structures. "So we not only engineered it, we engineered it the way nature did it," he says.

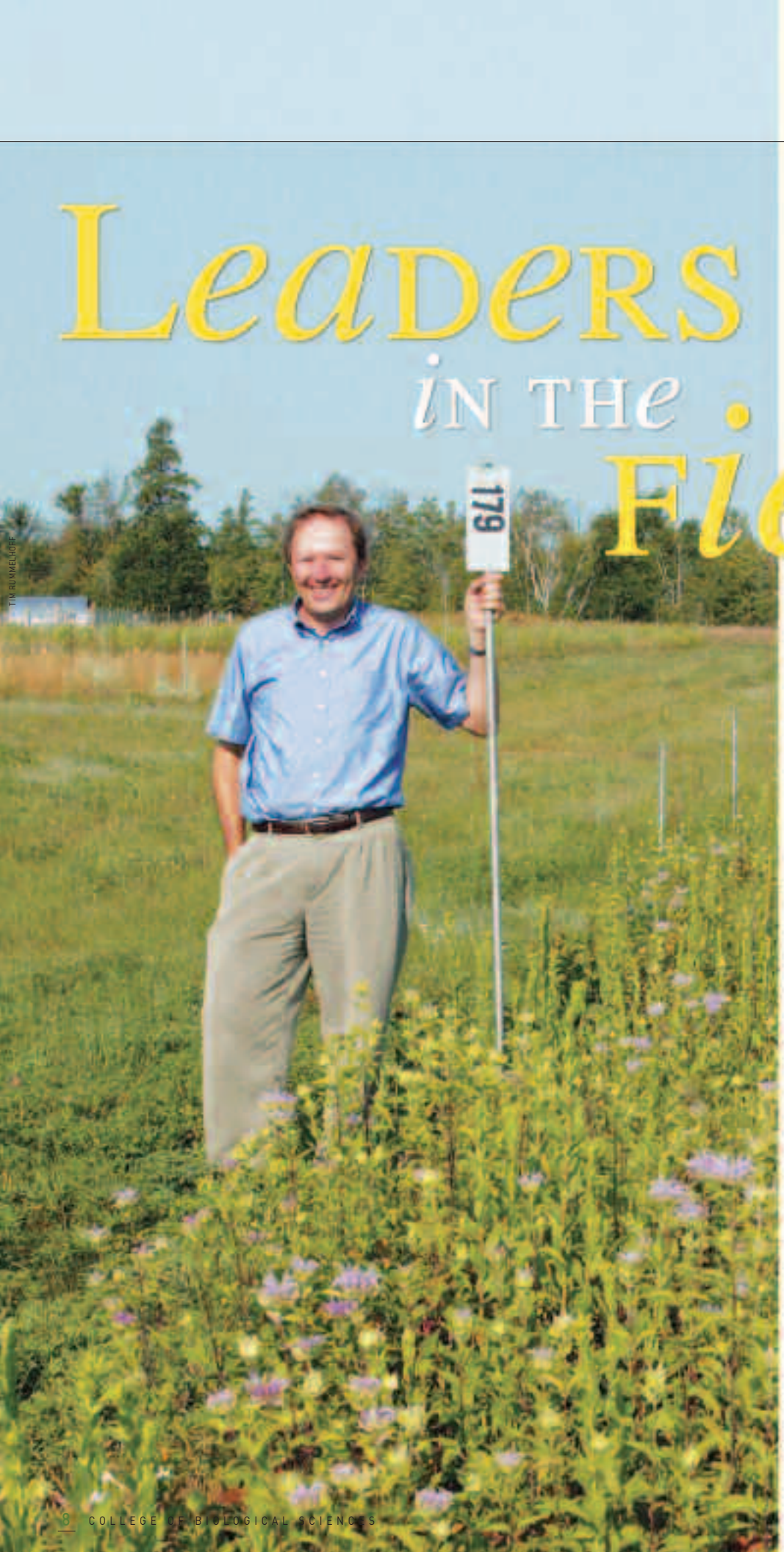
Dean and colleagues have now engineered *E. coli* that can't grow on acetate in hopes of seeing if they can get the IDH-NADP system to re-evolve in the face of acetate-based selection pressure. "We're going to try to rerun the tape of life," he says.

Dean says the U of M is a perfect place to pursue work at the interface of evolution and biochemistry because of the way the biological sciences disciplines are organized.

"This is a very unusual place to be," he says.

