Elements 2020

COLLEGE OF
NATURAL SCIENCES
COLORADO STATE UNIVERSITY

OUR **MISSION**

HARNESSING THE POWER OF THE FOUNDATIONAL SCIENCES,

THE COLLEGE OF NATURAL SCIENCES LEADS ...

TRANS**FORMATIVE**

... RESEARCH, EDUCATION,

AND COMMUNITY ENGAGEMENT;

REMOVES BARRIERS TO ACCESS;

AND FOSTERS A SPIRIT OF INQUIRY.

A LETTER FROM THE DEAN

On January 1, 2020, we welcomed the new year with anticipation and high expectations of what we would accomplish as individuals and as a society. Now, as we look back on 2020, we will think of an unprecedented year filled with challenges to our personal and collective social, economic, moral, psychological, and physical well beings. With challenges come opportunities to innovate and find solutions and during this time, Colorado State University and the College of Natural Sciences did just that. We found creative solutions to move much of our curriculum online, we continued to conduct high-level transformative research, many of our researchers applied their expertise to COVID-19 initiatives, and, as a college, we strengthened our commitment to diversity, equity, and inclusion, and engaged in important community outreach and engagement.

This year, we also enunciated our new mission statement for the college. It reflects the work that we have been doing for more than 50 years and, at the same time, serves as a beacon for us as we advance further into the new decade. Our mission statement focuses on the power of the foundational sciences and how we can use our knowledge and understanding to address the most pressing global concerns.

One important way in which the college is dedicated to improving the world and our society is by identifying and removing barriers that prevent access to the sciences. There are those who have been marginalized by academic culture, and we in the college want everyone to know they can be a part of science and succeed in their aspirations. Science is, by nature, collaborative, and its progress relies on innovation and creativity that comes from the expertise and curiosity of people from all backgrounds. In the College of Natural Sciences, we are committed to educating the next generation of scientists and preparing our students for the workforce. Being proactive in our diversity and inclusion efforts will produce better science, better scientists, and better citizens.

This issue of *Elements* is devoted to stories that exemplify our values and provide tangible examples of how our mission guides our thinking and our actions. You'll find stories of how our faculty, staff, and students pursue their work with a high level of curiosity and inquiry with the goal of making the world a better place. I trust you will enjoy reading the stories of some of our transformative programs in research, education, and engagement, and I hope that these stories will foster a spirit of inquiry in each of you.

Jan Nerger

Jan Nerger, Dean
College of Natural Sciences

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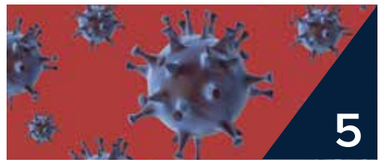

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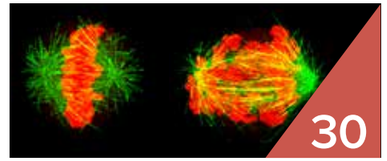

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ABOUT THE COVER

The cover of this year's *Elements* magazine was inspired by the artwork of John Dipietro, a student in the Department of Art and Art History.

MEET DEBBIE GARRITY

CHAIR OF THE DEPARTMENT OF BIOLOGY

WHAT IS YOUR VISION FOR THE DEPARTMENT OF BIOLOGY?

COVID-19 is upon us, and if there was ever a time for a growth mindset, this must be it. The logistics of moving forward with research, teaching, and outreach are complex, but our mission is clear: a world-class education for our students, steady progress on scientific research that makes a difference to our planet and our society, and meaningful connection with our broader community and our students. Recognizing that the world has changed, we have built hybrid courses and become intimately acquainted with the nuances of new technology. It has been hard work, but it has spurred creativity and pushed us to enhance our craft in new ways. One important component of student success is the sense of connection and inclusion. Both can be fostered by an effective instructor and, over the year, we have learned how to facilitate that process when face-to-face contact was limited. The future still holds many unknowns, but when it comes to education for our students, we're determined to do it and do it well.

HOW DOES BIOLOGY CONTRIBUTE TO BETTERING SOCIETY?

Those of us who do foundational research in biology enjoy peering into the inner workings of life itself, in all its variation, complexity, and beauty. Basic research in biology plays a critical role in bettering society. A detailed understanding of biological processes and relationships provides the foundation for treating and preventing disease, for growing food, and for ecological conservation.

The newly emerging therapeutics for COVID-19 provide one illustration of this process. For years, scientists studied the basic workings of the coronaviruses, a group of common viruses named for the crown-like spikes on their surface. When the deadly COVID-19 variant appeared, that basic knowledge provided a huge jump-start in conceiving approaches to hinder COVID-19 survival and replication.

Likewise, technology invented only within the last century is now leading to an explosion of new information about DNA sequences. Scientists can sort through that data to identify and track minute DNA variations that are associated with inherited disease, often identifying new genes that underlie the disease. In the future, our unique DNA sequence is likely to be the basis for medical treatments personalized to exactly our physiology. ●

MEET HAONAN WANG

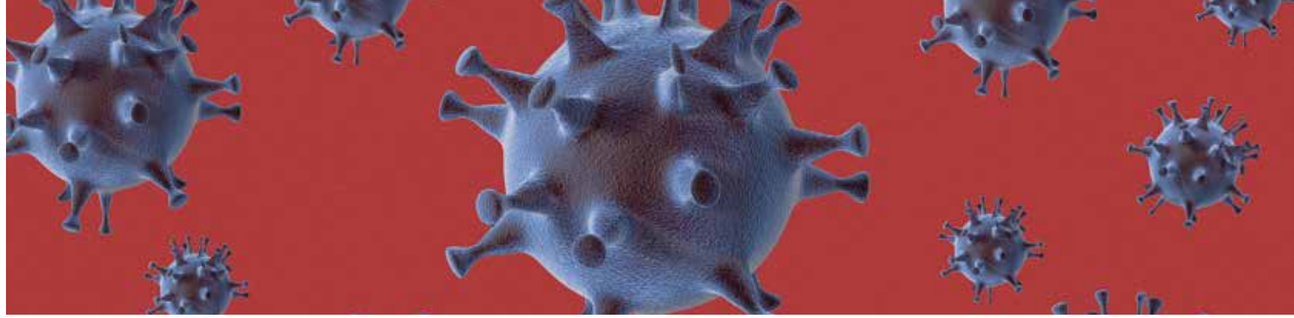
CHAIR OF THE DEPARTMENT OF STATISTICS

WHAT IS YOUR VISION FOR THE DEPARTMENT OF STATISTICS?

