



2016





$$K = \frac{1}{2}mv^2$$

ON THE COVER: Discovery Begins Here

At the College of Natural Sciences, our mission is to provide innovative programs of excellence in research, education, and public and professional service. This cover illustration, created by Adam Mendez and Cameron Nelson, represents just some of the many elements involved in the journey to discovery.

Welcome to Elements

We are excited to bring you the latest news from the **COLLEGE OF NATURAL SCIENCES** at Colorado State University in the second issue of *Elements*.

As a reflection of the college, the magazine highlights the varied aspects of science: the foundational and the applied, the big and the small, the early plans to the “eureka” moments. Most essentially, it brings to light the stories and people that make up the College of Natural Sciences’ community.

In this issue, we are highlighting the ongoing efforts the college is undertaking to increase diversity in the sciences – from bringing more female students into computer science to recruiting the very best faculty to ensuring first-generation students (one in four of our undergraduates) have the support they need (*read more on Page 8*). All aspects of diversity are important in moving science forward and creating even more landmark discoveries.

This year, we welcome the class of 2020 to campus (*meet them on Page 23*). See how the college is growing to meet the increasing demand for STEM degrees. We hope you will join us on the exciting journey ahead. **DISCOVERY BEGINS HERE.**

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COLLEGE OF NATURAL SCIENCES

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Meet the Class of 2020

DEVELOPMENT

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We welcome your support! To help create new stories of discovery visit www.natsci.colostate.edu/giving or contact Simone Clasen at **simone.clasen@colostate.edu** or **(970) 491-0997**. Thank you!



ural Sciences. For all of you, “here” can mean a lot more places than just on our beautiful Fort Collins campus.

One place of incredible possibility I visited this summer is the new Colorado State University Center at Todos Santos, in Baja California Sur, Mexico. As a permanent international satellite for

Since the center opened in 2015, the biology department has already become deeply involved. This summer, a group of students had the chance to study – hands-on – marine life and ecology in a variety of habitats (from the Pacific Ocean to the Sea of Cortez) an experience most students in Colorado never get. The department also hosted a dynamic bioinformatics workshop at the center, drawing students and researchers from the area and other research universities in Mexico (*read more on Page 15*).

Bonnie spoke on campus this spring, and I was thrilled to spend some more time this summer learning about her work. At CSU, she studied computer science and physics as part of her technical communications degree and has since galvanized important



Nerger (second from right, second row) and CSU faculty pose with local students at Todos Santos.



Ross (left) and Neger pose with a Halo Guardian at Microsoft.

conversations about women in STEM. She believes, as I do, that encouraging and supporting women in sciences begins well before students arrive on college campuses.

I am grateful for all of the time and wonderful experiences so many of you have shared with me this past year. And I cannot wait to see what journeys and discoveries lie ahead for the academic year to come.

Jan Neger

JAN NERGER
Dean of The College

OUR WOMAN OF VISION

THIS SUMMER, Dean Neger was named the 2016 Dr. Joan King International Woman of Vision and a Colorado Woman of Vision. The awards were not for her internationally recognized research into vision and perception (of which there is plenty) but for her leadership in making a difference in the community, in particular for her efforts supporting women in STEM. Neger received the awards at the annual Colorado Women of Influence gala.

Read more at: col.st/jtdYK

New Faculty – 2016

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Robert Cohen
Erin Osborne Nishimura

CHEMISTRY

Justin Sambur

COMPUTER SCIENCE

Lorenzo De Carli
Laura Moreno
Louis-Noël Pouchet

MATHEMATICS

Wolfgang Bangerth
Cameron Byerley
Kenneth McLaughlin, Chair
Amit Patel
Mark Shoemaker

PHYSICS

Emily Hardegree-Ullman

PSYCHOLOGY

Mark Prince

STATISTICS

Julia Sharp
T. Ander Wilson

TENURES AND PROMOTIONS

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Thomas Santangelo

CHEMISTRY

Brian McNaughton
Alan Van Orden

MATHEMATICS

James Liu

PHYSICS

Norm Buchanan

RETIREMENTS

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Norman Curthoys

BIOLOGY

Lorinda Anderson
Steve Stack

PHYSICS

Roger Culver

IN MEMORIAM

CHEMISTRY

Leslie DiVerdi
Marshall Fixman
Branka Ladanyi



BIOLOGY BUILDING AND CHEMISTRY RESEARCH BUILDING

Progress continues on the new Biology Building and Chemistry Research Building. This spring, we celebrated the placement of the final beam of the Biology Building with a “topping off” ceremony. This summer, we “topped off” the Chemistry Research Building as well (*learn more on Pages 15 and 16, respectively*).

Read more: col.st/2pnac

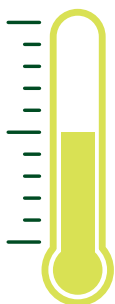


THANK YOU, MICHAEL SMITH!

This spring, energy entrepreneur Michael Smith, who studied chemistry at CSU in the 1970s, created 10 new full-tuition scholarships for undergraduates in the chemistry department. His gift of \$400,000 to the college was just one part of his \$13 million donation to CSU this year.

Read more: col.st/Lluf7

\$60M



STATE YOUR PURPOSE | HALFWAY THERE

As part of the University's \$1 billion State Your Purpose campaign, the College of Natural Sciences has been challenged to contribute \$60 million by 2020. Good news: We're more than halfway there, having already raised \$34 million.

LEARN HOW YOU CAN HELP: WWW.NATSCI.COLOSTATE.EDU/GIVING

**Distinguished Alumnus 2016****DEAN TSAO**

.....

The college named Dean Tsao ('73) as its 2016 Distinguished Alumnus. Tsao, originally from Taiwan, came to CSU and earned his Ph.D. in biochemistry and molecular biology. He is now a biotechnologist and entrepreneur who has dedicated his career to discovering and manufacturing biological and diagnostic products. He is currently CEO and chairman of PlexBio Co. one of five biomedical companies he has launched, which, together, have made advances in cancer, HIV, and Down syndrome diagnosis and treatment. Tsao will be on campus to speak and receive his award in October.

**Professor Laureate 2016****ANTHONY RAPPÉ**

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The College of Natural Sciences named chemistry Professor Anthony Rappé its 2016 Professor Laureate, the highest academic title awarded by the college. Rappé's work uses molecular mechanics to study catalytic reactions, among other topics. At the April award ceremony, he spoke on sustainability, from a chemist's perspective.

ALUMNUS SPOTLIGHT
TOM HEIDENFELDER

Punching Cards to Planting Seeds, CSU Alumnus's Career Spans Computer Science History

IN 1970, a freshman from Illinois arrived on the Colorado State University campus with a plan: to study computers.

At the time, CSU was one of just a handful of schools in the country that offered courses in computer science. Throw in a great campus – and being far from home – and Tom Heidenfelder was sold.

