spring 2003

BIO

COLLEGE OF BIOLOGICAL SCIE

UNIVERSITY OF MINNESOTA

Fermenting Revolution

Biocatalysis, which uses natural processes such as fermentation to turn plants into clean energy and biodegradable plastic, promises to revolutionize the way the world works. Page 9

RESEARCH NEWS • ALUMNI PROFILES • CLASS NOTES

FROM THE DEAN

Robert Elde, Dean

Creativity can help Minnesota seize the day

Biology is on the brink of making big changes in the way people live and work, much like the industrial revolution did more than a century ago and computers have done over the past 25 years. But to realize these changes we need substantial economic investment. And for the time being, at least, biology's upswing is terribly out of sync with the economy's downswing, particularly in terms of state funding.

One option is to wait until the economic clouds clear. But by that time, important opportunities could evaporate as well. A better course of action is to use the resources we have efficiently and to find creative ways to secure new revenue sources.

Recent investments through the Molecular and Cellular Biology Initiative are moving us in the right direction. While we are grateful, they are only a beginning compared to investments many other states are making. Consequently, if we don't find creative ways now to identify resources and become a leader in the life sciences, we will lose an important opportunity.

I believe the solution lies in public-private partnerships. We've already made a lot of progress in that direction through Biodale, the Biotechnology Institute, and the Cargill Microbial and Plant Genomics Building. In addition, we formed a nonprofit organization, University Enterprise Laboratories (UEL), to provide laboratory space for start-up biotech companies. We hope to locate the laboratory incubator along the transit way between campuses.

I am optimistic that we can build on this success and gain the support we need because a growing number of people recognize the benefits of investing in biology. So many of the problems our world faces—destruction of global ecosystems, dependence on petroleum, feeding and clothing the planet's growing population, the rise of new life-threatening diseases—have biological solutions. And the states that invest the resources to find these solutions will realize enormous economic benefits.

This is truly a win-win situation that is attracting the interest of entrepreneurs and ecologists alike. And it is a reminder that our work can transcend the world's current problems—the dismal economy, war, and terrorism—and create a better tomorrow. I'm counting on Minnesota to provide the creativity we need to be successful. Creativity has always been a Minnesota strength, from the sciences to the arts. I'm looking to all of you to tap your natural creativity to help Minnesota seize the day.

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BIO

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FEATURES

On the Cover Marc von Keitz (left) is director of the Biotechnology Resource Center, which provides fermentation services for faculty and biotechnology companies. To his right is David Reeder, Ph.D., a research engineer with Cargill Dow. *Photo by Tim Rummelhoff*

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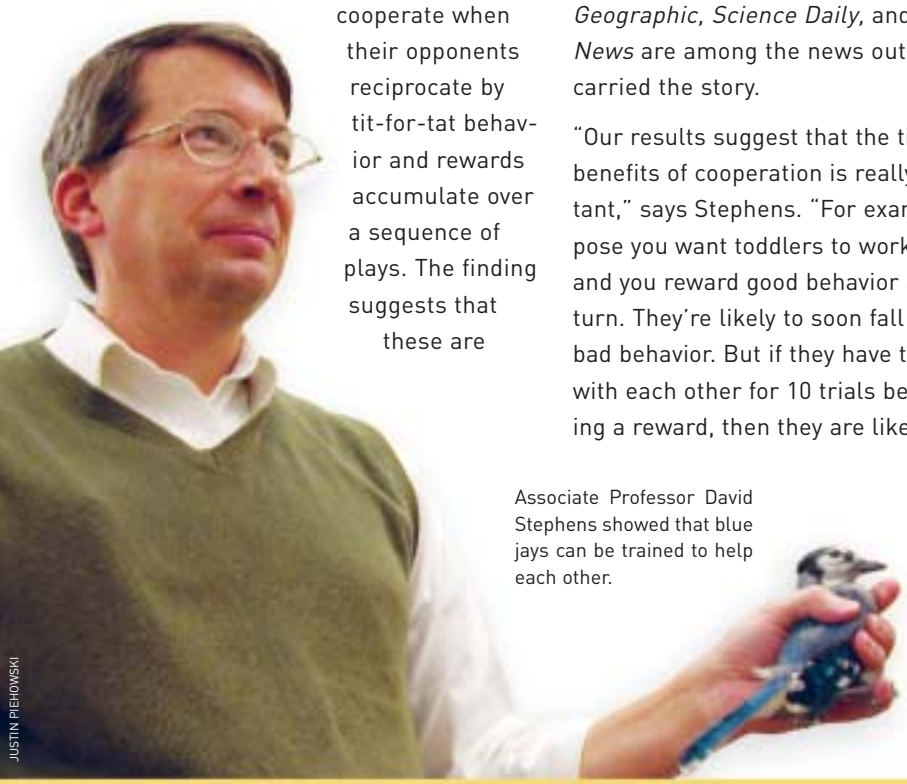
Study finds animals can be induced to cooperate

David Stephens, associate professor of ecology, evolution, and behavior, published a study in *Science* suggesting that animals may be induced to cooperate when their opponents reciprocate by tit-for-tat behavior and rewards accumulate over a sequence of plays. The finding suggests that these are among the factors guiding evolution of some animals—including humans—toward cooperative behavior. *The Star Tribune, United Press International, National Geographic, Science Daily,* and *Science News* are among the news outlets that carried the story.



JUSTIN PIEHOWSKI

Associate Professor David Stephens showed that blue jays can be trained to help each other.

"Our results suggest that the timing of the benefits of cooperation is really important," says Stephens. "For example, suppose you want toddlers to work together and you reward good behavior at every turn. They're likely to soon fall back into bad behavior. But if they have to play nicely with each other for 10 trials before receiving a reward, then they are likely to do it."

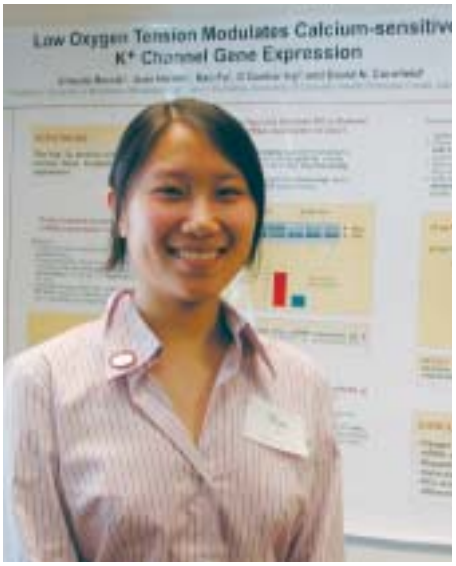
Animals that behave in reciprocal (tit-for-tat) fashion and reap rewards only after a sequence of interactions may be those most likely to cooperate in nature, says Stephens. An animal that knows it must help out in order to receive help and that it must interact several times before realizing a reward is the best candidate to exhibit cooperative behavior. By testing pairs of blue jays, Stephens and his colleagues were able to manipulate conditions to see whether reciprocal behavior and/or delayed rewards would lead to a stable pattern of cooperation.

