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Exploring frontiers of the brain

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**ON THE COVER**

A labyrinth of complexities and unanswered questions face Colorado State scientists who are studying brain injuries. The model is CSU alumna Marianne Provenza; staff photographer Joe Mendoza captured her image.
As an endlessly curious species, we humans can't help but explore new frontiers on Earth and in space. But we don't need to go very far to find other frontiers – some of the deepest mysteries imaginable are right inside our own skulls.

It’s staggering how 100 billion neurons, each linked to as many as 10,000 other neurons, fire away in our brains so we can breathe, walk, recognize faces, imagine the future, construct great cities, delight in a child’s laughter. Small wonder that our 3-pound bundle of sparking cells, which accounts for about 2 percent of our body mass, uses 20 percent of the blood and 20 percent of the oxygen that courses through our systems. And if we get headaches trying to keep up with all this wonder, we can’t blame it on our brains: There are no nerves within the brain that register pain.

Part of the mystery of the brain, which is capable of hosting more ideas than the number of atoms in the known universe, is that it works as well as it does. Researchers are just starting to figure out how our brains work – sometimes by trying to unravel what goes wrong. And it’s daunting how much can go wrong, whether internally, such as stroke, or from external injury.

When we met with the magazine’s advisory committee to brainstorm stories for this issue, one of the members, Jody Donovan, assistant to the vice president for Student Affairs, pitched in with ideas about brain injury research. Later in the meeting, she casually mentioned that she had suffered a brain injury.

At first, I thought her injury had been minor. After all, she was perfectly lucid and didn’t look at all like she’d suffered a head injury. But it didn’t take long to realize how mistaken my notions were – Jody had spent more than a year regaining her life, and she still didn’t feel 100 percent recovered. My mistake was assuming that she looked fine; ergo, she must be fine.

A key part of this April issue is how traumatic brain injury is sometimes called the invisible injury. The road back can be long and arduous, but with a lot of help and hard work, victims today are recovering in remarkable ways. Jody’s story, part of a feature on our internal landscape that begins on Page 18, is just one example of brain research that’s making the invisible visible.

The bottom line for Jody and countless others: teasing some of those billions of neurons back into the full swing of life.

Paul Miller
End of an era

Former head coach Sonny Lubick, one of Colorado State’s most popular football coaches, was honored with his own day in a ceremony in February at the State Capitol in Denver.

Gov. Bill Ritter proclaimed Feb. 9 Sonny Lubick Day to recognize the coach who led the Rams to nine bowl games and who won or shared six conference titles over the course of his 15-year career. He closed out his tenure as coach with a 108-74 record.

In 2003, the University’s football playing field at Hughes Stadium was named Sonny Lubick Field.

“Tou don’t think there’s a coach in the country who has had 15 years as good and as fun as I have had,” Lubick said at a press conference in November. “I will be a Ram until the end of time. I’ll be in your corner, and I’ll be watching you closely.”

New coach of Rams football is CSU’s own

Colorado State welcomed back one of its own in December by naming Steve Fairchild the 19th head coach in the 115 seasons of the University’s football program.

Fairchild returns to his alma mater from the National Football League, where he had tutored some of the game’s most productive young stars since leaving CSU after the 2000 season.

CSU Athletic Director Paul Kowalczyk said Fairchild has the spirit and experience to lead the Rams into a new era. He noted that the Board of Governors of the CSU System has set ambitious stretch goals for the University’s athletics program that include success in the Director’s Cup and a berth in the annual Bowl Championship Series.

“It’s just hard work, determination, put your plan in place and don’t flinch, and that’s what we’ll do here.”

Fairchild first came to CSU in 1978 as a junior college All-American, and he led the Rams in passing during his first season as quarterback. Following his playing days, Fairchild launched a coaching career that in 2008 enters its 28th season, 16 of which have been as a coordinator and 20 of which have been at the college level.

As a member of former coach Sonny Lubick’s original coaching staff, Fairchild coached quarterbacks from 1993-96 and was offensive coordinator from 1997-2000. During Fairchild’s tenure, the Rams experienced unprecedented offensive success, including the school’s all-time scoring (442 points) and touchdown (59) records in 1997, during Fairchild’s first season as coordinator. He helped secure five of the six conference championships during the Lubick era and five bowl games in eight years.

Fairchild finished the 2007 season as offensive coordinator for the Buffalo Bills before joining CSU.
Racking up the physics of pool

A (supposedly) misspent youth becomes a rewarding career for mechanical engineering professor

by Paul Miller

Mechanical engineering Professor Dave Alciatore tends to describe his youth as a misspent time hanging around the bowling alley and pool tables close to Antoine’s, a restaurant run by his family in the French Quarter of New Orleans.

But ultimately, all the years he spent racking up balls has paid off – he’s now known as a devoted pool and billiard enthusiast and an expert in understanding the physics of the game. And he’s passionate about teaching students the intricate principles behind one solid object cracking into another.

Alciatore’s misspent youth, you could say, is continuing to reap benefits. He hosts a popular website (billiards.colostate.edu), which includes teaching aids, links to physics resources, discussion threads, and an engaging mix of super-slow-motion videos that show pool and billiards principles.

“A few years ago, Dave gave a talk on the physics of pool in a local pool hall, not a lecture hall,” says Brian Jones, director of the Little Shop of Physics. “That’s something I really applaud – taking science outside the classroom to show students how it applies to the world around them. He has a real passion for teaching and for pool, and he merges them really well.”

Each semester, Alciatore’s students learn mechatronics, which focuses on the precision control of mechanical and machine systems. Students use that knowledge to design projects such as a cue-testing machine, or CTM.

The CTM may well revolutionize the cue stick manufacturing industry. Built from scratch, the machine measures and compares different cue sticks by measuring the squirt, or angular change, in the initial cue ball direction caused by an off-center hit. The machine releases a cue stick attached to a spring-loaded carriage that slides on a rail into a cue ball. A scale at the end of the table measures the squirt angle.

The team also hopes to add accelerometers and microphones to quantify the feel and sound of a cue, two crucial (and difficult to measure) qualities of cue sticks. Results of the research may lead to a numbering system that could be used on packaging labels in the retail market.

“We apply everything we learn to an actual project,” says Chris Ward, senior mechanical engineering student. “Unfortunately, I’m still a pretty awful pool player.”

Alciatore joined the College of Engineering in 1990 as an expert in robotics and the motion of machines. In 1998, he took a sabbatical in Washington, D.C., to work on a textbook and a government project. To fill up his down time, he joined a pool league and read books on pool playing. He decided to write his own book, *The Illustrated Principles of Pool and Billiards*, after observing incorrect descriptions in other books of the physics behind billiards.

Alciatore received master’s and doctorate degrees in mechanical engineering from the University of Texas at Austin in 1987 and 1989, respectively.

He remains an avid bowler and rolled a perfect game of 300 several years ago.
Out of Africa into the Rockies

Director of new CSU center links human and natural conservation

by Paul Miller

Although Robin Reid spent 18 years – more than a third of her life – in Africa, she recently traveled thousands of miles back to her alma mater to begin a new career.

Reid, who joined Colorado State on Jan. 1 as director of the new Center for Collaborative Conservation, admits it was difficult to leave Africa, a place of her heart. She was ecosystem scientist and global project leader at the International Livestock Research Institute in Nairobi, Kenya. In addition to her current position, Reid has been a senior research scientist at Colorado State’s Natural Resource Ecology Laboratory since 2002.

