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Chemistry Student Meets Nobel Laureates



Bernadette Hernandez overlooks Lindau, Germany, where she attended a Nobel Laureates' meeting last summer.

Chemistry graduate student Bernadette Hernandez was one of 27 American research participants from universities, national laboratories, and federal facilities chosen by the U.S. Department of Energy to attend the 52nd convention of Nobel Laureates in Lindau, Germany, last July. About 400 students and young researchers attended from around the world.

Hernandez called the experience "inspirational," saying the Nobel Laureates discussed subjects ranging from scientific theory, results, and procedures to ethics, education, politics, and religion.

"During his presentation on winning the Nobel Prize, Ahmed Zewail reminded me that the reason I chose to study chemistry was the 'thrill of discovery' and that the passion it evokes is the 'key to your success,'" Hernandez said.

Hernandez, a student in Associate Dean Peter Dorhout's lab, was selected because of her ferro-electrics research at Colorado State University and her undergraduate work at Sandia National Laboratories in Albuquerque.

Outlook from the Dean

As the new dean of the College of Natural Sciences, please allow me to introduce myself to you, tell you about the new leadership in the College, and let you know about some of the exciting new directions we are taking.

I came to Colorado State University as a faculty member in the Department of Mathematics in 1981. After spending the last year as associate dean of the College and the previous five years as chairman of the Department of Mathematics, I am now in my 21st year at the University.

Joining me in the dean's office are two new associate deans: Jan Nerger, an experimental psychology professor and researcher who also is associate dean for Instructional Affairs, and Peter Dorhout, a chemistry professor who now oversees research and graduate issues within the College. Along with Assistant Dean for Undergraduate Affairs Jack McGrew, whose background is in wildlife science and zoology, our staff will provide a balanced, interdisciplinary leadership for the College of Natural Sciences.

This issue of *Outlook* has separate sections covering news from each department within the College, giving you an easy way to keep up-to-date on happenings within your degree program. Among the departmental highlights in this issue are:

- the naming of Professor of Chemistry Robert Williams as a University Distinguished Professor;
- research into neuronal growth, with potential application to spinal cord injuries, being conducted in Professor of Biochemistry Jim Bamberg's lab;
- establishment of a new graduate-level Occupational Health Psychology concentration within the Department of Psychology;
- a scientific breakthrough in understanding the genetics of insecticide resistance, thanks in part to the contributions of Professor of Biology Tom Wilson;
- several exciting advancements in the High Energy Particle Physics group;
- international leadership provided by Professor of Mathematics Jennifer Mueller in electrical impedance tomography, a medical imaging technology;
- EPA-funded research on water quality issues by the Department of Statistics; and
- brainwave studies by Chuck Anderson in the Department of Computer Science that one day could enable a paralyzed individual to communicate with another person or perhaps control a wheelchair.

Research remains one of the priorities within the College, and for that reason, we are working to create a high-level, interdisciplinary undergraduate research experience in natural sciences. The new Undergraduate Research Institute will encompass academic and applied research, leadership skills development, and

critical thinking activities. This program will cross traditional disciplinary boundaries, connecting students across fields of natural sciences and preparing them to become leaders of a diverse, globally aware, technical workforce.

To strengthen our ability to attract outstanding graduate students and postdoctoral fellows to the College, we will be working to increase the number of endowed chairs – faculty positions filled by prominent, accomplished, and highly sought-after scientists – from one to eight. Research labs staffed by teams of this caliber are able to push the boundaries of science and add to Colorado State's reputation of excellence.

You may remember from previous issues of *Outlook* that our new, state-of-the-art Chemistry/Biosciences Hall is now up and running. This is a wonderful facility that offers a significant amount of new space for chemistry, biochemistry, biology, and life sciences classes through lecture rooms, break-out recitation rooms, and laboratories. The unique design allows faculty to move students from one type of learning environment to another depending on the teaching modality that best fits the content being delivered. As a result, students in these courses can learn science through a more integrated approach that combines lecture, discussion, and experiential learning.

In terms of funding, cutbacks in the state budget will make our jobs more challenging, but our development staff is working to secure necessary funding through grants, corporate donations, and the generous support of alumni and other individuals. (We've even provided an envelope with this issue of the magazine to make it easier for you to show your support!) With your help, I am confident we will be able to weather the financial storm and continue to move forward with our goals and objectives.

I look forward to my work as dean of this dynamic College and to all that our future will bring. If you would like to share any of your thoughts about our new directions, the content or design of *Outlook*, or your past educational experience here, please feel free to contact me at rick.miranda@colostate.edu.

Rick Miranda



Rick Miranda, CNS Dean



College News



Arlene Nededog

Awards and Notations

Arlene Nededog, director of retention for the College of Natural Sciences, was honored by having an award named after her. Given to businesses that do an exemplary job of serving racial and ethnic minorities in Fort Collins, the first five inaugural Arlene Nededog Merchant Recognition Awards were conferred last March.

Professor of Mathematics **Duane Clow** was honored with the Forrest Fisch Award by the Colorado Council of Teachers of Mathematics for his service to the organization and the math community of Colorado.

Kelly Chappell, assistant professor in the Department of Mathematics, was presented the Provost's N. Preston Davis Award for Instructional Innovation in April for her diligent efforts to bring reform and renewal to mathematics education.

The College of Natural Sciences awarded alumna **Vicki Farrow** a 2002 Distinguished Alumni Award for her work as an independent consultant specializing in leadership development. Farrow received her bachelor's in psychology from Colorado State in 1972 and her master's in human development from the University in 1975.

2001-2002 Faculty Retirees

Ned A. Daugherty, Department of Chemistry, 39 years of service

Paul W. Mielke, Department of Statistics, 38 years of service

Richard P. Osborne, Department of Mathematics, 33 years of service

Elmer E. Remmenga, Department of Statistics, 46 years of service

Thomas W. Sneider, College of Natural Sciences, 27 years of service

Best Wishes. . .

. . . to Associate Dean and Professor Emeritus **Thomas W. Sneider** on his retirement. Special thanks to Sneider for his many years of service to the University community, including a six-year stint as associate dean for the College and as interim dean for one year. Sneider and his wife, Judy, currently are studying Italian in Bologna, Italy.

. . . and congratulations to **Joan Herbers**, who recently was named dean of Biological Sciences at The Ohio State University. Herbers, an internationally known researcher on ant behavior, led the Natural Sciences Department of Biology as chairman for more than eight years.