One implication for this theory is that social (cooperating) animals may have a superior ability to wait for delayed rewards. As for humans, nature and history already have run tests.

"In the case of humans, I think we are more likely to cooperate when others reciprocate and the benefits accumulate over time."

Researchers discover molecular mechanisms that control embryonic development

Jeff Simon, associate professor of genetics, cell biology, and development, published a study in the journal *Cell* on the role of chromatin modification in control of gene expression during animal development. The *Cell* paper investigates molecular mechanisms that control embryonic development. In order for a multicellular organism to develop properly, specific genes must be turned on or off in specific cells. "We've been studying a particular set of transcriptional repressors, called Polycomb group proteins, which are needed to keep genes turned off during development in both animals and plants," Simon says. "Our paper shows that four of these Polycomb repressors cooperate to provide a specific enzyme activity, called histone methyltransferase." The histones are basic building blocks that package DNA in all eukaryotic cells. Thus, the work indicates that genes can be kept silent during development through transfer of methyl groups to the proteins that package DNA. The study pinpointed a specific amino acid residue, lysine-27 of histone H3, as the particular site modified by the Polycomb repressors. The findings suggest that methylation of this single lysine residue serves as a molecular signpost to help keep genes shut off.



Rao Fu, a biochemistry major, was one of five students who presented their research at "Impress the President: A Student Initiative on Public Engagement and Research Initiatives" as part of inaugural activities during Founders Week in February. Others were Pete Avis and Kari Eichstaedt, plant biology; Jennifer McNabb, biochemistry, and Michelle Solensky, ecology.

DAVID HANSEN

Global warming could affect Minnesota's ecosystems and economy

By the end of the century, Minnesota summers could be 7 to 16 degrees warmer and winters 10 degrees warmer, according to a report released by the Union of Concerned Scientists (UCS) in April. The forecast is attributed to heat-trapping greenhouse gases created by fossil fuel combustion.

Stephen Polasky, associate professor of ecology, evolution, and behavior and of applied economics, co-authored the report and acted as chief spokesperson at a news conference held at the Humphrey Institute.

"Climate changes may have a significant impact on the Minnesota landscape," presenting challenges to the environment, economy, and people who live here, " said Polasky, who was a member of President Clinton's Council of Economic Advisors before coming to the University of Minnesota.

Predicted effects include longer, drier summers, droughts, lower lake levels, shrinking wetlands, flooding of rivers and streams, encroachment of prairies onto forest lands, and changes in the mix of plant, fish, and bird species.

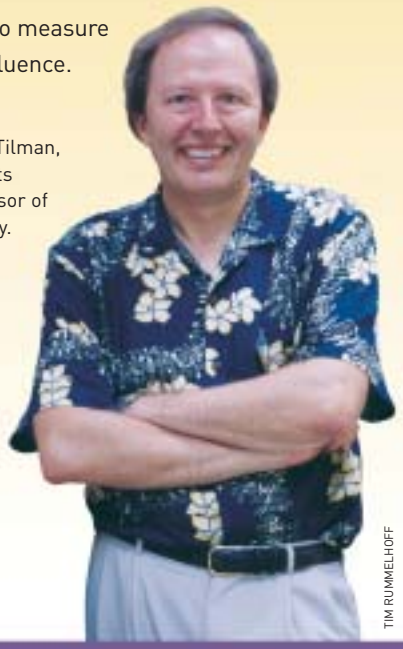
One apparent benefit for agriculture would be a four-to-nine-week increase in Minnesota's growing season. But heavy rainstorms, droughts, emergence of new diseases and pests, and ozone damage would likely outweigh advantages, Polasky said. The changes also could have negative consequences for the shipping, winter recreation, and hydropower industries, he added.

To prevent climate changes, Minnesota needs to look for ways to reduce fossil fuel use and develop renewable sources of clean-burning energy, the report stated.

To read the entire report, "Confronting Climate Change in the Great Lakes Region," go to http://www.ucsusa.org/greatlakes/.

Tilman named most cited environmental scientist again

David Tilman, Regents Professor of Ecology, was cited more often than any other environmental scientist during the past ten years, according to a report by the Institute for Scientific Information (ISI). Peter Reich, Department of Forest Resources, was the 13th most cited environmental author. Harvard was the only other school with two scientists in the top 20; they ranked 9th and 10th. Tilman was also the most cited environmental scientist for 1990 to 2000. ISI surveyed nearly 2000 environmental scientists to measure their influence.



David Tilman, Regents Professor of Ecology.

TIM RUMMELHOFF

Peter Tiffin, assistant professor of plant biology, received $356,000 from the National Science Foundation to study mechanisms that plants use to defend themselves against pests and pathogens.

Shinya Sugita, assistant professor of ecology, evolution, and behavior, received a $275,000 grant from the Andrew Mellon Foundation for "Controls of Resource Supplies on Below-Ground Processes."

Meet Robin Wright, new CBS associate dean

TIM RUMMELHOFF

Robin Wright, associate dean and professor of genetics, cell biology, and development.

Welcome to Robin Wright, new associate dean for academic and faculty affairs. Wright, who arrived in January, comes to CBS from the University of Washington, where she was associate professor of zoology and director of the Hughes Program for Undergraduate Education.

Wright received her Ph.D. from Carnegie-Mellon University in Pittsburgh in 1985 and completed her postdoctoral training at the University of California, Berkeley in the Department of Molecular and Cellular Biology. Her research focuses on yeast genetics.

In her new role, Wright will be responsible for leading educational planning at CBS. She will continue her research as a professor in the Department of Genetics, Cell Biology, and Development.

Rob Brooker wins 2003 Morse-Alumni Award for Undergraduate Education

Robert Brooker, professor and associate head of genetics, cell biology, and development, was among sixteen University faculty inducted into the Academy of Distinguished Teachers at a spring ceremony in the McNamara Alumni Center. Brooker is one of eight faculty who received the Morse-Alumni Award for contributions to undergraduate education. Eight faculty also received the University's Graduate-Professional Teaching Award for their contributions to graduate and professional education. As lifetime Academy members, award recipients will provide leadership to the University community by serving as mentors, advisers, and spokespersons for the University's mission.

Brooker also recently won the St. Paul Rotary Educator of the Year Award.

Provost Christine Maziar is CBS Commencement Speaker

Christine Maziar, Executive Vice President and Provost of the University of Minnesota, will speak at the College of Biological Sciences Commencement, which is on Saturday, May 17 at 7:30 p.m. in Northrop Auditorium.

Ecology alumnus Douglas De

Douglas DeMaster, director of the Alaska Fisheries Science Center, received an Outstanding Achievement Award from the University of Minnesota on March 6 in the Earle Brown Center on the St. Paul campus.

The honor, approved by the Board of Regents, is conferred upon graduates who have attained unusual distinction in their professions or in public

RICHARD ANDERSON

In Memoriam

Sheldon Clark Reed, CBS professor emeritus, died in February at the age of 92. A Harvard graduate, he came to the University of Minnesota in 1946 to head the Dight Institute of Genetics. Reed established the field of genetic counseling and conducted genetics research. Following his retirement, he learned the Hmong language and helped many Hmong refugees settle in the United States.