Since then, he has spent decades in the computer industry, rising from programmer to quality tester to consultant, using his acumen – and unfailing attention to detail – to help major companies, including Blue Cross Blue Shield, CVS, and U.S. Cellular, to improve their systems. Thanks to his early training at CSU, he says, “I’ve had a very rich career. My favorite work is online, real-time systems, which are much more challenging.” And in the industry, those have certainly not been in short supply.

PUNCH CARD PERFECTIONISM

When Heidenfelder started college, however, there were not a lot of real-time systems to learn on at CSU. In fact, there was only one computer. On the entire campus. “It was a monstrous thing, in the basement of the Engineering Building,” he recalls. It was a CDC 6400, and, yes, it ran on punch cards. “We would write up a program, punch it onto cards, and run it for class,” he says.

These cards, like any keyed programming today, demanded perfection. And that is a



Alumnus Tom Heidenfelder ('74)

quality Heidenfelder possesses in abundance. “He’s very, very meticulous,” says his wife, Randy Heidenfelder, honorary Ram and real estate lawyer. “He researches things very thoroughly. If he says it’s ‘x,’ it’s ‘x.’”

As computers and systems grew in complexity, Heidenfelder never lost sight of the goal of those early punch card programming days: to get the system to work – and work well. One of the biggest challenges he faced in his field was convincing others of the importance of excellence. Today, in the era of ad infinitum bug fixes and version updates, he still prefers to create a product that works as it should – the first time around.

EVOLUTION OF AN INDUSTRY

When Heidenfelder arrived at CSU, however, he was not on track to receive a computer science degree. Computer science, in fact, didn’t have its own department or degrees then. It was housed in the mathematics department. But Heidenfelder’s timing was impeccable. During his time in the College of Natural Sciences, the computer science field nationwide was gaining steam, and the area of study went from a handful of courses, to its own

section in the math department to, at last, becoming its own department. And just in the nick of time. Heidenfelder was a member of one of the first CSU classes to receive a Bachelor of Science in computer science.

“CSU prepared me wonderfully for a career,” he says. “I was able to step into my first couple of jobs and be competent almost from day one.” After a four-year post with the Air Force, he jumped right into computing, first getting a job at ACCO, the office supply company, where he was a programmer. From there, he rose quickly, moving on to Abbot Laboratories, then to the Boise Corporation, and finally to Galmont Consulting, where he was a senior consultant, until retiring in 2014. “Logic and programming concepts I learned at CSU transferred easily as the computer industry evolved,” he says.

GROWING SUPPORT

Grateful for the strong foundations he received in computer science while an undergraduate, Heidenfelder has served for years on the Department of Computer Science’s Industrial Advisory Board. The group, composed of alumni and industry representatives, provides insight into how current students can be best prepared to enter the workforce – and helps the department acquire the latest equipment so that students are up to speed and can jump right in after graduation.

Tom and Randy Heidenfelder know, however, that for many students, college is filled with financial strains. The two, who met in high school in a suburb of Chicago, appreciate their supportive families and science-minded high school (where they got to encounter lasers and early computers). But they recognize that many students are not so fortunate. And that is why they created scholarship funds for the College of Natural Sciences. “I feel honored to know so many great people at CSU who make a difference in many lives,” Tom



Heidenfelder says. “How can you not ‘give back’ to such a caring institution?” •



The Heidenfelders (right) pose with student scholarship recipients.



ABOUT THE ASPEN SCHOLARSHIP FUND

The Colorado landscape continues to inspire Tom and Randy Heidenfelder. That is why they named one of their scholarship funds after the aspen tree. As they note, “the aspen tree starts with a single seed and develops into a broad colony that grows and nurtures many trees that survive for many years.” They hope the scholarship will act as a “seed to create a long-lived, broad base of financial support to help many students grow.” This growth in turn, “will strengthen and grow the efforts by the college and the sciences.” “These are smart kids,” says Randy Heidenfelder. “We need this as a country. We need smart people.”

DONOR SPOTLIGHT JERRY DEFFENBACHER

Helping Students: Beyond the Classroom & Counseling Session

COLLEGE CAN BE STRESSFUL.

College of Natural Sciences’ Professor Emeritus Jerry Deffenbacher knows that well. The psychology professor, whose research has focused on stress, anxiety, and anger, will now help make the experience a little less so for students in the future. He is supporting a new scholarship endowment created in his name to help exceptional students at least eliminate the financial anxiety that can surround a college education.

Deffenbacher himself was the beneficiary of a scholarship when he was an undergraduate at the University of Washington. Having the extra support “made it a whole lot easier,” he says of his undergraduate experience. So, he says, “giving scholarships – like people gave to me – is bringing it full circle.”

Deffenbacher’s passion has long been for understanding issues facing young adults – and helping them work through those challenges. He was a member of the counseling psychology program in the department and, early in his career, worked as a senior psychologist in the University Counseling Center. He began his career at Colorado State in 1976 and formally retired in 2011. During his time here, he won the Jack E. Cermak Award for Advising and was named a college Professor Laureate.



Professor Emeritus Jerry Deffenbacher

“We are incredibly grateful for Jerry’s years of service to the college and to the greater community,” says Jan Nerger, dean of the College of Natural Sciences. “His contributions to science and his dedication to students and to the University has been extraordinary. And now, his gift will ensure a lasting legacy that extends his work for generations of students to come.”

The scholarship will support students working at a high academic level and with a financial need – with preference given to those who will be the first in their families to go to college. His contributions will help to make the Jerry L. Deffenbacher Scholarship in Psychology Endowment self-sustaining. He hopes that the awards “will make it easier for students to continue their studies.” In particular, he says, receiving the scholarship “may take a little of the pressure off to work as many hours,” while also full-time students. He sees it as “support to help them achieve what they want to do.” •



Diversifying the Sciences

THE COLLEGE OF NATURAL SCIENCES IS TAKING A BROAD VIEW TO MAKE SURE EVERYONE IS WELCOME AT THE BENCH – FOR THE SAKE OF SCIENCE

WHEN CHRIS WILCOX, a special assistant professor in computer science at Colorado State University, first looked out over his sophomore-level course, he noticed something striking: *only about one in 10 of his students were women*. With a University – and state and national – population that is roughly half female, it didn't take a software engineer to see that something in the code was broken.

Rather than accepting the disparity, he was inspired to do something about it. "I wanted to find out what was going on," he says. His efforts joined many ongoing initiatives from the University, college, and other departments to improve diversity.

The landscape in the sciences has shifted substantially in recent decades. But the country still has a long way to go. Women currently make up just a quarter of the STEM (science, technology, engineering, and math) workforce. Racially and ethnically diverse minorities are also often underrepresented. The College of Natural Sciences has been making significant strides, not just in increasing numbers of students of diverse backgrounds, but also in supporting everyone at the college – whether student, faculty, or staff member.

"We have a responsibility, not just to our college and University communities, but also to our state, country, and to the sciences themselves to take a deep look at this issue and find ways to address it," says Jan Nerger, dean of the college.