—MARY K. HOFF

Leaders in the Field



TIM RUMMELHOFF

CONCERNS ABOUT GLOBAL WARMING AND OTHER ENVIRONMENTAL ISSUES ARE RAISING THE STAKES FOR ECOLOGY RESEARCH. TO MEET THE CHALLENGE AND MAINTAIN THE ECOLOGY PROGRAM'S LEADERSHIP, THE UNIVERSITY'S FIELD STATIONS AT CEDAR CREEK AND ITASCA—WHERE ECOLOGY RESEARCH AND EDUCATION ARE CARRIED OUT—NEED NEW FACILITIES AND EQUIPMENT.

"THERE IS NO BETTER ENVIRONMENT FOR NURTURING AN APPRECIATION OF BIOLOGY. IT'S IMPORTANT FOR ALL ASPIRING BIOLOGISTS TO HAVE AN UNDERSTANDING OF BIOLOGY AT THE ECOSYSTEM SCALE."

—CBS Dean Robert Elde

Living Labs

There are two laboratories at the University of Minnesota that look just a little different from the rest. They are enclosed by the sky and the earth rather than concrete, steel, and glass. And they are simply but elegantly furnished with trees, native plants, lakes, and streams.

Cedar Creek Natural History Area and Itasca Biological Station are living laboratories and museums of Minnesota's natural history that provide valuable research and educational opportunities for University faculty and students.

Each field station has features that make it suited to different kinds of research.

Cedar Creek, located just 30 miles north of the Twin Cities, represents a variety of North American terrestrial ecosystems, including prairies, oak savannas, and pine forests.

Itasca Biological Station and Laboratories, located in Itasca State Park (four hours northwest of the Twin Cities) provides access to an abundance of aquatic ecosystems, including the headwaters of the Mississippi, Lake Itasca, and numerous bogs, ponds, and streams.

Both have been part of the University of Minnesota for decades. The Itasca field station was established nearly 100 years ago to train forestry students. Field biology programs have been offered since 1935. The Minnesota Academy of Science acquired Cedar Creek and turned it over to the University in 1942.

Cedar Creek has played a key role in the history of ecology. The legendary Raymond Lindeman, a University graduate student, produced his famous theory about how energy moves through levels in a food chain when he was at Cedar Creek in the early 1940s. Electronic technology for tracking the movement of animals within their habitats was developed at Cedar Creek in the1960s. And in the 1990s, David Tilman published research conducted at Cedar Creek proving that biodiversity stabilizes ecosystems.

Itasca, which has focused on field biology education, has provided generations of biology students with an appreciation of nature that can't be replicated in a classroom or laboratory.

Investment in both field stations has been minimal, especially relative to their value over the years. The only research facility at Cedar Creek is Lawrence Laboratory, which was built in 1956.

Both field stations are operating beyond their capacities. Their modest facilities can't accommodate the number of people who want to use them, and they aren't up to the challenges of ecology research and education in the 21st century.

Molecular biology and genomics have advanced by leaps and bounds over the past 20 or 30 years. Those advances are providing new insights into how ecosystems operate.

"There's a convergence of molecular biology and ecosystem ecology," says Robert Elde, dean of the College of Biological Sciences. "The research we do at Cedar Creek and Itasca needs to reflect that."

"The science of ecology is evolving and expanding," says Jeff Corney, associate director of

RICHARD ANDERSON

Cedar Creek. "It's becoming a laboratory-based science." Scientists are moving beyond what's happening to plants above ground and taking a

"THE SCIENCE OF ECOLOGY IS EVOLVING AND EXPANDING."

—Jeff Corney

closer look at the biogeochemistry of the soil, Corney explains. Ecology is getting increasingly technical and reliant on laboratory infrastructure.

Robert Sterner, professor and former head of Ecology, Evolution, and Behavior, explains that ecologists need to work on a much larger scale than they have in the past to address issues such as global warming and other changes in the biosphere caused by human activity.

"We have asked all the easy questions, the questions that can be answered working with

RICHARD ANDERSON

small containers, on small plots. Now we need to work on a larger scale," Sterner says. "Larger scale experiments are more realistic, encompass more biodiversity, and can run longer."

Other public universities are meeting the challenge. Facilities at the University of Michigan's ecology field station include a 24,000-square-foot lakeside laboratory, a stream simulation facility for stream ecology experiments, a new underground laboratory for studying interaction between soil microbes, invertebrates, and tree roots, and a tower for studying exchange of gases between forests and the atmosphere. UC Berkeley has installed an underground observation building adjacent to a creek at its biodiversity field station in the Sierras. Viewing windows enable faculty and students to observe stream research and a web cam allows remote monitoring.

"There's a big difference between studying a jar of lake water in a lab and studying it while it's still in the lake," says Claudia Neuhauser, professor and head of Ecology, Evolution, and Behavior. "That's why field stations are becoming increasingly like labs, equipped with very sophisticated equipment. This is a much more effective way to monitor natural environments in order to get the volume of information we need to address big problems like global warming."