UM ARCHIVES

Sheldon Clark Reed

Orville Dahl, chairman of the Botany Department from 1947 to 1957, passed away in February at the age of 92. A former student of Botany Head Otto Rosendahl, Dahl completed his Ph.D. at the University of Minnesota in 1938. He served on the faculty of Harvard University for several years, returning to the University of Minnesota in 1944. Three years later, he

Master receives top UM award

service, and who have demonstrated outstanding achievement and leadership.

DeMaster was recognized for his leadership in bringing people together to reach consensus on critical conservation issues involving marine mammals and for his scientific accomplishments as a marine mammal biologist. After receiving the award, DeMaster gave a lecture titled "Impossible Problems, Improbable Solutions: The Life of a Wildlife Biologist in a Federal Regulatory Agency."

Since receiving his Ph.D. from the Department of Ecology, Evolution, and Behavior in 1978, DeMaster has held many national leadership positions in his field.

Douglas DeMaster, second from left, with Professor Donald Siniff, his faculty adviser; Robert Sterner, head of ecology, evolution, and behavior; and Robert Elde, dean of CBS.

replaced Rosendahl as department head. After stepping down as department head in 1957, Dahl remained on the faculty until 1976. He conducted research on pollen and taught cytology courses.

UM ARCHIVES

Orville Dahl

Rex Lovrien, professor of biochemistry, passed away in March at age 75. Born in Eagle Grove, Iowa he earned a B.A. degree in chemistry from the University of Minnesota in 1953 and a Ph.D. in physical chemistry from the University of Iowa in 1958. He did postdoctoral studies at Yale University and the University of Minnesota. Lovrien joined the biochemistry department in 1965. His research focused on bioseparations, biorecognition, energetics, protein, and enzymology.

CBS Career and Internship Fair

More than 700 people attended this year's Career and Internship Fair, held in February in the McNamara Alumni Center. Guests included CBS students and alumni and students from other UM colleges, local community colleges, and high schools. Seventy-five companies exhibited and many alumni volunteers provided students with guidance about careers, resumé-writing, and interviewing. Exhibitors ranged from big companies such as 3M and Cargill to smaller biotech companies, health care organizations, and government agencies.

Exhibitors commented on the number, quality, and professional demeanor of students. Students appreciated the variety of organizations represented and the friendliness of exhibitors and alumni volunteers.

"Friendly people and helpful alumni made the experience great," commented one student. "My expectations were exceeded," said another. "I found several very interesting opportunities I had not anticipated."

PHOTOS BY RICHARD ANDERSON

FIELD NOTES

Balancing the demands of economics and ecology

JUSTIN PIEHOWSKI

Stephen Polasky holds a joint appointment in ecology and applied economics.

"People are the dominant movers on the landscape. You have to know how to motivate them and show them how to fit conservation planning into what they do to make a living."

—Stephen Polasky

Stephen Polasky wants to have his cake and eat it, too. A conservationist at heart, Polasky knows that environmental policy is enacted only when communities can balance the demands of economics and ecology. Fortunately, he is an expert in both fields.

Although debates that pit jobs against the environment are frequently divisive, Polasky would like to see everyone win by preserving both the landscape and their livelihoods. Since the mid-1990s, he's been trying to determine just how to make that happen in Oregon's Willamette Valley.

In a long-term study with colleagues at Oregon State University, Polasky framed his research question in practical terms. "We're looking at how you conserve biodiversity on a landscape where that's not your only goal. It's a working landscape where human communities depend on the land to make a living," he says.

Polasky applies his advanced knowledge of economics to better understand human motivations. "Conservation is really about managing people," he says. "How do we get society mobilized to, for example, reduce air pollution? People should be concerned about it, because it has a human health impact. However, since the negative consequences of my driving fall mostly on others I don't have the right incentive to restrict how much I drive. The same is true with conservation. You have to also make conservation economically viable." Finding such financially feasible means is the goal of the Oregon study.

Polasky and his colleagues mapped Oregon's Willamette basin according to habitat type and land use. They identified which parcels of land were devoted to agriculture or timber, for example, and showed where natural areas remained. Using this information, the group can model the effects of alternative land use. What would happen if marginal farmland were enrolled in a conservation reserve program? What would happen if areas of continuous habitat were created? A sophisticated computer model shows the level of biological diversity in an area in relationship to economic gain. "Using models, you hope to gain insights that suggest better ways to do things," says Polasky. "It turns out that, with smart management, you can at low cost increase biodiversity. Just by reorganizing a little bit where things happen across the landscape, you can do far better ecologically without sacrificing economically." The group's ultimate goal is to help guide the region's land use policy.

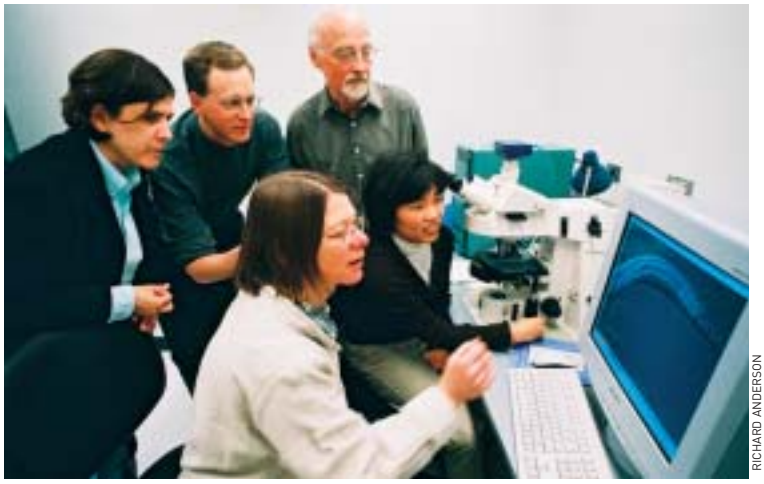
Polasky left his faculty position at Oregon State University to serve as a member of President Clinton's Council of Economic Advisors. In 1999, he joined the University of Minnesota faculty as the Fesler-Lampert Professor of Ecological and Environmental Economics. This one-of-a-kind position is a joint appointment in the departments of Ecology, Evolution, and Behavior and Applied Economics. Polasky's interdisciplinary approach draws students in conservation biology, economics, forest resources, geography, and public policy. Whatever their fields, they all share a common concern for the environment. "Most people involved in conservation feel in their souls the importance of conserving the natural world," says Polasky. "I have the same feeling, but I come at it with a different set of tools. People are the dominant movers on the landscape. You have to know how to motivate them and show them how to fit conservation planning into what they do to make a living."

—Jennifer Amie

Small worm helps

molecular geneticists make big gains

For thousands of biologists today, the organism of choice for exploring how genes do their jobs is a tiny nematode known as *Caenorhabditis elegans*. This pinhead-sized worm's unique combination of simplicity and complexity has made it the perfect pick for molecular biologists around the world—including three of last year's Nobel Prize winners and a half-dozen faculty right here at the University of Minnesota.