Student in a biochemistry lab class



BUILDING BETTER SCIENCES

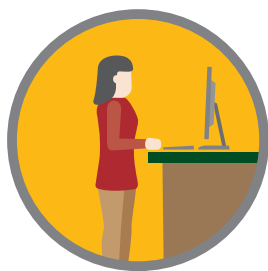
The big, challenging, and often unspoken question in this area is: Why? Why strive for greater

diversity? There is, of course, the moral call to ensure that everyone, regardless of socioeconomic status, gender, ethnicity, race, geographic background, or belief system, can pursue their personal passions – and feels welcome in doing so.

In fields dominated by data, however, it is easy to get hung up on numbers. A clear goal would be to cultivate a college whose student and faculty population closely mirrors the population of Colorado or the country. And to be sure, such an achievement would be a wonderful success, says Arlene Nededog, director of inclusion for the college.

But there is a broader reason for wanting to build diversity in the sciences – beyond numbers, beyond an equitable aim. "It's been demonstrated that when you create a more diverse team, you're more innovative, you're more creative, and you're more productive," Nededog says. And those are crucial elements to moving science forward.

"Scientific progress relies on creative thinking, diverse thinking," Nerger says. "When you have a group – and a field – that is truly diverse, you are really creating the best possible environment to make world-changing discoveries."



ORGANIC GROWTH

In 2009, when Nerger was appointed interim dean, she had already been with the college for two decades – beginning as an assistant professor in the psychology department in 1989. She knew firsthand that the college and its sciences would benefit from a better-supported female faculty. So, together with Ellen Fisher, a professor in the chemistry department, they created Women in Natural Sciences. Female faculty who join the college automatically become members of the group, which provides research and travel support as well as mentorship. The group now includes more than 90 members.

Additional support in the college has long come in myriad forms, including the Native American Women in Science Scholarship, the Computer Science Inclusion and Excellence Scholarship, and student groups, such as Women in Physics, which is open to all students. Additionally, the college has been the birthplace of campus wide programs, including CSU's chapter of SACNAS (the group formerly known as Society for Advancement of Chicanos and Native Americans in Science); Out in Science, Technology, Engineering, and Mathematics; and Students as Leaders in Science.

"These are all pieces of the puzzle that we are now able to bring into a more comprehensive whole," says Nededog, whose position was created in 2015 and who works closely with CSU's President's Commission on Diversity and Inclusion.

Nerger also has her sights set on the big picture – and the long term. "Establishing organic, authentic diversity comes from all sides: faculty recruitment and backing, student enrollment and support, and institutional growth," she says. "These things take time and thought."



THE HUMAN ELEMENT

As diversity-focused efforts are proving successful in truly expanding the college and its fields to more people, Nededog is quick to point out that the experience of students and faculty are not, of course, limited to a particular identity. Life on campus is much richer and more nuanced.

Bolstering a sense of community and belonging is crucial for everyone's success. That is why Nededog is looking at the college's efforts to improve diversity holistically. Alongside targeted organizations and scholarships, she also ranks departmental clubs, faculty connections, undergraduate research, and the College of Natural Sciences Learning Community as critically important in establishing the long-term diversity initiatives of the college.

The essential element in all of this is the human element. The sciences are often portrayed as fields where individual brilliance is paramount, and work is done in isolation – often with little direct impact on the actual day-to-day life of others. This stereotype, says Nerger, "cannot be further from the truth. Science is collaborative by its very nature – in fact, it requires teamwork," she says. "The problems we face today are too complex to solve alone. And by tackling them together, we help people – now and down the road."

A new effort in computer science is already showing fruits of this sort of thoughtful labor. Professor Adele Howe is championing the radical idea of proactive communication, coupled with open honesty. For the past few years, the department has written letters, and female undergraduates have made phone calls to women

admitted into computer science. In these communications, the current students acknowledge that they, as women, are still in the minority among majors. But, they emphasize, the department at CSU provides support and community (though the Association for Computing Machinery – Women club, for example). And that they, themselves, will be there as peers and mentors. Since these letters began going out – and since the advent of dedicated scholarships and more inclusive teaching practices – female enrollment has begun climbing out of that 10 percent rut. Some 17 percent of entering freshmen in the department this year are women. And, notes Wilcox with pride, the top three performers in his challenging sophomore course – the one previously stuck at 10 percent female – are all women.



SUPPORTING EARLY PASSIONS

By the time many high schoolers are selecting colleges and majors, however, they have already made up their minds about what they want to study – or, perhaps, what they *should* study.

That is why the college's diversity efforts aren't stopping with undergraduates – or even high school seniors. A passion for – and confidence in – the sciences begins early, says Nerger. "To paraphrase Carl Sagan: every child is born a natural scientist," she says. "It is only experience that teaches them that they cannot, or should not, continue. I'm afraid our society could do a much better job of telling everyone that if they want to, they can succeed in the sciences."

CONTINUED ON PAGE 10 •••►



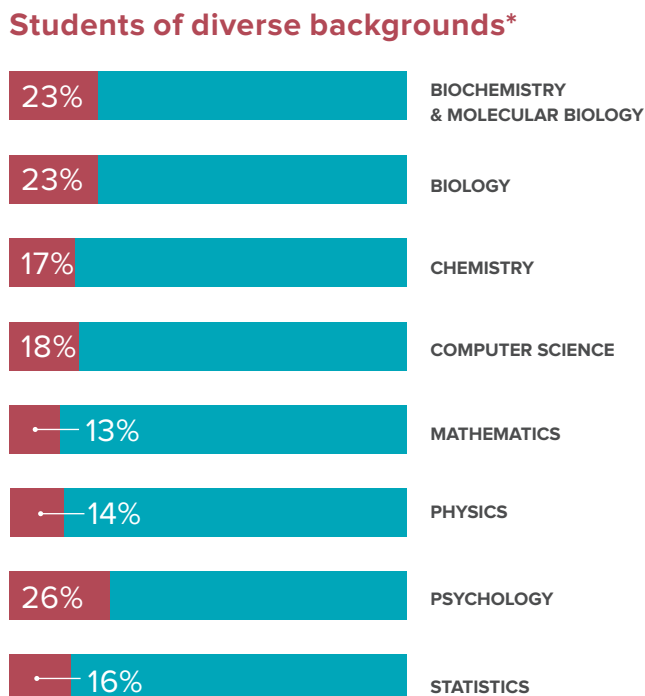
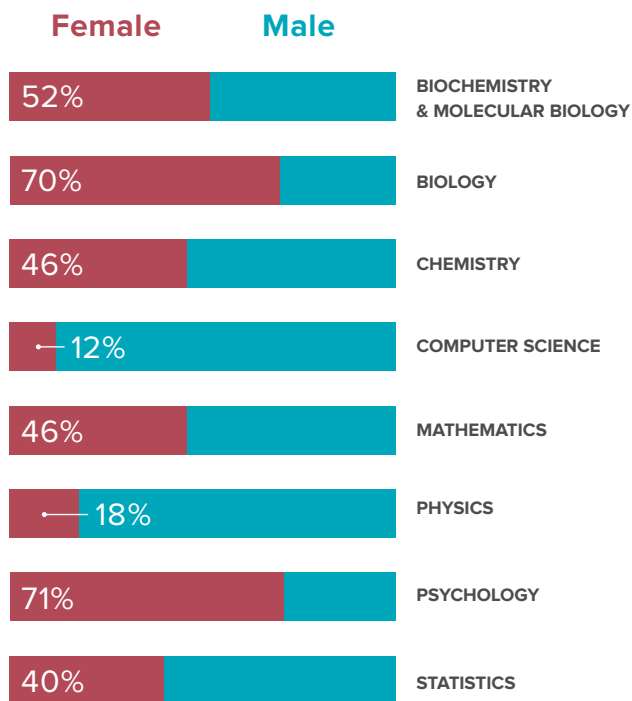
Indeed, research by two College of Natural Sciences faculty members published this summer in the journal *PLOS ONE* shows that about two-thirds of both boys and girls in the fourth grade report an interest in science. However, of those who graduate college with a degree in a STEM field, only about one-third are women.