Yates Announces Retirement

After 13 years as president of Colorado State University, Albert C. Yates has announced his retire-

ment. Citing the need to spend more time with his family and to pursue other avenues of study, Yates will depart the University at the end of June 2003 or shortly after his successor is named. The College of Natural Sciences wishes to thank President Yates, who is also a faculty member in the Department of Chemistry, for his lengthy and loyal tenure at Colorado State.

New Faculty

The Department of Chemistry welcomes **Charles Henry** to its faculty. Henry, an analytical and biological chemist, received his Ph.D. from the University of Arkansas in 1998. His research interests include instrumentation for the diagnosis and treatment of cancer and metabolic diseases.

Ross McConnell joined the Department of Computer Science this semester from his position at the University of Colorado, Boulder. McConnell works primarily in the area of graph theory and algorithms.

The Department of Mathematics added two new faculty members this fall. **Anton Betton**, a native of Germany, received his Ph.D. from Bayreuth University and specializes in combinatorics and symbolic computation. Professor **Paul Kennedy** heads up mathematics education within the department and is the new co-director of the Individualized Mathematics Program.

Professor **Lorann Stallones** recently relocated to the Department of Psychology and adds her expertise in the areas of epidemiology, health psychology, and agricultural safety and health to the department's Industrial/Organizational Program.

Fall 2002 Commencement

The College of Natural Sciences will honor approximately 250 undergraduates at the fall commencement ceremonies. All students are individually recognized by name and by the honors they have accrued throughout their tenure at Colorado State University.

The ceremony will begin at 7 p.m. December 21 in Moby Arena. Additional student and guest information may be accessed through <http://commencement.colostate.edu/>.

Chemistry/Biosciences Hall Open House

A crowd of alumni, students, and faculty gathered during Homecoming 2002 to attend the new Chemistry/Biosciences Hall open house celebration. President Albert C. Yates and Dean Rick Miranda were on hand to extend their thanks to the many people who made the building a reality. The project was funded entirely by state appropriations and took two years to complete. The 78,000-square-foot building boasts five stories of state-of-the-art teaching and laboratory facilities, new safety equipment, and a 254-seat auditorium.



"Newton's Corner" provides an artistic touch to the new Chemistry/Biosciences Hall.



President Albert C. Yates

CSMATE Targets Inner-City Science, Math Education

Colorado State University continues to chart new territory in math and science education nationwide, thanks in part to two projects under way in the Center for Science, Mathematics, and Technology Education, or CSMATE.

In one project, CSMATE has joined forces with four other universities, seven tribal colleges, and several school districts to create the Center for Learning and Teaching in the West. The center seeks to increase the number of qualified math and science educators in secondary schools and higher education, especially in inner-city and low-income areas. A five-year project funded in part by a \$10 million grant from the National Science Foundation, the center also involves Montana State University, the University of Northern Colorado, the University of Montana, and Portland State University.

Through the center, doctoral and postdoctoral students in math and science education will work to:

- promote science and math education reform in 68 participating K-12 schools;
- expand online professional development and graduate-level education courses, which are especially useful for teachers in isolated and low-income areas;
- conduct research on math and science education in schools serving rural, inner-city, reservation, minority, and low-income students;
- recruit and retain qualified faculty in rural schools; and

- increase minority students' participation in math and science.

"Colorado State and the University of Northern Colorado are known for training large numbers of math and science educators each year," CSMATE director Ed Geary said. "We hope that through center collaborations, we can create a new generation of teachers who will help Colorado students succeed in math and science."

Last January, CSMATE also received a two-year, \$900,000 grant from the National Science Foundation to develop a collection of 500 "exemplary" digital K-12 materials about water – a natural resource that has relevance across all sciences and that has many societal, economic, policy-related, and environmental implications. Over the next two years, university-level teachers and scientists along with informal trainers and educators will identify, review, and catalog water education resources available on the Web. When this "Digital Water Education Library" is complete, teachers and students at all grade levels will be able to quickly access high-quality, standards-based water resources.

The digital library is a joint effort of Colorado State, the National Science Teachers' Association, and the University of Colorado at Boulder's Lifelong Learning Center.



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*For more information, call toll-free
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or e-mail: SupportCSU@ua.colostate.edu*

**Colorado
State**
University

Knowledge to Go Places

Chemist Receives University's Highest Honor



Robert Williams

Last spring, chemistry Professor Robert Williams was named a University Distinguished Professor, Colorado State's highest honor. Only 12 current faculty members at Colorado State have this designation. Williams and the other professors will retain this title for the duration of their careers at the University. At 49, Williams is one of the youngest faculty members to receive this designation.

Williams has carried out a rigorous, internationally renowned research program for more than 20 years and has contributed to the development of important antibiotics and anti-tumor drugs. He joined Colorado State in 1980 and completed the total synthesis of the antibiotic bicyclomycin in 1984. Other important findings included discovering a novel mechanism responsible for the anti-tumor activity of certain cancer-fighting compounds.

He also has conducted research on the synthesis of amino acids that are primary building blocks for peptide-based drugs used to treat HIV. With Washington State University researchers, he has made

recent, notable contributions in understanding the biosynthetic route to Taxol, an anti-tumor drug that comes primarily from Pacific and European yews.

"Bob is extremely productive in his research and is a dedicated teacher," said Michael Elliott, professor and chairman of the Department of Chemistry. "He works very hard and is a credit to the department."

Over the years, Williams has brought in about \$10.6 million in external funding. Williams' research has been featured in *Chemical and Engineering News*, the premiere trade magazine in chemistry and chemical engineering. He was recognized this year with the Arthur C. Cope Scholar Award given by the American Chemical Society and has received fellowships from the Alfred P. Sloan Foundation and the Japanese Society for the Promotion of Science.

Williams also thrives in his role as educator.

"I love watching students become adult scientists," he said. "By the time they're done here, they're ready to take on the world, and that's very satisfying."

He earned a doctorate in organic chemistry in 1979 from the Massachusetts Institute of Technology and was a Postdoctoral Fellow at Harvard University.

Shi Awarded Monfort Professorship

Associate Professor of Chemistry Yian Shi has been given the prestigious Monfort Professor Award created to help the University recruit and retain its top-quality faculty. Shi and A. Scott Denning of atmospheric science each will receive \$75,000 per year for two years to support innovative teaching and research activities. They are the first of 10 professors to be selected through a campuswide nomination process over the next five years.