RICHARD ANDERSON

There are more *C. Elegans* experts at the University of Minnesota than anywhere in the U.S. Pictured (standing) are Margaret Titus, David Zarkower, and team leader Bob Herman. In the foreground are Jocelyn Shaw and Lihsia Chen. All are faculty in the Department of Genetics, Cell Biology, and Development.

Bob Herman, professor in the Department of Genetics, Cell Biology, and Development, began working with *C. elegans* in the 1970s while spending a sabbatical leave in the laboratory of British scientist Sydney Brenner, who won a Nobel Prize last year for introducing the worm to the world of molecular genetics research. Herman says *C. elegans* is perfect for such work because it's simple enough to explore at a molecular level, yet complex enough to exhibit traits not found in single-celled organisms.

"It's fairly simple, cellularly, with about 1,000 cells," says Herman. "Yet it displays behavioral features—it's attracted and repelled by chemicals, it has a sense of taste and smell, it has muscles and organs," he says. Other advantages include its ubiquity (it's found in soils around the world), its transparency (cells can be studied under a microscope), and the ease with which its genes can be manipulated.

In the decades since Herman got hooked on the worm, the University of Minnesota has become quite a hotbed for *C. elegans* research. Herman is using various mutants of the organism to study the genetic basis of a variety of aspects of behavior and development. Colleague Jocelyn Shaw, who frequently collaborates with Herman, is exploring the genetic control of intercellular communication during development and of nervous system development. Other *C. elegans* researchers here include David Zarkower, who is studying genetic determination of sex; Ann Rougvie, who is exploring what controls the timing of development; Margaret Titus, who is using genetics to study molecules involved in the movement of cells and organelles; and Lihsia Chen, who is exploring genetic control of cellular adhesion.

In addition to fostering *C. elegans* research, the University of Minnesota also manages the National Institutes of Health–funded Caenorhabditis Genetics Center, an international repository for *C. elegans* mutants. The center, which stores live worms in little vials submersed in liquid nitrogen, last year shipped more than 10,000 strains to more than 600 labs around the world.

Herman says he doesn't know how the U of M became a magnet for *C. elegans* research. But he does know the concentration of *C. elegans* researchers here—among the largest in the nation—is great news for scientific advancement. The researchers' weekly "worm meetings" offer abundant opportunities for sharing everything from ethereal ideas about control mechanisms to practical hints on worm husbandry. "There's a lot of sharing of techniques and ideas and so on," Herman says. "Everybody interacts."

—Mary K. Hoff

Using *C. elegans*, Sydney Brenner, H. Robert Horvitz, and John E. Sulston won the 2002 Nobel Prize in Physiology or Medicine for discoveries concerning genetic regulation of organ development and programmed cell death.


FER

MENTING REVOLUTION

There's a revolution quietly fermenting in research laboratories, cornfields, and corporate offices in Minnesota. The driving force is a process called biocatalysis, which uses enzymes and natural processes like fermentation to turn renewable raw materials, such as corn and other plants, into clean energy, biodegradable plastic, textiles, and other products. Ultimately, it could eliminate society's dependence on petroleum and revolutionize the way the world operates. It's also a winning proposition for everyone involved, from entrepreneurs to ecologists to politicians. Biocatalysis has enormous economic benefits. It's good for the environment. And it could even defuse oil-related tension in the Middle East. What more could you want in a revolution?

Bob Elde, dean of the College of Biological Sciences, believes that the time for biocatalysis is now and the place is Minnesota. "There are no other states with our unique combination of academic expertise and facilities, corporate leadership, and raw materials," he says. And he believes that Minnesotans also have the "creative juices" to make it happen.

Consequently, he's become an ardent promoter for biocatalysis, working with University, industry, and government leaders to bring the resources together to make Minnesota a center for this new industry.

"Biocatalysis is in its infancy," Elde says. "Right now there isn't a hub for biocatalysis in the U.S. We have a limited opportunity to seize the day and make this our niche in biotechnology. If we don't another state will beat us to it."

The Silicon Valley of biocatalysis

Cargill President Greg Page agrees. In a recent *Star Tribune* article he commented that Minnesota should be the "Silicon Valley" for biocatalysis. The story focused on how Cargill is positioning itself to use plant compounds to replace petrochemicals used in fuel, packaging, clothing, and medicine.

Such an undertaking can only be achieved through collaboration of academic, government, and private stakeholders. Budget restrictions created by the state's $4.2 billion deficit and concern about high taxes mean that the private part of this public-private partnership is more important than ever. But there's already a strong foundation for biocatalysis in place at the U, and momentum is building.

Elde, who led the U's reorganization of the biological sciences in 1997, has been suc-

Why Minnesota is the place for biocatalysis:

Academic expertise

Strong programs in biochemistry, genomics, chemistry, ecology/environmental sciences, plant biology, applied economics, business, public policy, and many other programs on the Twin Cities campus.

Research facilities

Biodale, the Biotechnology Institute, the Molecular and Cellular Biology Building, the Cargill Microbial and Plant Genomics Building.

Industry

Cargill, Cargill Dow, 3M, Medtronic, Surmodics, R&D Systems, and many other companies in the agribusiness, medical device, and biotechnology industries

Raw materials

Corn, soybeans, wheat, and other agricultural products and byproducts.

cessful at bringing people together to work on interdisciplinary efforts. Now, he is spearheading the University's Initiative for Renewable Energy and the Environment, which focuses on biocatalysis and builds on former President Mark Yudof's Molecular and Cellular Biology Initiative. Ted Davis, dean of the Institute of Technology (IT) and Charles Muscoplat, dean of the College of Agricultural, Food and Environmental Sciences (COAFES) are Elde's partners in this effort, which is attracting a growing list of University researchers. In recent meetings with Elde, federal energy and agriculture officials have encouraged the University's efforts. Several Minnesota legislators also have expressed support, and Governor Tim Pawlenty has identified biotechnology as an important growth area for Minnesota.

Biocatalysis means using enzymes (naturally-occurring or engineered) to catalyze chemical reactions. It's not a new idea. Fermentation, used since ancient times to make bread and wine, is a type of biocatalysis that employs yeast as a catalyst. But advances in scientists' ability to engineer biocatalysts for specific purposes combined with dwindling oil reserves and the effect of petrochemicals on the environment have given the approach a new life. While chemical manufacturing often relies on expensive, toxic catalysts and requires huge amounts of energy, biocatalysis relies on natural enzymes and uses far less energy to achieve similar results. Scientists are exploring the use of biocatalysis to create a wide variety of materials now made from petrochemicals and to produce hydrogen, which is being touted as the fuel of the future.

Biodegradable plastic made from corn

At least two products of biocatalysis already have leaped out of the lab and into the marketplace. Natureworks PLA, a biodegradable plastic, and Ingeo, a fiber, which were invented by University alumnus Pat Gruber (Ph.D., chemistry, M.B.A.) are being produced by Cargill Dow and are appearing at retail outlets in

Pat Gruber, Vice President and Chief Technology Officer of Cargill Dow.