Jess Ellis, an assistant professor in the CSU mathematics department, Bailey Fosdick, an assistant professor in the statistics department, and their coauthor from San Diego State University, are tracking this drop-off. “When women are leaving, it is because they don’t think they can do it,” Fosdick says – despite their grades being the same as those of their male counterparts. So the question becomes, Ellis says, “What about the climate is making them lack that sense of belonging or sense of confidence in themselves?” Next, they will be examining data from students of diverse ethnic and racial backgrounds that are underrepresented in the STEM majors.

These data are yet more inspiration to continue the work of the Little Shop of Physics, which brings hands-on science experiments to classrooms around the state and around the world (*read more on Page 19*); the Education and Outreach Center, which partners with researchers on campus to translate their research into portable kits for classroom teachers (look for more in a future issue); and other programs that reach underserved and underrepresented students locally – and globally.

“We are here to conduct cutting-edge research and to educate the next generation of science-minded leaders,” Neger says. “The best way to do that is to make sure there is a place for everyone at the bench – from grade school through a fulfilling career. In doing that, as a society, we have nothing to lose and everything to gain.” ●

COLLEGE UNDERGRADUATES AT A GLANCE



COLORADO HIGH SCHOOL STUDENTS AT A GLANCE



*Students who identify as racially or ethnically diverse

COLLEGE DEPARTMENTS AT A GLANCE



BIOCHEMISTRY & MOLECULAR BIOLOGY

Undergraduate Enrollment: 318
Graduate Enrollment: 47
Faculty: 17



BIOLOGY

Undergraduate Enrollment: 1,446
Graduate Enrollment: 43
Faculty: 30



CHEMISTRY

Undergraduate Enrollment: 142
Graduate Enrollment: 177
Faculty: 27



COMPUTER SCIENCE

Undergraduate Enrollment: 757
Graduate Enrollment: 93
Faculty: 21



MATHEMATICS

Undergraduate Enrollment: 220
Graduate Enrollment: 63
Faculty: 34



PHYSICS

Undergraduate Enrollment: 110
Graduate Enrollment: 65
Faculty: 19



PSYCHOLOGY

Undergraduates Enrollment: 1,061
Graduate Enrollment: 90
Faculty: 30

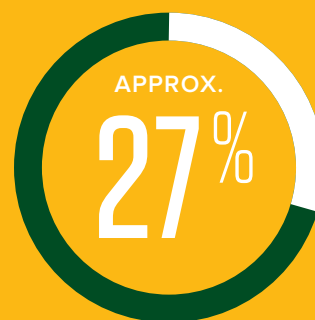


STATISTICS

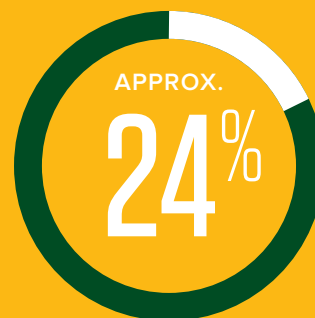
Undergraduate Enrollment: 75
Graduate Enrollment: 54
Faculty: 13

GROWTH POTENTIAL

We're committed to educating students from all backgrounds, shaping the science-minded leaders of tomorrow.



College undergraduate students are the first ones in their families to attend a four-year college.



College undergraduate students are Pell Grant recipients.



Transforming Medicine with Technology and Teams

HOW NATURAL SCIENCES ALUMNUS JACK COCHRAN HELPED TURN KAISER PERMANENTE AROUND – AND USHER IN A NEW ERA OF INFORMATION-AGE MEDICINE

The United States spends the most money of any country on health care – a total of \$3 trillion, or 18 percent of the total GDP. But, despite all of that spending, neither our health care nor our life expectancy is No. 1 – in fact, both rank 31st globally.

A big part of the problem? Lack of communication – among health care workers but also between people and data.

There is one health system in the country, however, that has pioneered a new path forward, one in which a patient's data is viewable by the entire care team simultaneously and accessible to the patient. It is a system that challenges its staff to learn from mistakes, look for patterns, and put patients – not docs – at the center of the care model. It is Kaiser Permanente.

Colorado State University biology alumnus Jack Cochran ('68) spent 25 years leading many of these changes – first on a regional level in Colorado, and then as executive director of The Permanente Federation, which supports the consortium's eight groups around the country, a care network that reaches some 9 million patients. "Jack Cochran's driving passion to help and his insights into how systems work – from human systems to technological ones – made an incredible impact on the industry," says Dean Jan Nerger. "We cannot be more proud to count him as one of our college's alumni. He sets an exceptional example as to what is possible with an inquiring and open mind."



HUMANITY IN HEALTH CARE

When Cochran arrived at CSU in 1964, however, he had no inkling he wanted to go into medicine or health care administration. He was a teenager from Wheat Ridge, Colo., who happened to have an aptitude for science. He settled into a biology major with a minor in political science. This diverse training gave him an important perspective through medical school – and his career – he says. "I am proud of my CSU roots, grateful for what it gave me, and

dedicated to be a positive supporter always" (see *sidebar*). From his time here, he learned of being a good doctor and administrator, "there's a whole lot more to it than just academic capabilities; you must bring the humanity to it."

After CSU, he attended dental school for a year, but it became clear he wanted to be a physician, so he enrolled at the University of Colorado School of Medicine, graduating in 1973. He then completed a residency in surgery at Stanford University Medical School and a fellowship in

plastic and reconstructive surgery at the University of Wisconsin Medical School. After training at three different leading medical schools, Cochran realized that his CSU education prepared him to succeed in myriad challenges.

He went into private practice of plastic surgery in Denver and, after 10 years, he joined Kaiser Permanente to create their new department. Over the next few years, the organization saw many challenges, which affected the group broadly, including morale. He was encouraged by colleagues

to run for their board to see what changes could be impactful. He was perceived as a steady force who listened well before reacting, so he was asked to run for board president and was elected in 1999.

With that position, he knew he would have to make big changes. He just didn't know what they were yet. So he listened. And listened.