The Department of Statistics at Colorado State University is perceived as a strong statistics department nationwide and internationally. Our faculty will continue to contribute to the development of new statistical and probabilistic theories and techniques and will maintain a high standard of scholarly work. We will continue to dedicate ourselves to the dissemination of statistical knowledge through teaching and advising at all levels. Our goal is to bring statistics education and training to other colleges and disciplines on campus and to everyone who needs statistics. The department will fulfill its commitment to serve the needs on campus and needs of other entities connected to CSU. The Graybill Statistics and Data Science Laboratory will play an important role as a bridge connecting to the campus research ecosystem through statistical consulting and collaborative research.

HOW DOES STATISTICS CONTRIBUTE TO BETTERING SOCIETY?

In the past two decades, along with the emergence of modern computing equipment, data-gathering technology, and data storage devices, statistics has undergone unprecedented transformation with both challenges and opportunities. Nowadays, data are everywhere and are penetrating every bit of our daily lives. Wherever there are data, there will be statistics. Statisticians can develop suitable models, theoretically sound inference tools, and efficient and tractable algorithms supported by techniques from computer science and mathematics. Statisticians have unique expertise in quantifying uncertainty embedded in various estimation and inference procedures. Consequently, statistics is also in the center of interdisciplinary research utilizing large amounts of data. ●



FOUNDATIONAL SCIENCES PROPEL COVID-19 RESEARCH EFFORTS

BY LISA STREEB CASE

Chuck Henry, a professor in the Department of Chemistry, has spent his career studying and developing chemical analysis devices for pathogen detection, environmental monitoring applications, and more. So, when the need arose to create cost-effective and accurate testing systems for COVID-19, Henry was ready.

In collaboration with Brian Geiss, an associate professor in the Department of Microbiology, Immunology, and Pathology, and David Dandy, a professor in the Department of Chemical and Biological Engineering, Henry and the team have created a simple device that can detect the presence of COVID-19 RNA from saliva. Not only is this test cost-effective, but it also can be performed quickly without the need for advanced lab equipment. In addition to this test, Henry is working with collaborators on antibody testing that is more accurate than current methods, as well as aerosol testing that can detect virus levels in the air in real time in places such as hospitals and college campuses.

In July, the COVID-19 testing device was licensed to Quara Devices, a company that specializes in diagnostic biosensors. This device has promise to be a fast, portable, and more accurate diagnostic device than those currently used for COVID-19 testing.

THE IMPORTANCE OF FOUNDATIONAL RESEARCH

"In our research, we start with a specific problem and work our way backward to understand where the limitation or challenge is," said Henry. "Oftentimes, that limitation is found at the foundational sciences level. So, when we study foundational sciences to solve a specific problem, what we end up doing is solving many other problems that have the same limitation."

This is exactly what Henry found when he began working on COVID-19 detection. Since 2009, Henry has been working on low-cost chemical diagnostic devices with the initial goal of environmental testing and biomedical applications. These remarkable devices work very similarly to a home pregnancy test, where the device takes a sample of saliva or blood and produces a readout that determines if a specific chemical is found in the sample. When the COVID-19 pandemic began, Henry and his collaborators were able to quickly pivot their research to focus on creating better testing devices.