Europe, Japan, and the U.S. as disposable food containers, packaging, clothing, pillows, and comforters. Both are made from a process that Gruber invented in 1989, while he was a Cargill employee. He made the polymers from lactic acid that he fermented from corn.

Now vice president and chief technology officer of Cargill Dow, Gruber consults with U chemistry and biochemistry faculty, and his company employs the services of Biodale and the Biotechnology Institute. This is just the kind of industrial-academic cross-fertilization that Elde likes to see and hopes to foster with other companies.

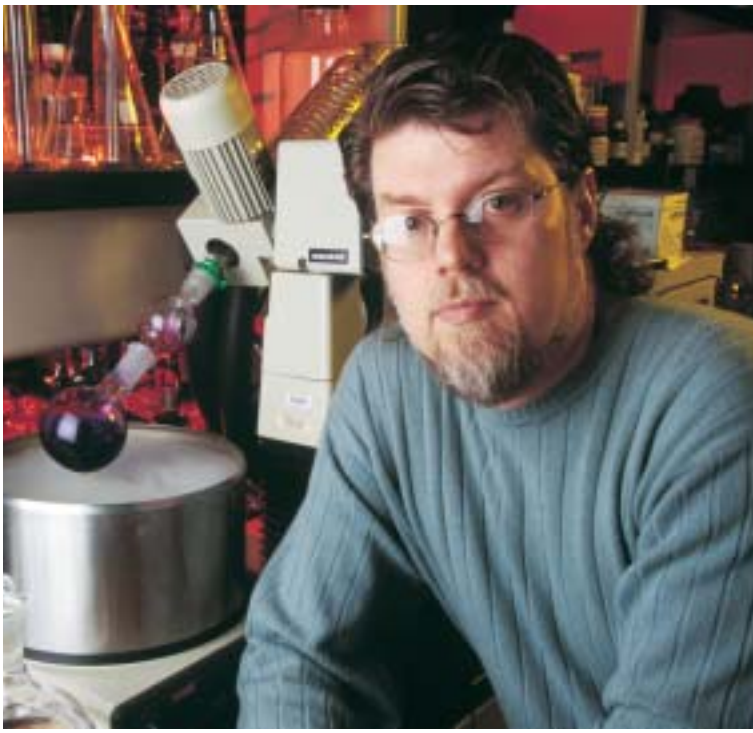
A strong foundation

The Biotechnology Institute (BTI) and Biodale are key resources for biocatalysis research at the University. BTI, directed by Ken Valentas, was created to bring scientists from different disciplines together to develop biotechnology. Biocatalysis is a focus of BTI. The Biotechnology Resource Center, located in Biodale and directed by Marc von Keitz, provides fermentation services for faculty and biotech companies. Biodale also offers many other services that support biocatalysis research.

CBS and other University colleges already have a number of faculty engaged in biocatalysis research and in other fields that support the renewable resources and energy initiative. They range from biochemistry and chemistry faculty to engineers, ecologists, and public policy experts.

Claudia Schmidt-Dannert, assistant professor of biochemistry, molecular biology, and biophysics (BMBB), "shuffles" the genes of bacteria to generate new forms of enzymes and biosynthetic pathways that can be used as biocatalysts. She then places the new sequences in *E. coli* cells to grow them, and using a process called high-throughput screening, quickly evaluates tens of thousands to identify those with useful activities. In the new Cargill Building for Microbial and Plant Genomics, she will direct a high-throughput facility to screen potential biocatalysts on a large scale basis.

Schmidt-Dannert is currently working with carotenoids (natural pigments known to have anticancer properties) porphyrins, (which make blood red and leaves green) and terpenoids (a biochemical family that includes cholesterol, plant oils, and taxol). A primary interest of hers is developing new drugs for cancer and other diseases. Her technique also can be used to develop other kinds of products.



TIM RUMMELHOFF

Larry Wackett, head of the microbial biochemistry division in the Department of Biochemistry, Molecular Biology, and Biophysics, has developed ways to use bacteria to clean up toxic spills in the environment.

Larry Wackett, head of BMBB's division of microbial biochemistry, and Michael Sadowsky in the Department of Soil, Water, and Climate collaborate on bioremediation research. Similar to biocatalysis, bioremediation employs bacteria to clean up the environment. The researchers have developed bacteria that break down atrazine, an herbicide used in agriculture. The bacteria are being used to clean up spills of the atrazine in soil. Wackett and Sadowsky are seeking to scale up the process to purify drinking water and detoxify waste water for municipalities. They are also developing atrazine-degrading green plants that could be used to remove the toxic herbicide from the soil, especially along waterways.

In addition, Wackett and Lynda Ellis, bioinformatics professor, have created the University of Minnesota Biocatalysis and Biodegradation Database, which provides genetic information to enable users to construct pathways to produce new compounds with biocatalytic activity.

Mike Flickinger, another member of BMBB's microbial biochemistry division, is an expert at biocatalytic coding. Currently, Flickinger is applying this technology to embed bacteria with biocatalytic activity in latex paint. The bacteria may be engineered for a variety of uses, including detecting contaminants in soil and water. Embedding them in paint makes it possible to apply them to any surface.

Meanwhile Lanny Schmidt, Regents Professor of Chemical Engineering, and an expert on fuel cells, is working on ways of transporting and interconverting fuels such as methane and hydrogen—a crucial area of research if hydrogen is to replace fossil fuels. And BTI staff are looking at ways to produce methane or hydrogen

fuel from biomass, says Valentas. Although the process is still in the idea stage, University expertise in areas such as photosynthesis and fermentation could play key roles in developing such technologies, he says.


TOM FOLEY

These glass bottles are home to cultures of algae and cyanobacteria, which will be used to produce compounds that have potential as biocatalysts.

Others involved in various aspects of this effort range from David Tilman, Regents Professor of Ecology, who studies the effects of nitrogen on the stability of ecosystems, to Kenneth Keller in the Humphrey Institute. Keller, professor of chemical engineering/materials science and co-author of a Citizens League report on the state's electrical energy future, is gearing up to help integrate scientific and policy issues related to the new technology.

Wanted: industry partners

With adequate funding, Elde would like to build on this foundation by recruiting faculty in a variety of disciplines that support biocatalysis and constructing a state-of-the-art new facility for them to work in. But given the economy, securing resources to do that is challenging to say the least.

He is hopeful, however, that by educating stakeholders about the value of this venture the pieces will fall into place.

"Over the past century, benefits from energy and new materials have come at the expense of the environment," Elde says. "Biocatalysis works with nature rather than against it. This is our chance to undo some of the damage and make the world a better place for future generations while strengthening our own economy. There aren't many opportunities that compare to this."

—Deane Morrison and Peggy Rinard

Note: For additional information about biocatalysis research, please call Marc von Keitz at 612-624-6758.