In fact, he sat down with and listened to every doctor in the entire group – a data-gathering mission that took about two months. He called it his “Listening Tour.” And from it, he learned a lot: “even if you don't know what all of the answers are, at least you can start to think about it,” he says. And his subsequent thinking built the foundations of his transformative management strategy and vision for the groundbreaking work that Kaiser would do.



DATA-DRIVEN, PATIENT- CENTERED

One of Cochran's innovations was to take a big-picture view of the whole system. “We did a turnaround of the whole region and group,” he says. By changing structures and thinking about support staff roles, he was able to empower doctors who had previously complained of being overworked to actually be more productive in terms of patient care.

The other hallmark of his tenure as president in Denver is the implementation of an early digital medical record system. This first version had its drawbacks – and was eventually replaced by the current system when rolled out nationally – but, says Cochran, through the experience, “what we developed over time were physicians who really saw the advantage of computers.”

“If you're taking care of a patient, and their information is in a paper chart, you better have that paper chart where the patient is,” he says. If that

patient was in oncology yesterday, cardiology the day before, and a different specialty today, “that chart could be anywhere,” he says. But once that information is digital, instead of being *anywhere*, that information can be *everywhere* – with the specialist treating the patient, with the primary care doctor, and with the system itself, which can now screen for missed tests, unfilled prescriptions, and important follow-ups (likewise, it avoids redundant tests and potentially dangerous drug interactions, and allows patients to e-mail their doctors, cutting down on unnecessary office visits). “It's wondrous,” he says. “It's so powerful. You have the data and the information on the patients, you have the science on the clinical outcomes.”

From there, they can analyze the data to even be proactive. For example, he says, if they know they have 1,000 people in Fort Collins with asthma and learn about a nearby forest fire or dust storm, “you can figure out the risk and reach out to these people – and anticipate problems. That's the good stuff.”

With all of that data can come uncomfortable truths as well: “The data shows us where we're good – and where we can improve,” he says. And that meant an additional sea change. “So we developed this culture that embraced measurement, acknowledgment, comparison, and improvement.” From this shift, “you redesign care practices, create different ways of measuring outcomes – and then it gets really exciting,” he says. “That's a long way from the old model, where everything took place in the doctor's office and the doctor's brain.”

Such systemwide data transformed the practice “to the information age: patient-centered and team-based,” he says.

He retired in 2015 and still prizes his own team. Cochran credits his colleagues for the great successes: “I had a tremendous team – I was lucky to be there.” ●

GIVING BACK

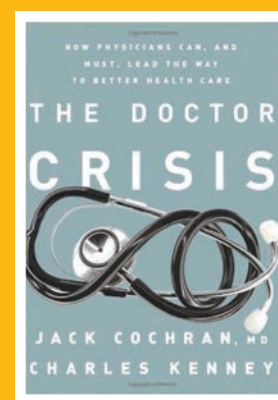
Jack Cochran credits a lot of his broad training to his time at CSU. “I am proud of my CSU roots, grateful for what it gave me, and dedicated to be a positive supporter always.” This summer, Cochran announced that he is giving back in a big way:



HE MADE
A SUBSTANTIAL

GIFT

TO THE COLLEGE OF
NATURAL SCIENCES.



Jack Cochran (biological science, '68) is also the coauthor of *The Doctor Crisis: How Physicians Can, and Must, Lead the Way to Better Health Care* (PublicAffairs, 2014).



Happy 50th Anniversary

THE DEPARTMENT OF Biochemistry and Molecular Biology celebrated its golden anniversary this year. In 1966, with the Nobel Prize for the discovery of DNA's double helix still fresh, four faculty members from the Department of Chemistry and the Endocrine and Chemistry sections of the Agricultural Experiment Station founded CSU's biochemistry department. The department lived in the then-Biochemistry and Radiation Biology Building for nearly a quarter-century (amid frequent train horns and, according to Department Chair Shing Ho, lots of chickens) before moving to its current home in the Molecular and Radiological Bioscience Building in 1989.

Since its founding, the department has contributed to international understanding of the inner workings of living cells – as well as to the intellectual culture of CSU, originating the first B.S./M.S. joint degree on campus and starting what

would become the massive annual Celebrate Undergraduate Research and Creativity Showcase and poster competition.

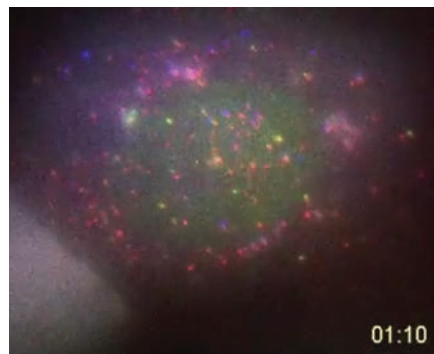
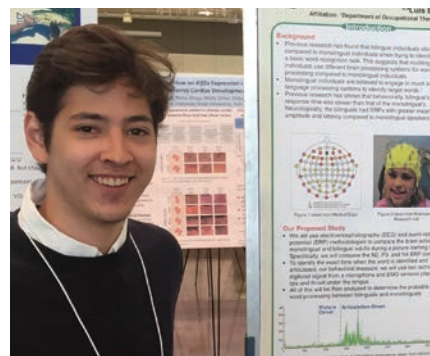
The department marked the occasion with a two-day symposium featuring alumni from the department as well as a keynote talk by recently retired Professor Emeritus Norman Curthoys. Curthoys has been with the department since 1988, arriving just a few years after the addition of the undergraduate degree. As you can see (*Page 11*), since then, the department has grown, especially for undergraduates. And it has no plans of slowing down, says Ho. "In looking to the future, I see the Department of Biochemistry and Molecular Biology continuing to be an innovator at CSU, with a young and vibrant faculty who will continue to push the frontiers of discovery – and enthusiastic about training the next generation of scientists," he says.



FIRST-YEAR NEUROSCIENCE MAJOR LAUNCHES BILINGUAL BRAIN STUDY

WHEN MEXICO CITY NATIVE Luis Gomez Wulschner arrived at CSU as a freshman last fall, he was eager to learn more about how the brain works. The neuroscience major might not, however, have expected to be designing his own study by spring. Gomez Wulschner, along with faculty mentors and another student, put together a Celebrate Undergraduate Research and Creativity Showcase prize-winning poster describing how to look at language-processing times in bilingual and monolingual brains. In multilingual brains, he says, "neurologically, we actually see the processing of a word is more complex."

Read more: col.st/5SuvQ



WATCHING GENE EXPRESSION IN REAL TIME

ASSISTANT PROFESSOR Tim Stasevich and his colleagues are among the very first people to be able to watch proteins being created through RNA translation in a live cell – in real time. The breakthrough landed them a paper in *Science* this May. Since then, Stasevich has also received a major grant from the W.M. Keck Foundation (in a joint award with Brian Munsky of the College of Engineering) and was one of two CSU researchers to be named a 2016 Boettcher Investigator.