Corney says that research conducted at Cedar Creek has broken ground in ecology since the field station was acquired by the University 60 years ago. But he wonders if the field station can hold onto that status without competitive investments.

Cedar Creek Natural History Area

THE SCIENCE OF ECOSYSTEM ECOLOGY WAS BORN HERE.

"Until about 60 years ago, field biologists were naturalists, not ecologists," says David Tilman, Regents Professor of Ecology and one of the world's most cited ecologists. "They made observations about species and families of flora and fauna. They didn't do research to understand relationships within an ecosystem."

Then Raymond Lindeman took the step that transformed ecology into an analytical science. By measuring the flow of energy and nutrients through ecosystems, he discovered the principle of trophic dynamics, which quantifies the amount of energy available to organisms based on their place in the food chain, from primary producers such as algae and plants to top-level predators. The "Trophic Dynamic Aspect of Ecology," published in 1942, became the foundation for the science of ecosystem ecology.

"WE HAVE ASKED ALL THE EASY QUESTIONS, THE QUESTIONS THAT CAN BE ANSWERED WORKING WITH SMALL CONTAINERS, ON SMALL PLOTS. NOW, WE NEED TO WORK ON A LARGER SCALE."

—Robert Sterner

"His research was classic," says Tilman, who is director of Cedar Creek. Tragically, Lindeman died shortly before his groundbreaking paper was published in the journal *Ecology*. But, Tilman says, "people still come to Cedar Creek to see the place where he worked."

After that auspicious start, Cedar Creek maintained its place on the leading edge of ecology

"THERE'S A CONVERGENCE OF MOLECULAR BIOLOGY AND ECOSYSTEM ECOLOGY. THE RESEARCH WE DO AT CEDAR CREEK AND ITASCA NEEDS TO REFLECT THAT."

—CBS *Dean Robert Elde*

research with other innovations. In the early 1980s, David Tilman arrived. He won funding from the National Science Foundation, and Cedar Creek was designated a Long-Term Ecological Research (LTER) site. The NSF has supported research at Cedar Creek for more than 20 years.

Long-term experiments at Cedar Creek (led by Tilman and colleague Peter Reich, professor of forestry) focus on rising levels of carbon dioxide in the atmosphere, increased nitrogen from fertilizers in land and water, and decreased biodiversity – three of the most significant ways humans are altering the environment.

One of Tilman's key findings is that biodiversity makes ecosystems more productive and better able to tolerate drought, pests, and other stresses. Use of nitrogen in agricultural fertilizers is reducing global biodiversity. While nitrogen is essential for plant growth, too much of it stimulates growth of a few species at the expense of others and weakens ecosystems.

As they explore these questions, ecologists draw on other disciplines, from genetics to microbiology. In the emerging field of biogeochemistry, for example, scientists study the interactions of plants with microbes, insects, chemicals, and particles in the soil, where much of the world's biomass and diversity are found.

As research has flourished, demands on Cedar Creek have grown. Lawrence Laboratory, constructed in 1956, was designed to accommodate about 12 people.

"On a typical summer day we now have about 120 people out there," Tilman says. "It's a very delicate dance—one group works in the building in the morning and then goes out in the field. In the afternoon, another group comes in. We clear up the dishes in the lunchroom and it becomes a lab or classroom. It's shoulder to shoulder, elbow to elbow." Faculty and students transport samples back to labs in the Twin Cities for analysis.

CBS has plans to add a 12,000-square-foot science and interpretive center and 10,000 square feet of new housing to the field station. The center will include three new laboratories with state-of-the-art equipment, a large multipurpose room for meetings, lectures, and events, and a public exhibit hall, where visitors can learn about environmental issues and research at Cedar Creek. The complex will overlook a biodiversity garden with walking trails.

"We want to show people what we're doing and why it's important," says Tilman, who is leading the effort to raise $7.5 million for the addition.

Itasca Biological Station and Laboratories

MINNESOTA'S WILDEST CLASSROOM

Students have benefitted from outdoor learning experiences at Itasca Biological Station and Laboratories for nearly 100 years. The field station was established in the heart of Itasca State Park in 1909 to train forestry students and opened to biology students in 1935.