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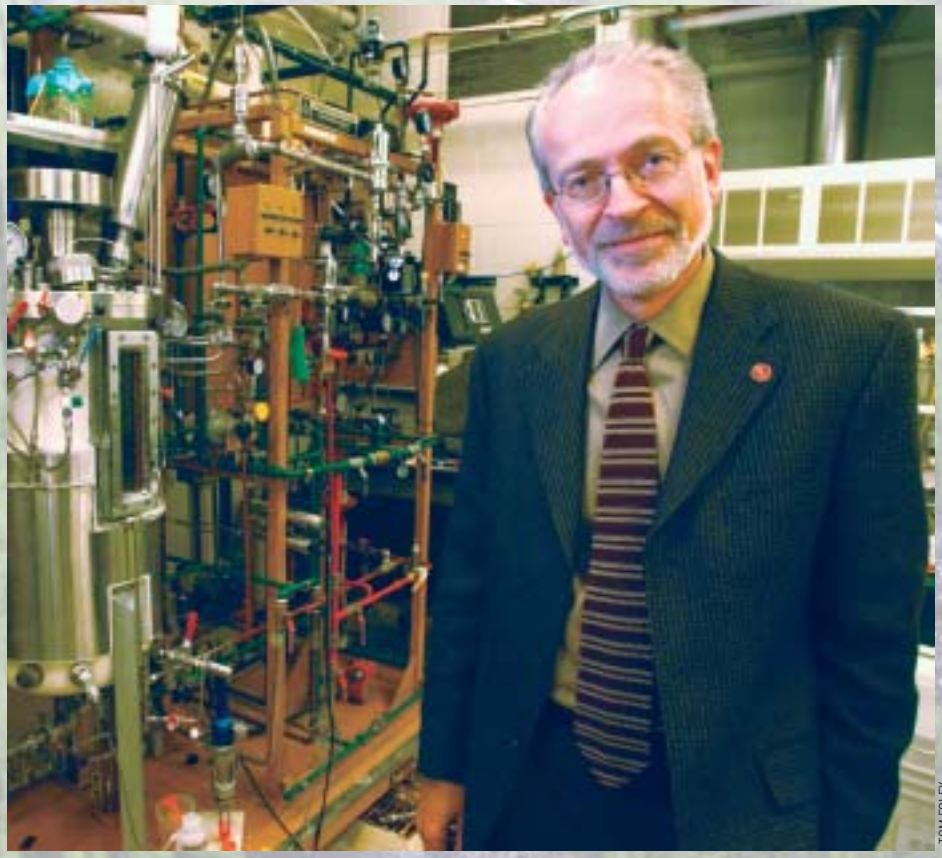
TOM FOLEY

McKnight and NIH awards fertilize plant growth research

Morning glories twine around fence posts . . . Spruce trees spire to the sky . . . Apple buds burst into flower, then form fat fruits . . . We human inhabitants of this green planet are as familiar with plant growth as we are with the sun above our heads and the soil beneath our feet. Many of us are also familiar with the hormone—auxin —that prods plants to grow. But even scientists who have spent their lives studying auxin can't tell you how it does its job.

Bill Gray intends to do something about that. An assistant professor in the Department of Plant Biology, Gray recently landed a five-year, $1.04 million National Institutes of Health grant to explore how this multitalented molecule tells plant cells when, where, and how to grow.

Gray started studying auxin in the mid-1990s. He found that, though people know plenty about how it affects various plants under various circumstances, nobody knows much about the mechanisms by which it does its job.

"There are literally libraries full of volumes describing what auxin can do," Gray says. "Now we need to learn how it actually works."

To do so, Gray has been tapping the talents of *Arabidopsis thaliana,* a member of the mustard family whose speedy life cycle and relatively simple genetics have made it the botanical equivalent of the laboratory mouse. Several years ago Gray and colleagues used a sequence of experiments—involving isolating mutants in which auxin doesn't work right, identifying the faulty gene, and studying the protein that gene makes—to discover what appears to be a key step in the cascade of occurrences that translate the presence of auxin into actual plant growth. In a 2001 article in the journal *Nature*, the researchers described the molecular interplay: Auxin causes a complex called SCF^{TIR1} to connect with proteins that repress the plant's ability to respond to auxin. SCF^{TIR1} attaches a protein called ubiquitin to the repressors, marking them for degradation. With the repressors out of the way, auxin is then able to modulate plant growth and development.

Supported by the NIH grant, Gray is now working to identify other links in the chain of events initiated by auxin. "We have a good handle on this one step," he says. "Now we want to try to work backwards up the pathway to determine how the hormone eventually impinges on this step."

The information Gray is gaining may be useful not only in understanding—and potentially manipulating—plant growth, but also in understanding human systems controlled by similar regulatory mechanisms. Recognizing the potential, in January the University awarded Gray a McKnight University Professorship, which gives junior faculty recognition for exceptional work and additional resources for enhancing their research programs.

RICHARD ANDERSON

New faculty member Bill Gray, assistant professor of plant biology, has attracted substantial support for his research.

Honored and energized by the NIH grant and the McKnight professorship, Gray figures he has his work cut out for him. Even if he gets the auxin pathway down pat, he expects the knowledge gained will open doors to whole new universes of questions and answers about growth and development.

"It's likely to keep me busy for a long time," he says.

—Mary K. Hoff

"There are literally libraries full of volumes describing what auxin can do. Now we need to learn how it actually works."

—Bill Gray

CAMPAIGN MINNESOTA
UNIVERSITY OF MINNESOTA

CAMPAIGN COUNTDOWN

ALUMNA MARY KEMEN HONORS UNDERGRADUATE ADVISER DOUGLAS PRATT

Mary Kemen smiles every time she sees a cattail patch. Her mind wanders back to her days as an undergraduate at CBS where she spent many hours working with Douglas Pratt in cattail patches established near the greenhouses on the St. Paul campus.

Alumna Mary Kemen as a CBS student in the 1970s.

"We looked like mud wrestlers after finishing a day of cattail work," she said.

It's memories like these that inspired Kemen and her husband, Brian Randall, to establish the Douglas C. Pratt Undergraduate Scholarship in the College of Biological Sciences.

Kemen, an anesthesiologist, worked in Pratt's lab as an undergraduate and was a student in a number of his botany classes. She said he was always accessible and good-natured despite the many demands on his time.

Pratt, professor emeritus of plant biology, former head of the Botany Department, and former acting CBS Dean, is touched and honored by Kemen and Randall's pledge.

"I have had many students in 35 years of college and university teaching, but some you never forget. Mary was one of those. I remember her as a thoughtful, bright, probing, energetic, and considerate student. It was a privilege to be one of her mentors," Pratt says.

While Kemen chose a career in medicine, her home reflects the love of plant biology she acquired at CBS. "I scurry around every spring with a book in hand to identify the myriad of mushrooms that thrive in our yard." Kemen also uses a salt water aquarium to grow various forms of algae, she said.

Kemen feels the ideal recipient of the scholarship should have a strong work ethic and a willingness to share ideas. She wants to support undergraduates who have sincere interests and intellectual drive.

"There are a lot of diamonds in the rough who, with a little polishing, can truly shine," she says.

