SPRING 2007

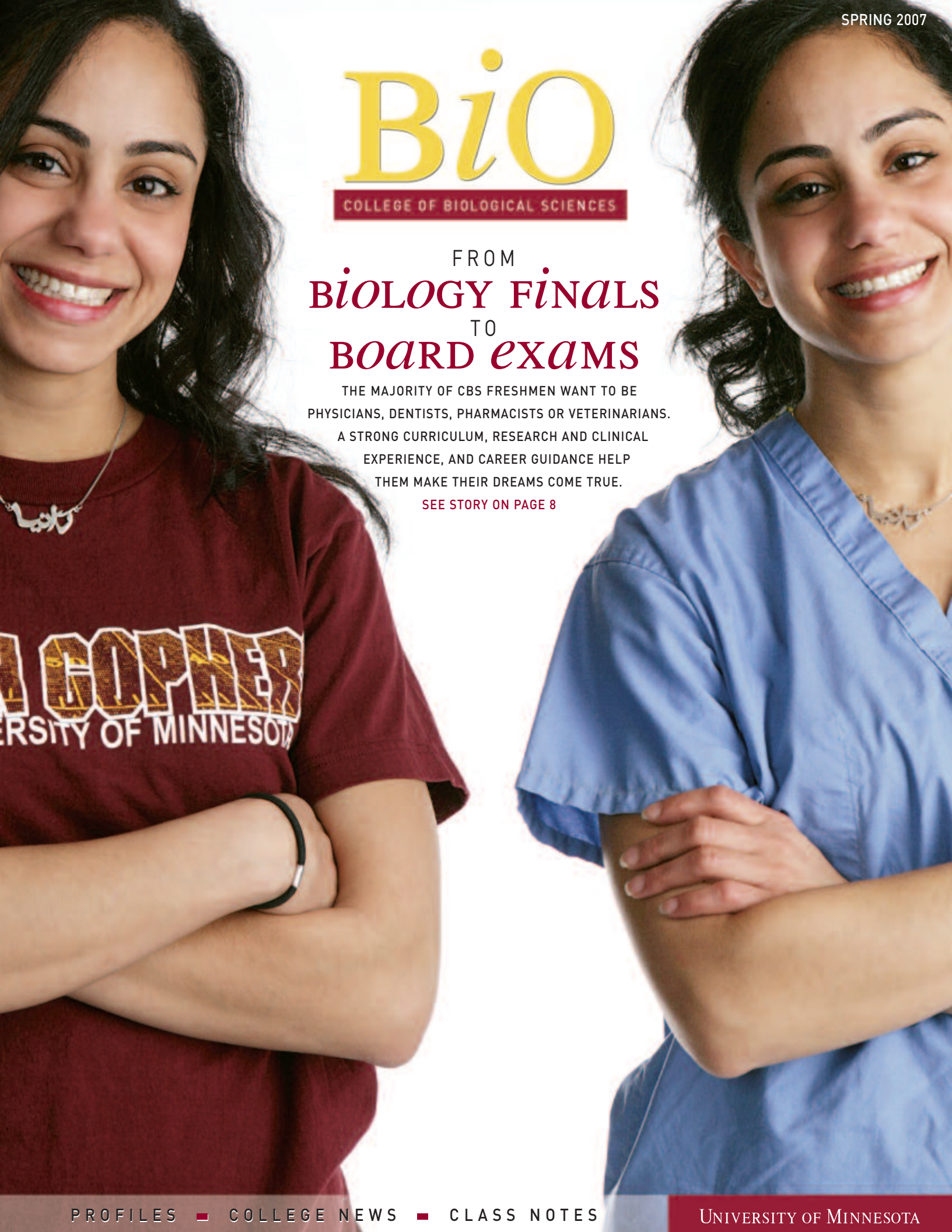
BiO

COLLEGE OF BIOLOGICAL SCIENCES

FROM BIOLOGY FINALS TO BOARD EXAMS

THE MAJORITY OF CBS FRESHMEN WANT TO BE PHYSICIANS, DENTISTS, PHARMACISTS OR VETERINARIANS. A STRONG CURRICULUM, RESEARCH AND CLINICAL EXPERIENCE, AND CAREER GUIDANCE HELP THEM MAKE THEIR DREAMS COME TRUE.

SEE STORY ON PAGE 8



Robert Elde, Dean

BiO

SPRING 07 ■ Vol. 5 No. 2

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Shawn Welch
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Administrative Assistant

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Printing

CBS helps undergrads

REACH CLINICAL CAREER GOALS

WITH ALL THE NEWS ABOUT BIOFUELS AND ENVIRONMENTAL RESEARCH COMING OUT OF THE COLLEGE OF BIOLOGICAL SCIENCES LATELY, IT'S EASY TO FORGET THAT WE DO LOTS OF OTHER THINGS. ONE OF THE MOST IMPORTANT IS TO PREPARE STUDENTS FOR PROFESSIONAL PROGRAMS AND CAREERS IN THE HEALTH SCIENCES. THE MAJORITY (80 PERCENT) OF INCOMING CBS FRESHMEN EXPRESS INTEREST IN THE HEALTH SCIENCES AND MORE THAN HALF OF OUR HONORS GRADUATES ENTER PROFESSIONAL PROGRAMS IN THE HEALTH SCIENCES.

When I became dean of CBS a dozen years ago, the first thing I did was to ask students what they wanted to be. The answer was almost always a doctor or a dolphin trainer. A lot has changed since then. Advances in molecular biology and biotechnology have launched dozens of new career opportunities. And the glamour of forensic science may outshine the glamour of dolphin training.

But one thing hasn't changed. Our students, who are ever more qualified when they arrive here, still want to be doctors, as well as dentists, pharmacists, veterinarians, nurses, physical therapists and public-health professionals. In fact, according to an exit poll conducted by Student Services, more than half of our honors graduates say they plan a career in health care.

I like to think that they came to the right place. We provide a very rigorous curriculum in the fundamentals of biology, from molecules to ecosystems. We offer opportunities to work with U of M faculty on research into just about every disease that affects human beings. And, through the Health Careers Center—a joint effort with the Academic Health Center—we help students make the transition to professions in the health sciences.

The latest addition to these offerings is the Health Sciences Track, which was approved by the Board of Regents in December 2006. In essence, this new program allows us to grant bachelor-of-science degrees to students who leave after three years with us to enter a health professional program in pharmacy, dentistry or veterinary medicine anywhere in the United States. These students can count the first year of professional school toward their B.S. degree. The program, which is retroactive five years, gives students an added degree and a place in our alumni community.

This is the frosting on a pretty nice cake for young people who come to the University with an interest in health care. CBS is one of few colleges in the country that focuses on biological sciences and the Academic Health Center offers programs in just about every clinical discipline there is. That's a combination that's hard to beat. But if you want to be a dolphin trainer, you'll still have to transfer to San Diego. We haven't figured that one out yet.

Robert Elde, Dean
College of Biological Sciences
elde@umn.edu

Visit our Web site at www.cbs.umn.edu.
For address changes, please contact Jean Marie Lindquist at lindq011@umn.edu or 612-625-7705.