TIM RUMMELHOFF

Planned $7.5 million addition for Cedar Creek Natural History Area

SCIENCE AND INTERPRETIVE CENTER

- 12,000 square feet for research, education, and outreach program
- New laboratories for analyzing plant, insect, and soil specimens from field experiments
- Public reception area and exhibit hall
- Multipurpose room, computer library, and offices
- Biodiversity garden
- Architects—Rafferty Rafferty Tollefson, who designed the new Visitors Center at the Minnesota Landscape Arboretum

HOUSING FOR STUDENTS AND VISITING FACULTY

- 10,000 square feet of new housing, including cabins, a campground with platform tents, kitchen, and community area
- Lawrence Laboratory will be renovated to provide housing and independent research space for undergraduates.

HOW WILL A WARMER CLIMATE AFFECT THE FOUNDATION OF THE AQUATIC FOOD CHAIN? HOW DO LOW LEVELS OF TOXINS IMPACT AQUATIC LIFE THROUGHOUT THE WATER COLUMN? HOW WILL RISING LEVELS OF CARBON DIOXIDE AFFECT ORGANISMS?

Itasca makes an ideal classroom for teaching biology students about nature because of its location at the headwaters of the Mississippi, its biodiversity, and its sheer natural beauty. The park encloses a stunning collection of old growth pine trees, hardwoods, bogs, ponds, and native Minnesota flora and fauna.

"There is no better environment for nurturing an appreciation of biology," says CBS Dean Robert Elde. "It's important for all aspiring biologists to have an understanding of ecosystem scale, even if they become molecular biologists who study cancer."

That's why Elde initiated Nature of Life, an immersion program that brings all entering CBS freshmen to Itasca for three days to learn about the curriculum at CBS. This and other programs that are bringing increasing numbers of students to the station inspired Elde to launch a plan to improve and expand facilities, which consist of about 70 rustic buildings constructed over the past century for seasonal use.

"They have exceeded their life expectancies," says David Biesboer, director of Itasca and professor of plant biology. A look at the complex confirms that diagnosis. Some have already been condemned or torn down. Others appear to be next in line. In some of the laboratories, the foundation has separated from the walls. And those that remain in fair condition don't meet basic needs for science education in the 21st century.

Last year, Elde launched "Habitat for Biologists," a private fundraising campaign to rebuild cabins at the station. He also hopes to gain support from the legislature to build a $3.5 million campus center with new instructional laboratories, classrooms, computer facility, auditorium, and dining hall. The center would also feature "lake towers," huge cylinders of lake water for controlled experiments on environmental issues such as the impact of global warming on Minnesota lakes.

The field station's location within a state park has limited research, an issue that has long concerned Elde, who believes that biology education needs to be integrated with research.

"We can't use Itasca for research the way Cedar Creek has been used," says Bob Sterner, who studies the role of plankton in aquatic ecosystems. "It just isn't possible to alter nutrients or species in Lake Itasca and then study the effects on the entire ecosystem."

Sterner says there is a solution. The Max Planck Institute for Limnology in Europe has pioneered "lake towers," which are essentially giant test tubes of lake water that rise above ground. The stainless-steel cylinders, more than 30 feet tall and nearly a yard across, are heated to simulate the temperature gradient of natural lakes, which are stratified. Temperature, pH, dissolved gases, and microorganisms can be varied at will, depending on the requirements of an experiment. The towers provide far more control for experiments than a natural lake. Yet they are larger than any aquatic environment that can be simulated in a laboratory.

"The lake towers allow limnologists to scale up from beakers and test tubes to actual lake conditions without sacrificing control," Sterner says. "They would enable us to address issues that are critical for the entire planet and do work that has a dramatic impact on scholarship."

Among the big questions that the towers might help answer: How will a warmer climate affect the foundation of the aquatic food chain? How do low levels of toxins impact aquatic life throughout the water column? How will rising levels of carbon dioxide affect organisms?

"The towers would be unique to the University," Sterner says. "This isn't catching up. It's getting out ahead of the pack. It would allow us to step forward into a leadership position."

Elde plans to use lake towers as the focal point of the new campus center. Students and other visitors could observe ongoing experiments through portals in the towers.

With these kinds of improvements Elde hopes Itasca will become to lake biology what Woods Hole Marine Biology Institute and Friday Harbor Laboratories are to marine biology.

—PEGGY RINARD

Between science and society

LAST YEAR, WHEN MARK BORRELLO RETURNED TO CAMPUS AFTER TAKING PART IN A PUBLIC RADIO CALL-IN PROGRAM ABOUT THE CONTROVERSY OVER TEACHING INTELLIGENT DESIGN AS AN ALTERNATIVE TO THE THEORY OF EVOLUTION, HE MET A MIXED RESPONSE.

"I got largely positive comments from most colleagues," says the assistant professor in the Department of Ecology, Evolution, and Behavior, "but others thought I was too easy on the advocates of Intelligent Design."