Known as an accomplished, energetic, and productive faculty member and researcher, Shi has discovered several highly fundamental chemical processes.

"These two outstanding researchers are part of

the reason we dedicated resources to support Colorado State's continued growth as a great university," Dick Monfort said.

The award is part of a \$5 million gift given to the University by the Monfort Family Foundation.

"It's very exciting and it's a big honor," Shi said. "CSU is very supportive of research by young faculty; it's a great place to develop a career."

Shi has conducted research on topics ranging from synthetic organic chemistry to biological chemistry. A graduate from Stanford University with a doctorate in chemistry, Shi previously received the National Science Foundation Career Award and the Colorado State 2000 Researcher of the Year.

Academic Enrichment Program Chosen

Materials chemistry research, a highly visible field of science that is integral to the improvement of technology, focuses on how chemical species behave in the solid state or interact with solids. Now, a \$700,000 Academic Enrichment Program grant from Colorado State will enable the department to strengthen its materials chemistry program, adding cutting-edge equipment and facilities. The department plans to redesign and

modernize existing laboratories into space appropriate for modern materials chemistry research and to purchase necessary equipment.

The facility improvements are expected to place Colorado State's materials chemistry research and education among the world's top materials programs; these improvements will benefit students in chemistry as well as those in the other physical and biological sciences.

Physicist Helps Educate Russian Students

When Dieter Hochheimer traveled to Russia for 12 days last July to help train young scientists, he may have learned as much as the students he taught.

Describing his experience there with “disbelief and amazement,” the professor of physics said that while most Russians are quite poverty-stricken, the scientists he met were rich in curiosity, warmth, enthusiasm, and national pride.

“Most people still live in a way unimaginable for most Americans; very often three generations live in a small apartment,” he said.

Though the cost of living is roughly one-third that of the United States, incomes are infinitesimally smaller. Professors, for example, earn the equivalent of only about \$60 per month, and most Russians survive on home-grown potatoes, other tubers, and cabbage, Hochheimer said.

“But the most striking experience was to see the eagerness of the students to learn, the work they put in their presentations, and the appreciation they had for the teachers,” he said. “We taught three hours in the morning, three hours in the afternoon, and gave talks in the evening, so students were very often tired. Still, they never missed an opportunity to discuss and learn new things.”

Hochheimer was part of a group of seven American and four Russian scientists, teachers, and Peace Corps volunteers who ventured to Lake Tourgajk in

the southern Ural Mountains to help train 40 graduate students selected from universities nationwide. The majority were physics students; others were in chemistry, engineering, math, and microbiology, and about 25 were women.

The instructors were part of a U.S. Civilian Research and Development Foundation-supported educational camp aimed at strengthening university-level research capabilities in biology, chemistry, earth sciences, mathematics, and physics.

About two weeks after the camp, Hochheimer received an e-mail that made the experience even more rewarding. Written in less-than-perfect English, the message said, “When you have left camp, we missed of you. You are spark!”

“It was a journey to a place with an incredible contrast between rich and poor but where there is a great desire to learn and to do everything to improve the situation,” Hochheimer said.



Physics Professor Dieter Hochheimer (third from right) and another faculty member talk physics with Russian students.



High Energy in Physics Department

Walter Toki, Robert Wilson, and John Harton of the high-energy particle physics group in the Department of Physics report several important discoveries:

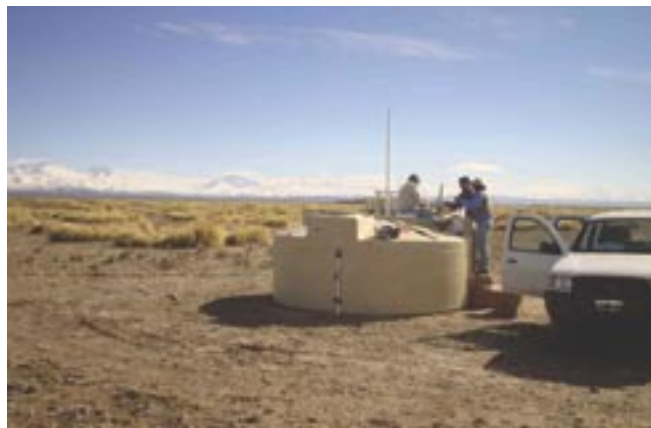
- At the Stanford Linear Accelerator Center (SLAC), the Colorado State physicists helped design, build, and operate hardware and analyze data on an experiment that revealed a fundamental difference between the behavior of matter and that of antimatter. They observed charge-parity violation in disintegrations of heavy subatomic particles called B mesons, which live for only one trillionth of a second.

- In July, SLAC collaborators announced their new measurement of a parameter known as “sine two beta,” which expresses the degree of asymmetry between matter and antimatter.

- An advisory panel to the Department of Energy and the National Science Foundation has recommended that construction of a high-energy, high-luminosity, electron-positron linear collider be the highest priority for the U.S. high-energy physics program.

Professor Wilson is leading Colorado State’s research for this next generation of particle accelerator.

- Harton and other scientists at the Pierre Auger Cosmic Ray Observatory in Argentina have detected high-energy particles from space. Many scientists are convinced that the Auger Observatory will discover new fundamental physics or some surprising astrophysics by studying the cosmic ray mystery.



A tank detector for the Auger Project under test on the pampas of western Argentina. In a couple of years, the scientists plan to have 1,600 such detectors spread over 3,000 square kilometers. The Andes are in the background.

Broad Mission of College Covers Education, Community Outreach,

If you are reading this publication, chances are good that you are a graduate of one of the departments in the College of Natural Sciences (CNS) at Colorado State University. But how much do you really know about the CNS? For example, did you know that based on student enrollment, the CNS is one of the largest colleges at Colorado State? Or that it awards 150 scholarships worth about \$226,000 per year? Or that it supports nine centers that offer specialized research, education, and other services to the community and campus?

Here is your chance to learn some facts that should make you proud of your alma mater. (Who knows, maybe you'll even find an impressive tidbit or two that could add some pizzazz to your resume, bio, or holiday letters.)

Departmentally Speaking

The College of Natural Sciences is responsible for education and research in eight departments: biochemistry and molecular biology, biology, chemistry, computer science, mathematics, physics, psychology, and statistics.

Many of the College's approximately 178 regular faculty and 40 support faculty and instructors have won major honors and awards and have achieved international recognition. In addition, the faculty have been cited for their excellent classroom teaching and outstanding contributions to undergraduate education.