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In Every Issue

Cover Story

Features

Cover photo by Tim Rummelhoff

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Nutrient overload

EXTRA WATER AND NUTRIENTS LIMIT BIODIVERSITY

Too much of a good thing (nutrients or water) actually decreases the diversity of species in an ecosystem while it increases the productivity of a few species, according to a grassland experiment conducted by David Tilman, Regents Professor of Ecology, and W. Stanley Harpole, a former University of Minnesota graduate student who is now a postdoctoral associate at the University of California, Irvine. Their findings were published in the online version of the journal *Nature* in April.

The reduction in species diversity occurs because increasing the amounts of limiting resources, such as nitrogen and water, makes an ecosystem more homogeneous and consequently reduces the number of opportunities for competing species to coexist.

"THE LOSS OF PLANT SPECIES FROM A HABITAT DUE TO NUTRIENT POLLUTION CAN PERSIST FOR MORE THAN 100 YEARS."

—David Tilman

"In essence, the data in the article strongly supports a new explanation for why the world contains so many species," Tilman says. "It shows that plant diversity is directly related to the number of limiting factors (such as soil moisture, nitrogen, phosphorous, potassium and water)." The study was carried out in a Santa Ynez Valley reserve in Southern California.

The findings help explain why grasslands, lakes and rivers that are polluted with nitrogen and phosphorous (usually from agriculture) have fewer species. The reduction of species where the Mississippi River empties into the Gulf of Mexico is one of the best-known examples of this phenomenon.

KEY TO ECOSYSTEM CHANGE UNDER FOOT

How fast leaves and grasses decompose can tell scientists a lot about the controls on carbon cycling. That's what makes the findings of a study co-authored by Jennifer King and published in the January 19 issue of *Science*, so intriguing. The results of the 10-year study of the rate of plant litter decomposition at nearly two dozen sites could help scientists predict ecosystems' response to climate change.

Jennifer King

King, an assistant professor with a joint appointment in the Department of Ecology, Evolution and Behavior (EEB) and the Department of Soil, Water and Climate; Carol Adair, a post-doc in EEB and Forest Resources; graduate student Leslie Brandt; and researchers from a handful of other universities studied how nitrogen is released into the soil and carbon dioxide into the atmosphere as plant litter decomposes. As a result of this study, scientists will be better able to predict both the rate of decomposition and carbon dioxide release—a key factor for predicting climate change—across a wide range of ecosystems.

"The results should make it easier to make large-scale estimates about how rates of decomposition will respond to climate change," King says. "It also gives scientists more information about how nutrients in soil behave in a broad range of ecosystems."

The researchers studied the process at 21 sites across seven of the world's biomes: coniferous forests, temperate deciduous forests, deserts, grasslands, rainforests, shrublands and tundra.

Organ development

IN SHARPER FOCUS

A team of researchers, led by **Stephen Ekker,** associate head of the Department of Genetics, Cell Biology and Development, has identified a group of novel genes critical to organ development. The international multi-institutional study included scientists from the Max-Planck Institute of Immunology and the Carnegie Institute. The group studied the roles of genes in the zebrafish secretome that make proteins located on the surface or outside of cells in the body. The genes are responsible for directing "patterning" in the body or ensuring that cells divide, differentiate and migrate to properly form vital organs in the correct places during development. "The different gene phenotypes found in the collection give us a new level of resolution for how these organs develop," Ekker says. The results were published online at *PLoS ONE* in December 2006.

Stephen Ekker's research has yielded important clues to how genes regulate cell division, differentiation and migration to form vital organs.

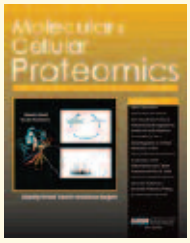
in print

A study led by **Gary Nelsestuen** (Biochemistry, Molecular Biology and Biophysics) has uncovered a variant of a common blood protein in people of American Indian and Mexican ancestry linked to elevated body mass index, obesity and Type 2 diabetes. The findings were published in the February 2007 edition of the *International Journal of Obesity*. (See page 13 for the complete story.)

Scott Selleck, director of the Developmental Biology Center, led a team of researchers that has identified a region of chromosome 10 susceptible to recurrent chromosome rearrangements. The region affects genes critical for normal neural and behavioral development. Disruptions of genes in this region affect language development and may contribute to disorders such as autism. Results of the study appear in the May issue of the *American Journal of Human Genetics.*

Naoko Shima (Genetics, Cell Biology and Development) and her research team published a paper in the January 2007 issue of *Nature Genetics* suggesting that the hypomorphic alleles of specific genes can increase breast cancer risk.

In the April 2007 issue of *Molecular & Cellular Proteomics,* **David Bernlohr** (professor and head of BMBB) and colleagues show that obese mice that do not adequately process glucose (obesity-linked insulin resistance) also produce chemically active lipids that can modify many proteins. The discovery represents an important step toward understanding the cause of obesity-linked insulin resistance and its connection to oxidative stress. The researchers' next step will be to determine which proteins are functionally linked to the development of insulin resistance. Co-authors include Timothy Griffin, Paul Grimsrud and Matthew Picklo, Sr. The story is featured on the cover.



The critical role of a specific protein in guiding cell division has just become a little clearer with the results of a study led by **Duncan Clarke** (Genetics, Cell Biology and Development). The study, published online at *PLoS ONE* in December 2006, offers insight into how DNA catenations (one of two forms of cohesion that keeps cells together until mitosis) are regulated in human cells.

The study determined that the protein plays a crucial role in accurate cell division and may be an important factor in preserving the integrity of the genome during development and adult cell division.

TWO CBS FACULTY RECEIVE MCKNIGHTS

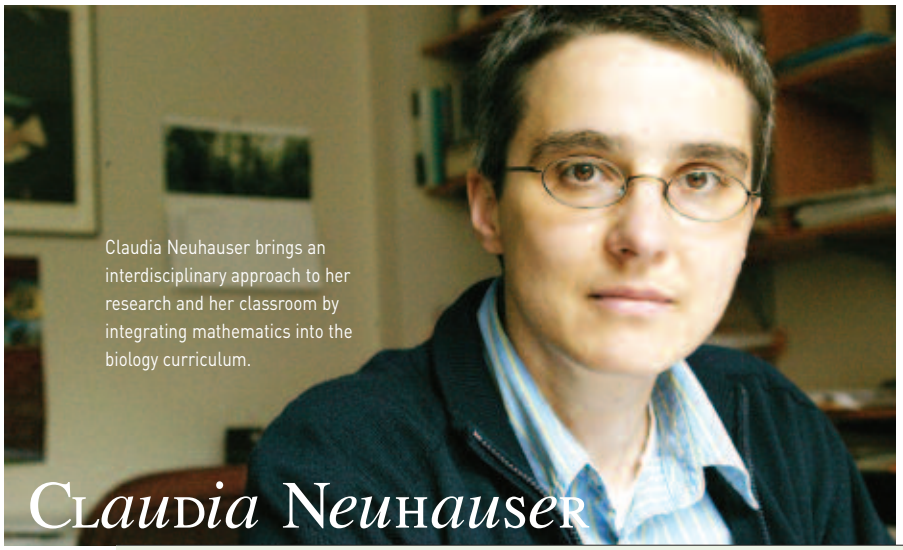
Daniel Bond and Helene Muller-Landau are among 11 University of Minnesota faculty named 2007–08 McKnight Land-Grant Professors. The award, given to highly promising junior faculty, consists of a research grant, summer support and a research leave. "I'm very proud of Daniel and Helene and the many other talented young faculty who have joined CBS in the past few years," says Bob Elde, dean of the College of Biological Sciences.