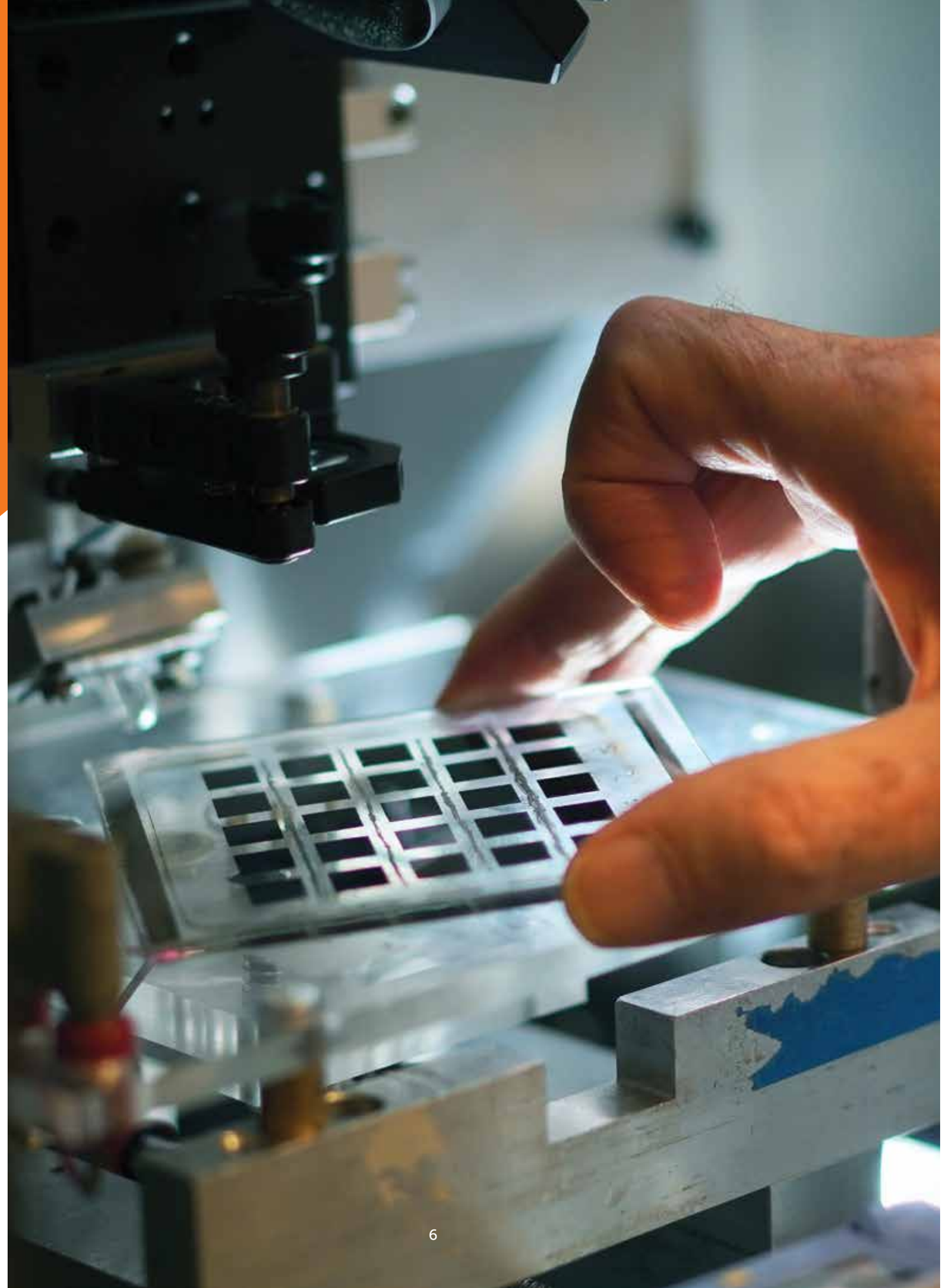
"Four or five years ago, we got into thinking about bacteria and virus detection. We were working on a number of things, including Zika detection and detection of plant pathogens that is impacting the chocolate supply of the world," said Henry. "So, when COVID came around, my collaborators, Brian Geiss, David Dandy, and I said, 'Look, this is such a natural fit for the things we are already trying to do. Let's begin to think about pivoting into that.'"

Because the researchers had the basis for analytical testing already in place, they were able to quickly create tests that are effective for COVID-19 and began working on projects in January.

BEYOND COVID-19

Henry's work is illustrative of the importance of studying foundational sciences. Through his chemistry knowledge, he has created a testing platform that can easily be flexed and used to address many problems and challenges.

"This platform is currently being used for COVID, because it is the problem we are faced with today and it is a virus with a high impact that will be around for a while. But this can be used for so many different things, from antimicrobial resistance to understanding the chemicals in our environment to other virus and bacteria diagnostics," said Henry. "This is a big reason why it is important to study and fund foundational research. When only applied research is funded, the utility of the results of that research is oftentimes pretty narrow. When foundational sciences are funded, you will often get much broader impacts. So, while we hope this will be an important tool in our fight against COVID right now, we see a much bigger impact of this technology down the road as other needs arise." ●



TRANSFORMING SOLAR TECHNOLOGY

BY ANNE MANNING

In 1971, solar cells were a rare sight on rooftops; expensive, and primarily used for satellite power. That was also the year Jim Sites first set foot on the Colorado State University campus, embarking on nearly 50 years and counting of research, teaching, and mentoring students of physics at CSU.

Today, rooftop and commercial solar is the world's fastest-growing electricity source and generates 2.5 percent of the electricity in the United States. It's fair to say Sites and his longtime collaborators can take credit for at least some of that explosive growth, thanks to an illustrious career in researching, characterizing, and improving the performance of photovoltaic technologies that are becoming more ubiquitous every day.

Just a few years after arriving at CSU as an instructor in physics, Sites, trained in low-temperature solid-state physics, became interested in the then-fledgling field of low-cost photovoltaics. Along with colleagues, he began investigating various thin-film materials with promise for efficient light-to-energy conversion. During the 1990s, he started a collaboration with Professor W.S. Sampath in the Department of Mechanical Engineering, specializing in the performance of a solar material called cadmium telluride.

With Sites' expertise in the measurement of individual cell performance and Sampath's vision for a system for rapid fabrication of the cells, they joined forces and began a research program that has garnered millions in federal funding over the years.

WORLDWIDE IMPACT

The fruits of their labor are reflected in a growing market for cadmium telluride solar technology, which is a more cost-effective, less energy-intensive alternative to standard crystalline silicon panels sold mainly in small- and medium-sized rooftop solar markets today. Worldwide, cadmium telluride solar panels, which have achieved record-breaking 22 percent light-to energy conversion efficiency, constitute 5 percent of photovoltaic power generation, but in the U.S., it is more than 30 percent.

The U.S. cadmium telluride market is dominated by the company First Solar, which employs several former students of Sites and Sampath, and whose products are primarily situated in Southwestern states for utility-scale power generation.

Sites attributes his contributions to this impressive explosion of cadmium telluride solar technology to two things.

"One, is my contribution to the understanding of how these cells work and ideas of how to make them work better," he said. "The other, and more important, is the training of graduate students."

Sites is quick to deflect credit for accomplishments onto his many students over the years, one of whom is Markus Gloeckler, chief scientist at First Solar.