From his perspective as a historian of science, "we see that science has nothing to say about the existence of a creator, and the controversy over evolution is largely a cultural dispute, not a scientific one. We're better off when we're clear about that."

As an explorer of the region in which biology, history, and philosophy overlap, Borrello knows that it pays to tread carefully through cultural clashes that involve science. His research focuses on the history of evolutionary theory in the 19th and 20th centuries, as well as the history of genetics and behavioral biology. "My goal is to promote the position that one's religious perspective doesn't matter in terms of science," he says of the evolution debate. "If we understand science as a historical process and acknowledge the parameters within which science works, then faith and science ought to be able to coexist." Yet cultural differences often prevent ideological opponents from finding that common ground.

The controversy over the teaching of evolution, Borrello notes, is uniquely American. "It is not an issue anywhere else in the world. Even in Catholic countries, when I meet with Italian or French colleagues, they are consistently flummoxed by it," he says. He observes that the debate periodically reignites in times of deep social stress, such as the period of rapid modernization between the world wars, when the Scopes "monkey trial" grabbed national attention, and the 1980s, when the rise of conservatism tipped the social balance.

> "THE CONTROVERSY OVER THE TEACHING OF EVOLUTION IS UNIQUELY AMERICAN. IT IS NOT AN ISSUE ANYWHERE ELSE IN THE WORLD."
>
> —MARK BORRELLO

He was drawn to the history and philosophy of science after studying biology as an undergraduate and later working as a forestry volunteer with the Peace Corps in the Dominican Republic. In subsequent work as a researcher for an archaeological consulting firm in Hawaii, Borrello saw history and science interact every day. He completed his Ph.D. in the history and philosophy of science at Indiana University and came to the U of M in 2004.

Borrello believes that this year's judicial decision that prevented the board of education in Dover, Pennsylvania, from bringing Intelligent Design into the classroom will carry lasting importance. "Intelligent Design theory will have to retool and get renamed and get new primary advocates," he says. But the conflict will undoubtedly resurface—a phenomenon that intrigues him.

— JACK EL-HAI

TIM RUMMELHOFF

Mark Borrello's research focuses on evolutionary theory in the 19th and 20th centuries as well as the history of genetics and behavioral biology.

TIM RUMMELHOFF

Cynthia Weinig was recently named a McKnight Land-Grant Professor.

Way to grow

SEARCHING FOR GENES THAT MAKE PLANTS STAND OUT IN A CROWD

IF YOU OR I DON'T LIKE SOMETHING IN OUR SURROUNDINGS—BRIGHT SUN, LOUD MUSIC, THE SMELL OF SAUERKRAUT—WE CAN USUALLY MOVE TO A MORE DESIRABLE SETTING. PLANTS, HOWEVER, DON'T HAVE THIS ABILITY, INSTEAD, THEY MODIFY THEIR GROWTH TO ACCOMMODATE LOCAL CONDITIONS.

This knack for making the most of their circumstances is the subject of study for Cynthia Weinig, assistant professor in the Department of Plant Biology.

"My focus is on understanding genes that allow plants to adapt to their natural settings," Weinig says.

When she joined the College of Biological Sciences in 2002, Weinig brought with her a five-year, $1.7 million National Science Foundation Young Investigator award to study how plants' genes help them cope with crowding. She's been looking at the interaction of two genetically controlled variables, circadian rhythm and shade-avoiding growth, in *Arabidopsis thaliana* and *Brassica rapa* as they struggle to outcompete their neighbors for access to sunlight.

Scientists have long known that a drop in the ratio of red to far-red light activates genes that enable "shade-avoidance" responses such as stem elongation. (Chlorophyll absorbs red light, so a low red-to-far-red ratio suggests the presence of nearby neighbors.) However, most studies of the genetics for shade avoidance have been in controlled settings using plants in which key genes have been deleted. Those studies are of limited value, Weinig says, because the genes may not be those on which natural selection acts today or that account for phenotypic variation. In fact, Weinig has found that variation in only a few of the genes affecting shade avoidance appear to affect current fitness. These genes, interestingly, appear to interact with those controlling circadian rhythms.

> "MY FOCUS IS ON UNDERSTANDING GENES THAT ALLOW PLANTS TO ADAPT TO THEIR NATURAL SETTINGS."
>
> —Cynthia Weinig

Weinig's research not only is improving understanding of the interplay of genes, environment, and structure, it also has practical application. Farmers try to increase yield by increasing plant density. If plants respond with increased stem growth, the production of commercially valuable leaves, roots, and fruits may suffer. "By minimizing shade avoidance, we may well increase crop productivity," Weinig observes.