NEW INSTITUTE TAPS TILMAN, WACKETT

David Tilman, Regents Professor of Ecology, and Lawrence Wackett, Distinguished McKnight University Professor, are among 15 faculty members selected as founding fellows of the University of Minnesota's new Institute on the Environment. The institute is tasked with coordinating the University's environmental resources across disciplines to make it easier for researchers to share knowledge with each other and the public. Tilman and Wackett will help create the foundation for bringing the University's wide-ranging environmental experts together.

U VIES FOR $125M RESEARCH GRANT

The University of Minnesota is in the running for a $125 million federal grant to establish a Center for Bioenergy Research. More than 100 participants from the University of Minnesota (including almost two dozen from the College of Biological Sciences), MnSCU, a number of other universities around the country, and private sector participants are involved. The center would serve as the basic science research arm of the planned National Center for Biofuels Research at the University of Minnesota. The awards will be announced this summer.



Claudia Neuhauser brings an interdisciplinary approach to her research and her classroom by integrating mathematics into the biology curriculum.

Claudia Neuhauser

NAMED DISTINGUISHED MCKNIGHT PROFESSOR

Claudia Neuhauser, head of the Department of Ecology, Evolution and Behavior, has been selected as a Distinguished McKnight University Professor by the University of Minnesota Graduate School and the Office of the Provost.

Recipients are chosen based on their research, educational and community contributions. A $100,000 grant accompanies the award.

CLAUDIA'S EFFORTS TO INTEGRATE MATHEMATICS INTO UNDERGRADUATE BIOLOGY CURRICULUM HAVE LED TO RECOGNITION BOTH WITHIN AND BEYOND THE UNIVERSITY.

Neuhauser, who authored a calculus textbook geared toward biology undergraduates titled *Calculus for Biology and Medicine,* works at the interface between mathematics and biology. She brings a unique quantitative perspective to the discipline—both as an educator and a researcher—at a critical time in its evolution.

Neuhauser's research addresses the effects of spatial structure on community dynamics. She is developing new mathematical tools to model, analyze and interpret biological data. She conducts research in population genetics and has developed statistical tools based on genealogical analysis of samples of genes.

Her efforts to integrate mathematics into undergraduate biology curriculum have led to recognition both within and beyond the University. She was named Howard Hughes Medical Institute Professor and has received the Morse-Alumni Award for Undergraduate Education. The National Science Foundation has awarded Neuhauser two $3 million grants to support research and training initiatives.

Neuhauser has also played a vital role in the University's strategic positioning efforts as co-chair of the Science and Engineering Task Force. She recently led an effort involving nearly 100 researchers and educators at the University of Minnesota and nearly a dozen partner institutions to create a proposal to establish a Center for Bioenergy Research with one of two $125-million DOE grants to be awarded this summer.

U PROJECT LOOKS AT GOODALL DATA

Jane Goodall visited the University of Minnesota campus in March to see a demonstration of a database that captures 46 years of data collected by the famed researcher and her team at Gombe National Park in Tanzania. The database contains records Goodall donated to the University of Minnesota—from handwritten notes to photos to field data.

Ecologists and computer scientists from the College of Biological Sciences and the Institute of Technology have organized the data to create a comprehensive, accessible resource for primate researchers.

The data focus on chimpanzee behavior and habitat. University researchers are analyzing the data for patterns in everything from female grouping habits to male aggression mating habits.

Go to www.discoverchimpanzees.org for more information about the Jane Goodall Institute's Center for Primate Studies.

Jane Goodall made a special visit to the Center for Primate Studies at the University of Minnesota to see a demonstration of a new database that contains nearly five decades of primate data collected at Gombe National Park.

ALL EYES ON RENEWABLE ENERGY RESEARCH

Gov. Pawlenty signs legislation setting higher renewable energy standards for the state on the St. Paul campus.

The College of Biological Sciences and the Initiative for Renewable Energy and the Environment (IREE) have been drawing attention and interest from politicians and reporters alike in recent months.

In late February, Gov. Tim Pawlenty—joined by Provost Tom Sullivan, Dean Elde, a handful of state legislators and a capacity crowd—signed an historic renewable energy bill within view of the IREE offices, a hub for renewable energy research at the University, on the St. Paul campus. The law, dubbed "25-by-2025," mandates that the state must get 25 percent of its electricity from renewable energy sources by 2025.

Dean Elde has made many trips to the capitol to present to lawmakers at the state Legislature this session. Along with Regents Professor of Ecology David Tilman, he also met with Minnesota's Congressional delegation in Washington, D.C. to brief them on the state of renewable energy research.

Dean Elde and Tilman made their case to the public as well. Both were interviewed in late January for a series on renewable energy research at the University for WCCO's Project Energy. And both have contributed opinion pieces to major newspapers, including the *St. Paul Pioneer Press, Minneapolis Star Tribune* and the *Washington Post,* in recent months. Dean Elde contributed two op-eds to the *Pioneer Press* on the next generation of biofuels and Tilman, along with postdoctoral associate Jason Hill, contributed opinion pieces to the *Star Tribune* and the *Washington Post* on the downside to corn-based ethanol and the upside to biofuel derived from prairie grass.

TIM RUMMELHOFF

The unusual proximity of closely related oak species in an area of north central Florida sparked Cavender-Bares' scientific curiosity.

Puzzling Populations

UNRAVELING AN UNEXPECTED CASE OF CLOSELY RELATED COHABITING SPECIES

FOR MANY, OAK TREES SYMBOLIZE STRENGTH AND ENDURANCE. FOR *Jeannine Cavender-Bares,* THEY REPRESENT A WINDOW INTO THE FASCINATING WORLD OF EVOLUTIONARY HISTORY AND ECOLOGICAL PROCESSES. CAVENDER-BARES USES OAKS TO EXPLORE HOW EVOLUTION AND ECOLOGY INTERACT TO CREATE PATTERNS OF POPULATIONS ON THE LANDSCAPE.

Cavender-Bares began her oak work a decade ago, exploring what to an evolutionary ecologist is a very odd situation: the co-occurrence of many closely related species. According to evolutionary theory, competition should whittle them down to a few best adapted to the setting. Yet in Cavender-Bares' study area, they seemed to be coexisting just fine. By looking at the evolutionary history of the oak species as well as other trees in the same communities, she discovered that the most closely related species were actually the least alike in how they used the habitat on a small scale.

"That was surprising to evolutionary and community ecologists," she says—previous studies had emphasized the similarity of close relatives. But when the analysis included more distant relatives (other tree species, for instance) and broader geographic scales, the impact of the environment on selecting for similar traits became more obvious.