“I was born to be in Africa, but I’m deeply from this country,” Reid says. “I felt it was time to connect the lessons I’ve learned in both places by returning to the United States. When I was at CSU (she received her doctorate in 1992), I loved the people and the setting. And the opportunity to lead a new center here was so interesting that it pulled me away from Africa.”

Joseph O’Leary, dean of the Warner College of Natural Resources, speaks confidently of Reid’s abilities. “Under her guidance, the center will provide new ideas and more outreach opportunities ranging from local to international that focus on the conservation and sustainability of natural resources,” he says.

Reid says that a $30 million gift to the college from geologist and alumnus Ed Warner in 2005 caught her imagination and sealed her decision to launch a new career. The establishment and endowment of the Center for Collaborative Conservation was one way the college put Warner’s gift to good use.

Reid emphasizes two words in the center’s name as keys to success: collaboration and conservation.

“The University and the whole region are full of intelligent, devoted people with amazing skills but limited time,” she says. “I’m determined to free up these people – whether researchers, faculty, environmentalists, ranchers, or students – to do what they do best. The center will bring people together to collaborate on critical conservation issues facing our society. I consider collaboration to be the vitamin we all need to be successful in linking human and environmental well-being.”

Reid has been an inveterate traveler all her life. During her childhood in New Jersey, her family would spend five weeks every summer camping throughout the United States and Canada. “Every year it was some place different,” she says.

But she wasn’t fully hooked on traveling until a trip to Europe in 1971 showed her how different life could be beyond her own boundaries. “The trip showed me the amazing diversity of people and landscapes in the world and how different it was compared to my own country,” she says.

Reid was only getting started, though. After earning her bachelor’s at Duke University in 1979 and master’s from the University of Washington in 1983, she decided to take a year off and wander around the world with a small pack and her wits. She visited New Zealand and Asia before joining a group of overland travelers making their way from Johannesburg, South Africa, to Cairo, Egypt, in a lorry.

Although the trip took six months, “I’m still living it, and it is one of my touchstones in appreciating the tremendous diversity and talents of different peoples around the world.”

Robin Reid, director of the new Center for Collaborative Conservation, brought her expertise to campus along with a wall hanging – now gracing her office – made by the Shona people of Zimbabwe.
Fulbright recipients at work in the world

Of 800 Fulbrights awarded nationally in 2007, Colorado State received five. Only six institutions in the United States received more Fulbright awards last year, and Colorado State outpaced all other schools in the state.

The Fulbright Program, sponsored by the U.S. Department of State, sends 800 U.S. faculty and professionals abroad each year to lecture and conduct research in a wide range of academic and professional fields.

Brian Bledsoe, associate professor, civil and environmental engineering

Bledsoe is at the Universidad de Concepcion in Chile hosting interdisciplinary river seminars on managing river flows and stream monitoring for environmental scientists, aquatic ecologists, and engineers. He also is conducting research on how hydrologic and geomorphic processes influence variations in stream ecology.

Mica Glantz, associate professor, anthropology

Glantz (center below), who is teaching at Auezov Technical University in South Kazakhstan, is surveying and identifying potential Paleolithic sites in the foothills of the Karatau Mountains. She is primarily interested in Neanderthal paleobiology and this group's relationship to early modern humans.

Bill Cotton

Niall Hanan, senior research scientist, Natural Resource Ecology Laboratory

Hanan is in Mali working with local universities to study ecological dynamics of West African savannas. The collaboration is developing field experiments to study complex interactions between climate, disturbance, and competition between trees and grasses that collectively influence vegetation structure.

Losonsky recently returned from Masaryk University in Brno, Czech Republic, where he taught a graduate seminar and lecture course about contemporary philosophy of language topics. Professional relationships Losonsky developed may lead to a graduate student exchange program between CSU and Masaryk University.

Michael Losonsky, professor, philosophy

Jorge Vivanco, associate professor, horticulture and landscape architecture

Vivanco is studying the chemical ecology of Peru’s Tambopata National Reserve, among the five most biodiverse areas in the world. His goal is to develop tropical chemical ecology as an internationally competitive discipline in Peru in addition to conducting his own studies.◆
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by Tony Phifer

By any measure, Bryan Berryhill is the greatest distance runner in Colorado State University history. During his stellar career, Berryhill became the first and only male CSU athlete to earn two individual NCAA track titles, winning the indoor mile championship in March 2001 and later adding the outdoor 1,500-meter title. He earned All-American honors 10 times – easily the most in school history – and was considered one of the nation’s finest middle-distance runners from the late 1990s until 2005, when knee problems forced him to give up competitive running.

While Berryhill’s accomplishments were the source of great satisfaction, he doesn’t hesitate when asked to describe his greatest thrill in sports. That came last fall, when the second-year Rams coach watched the CSU women’s cross-
country team win its first Mountain West Conference championship.

“In my mind, what I did at CSU and watching what those women did are not really comparable,” he says. “I took a lot of pride in what I accomplished here, but when you win an individual title, you don’t really have anyone to celebrate with. Watching these women win the title was an amazing experience – by far the most exciting thing I’ve experienced in athletics.”

Winning the Mountain West Conference title was just one highlight in what became a benchmark season for the Rams. They went into 2007 knowing their potential but then redefined excellence for a program long overshadowed by the accomplishments of conference rival Brigham Young and the University of Colorado.

“We realized we had a chance for a special season, and Coach Berryhill really helped us believe that,” says junior Kirsten Anthony. “We set our goals to win the conference, win regionals, and get to the top 10 at nationals.”

Running from the pack

The first tangible proof of the team’s potential came in September at the Dellinger Invitational in Eugene, Ore., where the Rams finished fourth in a deep, talented field. That meet marked the first time CSU had beaten BYU in a major meet.

Still, the meets that truly matter come at the end of the campaign, and the Rams never lost sight of their goals. Even though they were on a steady climb in the national rankings, they knew their season would be judged on their performances at the Mountain West Conference championships, the Mountain Region championships, and the NCAA Championships.

That’s when the Rams hit their first trouble spot. April Thomas, their senior leader and No. 1 runner, suffered a stress fracture in her foot two weeks prior to the Oct. 27 MWC championships. Thomas, who came into her final season determined to earn All-American honors for the first time, decided to keep competing but was unable to do any running as part of her training regimen.

“Amy definitely was our leader,” Anthony says. “Even when she couldn’t run, she still showed up for practice and told us over and over that we could still reach all our goals if we kept working as a team.”

Thomas did more than just give inspirational talks. Despite her painful injury, she finished first at the MWC championships, becoming CSU’s first individual cross-country champion.

Even mighty BYU falls

Thomas had plenty of help. The Rams took five of the top 15 spots in Albuquerque, N.M., to edge BYU 39-33 in the team standings, and it took some inspired work by Berryhill to make it happen.

With 500 yards remaining in the 6-kilometer race, BYU had its runners positioned to win the title. If the Rams were to pull off the upset, they would have to catch and pass BYU runners in the final stretch.

Anthony, in fourth place trailing Thomas and two BYU runners at the time, was the first runner Berryhill met.

Anthony, in fourth place trailing Thomas and two BYU runners at the time, was the first runner Berryhill met.

Kristen Hemphill (No. 158) keeps pace with the pack at the NCAA cross-country championships at Indiana State University. Opposite page: Coach Bryan Berryhill talks strategy to his runners.
“It was the race of my life,” she says. Within minutes, the Rams knew the title was theirs. Their victory marked the first time in 19 years the BYU women’s cross country team had been denied the conference title. The other seven teams and fans from around the Mountain West Conference congratulated the Rams on their feat.