In related research, Weinig is studying how flowers react to environmental cues. Although floral morphology is thought to be buffered against environmental variation, Weinig has found that expression of floral traits depends in part on the red-to-far-red ratio, photoperiod, and temperature. Because floral morphology affects pollinator effectiveness, such variability could alter the production of fruits and seeds that feed us.

In January the Graduate School and the Office of the Provost named Weinig a McKnight Land-Grant Professor in recognition of her exceptional contributions. The award provides research support for two years as well as a research leave during the second year of the professorship.

"I'm honored," Weinig says. "I appreciate the validation of the work I've done since I've arrived at Minnesota."

—MARY K. HOFF

A matter of degrees

GRAD SCHOOL? LAW SCHOOL? HOW ABOUT BOTH?

Alex Galaitsis knows just what to do if he's "had it up to here" with flasks filled with bacteria: prepare for moot court instead.

A doctoral student in Molecular, Cellular, Developmental Biology, and Genetics, Galaitsis is also earning a law degree through the University's Joint Degree Program in Law, Health, and the Life Sciences. When he graduates, after seven years or so, he hopes to help lawmakers address the interface of science and public policy.

"I'd like going into that kind of environment where someone will ask . . . 'What does the state of science say on this issue?'" he says. "Having a law degree opens up a whole lot of new doors."

> "I HOPE TO HELP LAWMAKERS ADDRESS THE INTERFACE OF SCIENCE AND PUBLIC POLICY."
>
> —Alex Galaitsis

The joint degree program is built in layers like the meat and cheese in a submarine sandwich. Galaitsis, who has a degree in biology, began with law school. He describes it as "kind of like jumping into cold water."

"There's something so stressful about the first year," he says. "It's probably good just to dunk yourself in, jump out and dry off, and move on."

Except for a seminar for joint degree students, his second year was that of a typical CBS graduate student. This year he continued in the Ph.D. mode, but added moot court. It's a challenging mix.

"I've been doing biology for almost two years—then suddenly I have to write a legal brief using proper citations," he says. "It gets frustrating. But it's kind of nice to be thinking about both sides of the program."

Galaitsis has been working with Distinguished McKnight University Professor Larry Wackett on alternative fuels research funded by the Initiative for Renewable Energy and the Environment (IREE). The researchers are studying bacteria isolated from sewage sludge that turn biomass into a waxy substance full of hydrocarbons. That substance has potential to be reshaped into the active ingredients in gasoline. Because it's made from new biomass and doesn't contain sulfur, it avoids the stigma that fossil fuels carry regarding contributing to global warming and acid rain.

"Right now, basically we want to find the gene or genes that are responsible for this totally new (at least in bacteria) metabolic pathway," Galaitsis says. Once the researchers do that, they or someone else could use that knowledge to develop bacterial "factories" that eat plant materials and give off gasoline or diesel precursors.

Because this research is aimed at finding environmentally sound substitutions for fossil fuels, it's a good fit philosophically for Galaitsis.

"My sense of wonder that I find in the universe and in life has always been something that comes out of nature and the wilderness," he says. "Doing something that can help to keep that around a little longer—that's definitely rewarding for me."

—MARY K. HOFF

TIM RUMMELHOFF

Alex Galaitsis is studying bacteria that turn sewage into biomass, which could be used to make gasoline that's easy on the environment.

Alan Price earned his Ph.D. in biochemistry under Huber Warner, who is now CBS associate dean for research.

Scientific skulduggery

ALUMNUS ALAN PRICE, WHO HEADS FEDERAL INVESTIGATIONS INTO RESEARCH FRAUD, HAS MADE A CAREER OF STALKING SCIENTISTS WHO MISREPRESENT RESEARCH RESULTS.

WHEN IT COMES TO SCIENTIFIC FRAUD, PLAGIARISM, FALSIFICATION, AND FABRICATION, ALAN PRICE (PH.D. '68) IS AN EXPERT. HE HAS BUILT A CAREER OUT OF RESEARCH MISCONDUCT, AND FEW VARIETIES HAVE ESCAPED HIS ATTENTION.

From 1989 through his retirement this year, Price has worked as an investigator and administrator first in the Office of Scientific Integrity of the National Institute of Health (NIH), and later in the Office of Research Integrity (ORI), an independent entity within the U.S. Department of Health and Human Services. He ends his career as ORI's associate director. His work has given him a close-up look at the schemes of people who lie, forge, cheat, and deceive in the name of science.

Colleagues and whistleblowers often launch the process that leads from a suspect's home institution to the ORI. The ORI usually steps in to rule on possible sanctions after the institution makes a preliminary investigation involving allegations of the misuse of NIH funding. "This work requires a completely different view of science than what you need in the lab," Price says. "Here you're like Dick Tracy — you have to be suspicious of everything. You look at notebooks, files, and data and try to figure out whether there is a case for misconduct, or whether the accused person is innocent or simply incompetent."