By the Numbers

During the last academic year, the CNS taught more than 157,000 student credit hours or 24 percent of the University total. At any one time, some 3,200 undergraduate majors and about 560 graduate students are enrolled in the College.

Our Majors and Degrees

The CNS offers graduate degrees corresponding to each department – biochemistry, biology, chemistry, computer science, mathematics, physics, psychology, and statistics – as well as in the interdisciplinary ecology and cell and molecular biology programs. With the exception of statistics, bachelor's degrees are offered in all departments as well as in the majors of botany, zoology, and natural sciences.

Toward Undergraduate Success

The College of Natural Sciences takes the success of its undergraduate students very seriously. For

instance, the dean's office has designated one of its two associate deans to oversee undergraduate instruction, ensuring that students' education and research needs are being met and that the curricula meet all University and state standards.

Specific programs and services include:

- The Ingersoll Residential College, located in Ingersoll Hall, enables CNS majors to live, study, and find academic success with other natural sciences students. In fact, the CNS was the first college at Colorado State to offer this now-popular residential option.

- The Students as Leaders in Science Assistantships program gives talented under-represented undergraduate students the opportunity to gain work experience as teaching assistants, research assistants, tutors, and student advisers. Students also are offered leadership experience through club involvement and committee participation.

- The Science and Mathematics Tutorial Hall provides tutoring – at no charge – to students in more than 32 science and math courses. Located in Ingersoll Hall, the facility is open five evenings per week, employs an average of 30 tutors, and serves up to 1,000 students every semester.

- Academic Excellence Workshops are small study groups for more rigorous freshman-level courses in chemistry, biology, physics, and calculus.

- Undergraduate research opportunities are available in all departments, allowing students to assist faculty with grant-sponsored research and develop their own independent research projects. The University-wide annual Undergraduate Research and Creativity Symposium, which allows students to showcase their research, was originally designed by former CNS Associate Dean Tom Sneider.

- Judy Brobst, a career counselor at the CNS, helps students research and secure internships, enabling them to gain real-world experience, clarify career goals, develop research skills, and network with potential employers. Students also have access to career guidance and assistance with job search skills.

Our Scholarships

- The CNS awards 150 merit and need-based scholarships to 154 students per year. Most of these scholarships range from \$100 to \$1,000, with the coveted Beckman Scholars Award topping the list at up to \$17,000. These awards are made possible by donations from individuals, corporations, and organizations as well as various University funding sources.

Research, Student Scholarships, and Service to Industry

- The College produces many national scholarship winners, including six students who have won the prestigious academic Goldwater Scholarship for their work in biochemistry. Three of these students were selected in a single year – the most of any university in the country. The College also is home to six National Science Foundation pre-doctorate fellowship winners.

- This year, an additional four undergraduate math students will be awarded one of the newly established endowed scholarships, which come from a \$217,000 gift from the estate of Howard E. Emigh.

Community Connections

The College also provides training, outreach, academic support services, research, and teaching to external organizations, private industry, and other campus offices through the following nine centers and institutes:

Center for Applied Statistical Expertise (CASE)

Located in the Department of Statistics, this center offers statistical consulting, collaborative research assistance, data analysis, and statistical computing to business, industry, and government.
<http://www.stat.colostate.edu/case.html>

Center for Science, Mathematics, and Technology Education (CSMATE)

Sponsored by the Colleges of Natural Sciences and Applied Human Sciences, the Center serves to develop programs and perform research to foster improvement, innovation, reform in science, mathematics, and technology education.
<http://www.csmate.colostate.edu>

Central Instrument Facility (CIF)

The Central Instrument Facility is an analytical core facility operated by the Department of Chemistry. State-of-the-art equipment includes six magnetic resonance spectrometers and four mass spectrometers. Instruments are available 24 hours per day to trained research personnel, staff, and students.
<http://www1.chm.colostate.edu>

Colorado Injury Control Research Center

The Injury Control Research Center provides research and community education to reduce injury frequency and severity.
<http://www.cvmb.colostate.edu/enhealth/CICRC/>

Colorado State Artificial Intelligence Laboratory

The Artificial Intelligence Laboratory operated by the Department of Computer Science provides research and education in areas such as computer vision, genetic algorithms, neural networks, and planning systems. Applications include image and signal processing, optimization, control, scheduling, web agents, data mining, and software testing.
<http://www.cs.colostate.edu/aigroup.html>

Fluorescent Microscopy/Image Analysis Center (FMIAC)

Located in the Department of Biochemistry and Molecular Biology, this center enhances the research and teaching capabilities of the molecular and cellular biosciences by providing access to a core imaging facility for undergraduates, graduate students, and researchers. The facility allows researchers to document events that occur within cells with extremely high precision.

Franklin A. Graybill Statistical Laboratory

Housed in the Department of Statistics, the lab provides consulting, collaborative research assistance, data analysis, and assistance in the use of statistical computer programs. Staff maintain and update University capabilities in statistical data analysis and offer consulting experience and training for students in statistics.
<http://www.stat.colostate.edu/statlab.html>

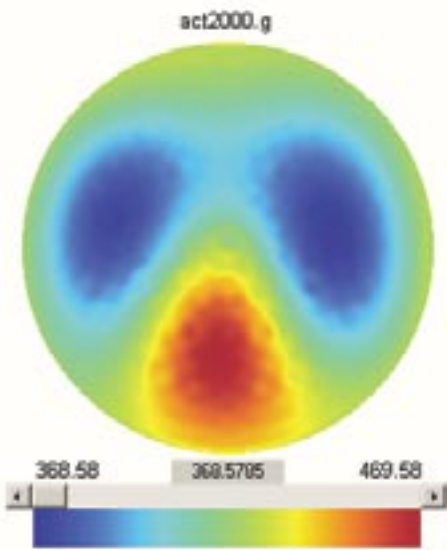
Macromolecular Resource Facility

This facility within the Department of Biochemistry and Molecular Biology supports research within Colorado State University by providing access to state-of-the-art instruments and techniques for the analysis and synthesis of biomolecules. Education on the theory and application of these technologies in the biological sciences also is provided to the campus community.
<http://mmr.bmb.colostate.edu>

Tri-Ethnic Center for Prevention Research

The Tri-Ethnic Center develops culturally relevant prevention measures for dealing with the problems of youth based on data gathered in ethnically diverse communities and grounded in empirical research.
<http://www.colostate.edu/Depts/TEC/>

Mathematician Among Imaging Technology Leaders



A model of the lungs and heart is used in electrical impedance tomography experiments.