“Being an athlete here, you realize how tough it is to defeat BYU,” says Berryhill, who was named Mountain West Conference coach of the year. “Beating them meant everything to our team and the program. Now, winning the conference title is something our team believes should happen on a regular basis and not just once every 20 years.”

On to the big show

But the Rams weren’t through. Two weeks later, they won their first Mountain Region Championship in Ogden, Utah, to earn an automatic berth in the NCAA Championships, edging Northern Arizona for the title. They not only repeated their win over BYU, they knocked off CU as well.

Thomas again led the way, finishing fifth despite not running in training for a full month. Berryhill remains humbled by her performance.

“April really wanted to become an All-American, and this was her last chance. But she sacrificed any individual goals for the team,” says Berryhill, who added the major roll. Not only were they riding high after winning Mountain West Conference and Mountain Region championships, they were ranked No. 11 in the country – best in the program’s history. Their final goal of finishing in the Top 10 appeared to be well within their reach.

The Rams, though, simply ran out of luck. Thomas finally proved human after seven weeks of not running during training, struggling to finish in 67th place. As a team, CSU finished 15th in the 31-team field.

Despite falling just short of their goal at nationals, the Rams still accomplished far more than any previous CSU women’s team. And it continued a recent trend of milestone achievements in the overall track-and-field program that have Berryhill and track coach Brian Bedard excited about the future.

The CSU men’s team won the Mountain West Conference Indoor Track and Field Championships crown for the first time in 2002, and the women won their first indoor title in 2006. The women’s program, in particular, heads into the outdoor season in position to once again challenge BYU.

In the long run, Anthony says she’ll always remember winning the conference title.

“It will be fun when I graduate, knowing that every time Coach Berryhill talks to a new team, he’ll bring up this season as the time we finally beat BYU,” she says. “It really was a special season.”

“I was scared out of my mind, but I went for it. We raced for each other all year, and I wasn’t going to let my teammates down.”

– Kirsten Anthony

The fleet team (from left): Coach Bryan Berryhill, senior Heather Losake, junior Kirsten Anthony, senior Melissa Thomas, first-year students Allison Gohl and Lauren Kleppin, senior April Thomas, and junior Kristen Hemphill.

Allison Gohl, cheeky with Ram pride.
Colorado State’s clean energy research is moving more rapidly into the global marketplace through an innovative enterprise called Cenergy.

“Through its leadership as a green university, CSU transforms lives – creating companies, generating jobs, improving health and living conditions for people worldwide, and stimulating economic prosperity,” said CSU President Larry Edward Penley. “CSU is home to the world’s finest faculty and student brain trust in the environmental sciences, in the development of alternative energy technology and biofuels, and in the management of state forest lands.

“In the long run, all these achievements are insufficient if we can’t get our research to market rapidly and in sustainable ways,” Penley said.

“Universities must go beyond the creation of ideas to realize the potential that they have to bring about market-based, enterprise solutions to one of our greatest challenges – global climate change.”

CSU’s leadership in alternative energy research dates to the 1960s. Now, faculty members in all colleges – from Liberal Arts to Engineering – are developing market-driven solutions to solve challenging environmental problems.

Cenergy, the business arm of the University’s new Clean Energy Supercluster, was unveiled at the state Capitol in March with the help of Gov. Bill Ritter and U.S. Sens. Wayne Allard and Ken Salazar.

More information on Cenergy and the Clean Energy Supercluster is online at www.Superclusters.Colostate.edu.

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– From Democracy’s University: A History of Colorado State University


This invaluable book by emeritus history Professor James Hansen is a fascinating narrative that takes readers through the tumultuous times, successes, and special challenges of Colorado State University over the past 33 years.

To order a book, call (970) 491-6198, e-mail ResourceCenter@ucm.colostate.edu, or visit 115 General Services Building on Colorado State’s Main Campus. Cost is $27, not including tax or shipping. James Hansen’s first volume of CSU’s history, Democracy’s College in the Centennial State, also is available for $40.
In praise of dirt and good health

Cleanliness isn’t always a healthy way to live

Commentary by Gerry Callahan, Colorado State immunologist and pathologist who holds a joint appointment in the Department of English

This Earth is literally crawling with life. Scientists have estimated that $10^{29}$ bacteria exist in the world. Even by liberal estimates, that’s $10^{39}$ bacteria for every man, woman, and child. There is no escaping them. All of us are here because we’ve struck a bargain with bacteria to share all that is ours with them. In return, bacteria present us a paradox of illness and health.

David Vetter, born with severe combined immunodeficiency, was the famous “Boy in the Bubble” whose life was threatened by even minor infection. When David died in 1984 after spending his life – 12 years – in a sterile bubble, doctors believed it was because David’s immune system had failed him. And surely that was part of the reason. But the doctors never suspected that cleanliness itself might have helped kill David.

Normally, the moment a human is born, he or she is quickly infected by bacteria, viruses, a few fungi, and possibly even a parasite. These creatures come to us from the birth canal; the dust in the air; on doctors’ clothes, breath, and hair; in our mothers’ milk; the dirt beneath our feet.

Scientists haven’t yet figured out all that bacteria give to us, but they’ve found that animals raised without infection don’t do very well. Without infection, animals’ immune systems don’t develop, gastrointestinal systems fail, even nervous systems sometimes go haywire. And if we try to infect these creatures as adults, the infections simply take over and quickly kill the animals.

Perhaps that’s what really killed David Vetter. Regardless, infection is part of our lives – without it we are not truly human. And our first infections have to happen while we’re still children. A window opens early in our lives, and through that window usually come microbes by the billions. But if the window closes before the microbes get through (that is, if childhood infections don’t happen), then we are forever damaged.

In the 19th century, Louis Pasteur and others demonstrated the horrors of infection – rabies, smallpox, polio, yellow fever. Penicillin, discovered in 1928, finally became available in large quantities in 1944, and we began to bathe the world in antibiotics, creating unnaturally clean lives for ourselves. We filled our children full of antibiotics and
and allergies than children who had grown up under cleaner conditions in West Berlin.

Allergies and asthma happen when immune systems malfunction. In both cases, the immune system mistakes something innocuous, like pollen, for something dangerous and mounts a massive attack. We know from animal studies that immune systems only develop normally if newborns get infected normally.

We know that, as our children grow, they will encounter good and bad people. But we don’t try to protect them from all people just because some are bad. If we did that, our children wouldn’t grow up to be able to distinguish between the two – and we all know the value of good people.

The same idea is true for immune systems.

An old church in Chimayo, N.M., draws people from throughout the world. Most come to eat the dirt beneath the church. They believe that soil has the power to heal them. Inside, a sign reads: Please, this earth is blessed. Do not play in it.

Though it is religious and not scientific reasons that draw these people, Earth clearly has powers beyond our understanding. Without such powers, we wouldn’t survive long as a species. For our own health, we might think of it another way: This earth is blessed. Please play in it. ◆

Earth clearly has powers beyond our understanding. Without such powers, we wouldn’t survive long as a species. For our own health, we can look at it this way: This earth is blessed. Please play in it.

But strange things began to happen. First we noticed that antibiotics were killing fewer and fewer bacteria. Then we noticed how more children were suffering from allergies and asthma. Clearly, our abolitionist’s approach to bacteria was producing some untoward results. There’s no doubt that overuse of antibiotics led to the appearance of so-called superbugs, bacteria resistant to our best antibiotics – like the virulent methcillin-resistant Staphylococcus aureus, or MRSA, that now haunts hospitals. Was the same overuse making our children sicker? Probably.