Others are now looking for such patterns in other species and communities around the world; Cavender-Bares is leading an effort herself to further explore the relationship among phylogeny, plant traits and ecological processes using data from federally-funded long-term ecological research (LTER) sites—including the U of M's Cedar Creek LTER.

> "IS IT POSSIBLE TO CHANGE IN A NOVEL ENVIRONMENT?... OR IS A TREE SPECIES LARGELY STUCK WITH WHAT IT EVOLVED WITH?"
>
> —*Jeannine Cavender-Bares*

To understand better the interplay of evolution and ecology, Cavender-Bares has filled several greenhouse rooms with seedlings from nine distinct populations of oaks. By exposing all populations to four different combinations of temperature and rainfall and watching how well they grow, she hopes to learn whether physiological differences exhibited across a species' range are due to genetic differences or variations in how genes they all contain are expressed under the circumstances.

"Is it possible to change in a novel environment?" Cavender-Bares asks. "Or is a tree species largely stuck with what it evolved with?" Results of that research could help predict plants' ability to cope with human-induced habitat alterations such as fragmentation and global warming.

On a more applied level, Cavender-Bares and colleagues have been exploring how one species of live oak regains a footing on former agricultural land in Costa Rica. After looking at a variety of possible explanations for the oak's inability to re-colonize the land (now a nature reserve) on its own, they now believe it is due to shyness: the agouti, a Costa Rican rodent that buries acorns—and in doing, plants the next generation—is afraid of open spaces. To give the oak a boost, Cavender-Bares is hoping to help organize local schools to plant seedlings.

"It's encouraging to think that with relatively easy techniques schoolchildren can use we can bring back ecosystems that have been lost," she says.

—MARY HOFF

Gone Fishing

DISCOVERY-BASED RESEARCH FORAY LANDS A BIG CATCH

Gary Nelsestuen WENT ON A SCIENTIFIC "FISHING EXPEDITION" AND CAUGHT A VARIANT PROTEIN THAT PREDISPOSES PEOPLE OF AMERICAN INDIAN AND MEXICAN DESCENT TO DIABETES.

It's a big fish, in scientific terms, and a great story. It could help prevent diabetes in high-risk groups. It illustrates the value of proteomics research. And it proves that "fishing," or discovery-based research, is worthwhile.

Nelsestuen embarked on his expedition a few years ago when he began using proteomics to screen blood samples for proteins related to diseases. He found one connected to obesity and diabetes in a sample from an American Indian donor.

The protein—apolipoprotein C1—transports cholesterol through the bloodstream.

All humans produce it, but this sample had a variation with characteristics indicating it could be the trigger for a hereditary disease, and diabetes ran in the donor's family.

To further explore the connection, Michael Martinez, a graduate student in Nelsestuen's laboratory, enlisted help from the American Indian Community Development Corporation in Minneapolis and St. Mary's Health Clinics in St. Paul.

Blood proteins from more than 1,000 people of American Indian, European, African, Asian and Hispanic descent were evaluated. The variant was found in 36 of 228 American Indians in the study and 10 of 86 Mexicans, but not in any of the other groups.

Nelsestuen and colleagues published a description of the variant protein in fall 2006. In the February 2007 issue of the *International Journal of Obesity,* they reported that people with the protein tended to have a higher body mass index (an average of nine percent) and higher rates of diabetes. The diabetes rate was even higher when their parents were included in the pool.

> "OUR FINDING SHOWS THE VALUE OF DISCOVERY RESEARCH AND OF HAVING UNRESTRICTED FUNDS TO PURSUE IT."
>
> —Gary Nelsestuen

The variant protein may allow carriers to store food as body fat and survive shortages, says Nelsestuen. This could have provided an advantage when food was scarce.

This project has been a departure for Nelsestuen, known for his discoveries of proteins involved in bleeding and coagulation disorders. The University licensed his blood-clotting proteins to companies that are developing them as drugs. Nelsestuen is recognized on the University's Wall of Discovery for these achievements.

Supported by license income and his endowment from the Samuel Kirkwood Chair, Nelsestuen used mass spectrometry, a tool that reveals protein structure, to screen blood samples for unusual proteins. Called discovery-based research, this approach is 180 degrees from hypothesis-driven research. He is as proud of the source of funding and approach as he is of the discovery itself because they buck the traditional scientific establishment.

TIM RUMMELHOFF

Nelsestuen collaborated on the project with Kim Strand and Medical Director Kenneth McMillan of the American Indian Community Development Corporation in Minneapolis.

"This is dismissed as a fishing expedition by federal agencies, who usually fund only hypothesis-driven research," Nelsestuen says. "But our finding shows the value of discovery research and of having unrestricted funds to pursue it."

Nelsestuen's next steps will be to expand the study to larger and more diverse groups of subjects.

—PEGGY RINARD

Phil Barbosa

CBS class of 2004, Second-year medical student

"I DISCOVERED THAT I WANTED TO GO INTO MEDICINE AS AN UNDERGRAD," SAYS BARBOSA. "I SPENT THREE YEARS WORKING WITH DR. KELVIN LIM IN THE PSYCHIATRY DEPARTMENT ON NEURO-IMAGING PROJECTS RANGING FROM SCHIZOPHRENIA TO AUTISM. … I FOUND I ENJOYED TALKING WITH THE PATIENTS MUCH MORE THAN SCANNING THEIR BRAINS."

The Biology Boost

BIOLOGY UNDERGRADUATES MAKE THEIR MARK IN THE HEALTH SCIENCES

It's no secret that majoring in biology as an undergraduate provides a strong foundation for a professional program in the health sciences. But at the College of Biological Sciences, a biology major is about more than knowing how to dissect a frog, being able to tell the difference between lysosomes and ribosomes or memorizing the location of the occipital lobe. It's about being immersed in research early, finding a community, getting exposed to a unique curriculum and accumulating real-world health sciences experience.

FROM MOLECULES TO ECOSYSTEMS

CBS students with an eye to the health sciences have a unique advantage over their undergraduate counterparts in other colleges: a comprehensive education in living systems. " You can explore every facet of applied biology here at the University of Minnesota—from stem cell biology to agriculture," says Robin Wright, associate dean for faculty and academic affairs for CBS. "That's powerful." And it's only a starting point.

The breadth and depth of the biology curriculum means students are well prepared for health sciences studies. "[CBS] attracts a lot of pre-health sciences students because the courses most health care-related programs require are included in our curriculum," says Sarah Corrigan, assistant director of the CBS Honors Program. "A lot of CBS students go on to medical, pharmacy and dental school at the University—and beyond to Ivy League schools."

CBS alum Paul Ruen (B.S. Biology, '88), a veterinarian in Fairmont, Minn., echoes that sentiment. He points to the grounding in the basics—"the understanding of the way organisms tick"—as a valuable foundation for being a practicing vet. As a student, Ruen says, he was introduced to basic concepts as well as specialized topics such as endocrinology, immunology and biochemistry that provided him with a solid knowledge base for a career in the health sciences.