Read more: col.st/ORiDc

Biology in the Field & at Sea

THIS SUMMER, seven CSU biology undergraduates had an opportunity to do something they could never do on campus: observe whales – and marine fish and crabs – in the wild.

They were part of the very first field marine biology course, run through the Department of Biology at CSU's brand-new Todos Santos Center, in Baja California Sur, Mexico. The center is a full-time outpost of the University and has been up and running for just a year. But already, the Department of Biology has taken full advantage of the new destination. Its location, close to both the Pacific Ocean and the Gulf of California – and to a major university, Universidad Autónoma de Baja California Sur – make it ideal for numerous programs.

"The accessibility of unique perspectives is key for our students' development, both as scientists and world citizens," says biology Department Chair Mike Antolin. "Todos Santos provides both within half a day's travel from Fort Collins."

The department is also busy creating other transformational experiences at the center. This spring, a bioinformatics workshop, taught by CSU biology faculty, drew local students, and members of the department are looking into working on a One Health research initiative there as well.

Read more: col.st/ngbMX



GOOGLE USES CSU SCIENCE TO MAP METHANE LEAKS

Methane is a major greenhouse gas and frequently leaks from natural gas lines, energy infrastructure, and manufacturing facilities. But it might not pass undetected for long. Researchers on campus, led by Associate Professor Joe von Fischer, have developed mobile methane detection technology. Google Maps has now outfitted some of its Street View cars with the technology, and the team is assembling maps of leaks in major U.S. cities.

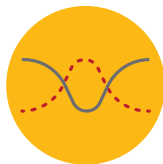
Read more: col.st/xRezR



OPENING FALL 2017

The new Biology Building is on track to open fall semester 2017. Its flexible lab and learning spaces will encourage collaboration across interests and expertise and among students and faculty. The department is the largest in our college, and it serves more than 60 percent of all undergraduates on campus.

Learn how you can help make your mark on the future of biology at CSU: www.biology.colostate.edu/new-building



TWO FACULTY WIN DEPARTMENT OF ENERGY EARLY CAREER AWARDS

The U.S. Department of Energy selected just 49 researchers across the country for Early Career Awards this year. And Colorado State is home to two of them – both in the chemistry department. Assistant Professor Amber Krummel and Assistant Professor Jamie Neilson each were honored with the award this year, a distinction that comes with a five-year \$750,000 research grant. Krummel's lab uses highly sensitive infrared measurements to understand microdynamics in the macro world. Her research is applicable to numerous fields, such as energy recovery. Neilson's work focuses on materials discovery, or "materials by design." The honors are just two of numerous large awards brought home by chemistry faculty this year.



CRACKING ZIKA'S CODE

As dozens of countries battle the Zika virus and its effects, a team of CSU researchers is using advanced computer modeling to try to better understand the disease.

Assistant Professor Martin McCullagh and his colleagues were studying the RNA replication process of dengue virus, which has a similar structure to Zika. So when Zika emerged as a new major health concern, they were well positioned to expand their focus. The team has already been able to model some of the virus's proteins in three dimensions to better understand it. With that, says McCullagh, "ultimately, you can use that model to try to prevent function."



BUILDING A BETTER BATTERY

Your laptop and power drill may someday be powered by College of Natural Sciences' brain power.

Chemistry Associate Professor Amy Prieto is working to power our future – more efficiently and sustainably. She began as a solid-state chemist, with no background in batteries. Now, however, her CSU spinoff company, Prieto Battery, has recently won investment from Intel Capital, the investment group of Intel, and from Stanley Ventures, the venture arm of Stanley Black & Decker. Additionally, the group entered a partnership with Intel's New Business Group. The team is fueled up for their next big breakthrough.



OPENING FALL 2017

The new Chemistry Research Building will provide 60,000 square feet of additional hood-intensive lab space, integrating collaborative student and faculty research across the many areas of chemistry. The building is on schedule to open for the fall semester in 2017.

Learn how you can help build the future of chemistry at CSU:

www.chem.colostate.edu/new-building



Assistant Professor of Computer Science, Sangmi Pallickara

FACULTY SOLVES

BIG PROBLEMS OF BIG DATA

THE AMAZING AMOUNT OF DATA that we can now collect has the power to transform our understanding of genetics, the environment, and the universe. That is, if scientists can figure out how to analyze all of it.

Here to help is computer science Assistant Professor Sangmi Pallickara. Pallickara recently won a National Science Foundation CAREER Award to build ad hoc models that will help turn massive amounts of observational data into usable, analyzable packages.

Her work will focus on data that involve both space and time, such as air pollu-

tion measurements or traffic jam readings. These points of information amass quickly. And soon they can leave even top researchers scratching their heads as to where to start an analysis. “When you have a peta-scale dataset, you have no idea what data you have,” she says. But with the right models to digest the data and the right graphic interfaces, she says, “you can really take the data to the next level, which is knowledge discovery.”

Read more: col.st/My0yu

SPARKING DIVERSITY

Faculty and students in the computer science department are making strides in improving diversity in the department (see Page 8). Sangmi Pallickara hosted an inaugural summer STEM computer camp for local female high schoolers as part of her NSF grant.

Read more: col.st/kOIcQ



Women undergraduates
in computer science



Welcome, Kenneth McLaughlin

**NEW CHAIR OF THE
MATHEMATICS DEPARTMENT**

THIS FALL, the mathematics department welcomed a new chair: Kenneth McLaughlin, who joins CSU from the University of Arizona.

"We are thrilled to welcome Ken to the mathematics department and to the College of Natural Sciences," says Jan Nerger, dean of the college. "We are very pleased to have his scholarly talent as well as his dedication to the success of students here at CSU."

McLaughlin's academic areas of expertise include nonlinear waves, the theory of approximation, and random matrices. At Arizona, he chaired the department and taught a wide variety of courses, from an undergraduate class called Mathematics in Modern Society to a graduate course on Universality.

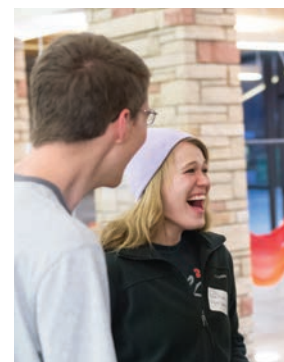
"I am delighted to be joining CSU's mathematics department," McLaughlin says.

"I am looking forward to growing our existing strengths and creating new initiatives in research – and continuing the important work of preparing our students for great careers."

As McLaughlin takes the mathematics reins, the college extends its gratitude to Gerhard Dangelmayr for his five years of excellent service as department chair. Under his supervision, the department grew from 22 regular faculty members to 31 – and from one special faculty member to four. It also introduced new courses and saw outstanding performances by CSU students in the William Lowell Putnam Mathematical Competition.

In addition to serving its faculty and students, the mathematics department continues to be an essential part of the university. Each year, it provides courses to some 10,000 students across campus.