He also credited students when addressing another recent honor: his receipt of the IEEE William R. Cherry Award this past June, which recognized his long career in the field of photovoltaic science and technology.

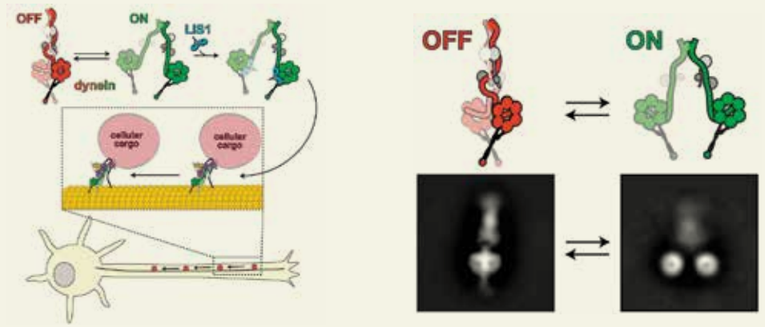
"I was thrilled by the award, especially because some of my colleagues have also received the award in past years," Sites said. "It was certainly a tribute to the students who have worked with me, and the cumulative number of things we have gotten done over the years."

WORK CONTINUES

Sites' work continues: He currently leads a $3.5 million grant from the Department of Energy for continuing to improve the performance of cadmium telluride solar cells. For this particular project, the team is focused on one of the technology's most notorious performance bottlenecks: the back contact, or the layer farthest from the light source. Until now, scientists have been unable to blend this layer seamlessly into the rest of the cell.

Partners on the grant include Sampath at CSU, as well as experts from the University of Toledo, First Solar, the National Renewable Energy Laboratory, and the University of Illinois at Chicago.

Beyond his contributions to science, Sites has also given back to the Department of Physics and the CSU community. Through a personal donation to the University, Sites recently established an endowed professorship that provides research funds for an incoming physics faculty member. He said he hopes this donation will secure a bright future for the department he's called home for nearly 50 years.



DISCOVERY LEADS TO INSIGHTS INTO SEVERE BRAIN DISEASES

BY ANNE MANNING

Movement signals life, and nowhere is this truer than inside a living cell. The millions of proteins and molecules within each of our cells bend, travel, and conform in a complex but orchestrated pattern, regulated by the genes that encode what goes where and when. As part of that pattern, an important class of proteins, called dynein, transport and deliver various cellular cargoes between different areas of the cell.

Biochemistry researcher Steven Markus is particularly intrigued by these large, intracellular motor proteins that move methodically along a network of filamentous tracks called microtubules.

How important is dynein? If dynein were to disappear, we wouldn't live past a few mitotic cellular divisions. And many neurological diseases, including one called lissencephaly, are linked to defects in dynein function. The goal of many labs, including Markus', is to understand why.

His research team has made a leap in that understanding by unveiling, in intricate detail, the mechanism by which one particular molecule affects dynein function. While it was long known that the lissencephaly-1 gene, or Lis1, affects dynein activity, the details were unclear. Markus and his team have revealed exactly how Lis1 activates dynein by preventing dynein's ability to turn itself off, stabilizing it in an "open," uninhibited conformation.

The new finding flies in the face of previously accepted views that Lis1 acted as an inhibitor of dynein. According to the Markus lab's study, published earlier this year in *Nature Cell Biology*, the exact opposite is true: Lis1 activates dynein, working to wedge itself in such a way that the motor protein is prevented from folding itself into an "off" state – inhibiting its ability to auto-inhibit, the researchers explain.

A person with lissencephaly, or "smooth brain," suffers seizures and limited motor function and rarely lives past a few years of age. This devastating disease is associated with a mutation in Lis1, a gene that encodes a critical regulator of dynein.

"I'm interested in the molecular basis for these diseases," said Markus, assistant professor in the Department of Biochemistry and Molecular Biology. "There will be no therapeutic interventions without understanding how these molecules function." Beyond that, Markus says, "molecular motors are fun, because we can purify these motors and watch them walk on microtubules in real time using fluorescence microscopy" – which is exactly what the team did for their study.

To carry out their experiments, the researchers employed budding yeast cells as a model system. In contrast to human cells in which dynein performs numerous activities, dynein performs only a single function in these cells. Their findings with this simplified system can translate into human and other higher eukaryotic cells, in which basic dynein function is preserved throughout millions of years of evolution.

The researchers employed several techniques to draw their conclusions. The most important was real-time single-molecule imaging. Using a high-yield technique they developed in the lab, the team purified dynein, added a fluorescent molecule, and assembled microscope imaging chambers with purified microtubules to watch the dynein "zip along," Markus said. This technique allowed them to establish the role of the auto-inhibited conformation in dynein motility.

They also used electron microscopy to take very high-resolution still pictures to determine if the dynein molecules indeed adopted an auto-inhibited conformation, which was unclear when they began their study.

Markus plans to conduct other experiments, using the same yeast cells, to further probe the role of Lis1 in what he and colleagues think is a multistep pathway that activates dynein. ●

INNOVATIVE CANNABINOID RESEARCH CENTER OPENS

BY LISA STREEB CASE AND TONY PHIFER

The new Panacea Life Sciences Cannabinoid Research Center, established through a gift from statistics alumna Leslie Buttorff, will give College of Natural Sciences researchers the tools to better understand these complex compounds – and, perhaps, discover new ones.

There are more than 100 known cannabinoids, the chemical compounds found in the cannabis plant, yet very few have been studied in any depth. The most well-known cannabinoids – CBD and THC – have proven effective in clinical applications and are widely available to consumers.

With so many cannabinoids still unstudied, and more that could be discovered, there is unknown potential for additional efficacy to treat human and animal ailments.