Students at the University also have access to introductory courses in health sciences professional programs. For example, Ashley Gray, now a second-year student at the University of Minnesota's College of Pharmacy started out with the idea of entering a physical therapy program. However, at the urging of her adviser, she took an introductory pharmacy course in her freshman year at CBS and discovered her passion for the subject.

"[AT CBS] STUDENTS ARE EXPOSED TO ALL OF THE BIOLOGICAL SCIENCES, NOT JUST GENETICS AND MICROBIOLOGY."

—Rania Habib

PHOTOS BY TIM RUMMELHOFF

A NEW TRACK

CBS just made it easier than ever for students to pursue their interests in the health sciences

Many professional programs in the health sciences do not require students to complete a bachelor's degree before entering a program. The new Health Sciences Track—introduced this spring—makes it possible for students who leave after three years at the College of Biological Sciences to enter a health professional program in pharmacy, dentistry or veterinary medicine anywhere in the United States to use credits from their first year of professional school toward their undergraduate degree. CBS is the only college at the University of Minnesota set up to grant degrees in this way.

The program, which is retroactive for five years, provides both closure and a sense of continuity. "Getting an undergraduate degree matters to students," says Assistant Dean Jean Underwood. "With the new Health Sciences Track, they're not cut off from the College of Biological Sciences when they go on to professional school. They continue as part of our community."

A COMMUNITY OF STUDENT-SCIENTISTS

Catherine Casey (B.S. Biology, '82), a gynecological oncologist based in Minneapolis, doesn't hesitate when asked what made her undergraduate experience at the College of Biological Sciences most valuable. "First and foremost were the other CBS students, many of whom had similar goals." More than half of CBS honors grads plan to go on to advanced study in one of the health sciences, according to an annual exit poll conducted by CBS Student Services. When incoming freshmen are asked about their goals, about 80 percent of them say they plan to enter health-related careers.

That commonality of intended careers provides fertile ground for building connections to the health sciences at the undergraduate level. It's one of the reasons CBS helped lead the effort five years ago to launch the Health Careers Center, which offers a wide variety of educational opportunities designed to introduce undergraduates to the realities of working as a health professional in the complex world of health care. And that means more than just an emphasis on medical school.

"HAVING A SMALLER COMMUNITY, BEING PUSHED TO HIGH EXPECTATIONS AND GIVEN ALL THE OPTIONS... SHAPED MY CONFIDENCE AND HELPED ME FIND MY PATH AND PURPOSE."

—Ashley Gray

"CBS fosters knowledge of the other health sciences," says Rania Habib, a second-year student at the University of Minnesota School of Dentistry. "[Without the CBS experience] you don't really hear about dentistry and pharmacy." CBS undergraduate advisers help guide students and urge them to explore courses in their fields of interest early.

BRIDGING THE GAP

Seeing a need to create a bridge between undergraduates and the health sciences programs, Dean Robert Elde went one step further. He played a critical role in creating the Health Careers Center, which connects the University's six health sciences professional programs and the Center for Allied Health with undergraduate programs. "You won't find a center like this in most universities," says Judy Beniak, director of the center. It's something that grew out of the need to serve undergraduates and create a more seamless transition to professional programs.

The center offers information sessions, workshops, credit-courses and special events. Undergraduates can take introductory courses in pharmacy, veterinary medicine, nursing and other professions. "This allows our students to envision themselves in traditional and emerging health careers early in their educational experience," Beniak says.

The Health Careers Center also facilitates courses that take students to the next level. Those interested in medicine, for example, can enroll in "The Future Physician," a class developed in conjunction with the Medical School. Highly motivated and talented students are invited to enroll in the course to learn about different pathways in medicine, meet medical school faculty and observe roles of physicians through experiential education in a hospital or community setting. "It's taught by Kara Pacala, a family practice doctor and designed to give students a real sense of what it's like to be a physician," Beniak explains.

ALL-IN-ONE EDUCATION

CBS is one of only a few colleges nationwide that focuses on biological sciences. And the University is unique within the academic world for the breadth of its health sciences

Ashley Gray

Second-year pharmacy student

"TAKING THE CBS CURRICULUM—[SUBJECTS] LIKE ORGANIC CHEMISTRY—I KNEW PHARMACY WOULD BE A CHALLENGE," GRAY SAYS. SHE STARTED HER UNDERGRADUATE STUDY WITH AN EYE TO PHYSICAL THERAPY, BUT DISCOVERED AN AFFINITY THAT ULTIMATELY PROPELLED HER IN A DIFFERENT DIRECTION. SHE'S NOW A STUDENT AT THE UNIVERSITY OF MINNESOTA COLLEGE OF PHARMACY, ONE OF THE TOP-RANKED PROGRAMS IN THE COUNTRY.

programs. With schools of medicine, dentistry, pharmacy, nursing, veterinary medicine and public health, it's one of the few universities with every discipline represented.

Students with an interest in health sciences are directed toward cutting-edge research and real-world health care environments early so that they can get a feel for what a career in the health sciences is really like. The fact that many health sciences are represented at the University means students have access to career exploration, research opportunities and information about the full range of options.

"There are so many options for a CBS undergraduate," Gray says. While an undergraduate herself, she gained a taste of what working in the health sciences might be like. She volunteered at Fairview-Riverside Hospital, and worked in a pharmacy and an infusion clinic where she observed drugs being administered to cancer patients.

"[CBS STUDENTS] ARE INVOLVED IN RESEARCH IN THE LABS OF PEOPLE WHO ARE DISCOVERING CURES FOR CANCER AND DOING STEM-CELL BIOLOGY."
—Robin Wright

Her undergraduate experiences made a world of difference for Habib, too. She had planned to go to medical school, but exposure to the round-the-clock demands of the medical milieu while working in the experimental surgical services unit made her re-evaluate that goal. She joined the pre-dental club—one of many health sciences groups on campus—and found herself increasingly drawn to dentistry for its emphasis on preventative care as well as the patient rapport and even the artistry involved.

Phil Barbosa, a second-year student at the University of Minnesota Medical School, discovered that his interest in bedside manner outweighed his love of the lab. After working in a neuroimaging lab for three years, he found himself drawn to the human element; a realization based on firsthand experience. Says Barbosa: "I found I enjoyed talking with the patients much more than scanning their brains."

Rania Habib

CBS class of 2004, Second-year dental student

"I ENTERED CBS WITH THOUGHTS OF GOING ON TO MEDICAL SCHOOL," HABIB SAYS. SHE SPENT TIME AS AN UNDERGRAD RESEARCH ASSISTANT IN THE DEPARTMENT OF SURGERY DURING HIGH SCHOOL AND AS AN UNDERGRADUATE WORKING ON, AMONG OTHER THINGS, EARLY DETECTION OF SEPTICEMIA, A LIFE-THREATENING INFECTION. HABIB'S EXPERIENCES AS AN UNDERGRAD NUDGED HER TOWARD DENTISTRY, A FIELD SHE FEELS SUITS HER FAR BETTER THAN MEDICINE.