Price began his career on a more traditional track. After working as the first Ph.D. candidate in the biochemistry lab of Huber Warner, now CBS associate dean, Price spent seven years on the faculty of the University of Michigan Medical School. A sabbatical in Denmark left him doubtful that he was cut out to succeed as a researcher, "I came back, looked at my lab, and wondered whether I could do this for another 40 years," he says. Gradually, as he moved into positions with administrative oversight for research at Michigan and the NIH, "I found that I was a more imaginative research administrator than researcher."

At the ORI, Price has looked into scores of examples of serious research malfeasance, which his agency has investigated at a rate of about eight cases per year. In what he believes was one of the ORI's most important cases, Eric T. Poehlman of the University of Vermont was found in 2005 to have falsified and fabricated data in an influential study of aging and in associated NIH grant applications. Poehlman, who Price believes was motivated by ego, was barred from receiving federal funding for life. In another recent case, the ORI determined that neurosurgical researcher Jessica Lee Grol of the University of Pittsburgh had fabricated research records for 15 subjects. She was debarred from federal funding for three years.

> "HERE YOU'RE LIKE DICK TRACY—YOU HAVE TO BE SUSPICIOUS OF EVERYTHING."
>
> —ALAN PRICE

"Nobody really knows why a few researchers do these things — why they don't want to take the time to do their work right," Price says. "We've investigated technicians, students, and faculty members. Some say they already know what their research results will be, so they make them up and hope that no one will know the difference."

— JACK EL-HAI

Note: Alan and his wife, Katharine, are retiring to Texas. Their e-mail address is alankathprice@earthlink.net.

Class notes

Irwin Goldstein (Ph.D. in Agricultural Biochemistry, 1956) continues his research as professor emeritus at the University of Michigan in Ann Arbor, where he has been a faculty member for 40 years. Before going to Michigan, he did his Ph.D. research with Professor Fred Smith, an internationally known carbohydrate chemist; he was a Guggenheim Postdoctoral Fellow in London and a NIH Special Fellow in Stockholm. Goldstein has had a research grant on protein-carbohydrate interaction for 40 years, which makes it the longest running grant at the University of Michigan.

Lynn Rogers (M.S. in Ecology, 1976; Ph.D. in Ecology, 1977) is continuing the black bear research she began in 1968 as a grad student of Al Erickson in the Department of Ecology and Behavioral Biology. Now, she and her grad students are building the North American Bear Center (www.bear.org) in Ely and conducting black bear courses, largely, she says, "taught by the bears themselves."

Jane Gillette Wattrus (B.S. in Biology, 1981) received her M.S. in Environmental Science in 1993 from the University of North Texas. Currently a faculty member in the biology department at College of St. Scholastica, Duluth, she will be presenting a paper entitled: "Environmental Ethics, Evolution, and Intelligent Design: What Would Darwin Say?" at Oxford University, England, in July 2006.

Kelly Bode Iyadurai (B.S. in Genetics and Cell Biology, 1996; M.S. in Molecular, Cellular, Developmental Biology and Genetics, 2002) and husband Stanley Iyadurai (Ph.D. in Molecular, Cellular, Developmental Biology, and Genetics, 1998) now reside in Phoenix, Arizona. Kelly works in a cancer research lab at the Translational Genomics Research Institute. Stanley completed his M.D. from the University of Minnesota in 2004 and is now completing his medical residency in neurology at the Barrow Neurological Institute. They have two boys, ages three and one.

Leif Dahleen (B.S. in Biochemistry; B.S. in Genetics and Cell Biology, 1998) will finish his residency in anesthesiology at the University of Florida this June and will begin traveling as a *locum tenens* physician.

Angie Vasquez (B.S. in Biology, 1998) returned to graduate school at the U's Carlson School of Management for master's degrees in Health Administration and in Business Administration. After completing her degrees in May 2004, she moved to New York City for a fellowship at North Shore-Long Island Jewish Health System. After a brief career break, volunteering and traveling in South America for three months, she plans to return to the U.S.

Jessica Bell (Ph.D. in Biochemistry, Molecular Biology, and Biophysics, 2001) is finishing her postdoctoral fellowship at the National Institutes of Health and will begin as an assistant professor in the Department of Biochemistry at Virginia Commonwealth University - Medical College of Virginia in fall 2006.