UNDERGRADUATE POSTER COMPETITION SPARKS CREATIVITY



In mathematics, undergraduate research and scholarship can often be overlooked. But in the College of Natural Sciences, math undergrads now have an opportunity to shine. The first Mathematics Undergraduate Poster Exhibition and Competition, held in December 2015, saw more than a dozen entries. The second, held this May, had 37 entries and a stiff field of competition for cash prizes. It also awarded a Special Prize for Mathematics and the Arts for an illustration of Einstein, with mathematical expressions drawn in for his wild hair.



CALCULUS CENTER OPENS FALL 2016

Research conducted in part by CSU faculty has shown that, nationwide, college Calculus I is a major barrier to students hoping to get majors in the STEM fields.

The results of these studies have helped to prompt CSU to open a Calculus Center this fall, which aims to improve learning for all students in calculus across campus. It provides a dedicated space in the Weber Building for tutoring, study groups, and special classes, and a center for faculty engaged

in teaching the topic. Assistant Professor Mary Pilgrim and Associate Professor Anton Betten co-direct the center and helped to plan and develop the hub. Cameron Byerley and Janet Oien join the department this semester to help as the center starts "functioning"



Farewell, But Not Lights Out, for Roger Culver

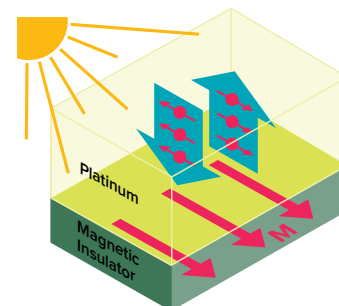
IT WAS 1966 when Roger Culver first arrived to teach astronomy at CSU. This summer, after 50 years on the job, he officially stepped down from his professional duties. He was feted with an astronomy party at the College of Natural Sciences Learning Community in May. On view: the transit of Mercury. On the menu: liquid nitrogen ice cream.

“One of the most remarkable things about Roger Culver’s record as an astronomy professor is the reaction of former students when I happen to mention his class,” says Jacob Roberts, chair of the physics department. “Almost uniformly, they comment on how much they enjoyed the class and really felt they learned about astronomy. His legacy is, in part, formed by the tens of thousands of students he has taught over his career at CSU – and how many of them have gained positive insights about astronomy from him.”

Culver’s professional research has focused on variable stars, which change in brightness. His recent interests have expanded to all stars, in particular those that we can see – or should be able to see – from here on Earth. Most recently, he and colleagues created a new way to measure this: the Light at Night Index. Because you can’t track anything very well if you can’t first measure it.

And measure it, he will continue to do, from the roof of the Natural and Environmental Sciences Building, right here on campus. Up there, he still maintains a photometer to measure sky brightness, tracking the changes to the light at night in Fort Collins. Although the physics department is losing one of its stars, the future remains bright with the arrival of Emily Hardegree-Ullman as the new astronomy instructor.

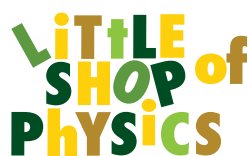
Read more: col.st/6wilg



NEW SPIN ON ENERGY

CSU physicists have a powerful new idea about quantum spinning: It can be harnessed and controlled using light to create spin voltage. Traditional batteries, which use positive and negative charge flow, have serious power and heat constraints. But by using the field of spintronics to miniaturize power and processing, our devices could get a lot smaller – and a lot cooler. Mingzhong Wu, an associate professor, along with colleagues in the department, at UC Irvine, and in China, published a paper describing the new model this spring in *Nature Physics*. The inspiration for the discovery, they say, literally came in the form of an old-fashioned light bulb.

Read more: col.st/nXUjk



LITTLE SHOP CELEBRATES 25 – AND 500,000

The Little Shop of Physics, the outreach program that brings hands-on science experiments to classrooms, this year celebrated its 25th anniversary – and 500,000th student reached. The group has worked with kids and teachers throughout Colorado and the world.



Science of Learning

THE DEPARTMENT OF PSYCHOLOGY is uniquely poised not just to offer excellent classes in the discipline – but also to use the discipline to help students excel in all classes.

The department currently houses three faculty members who are passionate researchers in the science of learning and memory. Associate Professor Matthew Rhodes studies how we form memories – and also how our own perception of our memory impacts how well we can actually remember things. Professor Anne Cleary specializes in the curious nature of our oftentimes fickle memory – focusing on subjects such as déjà vu and tip-of-the-tongue phenomenon (when we can almost find the right word). And Associate Professor Edward DeLosh studies the “testing effect,” the power of regular retrieval of information (OK, quizzes) to improve long-term retention and performance on future tests.

The team, together with support from then-chair Kurt Kraiger, banded together to create the course now known as PSY 152 Science of Learning, taught by DeLosh. The work inspired an anonymous donor to contribute funds to bolster the application of this research for students on campus, “to help students transform their overall experience at CSU.”

The class is open to all undergraduates and is now offered as part of the University’s All-University Core Curriculum, meeting the requirements for the social/behavioral sciences category. The material focuses on strategies to help students improve their learning, for life, thanks to the power of psychology – and our own excellent faculty.



MAKING WAVES WITH NEW CENTER FOR COGNITIVE NEUROSCIENCE

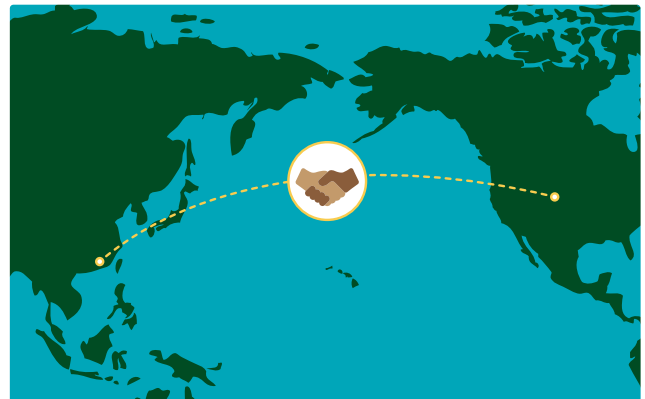
The new chair of the psychology department, Professor Don Rojas, who assumed the post in January, galvanized the creation of a new Center for Applied Cognitive Neuroscience, which opened this past winter. The co-leader of the program is Assistant Professor Lucy Troup. The center includes

EEG and functional near-infrared spectroscopy to use for research studies and clinical patients. The important difference between these pieces of equipment and larger fMRI machines, is that these are much smaller and more agile, allowing for more natural experiments – a key part of understanding how neuroscience connects to real-world problems.

The long-term goal is to bring the highest-tech instrumentation to campus – for use by all researchers, not just individual labs, Rojas says. “We want to make CSU a national player in brain imaging,” he says.

BUILDING PARTNERSHIPS IN CHINA

THIS SPRING, members of the psychology faculty traveled to China to kick off a collaboration with South China Normal University in Guangzhou. The goal is to create a research partnership and, potentially, opportunities for student exchange as well. Carol Seger, a professor of cognitive psychology, has been heading up the efforts, which include establishing the Joint International Laboratory for the Study of Mind and Brain.