In the United States, scientists found that kids who grew up in households with the fewest bacteria were the most likely to develop asthma and allergies. In Europe, children who grew up under very dirty conditions in East Berlin were less likely to have asthma. 

Callahan.

Bacterial biography

For each of the few disease-producing kinds of bacteria that can live in the human body, hundreds of others are necessary for our very existence. Bacteria help us digest our food, for example – otherwise, we’d starve.

Bacteria are microorganisms that are typically one-celled, multiply by simple division, and can be seen only through a microscope. Bacteria are so small that the dot over this “i” can be filled with nearly a million of some kinds of bacteria. Some are rod-shaped, some are round, some are corkscrew- or spiral-shaped, some have hair- and whip-like filaments that allow them to swim in fluids.

– from Nature Bulletin, Argonne National Laboratory

Francesca Narvaes, daughter of Amory Narvaes and CSU alumna Anna Baretta Narvaes, practices earth-friendly hygiene as suggested by CSU Professor Gerry Callahan.
Fair-trade efforts reshaping global economy

by Douglas Murray

Some years back on a return flight from Latin America where I’d been conducting research on fair-trade coffee, I discovered the passenger next to me was a coffee buyer for a major European company. I asked him, “What do you think of fair-trade coffee?” His gruff response was, “I hate it!” Taken aback, I asked why.

The coffee buyer then vented his frustration over how he, his company, the plantations from whom they buy, and the retailers to whom they sell were increasingly having to explain themselves to the press, government agencies, or consumers. He cited recurring questions: What are the conditions under which you produce your coffee and purchase it? Do workers go hungry? Are rainforests being cut?

“Fair trade raises questions about whether we’re something other than fair,” he said and pointedly ended the conversation. I was left to think about his complaint on the long flight home.

I decided that, however unpleasant this turn of events was for the coffee buyer and his colleagues, in the grand scheme of things, it represented a significant and positive change in the way we produce, trade, and consume on a global scale. That large-scale farmers are finding it necessary to defend the way they treat their workers, that corporations need to explain the terms under which they buy and sell, or that consumers are making decisions in the supermarket aimed at improving the health, well-being, and environment of people and places around the world all are important features of the 21st-century global economy.

From the now decades-old organics movement to the more recent fair-trade movement to the newly emerging “Be Local” movement, the global economy is being called to task by consumers, community organizations, entrepreneurs, and governments for its negative social and ecological effects through what has come to be known as market-based social change.

This is the focus of the recently created Center for Fair and Alternative Trade Studies at Colorado State. Over the past decade, an international team of researchers and practitioners working through the Center has investigated this emerging phenomenon, producing a wide range of scholarly articles and policy reports on fair trade, alternative trade, the organics industry, Be Local food in the Fort Collins area, and more. A newly released book, Fair Trade: The Challenges of Transforming Globalization (Routledge Press, 2007), edited by Center co-directors Laura Raynolds and myself (along with John Wilkinson), already is in its second printing – after only a few months in print – due to international demand.

“This book, which draws insights from across North America, Europe, Latin America, and Africa, helps us understand fair trade as a global movement,” Raynolds says. “What accounts for the book’s success is the academic rigor it applies in analyzing not only fair trade’s significant promise, but also the real
challenges it faces. Part of the book’s appeal comes from the recognition by policy makers, entrepreneurs, activists, students, and the general public that the Center is the only group working on these issues from an un-self-interested perspective.”

Center researchers have been awarded grants from the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, the Bohemian Foundation, and others. The Center also provides training for graduate students (including a fully funded research assistantship) and outreach in the form of technical support for local and international alternative trade efforts.

This spring, the Center is launching an Endowment Initiative to ensure the Center’s sustainability in the years ahead. Once funded, the Endowment will allow the Center to conduct regular local and international workshops on emerging issues related to market-based social change. It will provide scholarships for graduate students and support to the Center’s ongoing research and outreach efforts.

One of the first contributors to the Center’s Endowment was Tiffany Tompkins, a 1999 CSU graduate and CEO of Etica, a Minneapolis-based, fair-trade import business. In explaining her support for the endowment, Tompkins says: “Our business depends on well-informed consumers who make purchases based on a desire to create a more sustainable and socially just world. The Center is a unique source of unbiased and in-depth analysis for conscious consumers as well as socially aware entrepreneurs, public policy makers, and nongovernmental organization leaders seeking to improve conditions in the 21st-century economy. CSU can be proud of this endeavor.”

However frustrating it may be for some people to be questioned on what they see as business-as-usual, more people are scrutinizing the effects of the way we produce, trade, and consume. Momentum clearly is building toward reshaping the global economy in ways that foster better living conditions and a more sustainable environment. Through the Center, CSU’s contribution to our understanding of 21st-century, market-based social change is likely to have significant impacts on our ability to shape these processes in ways that meet the needs of both current and future generations.
Illustrator’s passion is mixing science and art

Alumna is one of the top professionals in her field

by Paul Miller

In Laurie O’Keefe’s studio on Orcas Island, a wooded neighborhood of artists and eccentric folks about a hundred miles north of Seattle, Wash., a lineup of skulls hold forth from a shelf above a drawing table. The glinting teeth of cat, rabbit, fox, mouse, dog, deer, and monkey are interspersed with sea shells, which keep company with dozens of colored pencils and brushes sprouting from holders like woody houseplants. Reference books are stacked like cordwood in nooks, and three computer monitors – staid electronic sentinels – are arranged in an arc across a desk.

A central figure in O’Keefe’s studio is a human skeleton named Albert. He’s a full-size plastic guy with moveable joints and bones realistic enough for O’Keefe to use in her work as a medical and biological illustrator.

O’Keefe is one of a relatively few artists who have been able to make a full-time living as a freelance illustrator, and she’s been in the business since 1985. Her intricate and compelling illustrations, mostly of animals, show close detail of bones, nerves, internal organs, hair follicles, or dozens of other views of how life is put together. She’s filled jungle scenes with birds, detailed life cycles of parasites, and for the Smithsonian, she conjured up an image of an extinct, Eocene-era primate called smilodectes using only photos of the skeleton. Her work has been featured in museum displays; textbooks; veterinary, health, and environmental publications; zoos; national magazines; children’s books; and interpretive signs in parks.

“For me, it’s the perfect mix of science and art,” O’Keefe says. “I started out at Colorado State in the pre-veterinary
program, but I kept going back to zoology and anatomy. During my last semester in school, I found out about medical illustration, and I really liked it from the beginning. It was an ideal place to develop my skills.”

O’Keefe received her Bachelor of Science in zoology from Colorado State in 1980. With the encouragement and guidance of teachers like Charles Ralph, professor emeritus of biology, and Ray Whalen, professor of biomedical sciences, O’Keefe earned her Master of Science in anatomy with a concentration in medical illustration in 1985. She was one of a small handful of people who graduated before the illustration concentration was discontinued.

**Off the clock**

O’Keefe, who is exuberantly animated herself, started her professional career as an independent artist in the 1980s and hasn’t answered to anybody else’s time clock since. The hours can be long, the research unending, and the deadlines sometimes numbing if not scary – but the key to success, she says, is dedication to quality and being willing to work in a wide range of subjects from sea urchins to song birds to extinct dinosaurs. A deep love of the work helps, too.