"Partnering with Panacea will propel us to the forefront of cannabinoid research and provide unprecedented opportunities for CSU faculty and students," said Jan Nerger, dean of the College of Natural Sciences. "This analytical research facility is unique in the region, and Ms. Buttorff's extraordinary gift places CSU in an unparalleled position to advance research in this burgeoning area."

The breadth of research capabilities at CSU and her long history supporting her alma mater were the reasons that Buttorff chose CSU as a research partner.

"We are very excited about this partnership with CSU," said Buttorff, founder and CEO of Panacea Life Sciences. "CSU offers expertise in the complete cannabinoid value chain, including botany, chemistry, biology, psychology, agricultural sciences, statistics, and veterinary research. Panacea's focus in developing scientifically driven and medically focused products will be further advanced with our partnership with CSU." ●

CELEBRATING TRANSFORMATIVE CONTRIBUTIONS TO SCIENCE

BY ANNE MANNING

Darrell Whitley, a professor in the Department of Computer Science, was the recipient of this year's Scholarship Impact Award, given at the *Celebrate!* Colorado State Awards, in honor of the remarkable advancements he has made in data analysis, algorithms, and programming, benefiting researchers well beyond the realm of computer science.

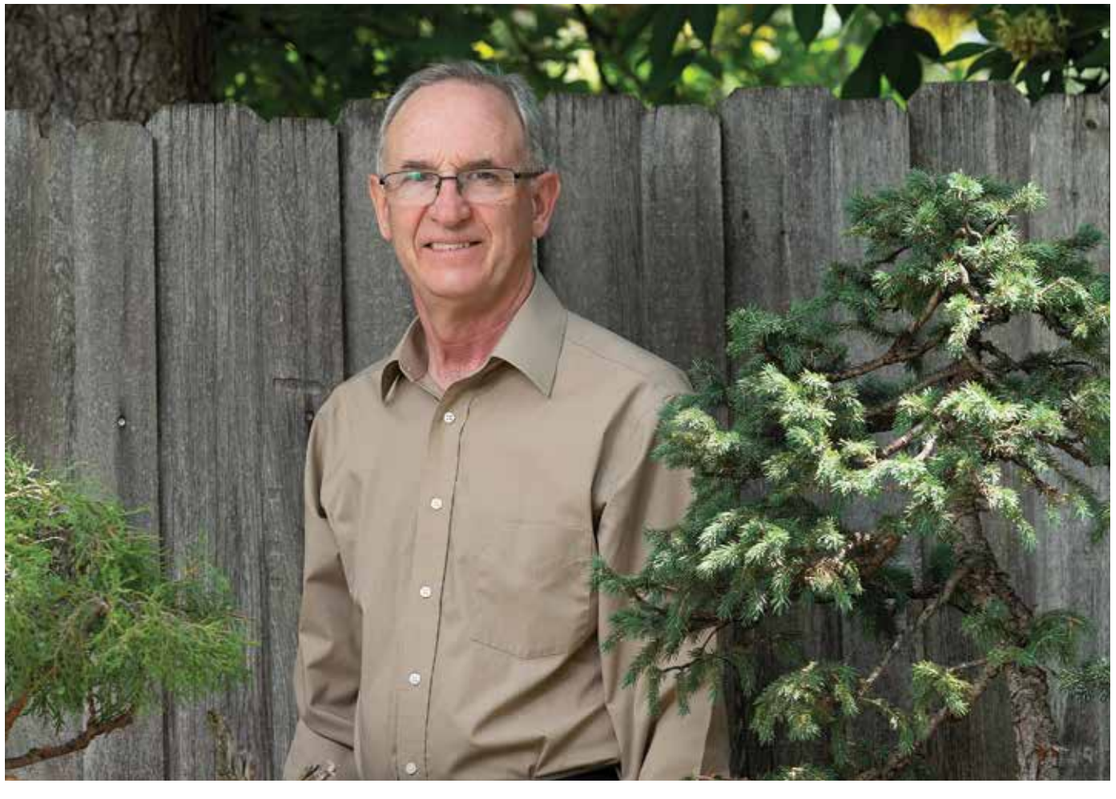
The Scholarship Impact Award recognizes distinguished CSU faculty whose scholarship has had a major impact nationally or internationally. Whitley fulfilled the criteria for this award in not just one area of expertise, but several, including machine learning, evolutionary computation, and genetic algorithms, where he developed a now widely used steady-state genetic computer algorithm.

Throughout his career, including 34 years at CSU, Whitley has gravitated to solving the most challenging problems in computer science. He has developed methods for efficiently discovering solutions for nondeterministic polynomial-time hard (NP-hard) problems, which are sets of computationally intensive problems in computing, with papers in this area winning best paper awards in 2009, 2015, and 2018.

Whitley is nationally and internationally recognized for his work and has brought great distinction to CSU, having published more than 160 refereed conference papers and 55 journal publications. He has also served as editor in chief of the journal *Evolutionary Computation*.

At CSU, Whitley has held the positions of chair of the Department of Computer Science and associate dean in the College of Natural Sciences. As if these accomplishments weren't enough, Whitley is also an award-winning bonsai cultivator, named 2018 Featured Bonsai Artist of the Year by the Denver Botanic Gardens.

Whitley's dedication to the University and the impact he has made during his time here make him exceedingly deserving of this year's Scholarship Impact Award. ●



VISUALIZING A PANDEMIC

BY ANNE MANNING

How humans take stock of the world through visual cues has been psychology Professor Jessica Witt's life's work. Now, she's applying that expertise to the current pandemic, helping to create graphics and visualizations to explain key scientific concepts to the public.

Witt and a team led by University of Michigan researchers have been awarded a National Science Foundation Rapid Response Research grant to develop COVID-19 "information visualizations" to identify the best ways to visually communicate COVID-19 risk data to the public. Their project aims to clear up misinformation and mistrust in science while helping people understand the benefits of behaviors and policies such as mask-wearing and social distancing.