Statistical Power to the People

ON THE SECOND FLOOR of the Statistics Building, major science, business, and research problems are quietly being solved, just as they have been for the past 55 years, at the Franklin A. Graybill Statistics Laboratory. This year, Jim zumBrunnen, who had been the associate director of the “Stat Lab,” retired after more than four decades with the department. The mantle will now be passed along to Julia Sharp, who will be joining the department as an associate professor. “We couldn’t be more thrilled that Julia is joining our department and will be taking the helm of the Stat Lab,” says Jean Opsomer, chair of the Department of Statistics.

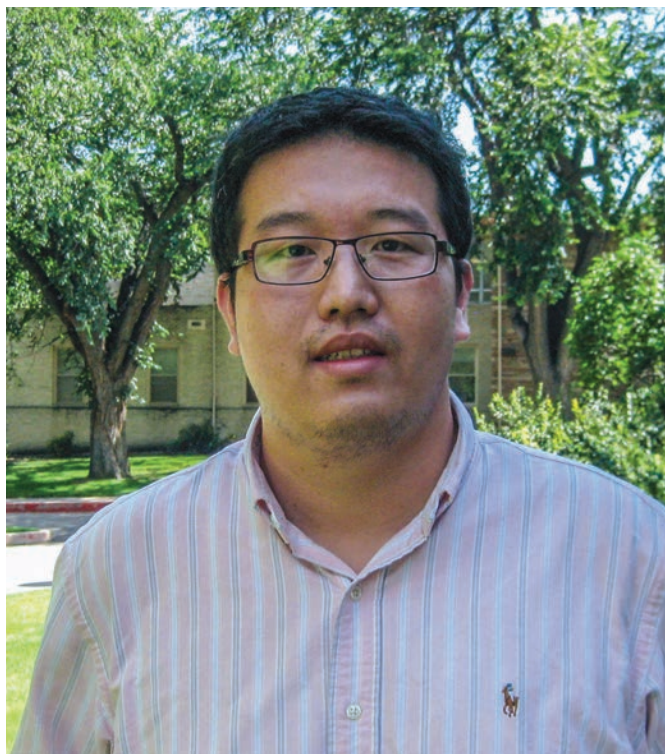
And Sharp will be entering a vibrant group. The lab clocks some 1,000 consulting sessions each year, in which faculty, graduate students, and undergraduates help businesses, nonprofits, and researchers from around campus and the region with statistics-based projects. “This is a time of rapidly

growing demand for statistical collaborations,” Opsomer says. “And Julia will enable us to continue to participate in many of the data-intensive research projects on campus.”



REWARDING COLLABORATION

Upon his retirement in January, zumBrunnen established the James R. zumBrunnen Statistical Collaboration Award to recognize student work with researchers in other disciplines.



CRUCIAL CONNECTIONS

SCIENCE RUNS ON STATISTICS. So perhaps it shouldn’t be a surprise that members of the department are involved in research projects throughout campus. Assistant Professor Wen Zhou is no exception. He was selected as this year’s star faculty member by the department and Dean Jan Nerger. His work spans research on genomics, high-dimension data, and developmental biology. In particular, he focuses his research on developing new models to analyze massive and complex datasets. As our capabilities to gather large amounts of data continue to accelerate, statistics is proving ever more essential in helping to make sense of it.

COLLEGE OF NATURAL SCIENCES LEARNING COMMUNITY

Students from all over the college can come together to find friends, fun, and common interests in the College of Natural Sciences Learning Community. The community is housed within two Laurel Village residence halls, where undergraduates from the college live, study, and connect. Flexible classrooms, workspaces, and outdoor areas provide a venue for students to pursue their passions – both academic and personal. A network of Peer Academic Leaders ensures student success and engagement through connections to faculty, field trips, and impromptu events.

READ MORE

www.natsci.colostate.edu/cnslc



IT'S ELECTRIC

Students at the Learning Community decided to put together an extracurricular science project. They tabled the standard activities (rockets, volcanoes) and picked something far more ... exciting. A fully functional Tesla coil.



Party with the Stars

FORT COLLINS IS STELLAR for star-gazing. And star photographing. We're talking about the celestial bodies, of course. This asset is what drew student Norm Revere to CSU all the way from his native New Jersey. Revere arrived last fall with the standard student gear – as well as a big camera and high-tech telescope.

He has since helped launch popular astronomy parties with the College of Natural Sciences Learning Community, bringing students together to take a look through the telescope – and watch images projected at the residence hall's amphitheater – during major astro events, from lunar eclipses to a plane-

tary transit. Coming next? A rare total solar eclipse next summer.

"The astronomy programs in the College of Natural Sciences Learning Community illustrate one of the many topics that students are interested in pursuing," says Allie Keller, coordinator for the program. "The goal for the Learning Community is to provide a space where students can connect their course work to their lives, passions, and aspirations."

Read more: col.st/FCxwK

Meet the Class of 2020

This fall, we welcomed the largest class in the College of Natural Sciences' history.

MOST WERE BORN IN 1998



Google

Google Inc.
was founded



Liquid water on
Jupiter's moon
Europa was detected

$f(x)dx$

Ambient calculus
was developed

Harry Potter

The second Harry Potter
novel was published

SCIENCE STRONG

THE RECORD NEW ENROLLMENT in the college (977 first-year students along with 313 transfer students) is a powerful reminder about the importance of science in just about every aspect of our lives today, says Dean Jan Nerger. "This exceptional growth is a tremendous statement about the crucial role our disciplines – and our graduates – will

play in shaping the world," she says. "It is also a call to action for us, our faculty, and our alumni and friends, to continue supporting and challenging these students so that they can become the best scientists, teachers, and leaders for future generations."

SUPPORTING STUDENTS

The college has dozens of scholarship funds that help make CSU's outstanding science education accessible to all. Learn more about how any sized contribution can make an outsized difference in the lives of our students:

ADVANCING.COLOSTATE.EDU/CNS/GIVE



Natural Sciences Says Thanks

IT'S NOT EVERY DAY that students, faculty, staff, tradespeople, and CSU's Board of Governors all get together for lunch – at an active construction site, no less.

This spring, all of the above assembled in the unfinished first floor of the College of Natural Sciences Biology Building for a celebratory barbecue and to put their names on a little piece of CSU history: the final beam of the building.

Read more: col.st/mzHVS

This spring, all of the above assembled in the unfinished first floor of the College of Natural Sciences Biology Building for a celebratory barbecue and to put their names on a little piece of CSU history: the final beam of the building.

Read more: col.st/mzHVS





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BIOLOGY BUILDING AND CHEMISTRY RESEARCH BUILDING

• OPENING FALL 2017 •

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Haselden Construction CEO Byron Haselden with Dean Jan Neger



President Tony Frank



Russ Young (Ph.D., '95, chemistry), global CTO at Hach Co.,
with Chuck Henry, chair of the Department of Chemistry



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