“I always look at her artwork to remind me of what quality means,” says Molly Borman, an illustrator and 1988 CSU alumna who, early in her career, received valuable encouragement from O’Keefe. “She’s one of the few in our field of biomedical illustration who combines accuracy with artistic beauty. I don’t know anyone else who can illustrate animals as well as Laurie. Whenever I have to draw animal fur or human hair, I pull out one of Laurie’s illustrations to see how it’s done.”

“I’ve known Laurie for 20 years, and during that whole time, she’s been an inspiration to me professionally and personally.”

Another colleague notes O’Keefe’s captivating work: “Laurie has crafted an envious career of creating illustrations of the natural world,” says Todd Buck, assistant professor of illustration at Northern Illinois University-DeKalb and president of Todd Buck Illustration. “While her watercolors are detailed and scientifically accurate, they speak to more than just the scientific community. They are truly artistic, warm, and approachable, much like the artist herself.”

Sometimes the inspiration for O’Keefe’s illustrations is found within her own family. Her husband, Jeff Brunette, a pilot for United, has had his features appear in some of her work, and two trundling, good-natured Samoyeds named Ory and Cirik also serve as models. And as Buck notes, O’Keefe can’t help being stimulated by the “somewhat remote and beautiful environment” where she lives on Orcas Island. She and Brunette have been living there for about seven years (prior to that, the couple lived in Conifer, Colo., for 14 years), steeped in the slower pace, lush forests, bald eagles, and views toward the west to other islands of the San Juan chain.

Brunette, in fact, can be counted as an O’Keefe fan. Although his own schedule includes plenty of red-eye flights, “Laurie is truly the night owl of the family. She’ll sometimes work all night then go walk the dogs at dawn. I don’t know how she does what she does. Her repertoire is amazing.”

Just outside her studio on a clear February day, O’Keefe ruffles the hide of Ory, who’s about 40 pounds of hair and 20 pounds of dog. She sits under a Pacific madrone, a striking broadleaf evergreen with rich orange-red bark that naturally peels away, leaving a smooth, silvery sheen. Just over the water of Haro Strait behind her is Victoria, British Columbia.

“Living here, you can’t help to be inspired,” she says. “But I’ve never had trouble finding inspiration wherever I am. That’s always been easy for me.”
Reclaiming the Lost Reaches of the Mind

Colorado State researchers help survivors of stroke and brain injury recover their lives

by Kathy Hayes

Photos: Joe Mendoza
Nita Mathews sits calmly while occupational therapy Professor Matt Malcolm attaches electrodes to her impaired right hand. He positions a magnetic coil over the left hemisphere of Nita’s brain.

In July 2002, when Nita was 50, a stroke caused mayhem on this part of her brain. The stroke paralyzed her right side, interfered with her memory, garbled her speech. Her husband, Tony, awoke that morning to find Nita unconscious on the bathroom floor.

“Is the coil pushing too hard on your head?” Malcolm asks Nita, a former bookkeeper and Fort Collins resident. She’s comfortable, so Malcolm turns on the machine that delivers several seconds of short, electronic pulses – or repetitive transcranial magnetic stimulation – to Nita’s brain. All she feels is a light tapping sensation on her scalp. On Malcolm’s monitor, he sees that the stimulation is exciting the neurons that control movement in Nita’s electrode-studded arm and hand.

“This is the Hebbian principle in action,” says Malcolm. “The more the nerve cells are communicating with each other, the stronger that connection becomes.”

Donald Hebb was a psychologist who studied how the physiological process of neurons firing relates to psychological processes, such as learning. His principle – summarized as “cells that fire together, wire together” – is at the heart of Malcolm’s BrainStim Project. Malcolm wants to know if combining magnetic stimulation with already proven constraint-induced therapy will help stroke survivors develop better abilities than those who don’t receive brain stimulation.

Last summer, Malcolm and co-investigator Michael Thaut, chairman of Colorado State’s music, theatre, and dance department, received a two-year, $380,000 National Institutes of Health grant for the BrainStim Project. The study is being conducted in two Colorado State laboratories – Malcolm’s NeuroRehabilitation Research Laboratory and Thaut’s Center for Biomedical Research in Music. Research team members also include Dr. Gerald McIntosh at Poudre Valley Hospital; Bill Gavin, a research associate in occupational therapy; and project coordinator Crystal Massie.

Thirty stroke survivors will participate. Half will receive magnetic stimulation and constraint therapy. The other half will receive placebo stimulation and constraint therapy. At intervals throughout the study, the research team will study collected data showing what changes in movement patterns have occurred in each participant.

After the brain stimulation, Malcolm accompanies Nita to an adjacent room, which contains a small kitchen, tables, and plastic bins filled with puzzles, cleaning tools, and other household objects used for constraint-induced therapy, or CIT.

During the first year after her stroke, conventional therapies helped Nita re-learn speech, walking, and memory skills. Like many other stroke survivors, however, her stroke-affected hand and arm haven’t worked freely after so many years of non-use. Constraint-induced therapy will compel this limb to start working again.

To keep Nita’s left hand from helping, Malcolm covers it with a large white mitt. Nita will spend the next four to six hours using only her right hand and arm to perform daily activities: washing and preparing food, bowling with plastic pins, washing a window, using a keyboard.

“The nervous system can adapt and change when you push it, and those physiological changes drive changes in the brain that may aid recovery.”

– Professor Matt Malcolm
Going to Stroke School

For two consecutive weeks, Nita undergoes daily brain stimulation followed by many hours of constraint-induced therapy. Each day, when Tony Mathews picks up his wife, she still has the mitt on. She continues wearing it for about 90 percent of her waking hours.

Since the 1990s, constraint therapy alone has helped many stroke survivors regain movement in stroke-affected arms. “The rationale behind CIT is that the nervous system can adapt and change when you push it, and those physiological changes drive changes in the brain that may aid recovery,” Malcolm says. “We know that CIT is the best thing we’ve ever had for regaining movement in a person’s stroke-affected hand and arm. Unfortunately, only about 25 percent of stroke survivors benefit from this therapy.”

Within two years, Malcolm looks forward to securing data to show whether brain stimulation combined with CIT will lead to longer-lasting results that will benefit a larger percentage of the nation’s 5 million stroke survivors.

While Malcolm hopes for positive outcomes, he emphasizes that participants play a crucial role in their own recovery. “Sometimes I call it Stroke School,” he says. “Our participants are learning how to use their bodies and think about how they’re using their bodies. We tell them: ‘You can use that side. You can be successful, and this will lead to long-term usability and a better quality of life.’”

Six weeks after Nita completes the BrainStim activities, she says, “My right hand is getting smarter.” Although it’s too soon to tell if the effects will endure, Nita so far is pleased. “Before the BrainStim Project, I did almost everything with my left hand,” she says. “When I was forced to use my right hand, I had trouble. Whatever I was stirring in the pot went all over the stove. But at Christmas I did something I haven’t done in a while. I spent a whole night making a crown roast. It turned out really good.”

Traumatic brain injury’s invisible damage

Jody Donovan, assistant to Colorado State’s vice president for Student Affairs, didn’t think her crash in November 2006 was very serious.

While sledding with her family in Breckenridge, Colo., her sled tipped. She pitched forward, and her head struck hard snow. The impact was so great, her glasses broke. She couldn’t think clearly or turn her head. But there was no blood, no visible injuries. She didn’t think medical care was necessary.

Two days later, Donovan got lost walking a short distance from her home to church. Sitting on steps and crying, she realized something was seriously wrong. When her husband, Nate, found her, he took her straight to the emergency room. The sledding accident had given Jody a severe concussion and a mild traumatic brain injury, or TBI. It had also turned her life upside down.