More than 50 prominent physicians, engineers, computer scientists, and mathematicians from 10 different countries convened at the Pingree Park Campus of Colorado State University last August to discuss the latest information on a novel medical imaging technology called electrical impedance tomography (EIT). The participants were the leading researchers in this field worldwide. Assistant Professor of Mathematics Jennifer Mueller helped organize the five-day conference.

The conference focused on improving all aspects of the science, including equipment, processes, and the mathematical algorithms that render electrical data into two- and three-dimensional images. EIT is an innovative medical imaging technology that is improving the way medical procedures are conducted and could eliminate the need for many painful, invasive, radioactive, or expensive diagnostic procedures.

“Electrical impedance tomography is a relatively new technology with a potential to greatly enhance

EIT uses measurements of electromagnetic fields outside the body to reconstruct and display approximations to the electrical conductivity inside the body. While X-rays measure tissue density and ultrasound measures the tissue’s acoustic properties, EIT provides information about the conductivity of the tissue, measuring how electricity travels through a given material. For example, by the nature of their cellular makeup, malignant breast tumors conduct electricity much better and therefore have much lower electrical impedance than normal tissue or benign tumors.

To use the technology, a medical professional attaches electrodes to the patient’s skin and delivers low-level electrical currents to the tissue. The resulting voltages are measured and processed by a specially developed reconstruction algorithm that computes the distributions within the body of conductivity and permittivity, a constant of proportionality between electric displacement and electric field intensity. A separate algorithm then maps the output in real-time images.

“Mathematics plays a key role in EIT because it is used to determine conductivity in the body from the measured voltage data,” Mueller said. “Reconstruction algorithms, which are used to make this calculation, have to be stable in the presence of ‘noise’ in the data in order to create an accurate image.”

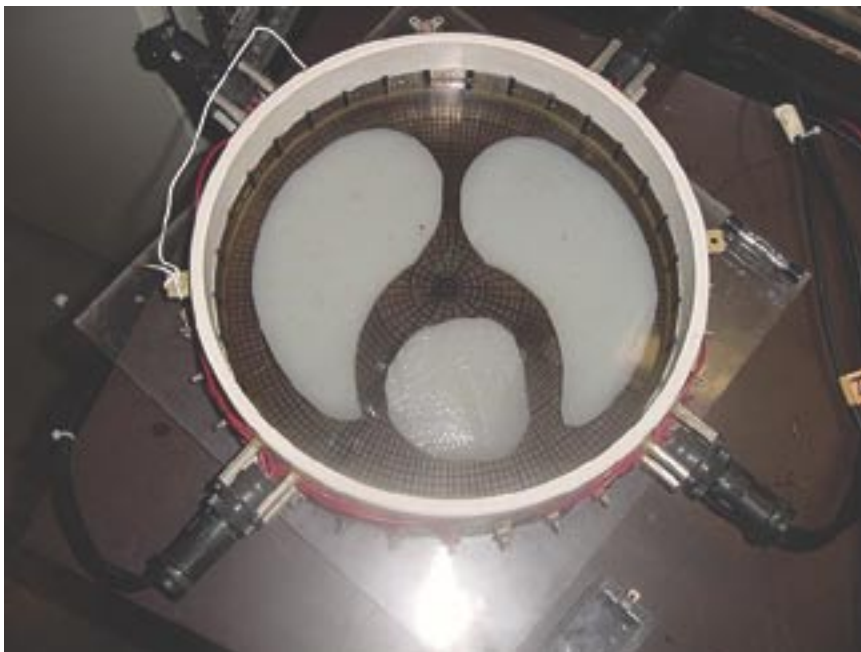
The technology can be used to study heart, lung, and stomach function and other medical processes. Electrical impedance imaging currently is used most extensively in the medical field for breast cancer examinations.

Mathematical Biology Emphasis Added

In recognition of the need to link education in math and the life sciences, the Department of Mathematics is developing a new emphasis in mathematical biology. Undergraduate students in the life sciences now can complete a minor in mathematics, which includes courses in calculus, differential equations, statistics, and, currently, an experimental mathematics class in biology and medicine.

“This minor will give students in the life sciences a whole new set of tools to use in solving problems on the job,” said Jim Thomas, interim chairman of the mathematics department.

In addition, mathematics faculty members Simon Tavener and Don Estep are heading up the department’s participation in the multidisciplinary Program for Interdisciplinary Mathematics, Ecology, and Statistics, or PRIMES. As a result of this effort, mathematics, statistics, and biology graduate students will receive cross-training in all of the disciplines and work in interdisciplinary teams on research projects directed by faculty from across the University.



EIT images indicate variations in tissue conductivity, which can be used to diagnose various medical conditions.

medical imaging procedures,” said Mueller, a renowned leader in EIT. “Two important applications are the early detection of breast cancer and the diagnosis of pulmonary embolus (blood clots in the lung). There is a strong interplay in EIT between engineering, mathematics, and medical science.”

EEG Research Could Aid Paralyzed Individuals

When Chuck Anderson tells people to use their imagination, he's not just making an offhand comment.

The computer science professor has found that when people perform certain tasks in their heads, their brains produce specific EEG patterns that can be correlated with each of the tasks. Anderson would like to enable individuals to harness this phenomenon to produce tangible actions such as communicating with other people, playing a video game, or even controlling a wheelchair. If he succeeds, individuals who are paralyzed or have neurological diseases such as amyotrophic lateral sclerosis, also called ALS or "Lou Gehrig's disease," could use just the power of thought to expand their communication and interaction with the outside world.

"People with ALS have the most to gain," Anderson said. "In the later stages of the disease, they develop the 'locked-in' syndrome when they can no longer communicate with caregivers. This technology could open up their worlds."

It's not that people can "tell" a computer what to do just by thinking it. Rather, when they perform certain mental tasks, they engage corresponding parts of their brains, producing brainwaves that are reflected in specific electroencephalogram patterns. Anderson believes these signals could be programmed to activate a computer, which in turn would produce the desired action. Anderson is studying five different mental tasks: writing a letter, performing complex multiplication, visualizing numbers being written on a board, imagining a three-dimensional object being rotated on its axis, and simply relaxing (for a baseline measurement). With these activities, he can identify the task the person performed, with 70 percent accuracy, based solely on the EEG pattern they produced.