The project will tackle public mistrust and confusion around COVID-19 infections and spread. The team will create visualizations that lay out factual information about how the disease spreads and how behaviors such as mask-wearing can help, then test the visualizations' efficacy through survey data. They will assess whether viewing the visualizations makes a difference in people's perceptions and attitudes during the pandemic.

"People are scared, and they want information," Witt said. "They don't always know how to make sense of the information. If we can make it easy and accessible for them and help them understand the importance of engaging in safe behaviors so we can return our kids to school or go on trips to visit family, that would be phenomenal."

The team ran pilot studies with preliminary graphics that indicated seeing the animations increased positive attitudes toward social distancing, for example. The NSF RAPID project will extend and refine that work.

Witt is a researcher in psychology who has expertise in the human visual system. She explained two aspects of how people perceive through vision: One is how sensitive we are to information, and the other is how biased we are in taking in information and estimating levels of risk.

With Witt's expertise in disentangling sensitivity from bias, she will help the team develop and empirically test data visualizations that best serve the public by clearly communicating the information while reducing biases in how that information is interpreted.

The team hopes their findings can be applied to policy-making decisions for things such as risks associated with sending students into classrooms.

"To be doing something that could have impact in a time of crisis does feel good, and I'm really hopeful that we are able to develop something that can help people while they are making what feels like impossible choices," Witt said. ●

MEET EBONNE ALEXANDER, LEARNING ASSISTANT FOR LIFE 102

Ebonne Alexander is a senior majoring in biological science. She is a learning assistant for the LIFE 102 course.

WHAT IS IT LIKE TO BE A LEARNING ASSISTANT?

The daily tasks of a learning assistant include attending lectures, holding study sessions, interacting with students and fellow learning assistants, actively going over course materials, and creating active-learning activities. It allows you to become efficient at managing your time, but it can be slightly overwhelming in the beginning. However, if you remain committed to the process, then you can garner strong interpersonal connections and resources. All in all, my experience as a learning assistant can be summed up in two words: busy and fulfilling.

WHAT IS THE BEST PART OF BEING A LEARNING ASSISTANT?

The best part of being a learning assistant is imparting both a passion and understanding of the course material to my students. As a freshman, I really struggled with the class and never could have hoped that I would understand the material as well as I do now. I had this wonderful moment when a student was overwhelmed about the topic of cellular respiration and had missed all the lectures covering the topic. I sat the student down and explained every nuance of the process and in the end, they looked at me and said, “That's it.” It was a full-circle moment for me, and every interaction like it has been just as impactful. As such, being able to help students understand the material, while also placing a seed of appreciation for the course is invaluable. Those interactions are the ones that have stuck with me the most and reaffirm my passion for being a learning assistant.

KNOWLEDGE BUILDERS FACILITATE ACTIVE LEARNING

BY LISA STREEB CASE

Active learning in small groups is an important part of the classroom experience, but it can be difficult to facilitate in an introductory class, such as LIFE 102, where the student-to-instructor ratio is 300:1. Enter learning assistants, undergraduates who have already taken the class and have come back to engage with current students.

“During active-learning activities, students typically work in groups of three or four. The learning assistants circulate among the tables and help students to think through challenges as they solve problems, draw out pathways on writable desks, or predict outcomes of test cases,” said Debbie Garrity, chair of the Department of Biology and former director of the LIFE core.

This model has proven to increase student success in the classroom. In a study performed with The Institute for Learning and Teaching at CSU, Garrity found that student success outcomes in LIFE 102 courses with learning assistants increased by 5.7 percent for all students, and by 14.4 percent for students with marginalized identities, when compared to LIFE 102 courses without learning assistants. With the data supporting this model of teaching, Garrity is working with other faculty and instructors to expand the use of learning assistants.

“The learning assistant role provides an opportunity for students to lead, help, and encourage their peers, and to be recognized as the smart, successful, and kind people they are.”

LEARNING HOW TO TEACH

Learning assistants gain a deep understanding of the learning process through a one-credit pedagogy course that prepares them to guide students along their own educational journeys.

“They may not know all the course material perfectly, but they do know how to study and how to succeed,” said Garrity. “They are friendly and accessible and encourage a sense in students that one can succeed, even thrive, in this tough class.”

Learning assistants also provide important feedback to instructors. “They are also a great source of feedback on what could be better, what students are struggling with, etc.,” said Paul Laybourn, professor in the Department of Biochemistry and Molecular Biology, who has employed learning assistants in his courses since 2016, including large-enrollment life sciences courses LIFE 210 and BC 351.

GAINING IMPORTANT LIFE SKILLS

Participating in the learning assistant program allows students to not only have a job that is relevant to their field of study, but also gain important career and life skills.

Learning assistants often find that teaching the concepts helps with their own understanding.

“They also report grasping the course concepts much more completely after serving as a learning assistant,” said Laybourn. “The training they receive through TILT greatly improves their effectiveness and confidence as peer educators and mentors.”

EXPANDING TO THE FUTURE

Over the past two semesters, the use of learning assistants in LIFE classes has expanded to six sessions of LIFE 102; other biology and LIFE courses with large student enrollment will be using learning assistants in future semesters. Building on the success of the undergraduate program, Garrity is working with others at CSU to look at how this could be replicated for graduate students.

“We recognized a need to help graduate teaching assistants understand the diversity of our students and expand our thinking about how people learn,” said Garrity. “Not only do graduate teaching assistants need skills in instructional delivery, but also in their ability to foster an interactive classroom community and understand something of the experiences of a broad range of students as they begin college.” ●

LAB CLASSES GO HOME
DURING THE COVID-19 PANDEMIC

BY LISA STREEB CASE

Physics is the study of matter – and the principles of physics learned in a lab class can be experienced in everyday life.