“There was just chaos inside my head,” recalls Donovan, a Type A super-achiever who had recently completed her Ph.D. while working full time, running half-marathons, and being a mother. “I remember lying on the couch in my pajamas and not knowing what I was supposed to be doing. Should I get dressed, and if so, how do I do that? If I want to put on shoes and socks, which do I put on first?”

Unlike stroke, in which the body inflicts its own brain damage, traumatic brain injury is caused exclusively by an external force. Every year, more than 1.4 million Americans receive one of two types of TBI: a closed head injury, like Jody’s, or an open head injury, such as a gunshot wound. Most of them spend the rest of their lives relearning, readjusting, and trying to cope with a brain that might never work the way it used to.
‘It doesn’t look like anything’s wrong’

TBI is often called the invisible injury. People with a brain injury may look normal but may be struggling to organize thoughts, make decisions, find words, and deal with life’s myriad sounds and sights.

“Until you know someone with a brain injury, you don’t really know anything about it,” says occupational therapy Professor Pat Sample (pictured below), who has spent 17 years studying brain injury and identifying services people need to help resume their lives.

Even a mild brain injury can destroy someone’s life, Sample notes. “You can’t multitask; you start dropping all the balls you’ve been juggling. Often, these behaviors are diagnosed as ‘psychiatric.’”

After the 1995 Oklahoma City bombing, for example, many survivors who received traumatic brain injuries were diagnosed with post-traumatic stress disorder. PTSD is psychological in nature. But TBI patients have physical and cognitive injuries. They require medical treatment, a range of therapies that will help them regain physical and mental abilities, and lifelong services to help them reintegrate into communities.

In 2006, 11 years after the bombing, Sample went to Oklahoma City and interviewed people who had sustained traumatic brain injuries from the blast.

“They’d lost their homes, marriages fell apart, they had trouble working,” Sample says. “I asked them, ‘What help did you need, so you could resume your pre-bombing life as fully as possible, and when did you quit getting help?’”

Participants commonly responded with, “Pull up a chair,” or “How many hours do you have?” They cried as they retold their stories. Like Humpty-Dumpty, they said they were still trying to put their shattered lives back together. Many were dealing with physical and psychological wounds. They had ongoing problems with memory, fatigue, dizziness, confusion, finding words, and concentrating. Personalities had changed. Family life disintegrated for some, robbing them of critical support systems.

“A number of these survivors are having a harder time than they or anyone else expected,” Sample says, “and the funds and resources are no longer as available for them to get the care they need as they were in the early years.”

Returning soldiers: The next generation of TBI survivors

Brain injury is a rapidly escalating national problem. The highest brain injury group is males 16 to 25 years old, many of whom can look forward to living long lives, thanks to advances in neurosurgery.

“That’s good,” says Sample. “But that also means they’ll be needing services for a lot more years. Who’s going to pay for these services?”

Will brain-injured soldiers returning from Iraq receive the treatment and services they’ll need to resume quality of lives and be productive citizens?

Sample hopes her research findings will help address these issues.

“Oklahoma City is a living laboratory of blast TBIs,” she says, adding that this is the same type of brain injury affecting many soldiers whose heads are “rung like a bell” inside their helmets when a blast occurs.

“I hope the Oklahoma City knowledge will help us look at the long road ahead and the services people with brain injuries will need once they’re no longer patients but just people who are trying to re-establish productive lives.”

◆
Boosting the odds for recovery

Eighteen months after a sledding accident put her life into a tailspin, Jody Donovan, assistant to Colorado State’s vice president for Student Affairs, has regained much of what a traumatic brain injury took away from her. She is again working full time. Her family helps with tasks that challenge her, such as preparing meals.

In some ways, she says, her life is better than it was before. “I’m not nearly the workaholic I used to be. I treasure my time with my family.”

Donovan is grateful to CSU Emeritus Professor Tim Bennett, founder of the Center for Neurorehabilitation Services in Fort Collins, for putting all the resources she needed together in one place.

Beginning with her first visit, professionals at CNS worked as a team to ease the symptoms of Donovan’s brain injury. A physical therapist performed manipulations to loosen the muscles in her face, neck, and rib cage, which helped open up compressed vertebrae that were causing “smashing” headaches and fatigue. A speech therapist helped her learn word association and retrieval skills. She and her family received psychotherapy to help deal with the emotions and changing family dynamics incurred by Donovan’s injury.

A neurotherapist studying the big picture of Donovan’s symptoms recommended other therapies that would benefit her most. Now Donovan is helping some of CNS’s higher-functioning clients who are struggling with coping. “Getting therapy is key,” she says.
Scanning for trouble

Investigations into how the brain works may help families grappling with devastating disorders

by Kay Rios

The challenges facing researchers can be compared to searching through an intricate maze of hazy – and sometimes clear – evidence. The stakes are higher yet when the research involves the labyrinth of our own brains.

In the case of autism, Asperger syndrome, attention deficit hyperactive disorder, or other neurodevelopmental disorders, the maze slowly is revealing answers, thanks in part to the work of occupational therapists Patricia Davies and William Gavin. The researchers in Colorado State’s College of Applied Human Sciences are measuring electrical activity in children’s brains with the hope of impacting the diagnosis and treatment of children who have such disorders.

Davies and Gavin are co-principal investigators and research scientists for the electroencephalograph research project in the Department of Occupational Therapy. Their research may help stem the rising incidence of such disorders. For autism alone, the Centers for Disease Control and Prevention reported in 2007 that the prevalence of the disorder had risen to 1 in every 150 American children, up from 1 in 166 reported in 2004.

“Having a better idea of the underlying neurophysiological mechanisms in children, regardless of their diagnoses, may help therapists better direct the intervention that will help both child and family,” Davis says.

“Therapists now choose treatment strategies primarily based on the child’s behavior, but knowing the brain function in these different areas through electroencephalograph research may give therapists a basis for treatment so they can get to the root of the problem sooner.”

A long-term goal is to establish reliable and objective measures of the brain’s ability and inability to process sensory information. The model would potentially help identify children and adults who have disorders and guide treatment choices.

“Sensory process disorders can be one of the symptoms of either autism or attention deficit hyperactive disorder,” Gavin says. “There will also be some behavioral measurement so that we can relate performance to actual brain physiology.”

Findings of the research may be applicable in a number of areas. “Brain injury or brain dysfunction is a common theme of research conducted by some faculty in our department,” Davies says.

“In the case of our research, the cause of brain dysfunction is thought to occur prenatally, as in autism.

“One of the difficulties in our profession is that, when a child is referred to us, it’s sometimes hard to distinguish the primary deficits. Assessments are often based on parent reports, so actually measuring the brain processing is a lot more objective.”

Beyond diagnosis, research can help with treatment choices, Davies says. “If therapists are able to get to the root of the problem quicker, treatment length may be shortened with better outcomes for the child and family. Research has the potential to help resolve some of these issues.”
At nine months old, Oliver Orgolini already was exhibiting delays in physical development. He had problems with his bowels and suffered from long-term respiratory infection. As he grew, his parents noticed other symptoms. “His verbal and nonverbal skills had missed common growth milestones,” says Jennifer Orgolini, a Fort Collins resident. “His attention span was very short, and his sensory perception was off. When he was 18 months old, the pediatrician mentioned the possibility of autism.” They were devastated, she says. “It is profoundly heartbreaking. Just realizing that I wouldn't be able to play those cute games you play with your baby – that my son would never babble. It’s taken several years to come to terms with it.”