Kemen knows what a scholarship can mean. She received the Eloise Newcomb Pittman Scholarship when she was an undergraduate. Pittman, who received botany and chemistry degrees from the University in the late 1930s and went on to be a teacher, created the scholarship for women with outstanding academic qualifications and an interest in plant biology.

"The multitude of opportunities I enjoyed at the U changed my life immeasurably . . . What more important endeavor could one support?"

—Mary Kemen

The Douglas C. Pratt Undergraduate Scholarship also strengthens the connection between Kemen's family and the University.

Her great-grandfather and grandfather were University faculty. Her parents,

JUSTIN PIEHOWSKI

Professor Douglas Pratt today.

both of whom graduated from the University, met on the intercampus streetcar. And Kemen has two degrees from CBS and one from the Medical School. She hopes that her 14-year-old daughter will attend the University.

For Kemen, there is no better place to support than the University.

"The multitude of opportunities I enjoyed at the U changed my life immeasurably. The University brings together people from many backgrounds, helps them fine-tune their academic skills, and sets them free to change society and improve the condition of people. What more important endeavor could one support?"

—Justin Piehowski

ALUMNI PROFILE

Paul Savereide
scientist, lawyer, bagpiper

On St. Patrick's Day, don't look for alumnus Paul Savereide in his Cargill law office. That's the day he's most in demand as a bagpipe player and member of the Pipe and Drums and the Emerald Society band. He shuttles between performances with the Minnesota Pipes and Drums in St. Paul and Minneapolis parades and winds up the busy day with a gig at First Avenue.

Savereide is used to juggling such a demanding schedule, having perfected the art during his years as a graduate student. He simultaneously obtained a Ph.D. in Cell and Developmental Biology and a J.D. from the University of Minnesota Law School in 1991. His program of study was inspired by his grad school roommates, a group of Hamline law students. "One of my friends was going into patent law, and I started to think that maybe there are some synergies between the two fields," says Savereide. Deciding to pursue a dual degree, he bounced between the lab and the library, defending his Ph.D. thesis just days after taking his law school finals.

Savereide adds that the guidance and the support he received from his graduate adviser, Paul Lefebvre, enabled him to complete the requirements for both degrees

"At that time, molecular biology, immunology, and cell biology were really starting to take off," says Savereide. "And along with them were the first big patent cases related to biotech inventions." The market for lawyers with biotech experience was heating up, and Savereide swiftly landed a job with the law firm of Dorsey & Whitney, later moving on to Chiron Corporation, a biotech firm in California. For the past four years, he has worked as a senior attorney at Cargill, Incorporated where he specializes in intellectual property law.

Recently, Savereide joined the Advisory Board for the Joint Degree Program at the University of Minnesota Law School. Thanks to this program, it is now much easier for students to obtain an advanced degree from more than 15 programs in the Graduate School as well as a J.D. from the Law School.

TIM RUMMELHOFF

Paul Savereide, who earned a Ph.D. from CBS and a J.D. from the Law School, is now a Cargill senior attorney.

"A joint degree program allows you to look at a different slice of life," says Savereide, "and to explore the impact of the law on a particular field, from biology to public health to business."

—Jennifer Amie

Campaign Minnesota ends on June 30

Campaign Minnesota is fast approaching the June 30, 2003 finish line. Although the Campaign officially ends then, there are many reasons to continue to support the University, and particularly the College of Biological Sciences. Increasing tuition and decreasing state support are making scholarships and fellowships more vital than ever.

If you already have made a commitment this year, we extend our sincere thanks. If you have not yet made a contribution, please respond before June 30. Your gift will be greatly valued and you will be counted among the donors of Campaign Minnesota.

You can make a cash or credit card gift or you might want to consider transferring stock or real estate. Perhaps a meaningful legacy is important to you through an estate plan, a charitable gift annuity, or charitable remainder trust. Support from alumni, faculty, and friends creates exceptional opportunities for students. Please contact Janene Connelly at 612-624-7496 or connelly@cbs.umn.edu for information, or visit www.foundation.umn.edu.

Class Notes

Claude Hills (Ph.D. in Biochemistry, 1937) and his wife Signe recently moved to a retirement community in Pennsylvania, where he competed in Masters Track and Field events and won four world championships and numerous national championships. Dr. Hills recently was elected to the Masters Track & Field Hall of Fame.

Joseph Novak (Ph.D. in Botany, 1958) is a visiting senior scientist at the University of West Florida and professor emeritus at Cornell University in New York

Allison Purtell (B.S. in Biology, 1972) was in Minneapolis for the 25th anniversary of her Medical School graduation in June. Purtell, who has had a private practice in internal medicine and rheumatology in Orange County for many years, also completed her rheumatology fellowship at the U. And she did a residency in internal medicine at the University of Missouri, Kansas City. After leaving the Midwest, Purtell completed a one-year rheumatology fellowship at Scripps Clinic in La Jolla, California, was a staff rheumatologist at Kaiser-Permanente in Panorama City for a little over a year, and was head of rheumatology for Family Health Plan for a year.

Calvin Tormanen (Ph.D. in Biochemistry, 1974) has been at Central Michigan University in Mount Pleasant, Michigan since 1981. He is a professor in the Department of Chemistry. On a recent visit to campus to participate in FinnFest, Calvin was happy to see that Professor Wayland Noland is still teaching in the Chemistry Department.

Judith Hessert (B.S. in Biology, 1981) has lived for the past 19 years in Hamilton, Montana, where she owns and operates a nursery and garden center. She credits a night class that she took at the Arboretum for her successful business and her love for plants.

Maryann Schneider Reynolds (B.S. in Biology, 1983) has been living in the Washington, D.C. area and in Boston working in reproductive medicine/embryology.

Todd Gusek (B.S. in Biology, 1983) currently works for Cargill Inc. as a senior research scientist. Todd has been with Cargill for nine years.

CPT Mitch Belanger (B.S. in Microbiology, 1989) works in Medical Operations at the Combat Support Hospital located at Coraopolis, Pennsylvania.

John Beauchamp (B.S. in Biology, 1990) is Manager for Immunoassay Product Support at R&D Systems in Minneapolis.

Michelle Mandrekar (B.S. in Genetics and Cell Biology, 1991) received two R&D 100 awards in 2002 for the research products AluQuant ™ Human DNA Quantitation System and READIT ™ DNA Interrogation System. She was project leader for the first, which determines the amount of human DNA in a sample. The product is used by forensic scientists prior to amplifying the DNA with PCR -"DNA fingerprinting." Michelle was a member of the research team for READIT ™ DNA interrogation technology, which determines the polymorphism (e.g. SNP) that is present in a DNA sample. These awards are given by *R&D Magazine* to the top 100 new products in the world. Products range from medical innovations to many other fields.

Ross Kedl (B.S. in Biology, 1992 and Ph.D. in Pathobiology, 1997) recently moved back to Minnesota after completing postdoctoral work in Denver, Colorado. He is now a Ph.D. Senior Immunologist in the Department of Pharmacology for 3M Pharmaceuticals.