"Dozens of diseases are being studied as well as being treated," points out David Bernlohr, head of biochemistry, molecular biology and biophysics.

"Medicine in general is paved by basic research," adds Casey. "I worked in Dr. Snustad's genetics lab during my entire senior year. ... It gave me some great research experience that was useful at various points in my life when I revisited basic research." Ruen concurs. "These were great experiences that exposed me to the world of research and introduced me to the possibilities and necessities of constantly incorporating new knowledge into my work world. ... I have many opportunities in my work day to use data analysis and field and clinical trials to generate information and convert that to knowledge."

That balance of research and clinical experiences creates well-rounded students, but it's also a key ingredient to cultivating future faculty. "Exposure to clinical practice and research is key to cultivating the next generation of professors in health sciences programs," Wright points out.

MEETING THE DEMAND

With a surge in demand from an aging population, the need for well-trained doctors, dentists, pharmacists and health care providers of all disciplines—not to mention health sciences faculty to teach the next generation—is paramount. Whether they end up enrolled at a professional school at the Academic Health Center or across the country at Harvard or UCLA, CBS paves the way for undergraduates to move into the health sciences to meet that need.

New undergraduate coursework to be introduced this fall will take CBS's comprehensive biology curriculum a step further. Molecular and ecosystem problems will be integrated into the same course to get at what Associate Dean Wright describes as "multiple levels of complexity." Students will get a complete picture of living systems, from micro to macro.

—STEPHANIE XENOS

RESEARCH-READY

CBS undergraduates have worked on research related to a range of major illnesses including:

- Diabetes
- Septicemia
- Heart disease
- Schizophrenia
- Stroke
- Cancer
- Autism
- Alzheimer's

RESEARCH MEETS REAL LIFE

Working in a lab as an undergraduate used to be more exception than rule. Now, it's *de rigeur* in undergraduate programs at universities across the country. The emphasis on inquiry and hands-on learning experiences at CBS is particularly useful to students looking to make a transition to the health sciences. CBS undergraduates have numerous research opportunities, many of them cutting-edge.

TIM RUMMELHOFF

Gianluigi Veglia uses magnetic resonance to study the structure of membrane proteins.

Mission Possible

DECODING THE STRUCTURE OF MEMBRANE PROTEINS IS GIANLUIGI VEGLIA'S KIND OF CHALLENGE

Gianluigi Veglia GAZES FONDLY AT A BIG PATCH OF EMPTY FLOOR IN A CONCRETE-LINED ROOM FULL OF HIGH-TECH DEVICES ON THE GROUND LEVEL OF NILS HASSELMO HALL. "THAT'S BASICALLY WHY I DECIDED TO COME HERE," HE SAYS.

Not for the vacant space, of course, but for what will soon occupy it: A 700 MHz solid-state nuclear magnetic resonance (NMR) spectrometer. That machine will make it possible for Veglia, associate professor of chemistry and biochemistry, molecular biology and biophysics, to pursue his passion: exploring the structure and function of proteins found in membranes within cells.

Figuring out the conformation of proteins—how the long strands of amino acids that comprise them fold up into three-dimensional shapes—is a hot topic in biology today. The structure determines the function, and protein malfunction is an important contributor to a lot of diseases. Proteins are the worker bees of cells, and, like house keys and socket wrenches, their structure is central to their function. By learning what biologically active proteins are shaped like, chemists like Veglia hope to contribute to understanding and correcting conditions in which they aren't doing their job.

Working with University of Minnesota NMR facility director David Thomas and Susan Taylor at the University of California, San Diego, Veglia is currently focusing on three proteins found in membranes inside muscle cells. These proteins play a key role in the rhythmic contraction of the heart, and mutations in the genes that code for these proteins are linked to heart malfunction. If the researchers can figure out the structure and how the three proteins interact, Veglia says, they'll have gone a long way toward developing interventions for such disorders.

"We all want to make molecular frameworks that can serve as templates for developing new therapies to ameliorate muscle disease," he says. "It helps to know this research makes a huge difference."

For a molecule made from thousands of atoms, that's far more easily said than done. The standard procedure for figuring out a non-membrane protein's conformation is to use a combination of X-ray crystallography and solution NMR to produce clues about what atoms are next to what other atoms, then surmise from that the overall layout. It can take years. And for membrane proteins, it's even tougher. Only solid-state NMRs and specialized research teams like Veglia's have the ability to pull that off. Since the first protein structure was solved 50 years ago, more than 35,000 others have been unraveled. Only 100 or so of those are membrane proteins—even though membrane proteins hold the most therapeutic potential.

> THE STRUCTURES OF MORE THAN 35,000 PROTEINS HAVE BEEN UNRAVELED, BUT ONLY ABOUT 100 OF THOSE ARE MEMBRANE PROTEINS EVEN THOUGH THEY HOLD THE MOST THERAPEUTIC POTENTIAL.

"The membrane protein is really the beast," Veglia says. "That's the way my life is organized, to do the most complicated thing, the most challenging and exciting thing."

Veglia's eventual vision is to help establish the U of M as a center for excellence in membrane proteins. Arrival of the 700 MHz NMR in May will be a major move in that direction.

"This is a real step forward in the study of membrane proteins," he says.

—MARY HOFF

One for the Rhodes

CBS SENIOR NAMED RHODES SCHOLAR

Katie Lee, AN UNDERGRADUATE STUDENT IN THE COLLEGE OF BIOLOGICAL SCIENCES, WILL JOIN THE RANKS OF ACADEMIC ROYALTY IN SEPTEMBER WHEN SHE TRAVELS TO OXFORD UNIVERSITY TO TAKE HER PLACE AS A RHODES SCHOLAR.

Lee, who will receive a bachelor's degree in biochemistry (CBS) and chemistry (Institute of Technology) this May, plans to earn a master of science degree in immunology at Oxford and return to the United States to complete an M.D./Ph.D program. The dual degree will qualify her to conduct laboratory research and care for patients in order to develop new and better treatments for cancer and other diseases.

Not surprisingly, Lee's CV includes other prestigious awards. She declined a Marshall scholarship offered the week before to accept the Rhodes invitation. Her other credits include a two-year Goldwater Scholarship for undergraduates, a Maroon and Gold Leadership award and the L.M. Henderson Biochemistry Scholarship.

Lee became a full-time student at the University of Minnesota when she was only 15 through the Post-Secondary Education Opportunity Program (PSEOP), which allows advanced students to complete high school while attending the University and earning college credits.