She coped by tackling the situation analytically. “I was going to be the problem solver. There was that seduction, ‘If I figure out the research, I’ll make it better. If there’s a resolution, I’ll find it.’” She did that for several years. “I did the research; we tried every intervention. But I’ve had to back off because it becomes exhausting.”

Oliver then was placed in a study at the University of California-Davis, and that’s where his diagnosis of autism was made, just before his fourth birthday. At that point, Orgolini says, there was a need to go through stages of grieving. “Not only has your dream died about what your child would be like, so has the person you were before you were a parent of an autistic child. It changes your life that much.”

The family’s household is chaotic, she says. “It’s hard to take vacations. We can’t have people over who don’t understand, because Oliver is disruptive and demands a lot of attention. He screams; he throws things. He bites his hand when he’s frustrated.” She, husband Peter, and 6-year-old daughter Lucy live what she describes as a more circumscribed life. Although the emotional pain of that diagnosis has eased, there still are times when her child’s condition is difficult to accept. But she hasn’t given up hope. “His health is really good, and I feel that’s from the interventions we put in place. He’s developing but still miles behind his peers.”

“There’s no silver bullet, just slow progress in multiple areas: on behavior, attention span, putting your coat on, engaging others. We’re fortunate to have a good income and somebody who comes in to help. Oliver also attends a special-ed preschool. The more help we can get, the better.”

From Orgolini’s perspective, early diagnosis is essential. “It’s not just because early treatment is so important but also because parents need answers to why their child behaves the way he or she does.”

Early diagnosis also eluded the family of Colorado State Professor Temple Grandin, who as a child exhibited autistic traits such as emotional distance, rocking, and fixation. Her parents were told to institutionalize her, but the advice wasn’t followed. And although Grandin didn’t talk until she was 3½ years old, communicating instead by screaming, peeping, and humming, she eventually surmounted her challenges and received her doctorate in animal sciences in 1989. She joined Colorado State a year later and now is one of the foremost animal behavior experts in the world and a popular guest speaker and author of books on autism and animal science. She also has been featured on major television programs and in national publications.

– Kay Rios
A frozen landscape of research

by Paul Miller

Even the most crucial research has caveats, especially if months of frigid work in the Antarctic are involved. As Colorado State atmospheric scientist Glen Liston will tell you, just trying to keep your frozen feet on the ground in the face of 132 mph wind gusts can be challenging.

Liston is part of an International Polar Year Expedition traversing from the Antarctic coast to the South Pole. On this most recent expedition, Liston was one of four American scientists who joined eight Norwegian researchers to travel 2,000 miles across the Antarctic Ice Sheet to the South Pole, pausing often to drill and collect snow and ice samples to be shipped back to the United States and Norway.

Liston studies how snow is distributed across various landscapes to more accurately predict how climate change occurs. He’s one of the few atmospheric scientists in the world who creates computer models to predict future climate changes and also trudges into the field to determine whether his models are on target.

“Field observations keep the models honest,” Liston says. “We’re constantly finding ways to improve them.”

Liston has developed a model that simulates how snow is distributed across any landscape in the world and how that snow influences atmospheric, hydrologic, and ecologic processes.

He also finds time to update a journal: “As I lie in my small tent at -48 °C (-54°F) near the center of Antarctica, I try to mentally force my near-frozen toes back to life. The temperatures I’m experiencing now are just about equal to the mean annual Antarctic air temperature in this area, something that typically changes only slowly over the decades and centuries.”

During the fourth International Polar Year of 2007-2009, thousands of scientists from more than 60 countries are conducting more than 200 expeditions or projects on physical, biological, and social issues in the Arctic and Antarctic.

Liston joins CSU scientists and faculty who conduct International Polar Year-related research in other areas including Diana Wall, Edward Ayres, John Moore, Breana Simmons, and Matthew Wallenstein from the Natural Resource Ecology Laboratory; Shane Kanatous, Department of Biology; and Ken Reardon, Department of Chemical and Biological Engineering.

“The research being done at the poles will advance our understanding as to how these frigid ecosystems are tied to our lives and how their climate and hydrology affect the world,” Wall says.

Liston agrees on the importance of polar research to understanding climate change.

“What’s happening in the Antarctic and the Arctic is much more dramatic than what’s happening in mid-latitudes – shortening of the snow season, increases in temperature, changes to vegetation, thinning of sea ice, melting of ice sheets,” Liston says. “There’s no question that the changes being observed are huge.”

The Antarctic team now is taking a break and will return to the South Pole to start their return traverse in November.
The backseat driver is in your head

We’re going places, but how quickly and safely?

by Nik Olsen

Go straight three miles, then take a right. From there, take the second left, go over the hill, take a right, and you’ll reach your destination — if you can remember the directions. New research, though, may help drivers find their way — and possibly get there more safely.

Ben Clegg, Colorado State University cognitive psychologist, is exploring just how well drivers do when they receive varying amounts of information on where they’re heading. Would just a map be better than only verbal directions, or vice versa? How about if a driver is given both?

Whether you’re navigating through midtown Manhattan, exploring winding dirt roads of the Rockies or negotiating CSU’s campus, finding your way based on travel directions is a process of acquiring cognitive skills, Clegg says. He’s researching how people learn complex skills and to what extent they learn at a constant rate over time.

Advancements made in this area of cognitive psychology can have far-reaching impacts. More than 1 million people each year are killed in traffic accidents worldwide, according to the World Health Organization. Even slight adjustments to vehicles or traffic laws may save many lives.

“A lot of questions have been raised about the safety of talking on a cell phone while driving, which emphasizes the fact that there are many fundamental questions we don’t know about driving,” Clegg says.

Driving is a prime example of sequential learning, says Clegg, who has collaborated on driving instruction research with Professor John Groeger of the University of Surrey in the United Kingdom. Research suggests the way the brain represents sequences changes between the initial acquisition of a skill and later performance of that skill.

“Some skills in driving must be learned independently,” Clegg says. “Parallel parking is not connected to how well you handle a T-junction.”

On-the-road training

A parking garage contains ample evidence of people acquiring new driving skills, Clegg says. Most drivers aren’t required to navigate its tight confines on a regular basis and are forced to learn on the spot. Each paint scrape on a wall represents feedback of an error relayed almost instantly to the driver. “Many people don’t visit parking garages on a daily basis and must teach themselves how to drive in one.”

Drivers are constantly teaching themselves new skills. On average, driving instructors provide information on a major driving hazard only once per lesson, such as avoiding an oncoming truck that’s likely to pull into your lane to pass a bicycle.

“You’re almost certainly teaching yourself about hazards on the road while you’re on the road,” Clegg says, adding that the United Kingdom has instituted hazard-preparation tests for drivers.

While driving is cognitively taxing enough, drivers also are required to navigate a maze of roads to reach destinations. Clegg recently conducted an experiment to find out what kind of directional information best benefits drivers: just seeing a map, just hearing directions, or having both provided at the same time.

Traveling a virtual highway

Among a cluster of offices and a maze of hallways in the basement of the Clark Building is a driving simulator that Clegg

Cognitive psychology research may help reduce the estimated 1 million people killed each year in traffic accidents worldwide.
uses to find out how drivers learn and retain directions. Real-world driving in this instance wouldn’t work very well because knowledge of directions around town masks participants’ learning in the actual experiment.