Matthew Dufek (B.S. in Neuroscience, 2002) has been working at Hennepin County Medical Center researching the pharmacological effects of nicotine and the development of a new immunotherapy for treatment of nicotine abuse. He plans to continue his education with a Ph. D. in pharmaceutics and pharmacokinetics, by selecting a graduate school this spring.

Rachel Mann (M.S. in Applied Plant Sciences, 2003) is now working as a technical services scientist at Promega Corporation in Madison, Wisconsin.

Jessica Dreis Nguyen (B.S. in Biology, 2003) was married in October 2003 and has a 17-month-old son named Johnathan. She is in her second year at the U of M College of Pharmacy.

Bynthia M. Anose (Ph.D. in Biochemistry, Molecular Biology, and Biophysics, 2004) is an assistant professor of biochemistry at Bethel University in St. Paul.

Kristopher Nielsen (B.S. in Biology, 2004) is a lieutenant in the U.S. Air Force and is currently stationed at Minot AFB, North Dakota. He graduated from his technical training with honors. He also just began his master's in education and plans to teach biology after he completes his air force career.

Ted Sibley (B.S. in Biology, 2004) started medical school last fall at the University of Minnesota. He will be in the graduating class of 2009.

— EMILY JOHNSTON

Calendar

Commencement

Saturday, May 13, 7:30 p.m.
Reception on the Plaza, 6:00 p.m.
Northrop Auditorium

UMAA Annual Celebration

Tuesday, May 23
Northrop Mall and Auditorium

Sandra Day O'Connor, recently retired Justice of the United States Supreme Court, will be the special guest and keynote speaker at the UMAA's 102nd Annual Celebration. In 1981, O'Connor became the first woman ever confirmed to the nation's highest court. She was often known to be the moderate "swing vote" on an increasingly polarized court.

Individual tickets start at $55 per person for the dinner and program, and $30 for the program only. Student tickets are available for $15. (All prices are subject to a ticketing fee.)

Complete ticket pricing and event information is available at www.alumni.umn.edu/oconnor .

The UMAA's Annual Celebration is presented by Gray Plant Mooty and The Mooty Foundation.

Habitat for Biologists

Dean Elde would like to thank everyone who donated money or time to the Habitat for Biologists campaign to improve facilities at Itasca Biological Station and Laboratories. Thanks to your support, a new cabin for women students has been completed. To date, $43,000 of the needed $50,000 has been raised for this project. Donors have contributed $61,000 of $150,000 needed to rebuild historic cabin #4, which was built in 1911. If you would like to contribute to either of these, please use the enclosed envelope or contact Laurie Hennen at hennen@umn.edu.

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PLANT BIOLOGY

DNA 'fingerprinting' technique

separates hemp from marijuana

Hemp and marijuana, both members of the species *Cannabis sativa*, look identical. The difference is that marijuana contains high levels of the psychoactive drug tetrahydrocannabinol (THC). Consequently, since 1937, it has been illegal to grow cannabis in the U.S. This has prohibited growing hemp—which has potential economic, environmental, and health benefits—as a crop.

Plant biologist George Weiblen hopes to develop a variety of hemp that can be grown in the U.S.

But a new DNA fingerprinting technique developed by George Weiblen, assistant professor of plant biology, and Shannon Datwyler, a former postdoctoral associate, makes it possible to distinguish varieties of *Cannabis sativa*. Weiblen believes the technique, which relies on genetic markers, may be a first step toward developing a hemp variety suitable for the United States.

"Our goal is to develop a crop alternative for Minnesota farmers," Weiblen says. There is no annual fiber crop that can be grown in Minnesota. The weather is too cold for cotton. Hemp is very durable and produces its own defense against pests, which is good for the environment. And the seeds, which are rich in healthy fatty acids, can be used in a variety of food products. There's a growing market in the U.S. for hemp products, but the law requires them to be imported.

Meanwhile, the technique can be applied to marijuana as evidence in criminal cases, which could help identify drug sources and distribution networks. It may also prove useful in countries where growing hemp is permitted but marijuana is illegal, as in Canada and Europe.

The work appears in the March issue (volume 51, No. 2) of the *Journal of Forensic Science.*

Weiblen, whose research focuses on co-evolution of fig trees and insects in rain forests, became interested in the research because of genetic similarities between fig trees and Cannabis. Because Cannabis has much shorter generations, it provides a good model system for studying the fig genome, much like studying fruit fly genetics helps scientists understand human genetics.

A few years ago, Governor Ventura commissioned a task force to look into the feasibility of growing hemp in Minnesota. Weiblen offered to help. Thus far, he has used a Packard Fellowship to support the work, but he is seeking public or private funding. His ultimate goal is to learn enough about the Cannabis genome to produce a drug-free hemp plant that looks different than marijuana.