While other researchers studying "Brain/Computer Interface" are using just one electrode to measure brainwave activity, Anderson uses as many as 12. Also, in most other studies, subjects perform only one task, not five. This more in-depth data is important for programming complex user-computer interactions. In addition, mathematics Professor Michael Kirby is separating the true brain signals from EEG "noise" produced by fine movements such as the blink of the eye.

In September, the National Science Foundation awarded Anderson and Kirby a new four-year, \$700,000 grant to study additional mental tasks, add a biofeedback component, and further refine the data.

Using brainwaves to perform complex tasks is still a ways off. But by the end of the grant period, Anderson hopes that technology will enable two people to exchange e-mail or play a simple game like "Pong" over the Internet – without ever touching a keyboard. <http://www.cs.colostate.edu/~anderson>



Chuck Anderson uses an electrode cap, EEG amplifier, and laptop computer to track brainwaves.

Decoding the "Mega-Database"

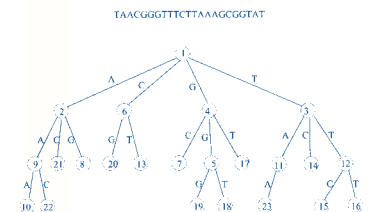
While many in today's communication-driven society complain of "information overload," Ross McConnell thrives on it.

The assistant professor of computer science, who joined Colorado State University in August, develops computer algorithms that can work with extremely large databases involved in discrete math and graph theory.

He has developed ways of structuring a large piece of text so that queries can be found very quickly. Conventional algorithms used to solve similar problems, such as those used in "find" operations in word processing software, are too slow for the huge amounts of data involved in many biological applications. McConnell, who often collaborates with CU-Boulder computer science Professor Andrzej Ehrenfeucht, has helped develop an algorithm for quickly searching within these "super-sized" databases, making them virtually instantaneous. The computer scientist says other researchers have used this data structure to produce the first Scrabble program that routinely beats even champion players.

Future genetics-related applications of McConnell's research include increasing the accuracy of DNA testing on human remains, determining when a DNA sample has become contaminated, and identifying and mapping intervals on the human genome, which involves approximately 30,000 genes and some 3 billion chemical base pairs.

"When a conventional approach is applied to certain common problems with genetic data, even the fastest computer will slow to an imperceptible crawl," he said. "But our approach often can speed up such calculations by a factor of 10,000."



McConnell's algorithm makes fast work out of large databases.

Psychology Adds Injury Reduction Focus

During World War II, industrial and engineering psychologists found a serious design flaw in two switches in military airplanes. One switch lowered the plane's wheels; the other lowered the wing flaps. But the switches were identical and side-by-side, which could easily confuse an already stressed wartime pilot. Today, wheel and wing flap controls are easily distinguished by shape, and many other cockpit characteristics have been redesigned for safety, all thanks to the work of psychologists.

More than half a century later, occupational health psychology is getting its due, both at Colorado State University and nationwide. This field, which involves applying psychological principles and research to improve worker health, safety, and well-being, is now a new concentration available to Colorado State graduate students.

Other examples include grounds workers who refuse to wear earplugs while using power lawnmowers, despite the risk of hearing loss, and employees working around solvents for short periods of time who shun the recommended protective clothing and equipment because of the "hassle."

Students who enroll in the concentration will take Occupational Health Psychology, taught by Chen, and Prevention of Occupational Injuries, taught by Lorann Stallones, a professor in the psychology department, and other classes such as Ergonomics, Industrial Hygiene, and Industrial, Organizational, and Health Psychology.

Students currently enrolled in this concentration are conducting research on job stress and sleep loss, safety in union work settings, and workplace violence.

The psychology department also houses a related program: the Colorado Injury Control Research Center, established in 1995 to reduce injury frequency and severity of injuries. Originally part of the Department of Environmental Health within the College of Veterinary Medicine and Biomedical Sciences, the center moved to the Department of Psychology last year and is directed by Stallones.

"Injuries are the leading cause of death in people under 40," Stallones said. "They are a tremendous burden to society because of the costs involved in medical care and permanent disability."

The center is funded primarily by the National Center for Injury Control and Prevention within the Centers for Disease Control (CDC) and is a collaboration of researchers from four colleges at Colorado State: Natural Sciences, Veterinary Medicine and Biomedical Sciences, Liberal Arts, and Applied Human Sciences. The University of Colorado Health Sciences Center and the Colorado Department of Public Health and Environment also are collaborators.

The CDC has funded the center since its inception and in 2001 awarded a five-year grant of \$950,000 per year. Part of the funding goes toward research, including a recent study that found farm workers who had been poisoned by organophosphate pesticides were nearly six times as likely to become depressed as farmers who had not been poisoned. Another study focused on work-related respiratory disease among farmers, which initially can be misdiagnosed as influenza.

In its community-initiated prevention program, the center distributes a total of \$8,000 to \$12,000 per year to organizations involved in injury prevention, especially those that work with Hispanics, Native Americans, agricultural workers, and other underserved populations.



Last year, Associate Professor of Psychology Peter Chen secured a \$25,000 training grant and helped launch the new focus, which he says is most appropriate for students in counseling, industrial/organizational, or applied social psychology; and occupational therapy, industrial hygiene, occupational health, ergonomics, and epidemiology.

"People in ergonomics and other disciplines have started to realize that no matter how much the hardware is improved, accidents and illnesses still occur," Chen said. "While guidelines can be prepared for employees, they don't always follow them."

For example, the safest way for a worker to remove a 300- to 400-pound manhole cover involves using an 8-foot-long bar made for this purpose. But many workers instead use a 2-foot crowbar and a good deal of bending, lifting, and back strain. Why? It's macho.

"Some of the workers think only 'sissies' use the 8-foot bar," he explained.

Pesticide Resistance Gene Discovered

A new study by a team of worldwide researchers, including Colorado State University biology professor Tom Wilson, has made a major scientific breakthrough in understanding the genetics of insecticide resistance.

Scientists only now are beginning to understand the genetic changes that allow global populations of insects to develop resistance, rendering pesticides ineffective.

Wilson and his colleagues have identified the gene responsible for resistance in *Drosophila*, the common fruit fly. This fly develops pesticide resistance from a mutation in a single gene known as DDT-R. The team's new research results show that over-activity of this gene can cause insecticide resistance.

"It is common for insecticides to work well for several years but then lose their effectiveness because insects evolve resistance to these poisons," Wilson said. "Our current research has identified, for the first time, a gene responsible for insecticide resistance and how it became mutated in a model insect."