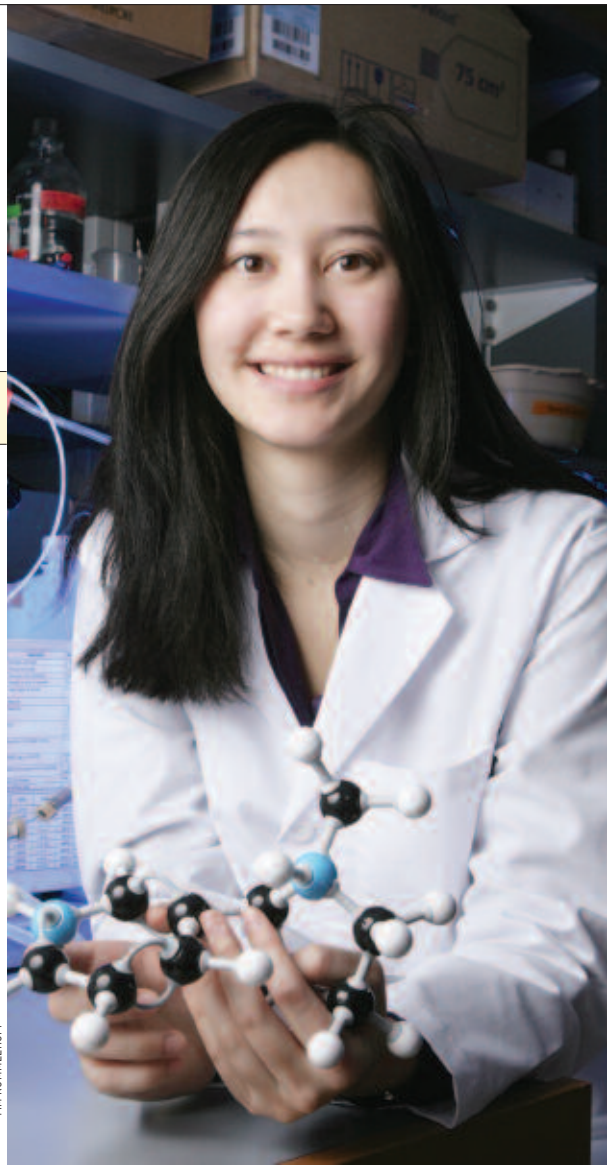
That head start positioned her to graduate from the University early, but she took her time to pursue a double major in biochemistry and chemistry and to gain lots of research experience. She has done research at the University with Medical School faculty members Timothy Behrens on lupus, an autoimmune disease, and with Sharon Murphy on the metabolism of nicotine, the addictive chemical in tobacco. And she has spent two summers in Harvard University's summer undergraduate honors program conducting research with Karl Munger on the human papilloma virus.

Lee, who has studied violin since she was two years old, is also an accomplished musician. In spite of her busy class and lab schedule, she has found time to play the violin for the University's student orchestra and has served as its concertmaster.

"Music has taught me dedication, persistence and the importance of collaboration," she says—qualities that have guided her work in biomedical research.

Her teachers say her personal qualities are as impressive as her academic ability.

"Katie stands out as perhaps the most impressive undergraduate student I've met in 40 years of teaching and advising," says Pete Magee, professor of genetics, cell biology and development. "She's an exceptionally talented scientist, an accomplished musician and remarkably mature for her years."



TIM RUMMELHOFF

Rhodes Scholar Katie Lee plans to conduct cancer research next year at Oxford University.

"In addition to her superb work in the classroom and the laboratory, Katie is a delightful person," says Paul Siliciano, director of undergraduate studies for biochemistry. "She is very modest and sincere. Although she likes to talk about music, she does not let on that she is concertmistress of the University of Minnesota Student Orchestra and an award-winning violin player."

—PEGGY RINARD

TIM RUMMELHOFF

Jeff Carpenter helps guide the process of converting basic research into marketable technologies.

The Market-placer

BRINGING UNIVERSITY INVENTIONS TO THE MASSES

HE'S STUDIED FORESTRY AND ECOLOGY, RESEARCHED GENE EXPRESSION IN PLANTS, DEALT WITH ENVIRONMENTAL POLICY ISSUES AND WORKED FOR A START-UP COMPANY. TODAY, JEFF CARPENTER (PH.D., '91) USES ALL OF THESE SKILLS TO MOVE SCIENTIFIC INNOVATIONS OUT OF THE LAB AND INTO OUR LIVES.

As director of biological, engineering and computer technologies at the University of Minnesota's Office for Technology Commercialization (OTC), Carpenter draws on his background in science every day. Yet, scientific expertise alone won't persuade companies to commercialize University inventions. That takes business savvy.

After earning his Ph.D. in cell and developmental biology, Carpenter spent 15 months in Washington, D.C., on a congressional science fellowship. From there, he went to work on product development and commercialization for an East Coast start-up, finally joining the University's technology commercialization group in 1998.

Carpenter moved into his leadership role just a few months prior to the OTC's makeover. Formerly Patents and Technology Marketing, the new-and-improved OTC streamlines all aspects of tech transfer at the U of M. This includes patenting and licensing of intellectual property, developing start-up ventures, and providing grants and other resources to help push early-stage research closer to commercialization.

The office has also hired liaisons to seek out inventions from faculty and assist them in the process. "Our job is to find those inventions that need to be patented in order to benefit people, and then find companies that will be good partners in bringing the resulting products to market," Carpenter says. Thanks to the revitalized tech-transfer program, the OTC hopes to deliver more and more benefits to the public.

Even with all the recent improvements, Carpenter's job is no walk in the park. "Most University inventions are very early stage and will take a lot more work to develop a product that people can buy," he says. "So it can be challenging to find partners that are able to effectively integrate our technology with their own product development."

On average, the U spends $20,000 to $35,000 per patent. This doesn't include the major dollars a company invests to make the technology work. That's why Carpenter makes decisions based on business first, then science.

Take biochemistry professor Claudia Schmidt-Dannert's new method for manufacturing plant compounds. Right now, Carpenter and his colleagues are exploring how this method could transfer to nutritional, cosmetic and drug applications. To begin with, though, the OTC must identify a technology that companies could develop around the research. Next, they must get companies up to speed to find out who will pay for patent access. This is just one small part of the whole commercialization process.

Despite the challenges and intricacies, the OTC has issued 212 patents, established 17 start-ups and 392 new licensing agreements, and grossed more than $215 million in the past five years. University-developed technologies generated $56 million last year alone, with about a third of that going back to the inventors, and the rest toward bills, salaries and more research.

On the horizon, Carpenter expects to see an influx of renewable energy technologies, as well as environmentally friendly polymers and industrial biotechnologies with origins in the College of Biological Sciences. Judging by the current state of technology transfer, he says the future looks promising.

"University researchers are more aware of what's needed to make a good product, and companies are more aware of what's available at the universities. It's becoming easier to make those connections."

—EVE DANIELS

Laurie Hennen, CBS Director of Development

One size does not fit all

FOUR DIFFERENT CBS DONORS SHOW THE RANGE OF GIVING STYLES

THEY SHARE A PASSION FOR THE BIOLOGICAL SCIENCES AND A DESIRE TO HELP, BUT NOT MUCH ELSE UNITES COLLEGE OF BIOLOGICAL SCIENCES DONORS. THEY ARE AS DIFFERENT FROM ONE ANOTHER AS YOU CAN IMAGINE. EACH HAS A UNIQUE MOTIVATION FOR GIVING—AND A DIFFERENT EXPERIENCE.

Some donors prefer to stay out of the spotlight. They aren't looking for recognition. One couple recently gave a substantial anonymous gift to the college. Their joy came from knowing that their gift will be used to help exceptional young adults evolve into amazing researchers and biologists.