So, when classes throughout Colorado State were converted to remote learning amid the COVID-19 pandemic during the 2020 spring and summer semesters, the Department of Physics seized the opportunity for students to learn outside the lab with take-home lab kits.

"We designed a kit to provide students with a range of tools that could complement the things they have around their home," said Kenn Lonnquist, lab coordinator. "Our hope is that these would allow the students to perform exciting experiments in the comfort of their own homes, and hopefully make the lab experience more meaningful to them."

The kits – which include light bulbs, magnets, glow-in-the-dark paper, and many other items – combined with sensors found on any smartphone, allow students to run experiments that explore acceleration, rotation, air pressure, sound and hearing, magnetic fields, light, and more.

At-home experiments can be performed with many different subjects – even a pet dog.

"One of the first labs of the semester is one-dimensional motion," said Lonnquist. "For this activity, I went into my backyard and had my dog, Yuvi, run around, chasing her favorite toy. I recorded a video of her sprinting on my iPad, imported the video in Vernier's video physics app, plotted her motion out, and then fit a curve to the data."

From this experiment, Lonnquist was able to describe Yuvi's acceleration through the different phases of her running.

Future lab classes will incorporate some of this same technology by providing iPads to students who will be able to use them to understand the physics of the world around them. ●

RE-ENVISIONED: PACE BECOMES
THE PRECALCULUS CENTER

BY LISA STREEB CASE

Student success in precalculus math has long been the mission of the PACe center (Paced Algebra to Calculus electronically). Now, with a new name – the Precalculus Center – an updated physical space, and programming built on the latest research in the science of learning, this mission will continue with full force.

"When we reopened in Fall 2020, under the new name, there were some immediate differences students noticed," said Steve Benoit, co-director of the Precalculus Center. "A refreshed look with a more open and inviting space, including more flexible space with fewer fixed desktop computers and more seating options. There is also more room for students to interact with courses' assistants, including two new quiet rooms for focused study."

The refresh includes programmatic changes as well. While the focus on precalculus instruction remains the same, the learning methodology will follow findings from the Student Experience Project, a multi-university collaboration with experts in the science of learning and researchers who focus on factors in student success.

"Our participation in the Student Experience Project has provided us with excellent data- and research-based strategies that are proven to increase success, as well as improve students' sense of community, inclusion and belonging, and self-confidence and growth mindset," said Benoit.

This research was fundamental to the redesign of the Precalculus Center. "Through this project, we've critically examined how space, messaging, and faculty behaviors influence a student's engagement with course material, which informed how the Precalculus Center was designed," said Lisa Dysleski, associate dean for undergraduate programs. "With student success in mind, we hope we created a center where students feel accepted, affirmed, and connected to a community of learners."

DEPARTMENT OF MATHEMATICS
Precalculus Center

GROWTH MINDSET

Growth mindset is a central theme of the research from the Student Experience Project. With a growth mindset, a student begins to understand that success is a process and that failing or making mistakes is inherent to that process. New communication materials from the Precalculus Center will focus on encouraging a growth mindset for students.

Bolstered by its new name, space, and research from the Student Experience Project, the Precalculus Center looks forward to continuing to improve its student success outcomes.

"We would love to see our success rate rise above 80%, and we want to make sure that success in our program means our students have a solid conceptual grasp of the ideas and ways of thinking and problem-solving that precalculus, and courses that use precalculus, rely on," said Benoit. "We want to move forward in the Student Experience Project spirit of continuous improvement informed by experience and research, and to look at making our precalculus program better for our students as a continuous and ongoing process rather than a one-time change." ●

EARLY-START WEEK FOSTERS
COMMUNITY AND INCLUSION

BY ALLIE RUCKMAN AND LISA KNEBL

In Fall 2019, Colorado State University's new Key Natural Sciences Learning Community welcomed a cohort of undergraduate pioneers ready to create a change they want to see in the world – more diversity in science and technology – and they started early.

Before the semester began, the 38 first-year students, all studying a major within the College of Natural Sciences, moved onto campus one week earlier than usual. They immersed themselves in a whirlwind of activities designed to help build a support system by establishing relationships, understanding the CSU system and resources and, most importantly, learning how to navigate college academic life. Each student was also paired with a Key mentor.

"For our first early-start week program, we had an incredible group of incoming freshmen with so much talent and personality," said program coordinator Elisa Cundiff. "I can't wait to see what they do next."

The community's early-start week experience was funded by the Green and Gold Foundation and supported by participation from computer science faculty, instructors, staff, 25 student volunteers, Little Shop of Physics, Key Communities, the College of Natural Sciences Learning Community, the Astronomy Club, and the Office of Transportation.

"It made my transition to becoming a CSU Ram an unforgettable, enjoyable, valuable experience that ultimately better prepared me for college life," said Tay Monteau, then a freshman biology major. "Upon arriving, I immediately felt a sense of community among my fellow Key students, and now we are like a little family." ●