To dissect the genetic basis of insecticide resistance, Wilson and his colleagues conducted research on global populations of fruit flies.

An insect's resistance to pesticides revolves around the DDT-R gene, which produces a metabolic enzyme responsible for breaking down DDT and other poisons. The researchers found that when insects become resistant to pesticides, the expression of the DDT-R gene causes a dramatic increase in the amount of the cytochrome P450 metabolic enzyme. When an insecticide enters the insect's body, it is broken down so efficiently that the poisons never reach their target tissue to cause death.

"We are witnessing evolutionary changes in a population in a matter of years, rather than in millions of years," Wilson said. "This research is, in part, telling us how living organisms respond to all of the chemicals we put out into the world."

Assisting Wilson in his lab was undergraduate Scott Jeffers, a fact that demonstrates the important role students play in research at Colorado State, Wilson said. Jeffers is now a doctoral student at Purdue University.

Other research team members are from Australia, France, and the United Kingdom.

Greyhounds Teach Students About Animal Behavior

In a unique animal behavior course offered recently at Colorado State University, undergraduate zoology students gained first-hand experience applying scientific principles while training retired greyhounds to become household pets. The class was taught in fall 2001 and spring 2002 through a partnership between CSU's Office for Service Learning and Volunteer Programs and Colorado Greyhound Companions. Through these two courses, students prepared 21 greyhounds for home adoption.

Behavior problems are the number one reason dogs are given to humane societies, and each year, more than 7 million healthy dogs are euthanized in the United States. Dogs that are better socialized and trained are more likely to be accepted into homes.

When first taken from the track, greyhounds are not familiar with doors, windows, other pets, children, or open space and are not accustomed to attention or relationships.

"This class gives students an opportunity to practice what they are learning from lectures and textbooks," said Janice Moore, a biology professor who teaches the class. "They actually are applying scientific techniques and gaining invaluable hands-on experience, all while realizing the benefits of volunteer work and helping some wonderful animals find homes."

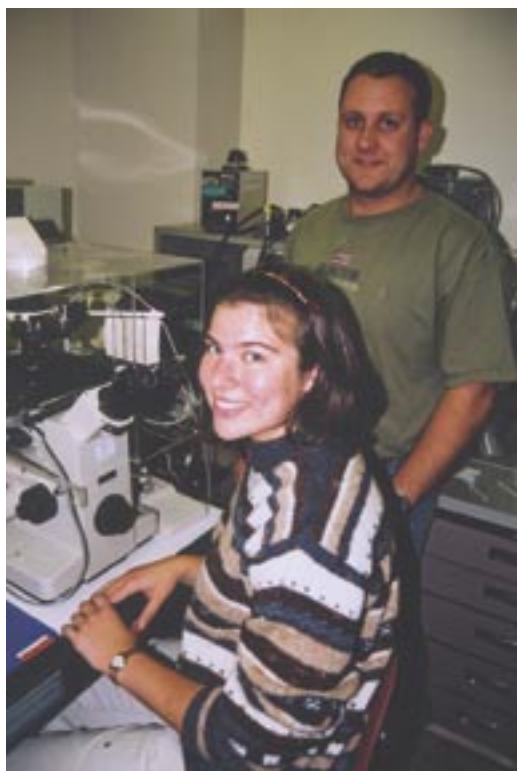
From Greyhounds to Pill-Bugs

Demonstrating another area of her expertise in animal behavior, Moore authored *Parasites and the Behavior of Animals*, a book about host-parasite interactions published by Oxford University Press earlier this year. A review in the June edition of *Nature* stated, "Moore's writing is witty and conveys the flavor of her deep interest in beasts that most people like to avoid." The review even says, "Some examples can send chills up your spine."

Ingersoll Residential College students befriend one of the retired greyhounds trained by students for home adoption.



Undergraduate Research a Biochemistry Priority



Undergraduate Christy Bill studies the cellular cytoskeleton as part of neurological research supervised by postdoctoral fellow Patrick Sarmiere.

On the second floor of the biochemistry or MRB building at Colorado State, two talented and fortunate undergraduate students are conducting molecular biology research that one day could contribute to new therapies for spinal cord injuries and degenerative neurological diseases.

Jennifer Durdin and Christy Bill, both juniors majoring in biochemistry, are working in Jim Bamburg's lab on studies of molecules that regulate formation of the cellular cytoskeleton. Somewhat like bones and cartilage in the body, the cytoskeleton provides strength and support for the cell. Previous research by Professor Bamburg and others has shown that cytoskeleton growth can be altered by signals that direct neurons toward their targets.

Students Durdin and Bill are working to expand the body of knowledge about how these signals prompt changes in the neuron and how these changes cause a restructuring of the part of the cytoskeleton that directs its growth. By developing a better understanding of the underlying neuron cellular biology, the work at Colorado State ultimately may enable other scientists to learn how to trigger regeneration of neurons in the spinal cord. Patrick Sarmiere, a Christopher Reeve Paralysis Foundation postdoctoral fellow, supervises the students' work.

Durdin's work involves using an antibiotic to determine whether a regulating protein called ADF, or actindepolymerizing factor, influences the direction of neuronal growth, or "path-finding." Bill is studying components of the cytoskeleton called microtubules, something like conveyor belts that cause movement

within cells. She is constructing various forms of stathmin, a type of protein that destabilizes microtubules to determine whether they influence path-finding.

Durdin was awarded a summer undergraduate research fellowship from Pfizer, and both students are Beckman Scholars Program award recipients.

"I am amazed at how far I have come in such a short time," Durdin said. "I am very grateful to the biochemistry department, Dr. Curthoys, and particularly to Dr. Bamburg for providing these incredible opportunities and for their dedication to undergraduate research."

Other Biochemistry Programs

For the eighth year the Research Experience for Undergraduates (REU) program in the Department of Biochemistry and Molecular Biology at Colorado State University is providing students from across the country opportunities to take part in biochemistry and molecular biology research projects for ten weeks each summer.

With financial support from the National Science Foundation (NSF), students are placed in a research lab within the department, given on-campus room and board, and receive a stipend and travel compensation. In addition to the work with faculty mentors and graduate students in the laboratory, students participate in weekly meetings, seminars, field trips, and social events.

The NSF is also providing financial support for the International Internship Program. Established by department, the program provides the opportunity for students to conduct research abroad for one semester or for one summer. All students are eligible. Student applicants for the program must have at least one semester of experience in the research laboratory of a CSU mentor within the department or be affiliated with an REU Program that has an existing contact with a foreign host laboratory.