Many others, however, find that giving back brings entirely new connections to the college and to students. Case in point: Carol and Wayne Pletcher. The couple has observed firsthand how their gift has benefited graduate student Meggan Craft. They even traveled to Tanzania to meet the 2006 Pletcher Fellowship recipient and learn about her work researching African lions.

"We believe that these students have the ability to make a difference, so we like to keep up on their accomplishments," Wayne says. "Yes, funding a fellowship is significant. But it's even more important to understand what it's making possible." Carol sees it as one-of-a-kind opportunity to get to know the student behind the research. "Any donor who chooses to get to know their recipient is in for a royal treat," she says. "Why would you let it pass?"

Jean Parmelee takes great pride in the scholarship she established in her husband's memory in 1998. Her connection to students comes in the form of the CBS Recognition and Appreciation Dinner where she has the opportunity to meet recipients of the David F. and Jean M. Parmalee Scholarship and their parents. Last year's dinner was so meaningful to her that she wrote about it in her annual Christmas letter to her family and friends.

And then there are the Dvergstens. Denny and Joan have supported CBS in ways that are too numerous to mention. They have been great supporters of Itasca Biological Station providing everything from financial assistance to students to funds for much-needed new equipment. They are committed to ensuring that the learning environment at Itasca is as rich as possible. They stay in touch and know what's needed.

Four different donors, four very different giving experiences. Yet each is equally rewarding. I have seen firsthand the joy, the satisfaction and the pride that goes into making this kind of difference whether it's quietly or front and center.

If you think that the time is right for a gift to CBS, let me help you create something that fits your giving style. Contact me at hennen@umn.edu or 612-624-9460.

—LAURIE HENNEN

Class notes

An assistant professor at the University of Georgia's Institute of Ecology, **Sonia Altizer** **(Ph.D. Ecology, 1998)** recently received a $679,942 National Science Foundation Faculty Early Development Career award to study migration and infectious disease patterns in Monarch butterflies.

Don Beimborn **(Ph.D. Ecology, 1974)** traveled to the Galapagos with fellow CBS alum, Cliff Dill, the summer before last. The trip made a lasting impression. Don found most memorable the incredible abundance of seabirds as well as iguanas, lava lizards and other unique fauna. Biggest surprise? "We found most of the islands to be dry and desert-like. ... It looked like a tough place to live if you are a finch or a heron." Next stop: the penguin colonies on the Falkland and South Georgia islands.

Anna Cheesebrow **(B.S. Genetics, 2003)**—now Anna Hamlin—finished a post-baccalaureate forensic sciences certificate at Hamline University last year. She works as a forensic scientist for the Minnesota Bureau of Criminal Apprehension in St. Paul in the FBI's regional mitochondrial DNA program.

After several years researching the pharmacological effects of nicotine with Paul Pentel and Daniel Keyler at the University of Minnesota Medical School, **Matthew Dufek** **(B.S. Neuroscience, 2002)** has returned to school to pursue his doctorate. Last fall, he started a graduate fellowship at the University of North Carolina-Chapel Hill in the School of Pharmacy researching cancer vaccines.

Since graduating, **Heidi Flashinski Walz** **(B.S. Biology, 2002)** got married and is a fourth-year medical student at the University of Minnesota. She plans to go into emergency medicine.

Since earning his doctorate, **Richard W. Frazee** **(Ph.D. Biochemistry, 1994)** has done post-doctoral work at North Carolina State University and Johns Hopkins University, and worked as an assistant professor of chemistry at the University of Michigan-Flint. He taught undergraduates for six years before moving to Rowan University in New Jersey. Last year, Richard moved back to Michigan to pursue a new career in drug discovery. He is currently working in an academic lab conducting research related to autoimmune disorders.

Charles Hernick **(B.S Ecology, Evolution and Behavior, 2003)** completed a master's degree in environmental economics at Boston University and now works for the Massachusetts Office of Coastal Zone Management. He is developing an early-detection, rapid-response protocol for newly introduced aquatic invasive species. Chuck lives in Boston with his wife Michelle Vervais, also a University of Minnesota graduate (CLA, 2004).

Megan Schmidt **(B.S. Neuroscience, 2006)** works in Dr. Karen Ashe's lab at the University of Minnesota researching Alzheimer's Disease. Megan co-manages a transgenic mouse colony and conducts behavioral testing using the Morris Water Maze. Her duties include tissue collection, DNA extraction and genotyping. Outside of the lab, Megan works part-time as a personal care assistant for a family with two autistic children. She is also involved in Big Brothers–Big Sisters and is on the Metrodome First Aid Team where she volunteers as an EMT. Megan's future plans include medical school with a pediatrics emphasis.

Dana Wegener **(B.S. Biology, 2006)** started a job as a bio-analyst at SurModics in Eden Prairie earlier this year. She attributes her success in landing the job to her class work and experience with research at the University. Dana eventually plans to explore the possibility of graduate school.

Please take a couple minutes to update us about your career and personal life. Let your fellow alumni know about your new job, awards, publications, current research, family changes and travel experiences. E-mail rlb@umn.edu.

JOIN THE CLUB!

Watch for the next BioBook Club this summer. We'll read and discuss Michael Pollan's *The Botany of Desire: A Plant's-Eye View of the World.*

Go to www.cbs.umn.edu ➡
Alumni and Friends ➡
Alumni Events

In memoriam

Jean M. McIntosh (B.S. Botany, '42) who served the Botany (now Plant Biology) Department as secretary and administrator for more than 40 years, passed away on January 16, 2007, at the age of 85. Jean remained active in department and college events after her retirement and generously supported the Eloise Newcomb Pitmann Scholarship—Pitmann was a classmate of McIntosh's—for undergraduate women students majoring in plant biology.

Paul E. Ramstad (B.S., '39 and Ph.D., '42), formerly of St. Paul and Golden Valley, died March 13, 2006, at the age of 88. After receiving both his bachelor of science degree and a doctorate from the University of Minnesota, Paul became a research chemist at General Mills where he was responsible for developing several products. He was later director of quality control. Paul was also on the faculty of Cornell University for five years and continued to live in Ithaca, New York, after his retirement.

COLLEGE OF
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Jim Cotner, Moos Professor of Limnology

Search Results Water comes and goes.

The short answer is that it does, says Jim Cotner, Moos Professor of Limnology. Water continuously enters lakes via groundwater, precipitation, and runoff from rivers and streams, and leaves via rivers and streams, groundwater, and evaporation. Water levels depend on the balance of these processes.

The question is a good one because the processes are often invisible. Groundwater usually determines water levels in small lakes, and precipitation/evaporation typically maintain levels in large lakes.

Over the past 20 years, the amount of water in the Great Lakes, including Superior, has been decreasing. Many scientists believe this is because global warming is increasing evaporation. Levels of some Minnesota lakes, particularly in the northern part of the state, have decreased recently because of drought and high levels of evaporation.

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The University of Minnesota's Driven to Discover campaign has generated dozens of biology-related questions. For a complete listing of Q&As featuring CBS faculty, go to www.cbs.umn.edu and click on the Driven to Discover box in the right column.