Deanna Croes (B.S. in Biology, 1992) is employed as a clinical research associate in the Pharmaceutical Services division of Ingenix, located in Eden Prairie. Ingenix provides clinical trial management and monitoring for pharmaceutical companies on a contract basis. Deanna is also active in her neighborhood, primarily concentrating on environmental issues. She serves as a community representative on the Blue Water Association, a multi-neighborhood non-profit organization that works to improve and protect water quality of Lakes Nokomis and Hiawatha. She has also served on the planning committee for the Longfellow Gardens project for the Minneapolis Park and Recreation Board.

Steven Lund (Ph.D. in Plant Biological Sciences, 1995) is an assistant professor in viticulture/plant genomics at the Wine Research Centre at the University of British Columbia in Vancouver, Canada.

Brandon Lujan (B.S. in Biology, 1996) studied functional neuroimaging at Oxford University and graduated from Harvard Medical School in July, 2002. He will soon begin a residency in ophthalmology at the University of California, San Francisco. His interest in the anatomy of the eye began at the 1994 summer neurobiology course at Itasca, where he also has fond memories of night canoeing under the Aurora.

Erik Pratt (B.S. in Ecology, Evolution, and Behavior, 1997) is at Minnesota Environmental Initiative as an Energy Alley Manager.

Rebecca Marrs-Eide (B.S. in Biochemistry, 2001) is working for the University of Minnesota as a quality assurance specialist at the Molecular and Cellular Therapeutics Facility, located on the St. Paul Campus. She works with several groups that produce cellular and genetic therapies for clinical research.

Sina Moassesfar (B.S. in Biology, 2002) is working full-time at Abbott Northwestern Hospital in the pathology laboratory and teaching part-time at National Karate in Roseville. He is applying to osteopathic schools and plans to matriculate in the fall of 2003 or 2004.

Sara M. Vetter (B.S. in Microbiology, 2002) recently appeared in ASM News, which highlighted her research as an undergraduate student and her involvement in the University's ASM Undergraduate Chapter. Sara is currently in the first year of her Ph.D. program in Microbiology, Immunology, and Cancer Biology at the University of Minnesota.

Do you want to stay connected to CBS and the University of Minnesota? Join the CBS Alumni List-serve and receive updates every month on campus events, volunteer opportunities, CBS and University news, and job openings. To join visit www.cbs.umn.edu and follow the links to Alumni News

Homecoming 2003

Before you know it leaves will be turning and it will be time for Homecoming Minnesota style. Please mark your calendars for October 18 and plan to join us for all of the University of Minnesota Homecoming festivities including pancake breakfasts, parades, pep fests, bonfires and of course Gopher Football! We hope that you'll join Dean Elde and the rest of the CBS community as we cheer for the Gophers when they take on Michigan State. CBS will be tailgating prior to the football game and will be offering tickets for the game. So even if you're not a football fan, we hope that you'll plan to join us! Go Gophers!

BioBuds give freshmen a student's view of college life

Last fall on the Twin Cities campus there were 46,734 students, 2,864 faculty members, 250 buildings on two enormous campuses, and one Carolyn Ahlstrom.

Luckily, she had Jessica Cott, her BioBud.

BioBuds is a program created by the College of Biological Sciences to connect freshman with upperclassman who are more familiar with CBS and the University.

Cott and Ahlstrom meet when their schedules allow, and stay connected by e-mail. "Most of the time we chat over a cup of coffee," says Cott, who, like Ahlstrom is majoring in genetics, cell biology, and development.

JUSTIN PIEHOWSKI

Freshman Carolyn Ahlstrom (right) with her BioBud Jessica Cott.

During summer orientation, incoming freshmen get the chance to fill out an online questionnaire that lists their potential major, career plans, and extracurricular interests. Each student is then paired with a sophomore, junior, or senior in CBS whose interests match their own.

After they are matched, the BioBuds meet at least once a month. They are encouraged to meet more; however, the program is designed to accommodate students' busy schedules.

"We hope that pairing new students with more experienced peer mentors in a flexible program like BioBuds will help them feel welcome at the University of Minnesota and provide them with an "insider's view" of our college," says Sarah Huhta, BioBuds coordinator.

Ahlstrom says that Cott has been very helpful in describing the biology classes she has taken. She feels like she can ask her anything. Cott said it is important for upperclassmen to mentor freshman and share information and insights. "There's really nothing like getting a student's perspective on the University of Minnesota to help you get started," Cott says.

Cott and Ahlstrom have also realized that BioBuds doesn't just mean the two of them. "We could just meet on our own, but sometimes it's more fun to meet in big groups with other BioBuds pairs," Ahlstrom says. "It's nice to be able to compare things with a whole bunch of people," Cott adds.

Although the program is geared towards helping freshmen, Ahlstrom is not the only one who benefits from the program. Cott, who is interested in a career in genetic counseling, finds satisfaction in helping other people succeed. "I have my own mentor and I know how important it is to have someone to talk to."

—Justin Piehowski

"There's really nothing like getting a student's perspective on the University of Minnesota to help you get started."

—Jessica Cott

CBS Calendar

CBS Year-End Picnic
Friday, May 9, 12 to 2 p.m. on the lawn in front of Snyder Hall and Gortner Labs. Come celebrate the last week of classes with free food served by deans, department heads, and faculty; gifts for graduating seniors; music, and door prizes.

CBS Commencement
Saturday, May 17, 7:30 p.m. in Northrop Auditorium. Executive Vice President and Provost Christine Maziar will be the commencement speaker.

UMAA Annual Celebration
Thursday, May 29, 5:30 p.m., in Coffman Memorial Union. Celebrate the 100th anniversary of UMAA. Alumnus Harvey Mackay will be the keynote speaker.

St. Paul Saints Game
Friday, June 27, 7 p.m., Midway Stadium. Join the CBS community for outdoor Minnesota baseball as the Saints play the Sioux Falls Canaries.

Homecoming football game against Michigan State
Saturday, October 18, at the Metrodome.

BSAS "After the Harvest Pumpkin Festival"
Saturday, October 25, MN Landscape Arboretum.

Contact Emily Johnston at alumni@cbs.umn.edu or (612) 624-4770 for more information about any of the above events.

Cargill Building for Microbial and Plant Genomics opens

The Cargill Building for Microbial and Plant Genomics Research Building was dedicated on May 5.

Speakers at the dedication ceremony included Warren Staley, President and CEO of Cargill; Claire Fraser, president of The Institute for Genomics Research in Washington, D.C.; President Bob Bruininks; CBS Dean Bob Elde, and Charles Muscoplat, Vice President and Dean of the College of Agriculture, Food, and Environmental Services.

Funded by a $10 million gift from Cargill, Inc. and a matching grant from the state, the building will soon be home to 15 principal scientists and their research staff. Research will focus on using microorganisms to clean up the environment, making agricultural plants hardier and more productive, and developing new drugs.

JUSTIN PIEHOWSKI

COLLEGE OF Biological Sciences
UNIVERSITY OF MINNESOTA

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