<http://www.bmb.colostate.edu/undergraduate.htm>

Biochemistry Chairman Honored

Colorado State University selected Norm Curthoys, chairman of the Department of Biochemistry, for an Oliver P. Pennock Award last year for outstanding service. The award includes a cash prize of \$1,250.

All candidates are nominated by one or more faculty members.

"What I appreciated most was the fact that many of the faculty in biochemistry contributed to the nomination letter," Curthoys said. "However, the cited accomplishments were clearly the result of the entire faculty and staff of the department."

The University gives the Oliver P. Pennock Award to five faculty members each year.

Statistics Awarded \$3 Million Water Quality Grant

Colorado State University researchers are beginning work on a four-year, \$3 million project funded by the Environmental Protection Agency to improve water quality assessments and address environmental problems related to water resources. Project results will help environmental and conservation officials to map species' habitats, measure biological diversity, and monitor water chemistry.

"We rely on clean water for nearly everything we do, so taking care of water resources is critical for humanity," said Scott Urquhart, project director and senior research scientist in the Department of Statistics at Colorado State. "An important step in ensuring clean water is obtaining accurate water-quality measurements."

The Space-Time Aquatic Resources Modeling and Analysis Program, or STARMAP, will create statistical models to predict the environmental quality of lakes, streams, rivers, and wetlands. Additionally, the program will develop mathematical tools to monitor and analyze the condition of the organisms and non-living components within each water system.

The research, education, and outreach funded by the project are expected to substantially improve processes for determining the environmental conditions of water resources. Other results may include new guidelines for ecological monitoring studies and a comprehensive database of aquatic environmental conditions.

The program, based in the Department of Statistics, is an interdisciplinary effort involving statisticians, geographic information systems specialists, ecologists, engineers, and other researchers. The project will develop statistical models, train future environmental statisticians, and provide assistance to state and tribal agencies.

According to the Colorado State research team, there traditionally have been inconsistent measurements and a lack of reliable data to make objective decisions. The STARMAP team is developing tools to help states and tribes make consistent, information-based assessments.

"By developing good statistical models, we can formulate accurate predictions for measures of animal life, pollutants, and a variety of other indicators for inland aquatic resources," Urquhart said. "We will give these completed models to state and tribal organizations and work with them in developing programs that will allow them to effectively conduct these analyses on their own."

The project also will develop models incorporating data from different scales and different sources including onsite sampling and satellite remote sensing. The result will be the most encompassing and accurate estimates of aquatic resources to date.



"It is expensive and time-consuming to obtain extensive detailed sampling data from the ground, and the information received from satellite imagery provides only an overview," said Richard Davis, statistics department chairman and the project's co-principal investigator. "Our plan is to link sample data to satellite data and create models that can be used to make affordable and accurate assessments of aquatic resources."

Davis Named Statistics Fellow

Richard A. Davis, professor and chair of the Department of Statistics at Colorado State, has been named a Fellow of the American Statistical Association, the world's leading statistical science organization and the second oldest professional society in the United States.

American Statistical Association members nominated 48 of its 16,000 members as fellows of the association this year. According to the ASA, Davis was named a fellow for his contributions to time series analysis and extreme-value theory and their applications and for his editorial, educational, and administrative contributions.

Davis is co-author of *Time Series: Theory and Methods* and *Introduction to Time Series and Forecasting* as well as the time series analysis computer software package ITSM 2000.

Left to right: Richard Davis, Jay Breidt, Jennifer Hoeting, and Scott Urquhart review an ecosystem map as part of their water quality research.

Emeritus Faculty Directory Web page: Want to connect with one of your favorite, but now retired, former professors? Find their e-mail addresses at: <http://www.colostate.edu/Depts/NatSci/html/DirectoryEM>

New Leadership Team Guides Natural Sciences



Back row, from left: Dean Rick Miranda, Associate Dean Janice Neger, and Assistant Dean Jack McGrew. Front: Associate Dean Peter Dorhout. Photo by Roni Hoffman.

A mathematician, research psychologist, chemist, and zoologist have taken the helm at the College of Natural Sciences (CNS) this year, creating a dean's office leadership team with more varied backgrounds and education than ever before. All were faculty at Colorado State University before joining the dean's office.

Rick Miranda, who had directed the Department of Mathematics for

the previous five years, was appointed dean of the College in July. Miranda, 48, replaced Interim Dean Thomas Sneider, who had filled the position after Dean John Raich stepped down last fall.

Miranda earned a bachelor's degree in math from the College of the Holy Cross in Worcester, Mass., and a doctorate in math from the Massachusetts Institute of Technology. He taught at Tufts University and the University of Chicago before coming to Colorado State in 1981 as an assistant professor. He was promoted to associate professor in 1984 and full professor in 1990. His primary field of interest is algebraic geometry.

"After a national search, Colorado State found the best person for the job right here on campus," said Colorado State President Albert C. Yates. "We are pleased to welcome Rick Miranda as the College's

new dean." Miranda had served as interim associate dean for instructional affairs at the CNS for the past year.

Joining Miranda in July as associate dean for instructional affairs was Jan Neger, a professor of psychology and behavioral neuroscience coordinator. Neger, 41, completed her doctorate in experimental psychology at the University of San Diego. She specializes in neural processes of human color vision and has taught courses in sensation and perception. As associate dean, Neger is responsible for the CNS events and all issues regarding undergraduate instruction at the College, University, and state levels.

Also in July, Professor of Chemistry Peter Dorhout was appointed associate dean for research and graduate education, replacing physics Professor Jim Sites, who had filled the position on an interim basis. Dorhout, 40, oversees graduate school issues and projects while still teaching inorganic and materials chemistry. He earned his doctorate in chemistry from the University of Wisconsin. In his research, he has collaborated with scientists at the Los Alamos National Laboratory, Moscow State University, and the Russian Federal Nuclear Center.

Jack McGrew remains as assistant dean for student affairs, a position he has held since 1986. McGrew, 56, earned a master's degree in wildlife science at Utah State University and a doctorate in zoology at Colorado State. He serves as the key adviser for the CNS, the faculty sponsor for the CNS Student Council, liaison to the Student Affairs Division, and faculty sponsor for the Ingersoll Residential College and is involved with all CNS-sponsored student activities.

We welcome your comments! E-mail the College of Natural Sciences dean's office at cns@lamar.colostate.edu

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