The simulator is as high-tech as it is odd-looking. Participants take virtual spins in the simulator – the front half of a late-model Saturn sedan with a Ford Escort interior. In front of the car, three floor-to-ceiling screens project images associated with driving – roads, traffic lights, oncoming traffic. Small LCD screens serve as the rear- and side-view mirrors that complete the 360-degree illusion.

Clegg’s team found participants who heard directions and saw a map were most successful in completing the simulation. He theorizes that the combination of auditory and visual instructions enabled the mind to build a route with the least cognitive effort, or “cognitive cost,” as Clegg calls it.

“Multimedia information improves our ability to develop a cohesive understanding of what we need to do,” Clegg says.

Clegg’s cognitive research has benefited more than just drivers. Undergraduate Laura Morett, a student at Washington College in Maryland, says that joining Clegg to conduct research has given her new skills and a chance to use resources to which she’d otherwise not have access.

Morett came to CSU to participate in the Summer Research Experiences for Undergraduates Program on Mind and Brain.

“Ben provided me with valuable advice about conducting fruitful research in cognitive psychology and choosing a graduate program in this discipline,” Morett says.

For Clegg, diving into the processes of the brain continues to hold his fascination.

“How people think is the most amazing area of study we have,” he says.
Teasing the mystery out of clouds

Scientists are peering miles into the atmosphere and gathering unprecedented data on long-term climate change through the unblinking eyes of CloudSat and other NASA spacecraft.

CloudSat, part of a constellation of five satellites observing the planet, is the brainchild of Professor Graeme Stephens at Colorado State’s atmospheric science department. The highly sensitive radar is weighing water and ice in clouds and, for the first time, helping scientists around the globe gain important insights into reductions of Arctic sea ice, global rainfall patterns, and the effects of pollution on clouds.

Last summer, NASA’s Jet Propulsion Laboratory released the radar’s first images, which revealed extraordinary views of tropical weather phenomena. The images were produced by the CloudSat Data Processing Center at CSU’s Cooperative Institute for Research in the Atmosphere, or CIRA.

“The most surprising result is the horizontal extent of some of the areas of cloud and rain that we’re able to see,” says Don Reinke, manager of the data center. “In about four minutes, we can image a cloud system that extends over 1,800 kilometers (1,120 miles). It would take more than six hours to sample that amount of data with an aircraft.”

Stephens, who is a University Distinguished Professor, recently outlined results of several studies. In one, a team led by Jennifer Kay at the National Center for Atmospheric Research in Boulder, Colo., examined the influence of polar clouds on 2007’s record low extent of Arctic sea ice. The data showed that total cloud cover over the western Arctic, where most of the ice loss occurred, was 16 percent less over the 2007 melt season than in 2006. The resulting clearer skies in 2007 heated the Arctic surface enough to warm ocean waters about 4 degrees F, or enough to melt 1 foot of sea ice.

The results highlight the importance of weather pattern variability to a warming Arctic environment. “As Arctic sea ice thins, its extent is more sensitive to year-to-year variability in weather and cloud patterns,” Kay says. “Our data show that clearer skies (last summer) allowed more of the sun’s energy to melt the vulnerably thin sea ice and heat the ocean surface.”

A separate CloudSat study led by John Haynes, postdoctoral student in atmospheric science, found it rains more often and in greater amounts over the oceans than previously estimated. The team found that, on average, 13 percent of clouds over Earth’s oceans produce rain that reaches the surface. The difference in total rainfall amount estimates was greatest during winter, when large storms produced much more rainfall than previously estimated.

“By improving our understanding of present rainfall patterns, scientists can also improve climate model projections of how rainfall will increase or decrease in the future around the world,” Haynes says.

In another study, Stephens and Colorado State student Matt Lebsock found the first global evidence that pollution of clouds by aerosols – small particles suspended in the atmosphere – is indeed making clouds brighter and more reflective, reducing the amount of sunlight available to warm the surface. These indirect aerosol effects are not well understood and create major uncertainties in climate models.◆
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Music in motion

At home and abroad with CSU's choral director

by Kimberly Sorensen

Early in his life, James Kim, director of CSU's choral division, never guessed he'd become an accomplished musician and choral conductor. That all changed in his teens, when he picked out a few keys on the piano for the first time.

He's had a melodious journey ever since.

Kim was born and raised with his three brothers and sister in South Korea and immigrated to the United States in the 1980s with his mother when he was 15 years old. “My mother and I moved to L.A. because she wanted better opportunities for me. My mother is like many other Asian parents who invest so much in their children's education including time, money, and other resources,” Kim says.

Kim and his mother became involved with a local church in California, and that's when he discovered his passion and talent for music.

“I had never played an instrument in my life,” Kim says. “When I was about 18, I was encouraged to learn how to play the piano and guitar at church. Soon I was conducting the church's choir. I didn't have any background or training, but I started to learn on my own and found out I really enjoyed it. I knew then that music was what I wanted to do with my life.”

He attended the University of Southern California at Los Angeles, where he earned his Bachelor of Music and Master of Music. He continued his education abroad after graduation, something he would encourage his future students to do. He was invited by the Internationale Bachakademie Stuttgart in Germany to study there for two years.

“I had the opportunity to study in Germany and England, but I decided to spend time in Germany because, as a conductor and choral musician, I wanted to truly experience the culture and heritage of the roots of choral music. Plus, by going to Germany, I could learn another language, and that was a good challenge,” Kim says.

“Music chose me rather than me choosing music, and it was the best thing I could have hoped for.”

Kim came back to America in 1999 and attended the University of Cincinnati's College-Conservatory of Music, where he received his doctorate in 2001. He taught there as well as at Simpson College in Iowa before coming to Colorado State.

As director of choral activities within CSU's School of the Arts since 2004, Kim says he's had the opportunity to shape and mold the program, which includes Chamber Choir, Concert Choir, Women's Chorus, and the University Chorus. The latter two, open to all CSU students, don't require auditions.

“We've created places and opportunities for anyone who wants to sing. Some of my strongest musicians aren't even music majors, which is one of the wonderful things about CSU's choral program. Students across campus with different backgrounds are brought together by a common interest and joy in singing,” Kim says.

“Singing under Dr. Kim in the Chamber Choir has been a great experience for me because I can take a break from math and physics,” says physics student and singer John Wright. “Dr. Kim brings out the potential in people, and I'm thankful to him for allowing me to be a part of the choir.”

As a professor, Kim anchors his philosophy on a teaching-outside-the-classroom principle. “Some people never have the chance to travel beyond the classroom in college. I believe that we learn in classrooms, but knowledge is also garnered in the real world where you take what you've learned in class and apply it,” he says.

Kim has taken his students on three international trips in the four years he's been at Colorado State. The Colorado State Chamber Choir has visited and performed twice in South Korea and Italy. The group's latest nine-day tour happened last fall, when the Chamber Choir was invited to sing as a special guest choir in the Third Changwon Grand Prix Choral Festival in South Korea.

The festival, hosted by the city of Changwon, is a two-day music festival featuring invited, internationally known professional ensembles. The 27-member Chamber Choir was the first non-professional choral group to be invited to the event.

At home, Kim and his wife are busy with two kids, ages 3 years and 11 months. A third child is due in September. Kim's wife, Heejung, is a violinist who plays with the Fort Collins and Cheyenne symphonies as the assistant concertmaster.
Visions

A Corsican violet shows full spring beauty in this image captured by Colorado State photographer Bill Cotton. The violet is included in Plant Select, a program that identifies and distributes the best plants suitable for growing in Colorado’s high plains and intermountain regions.
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