NEW COURSE IN DATA ANALYSIS
AVAILABLE TO ALL CSU STUDENTS

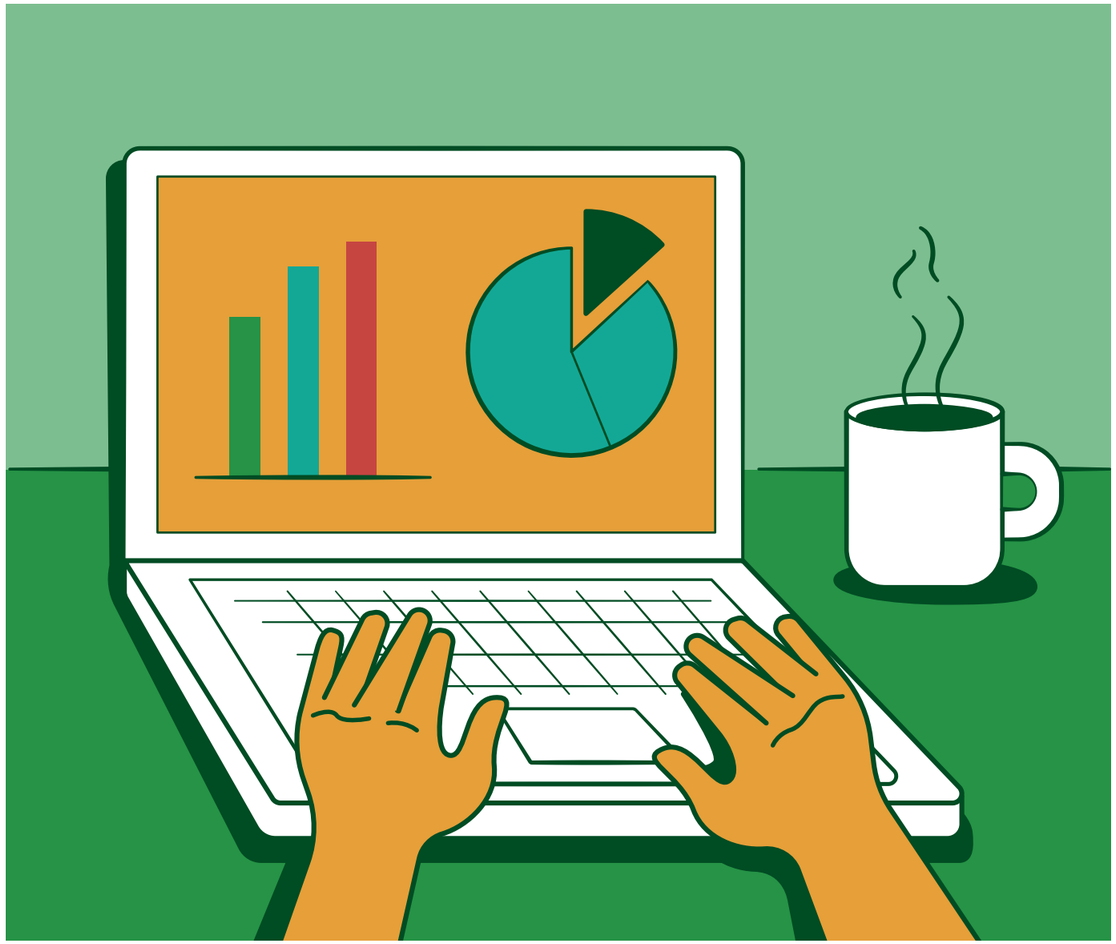
BY ALLIE RUCKMAN

Colorado State University students majoring in subjects from anthropology to zoology need to be able to analyze and understand large sets of research data, and the Department of Statistics is here to help.

Over the summer, faculty and graduate students began developing a series of three undergraduate courses to teach the fundamentals of R, an important programming language used for data analysis. The purpose of the linked courses is to help students develop proficiencies in both analytical techniques and programming languages that perform these analyses early in their academic careers.

With funding from CSU's Digital Learning Initiative, Ben Prytherch, senior instructor and undergraduate adviser in the Department of Statistics, and Matt Ross, a professor in the Department of Ecosystem Science and Sustainability in the Warner College of Natural Resources, assisted by statistics Ph.D. student Alex Fout, began developing these virtual courses. The one-credit courses will centralize R training, be flexible and accessible to students from all colleges, and allow faculty to spend more time in class teaching core material and less time teaching R.

The courses will be offered in the spring semester starting in 2021. ●



LITTLE SHOP OF PHYSICS GETS NEW LOGO, REAFFIRMS MISSION

BY ALLIE RUCKMAN

Little Shop of Physics has been a part of the College of Natural Sciences and Colorado State University for nearly 30 years.

The program has grown over that time, developing from do-it-yourself science experiments and local school visits into an international educational presence. Little Shop has been committed to engaging young students in hands-on learning as well as undergraduate students at CSU since its inception.

With name recognition and popularity growing alongside the development of the programming, it was only natural that the branding evolved too. This year, Little Shop released a brand-new logo.

HANDS-ON LEARNING

Little Shop's signature program of hands-on science was created when Brian Jones, a physics professor at CSU, started giving presentations to middle schools in the area. Students would pass notes and chat with one another, and Jones realized that traditional, lecture-style teaching wasn't the right way to capture the attention of such a young audience.

"At the end, I invited them to come down and play with all the stuff I brought," he said. "They were excited about that. I realized they don't want to listen to me, they want to get their hands on things."

Jones took this new understanding and capitalized on CSU's enthusiastic population of undergraduates "who are very driven by service and giving back," to create the now-global science education program that is Little Shop of Physics.

"We just made it up as we went along, and we did the same thing with our first logo," said Jones. A student volunteer designed it, and for years that logo has graced the front of Little Shop's "trademarked" tie-dye T-shirts. "It just grew extremely organically, which was part of the joy of it."

SOMETHING VERY SPECIAL

Eventually the team realized that they had created something very special and identified a need to develop a clear mission and set of goals.

In their nearly three decades of service, Little Shop has worked with students on Native American reservations across the country and taken their work overseas to Uganda and Namibia.

"We've built up a network of communities across the globe that we work and exchange ideas with, and our goal is always engagement," Jones said. "Everything we do starts with collaboration and community."

This idea is one of the things that makes Little Shop of Physics so special. The focus on engagement and collaboration, as well as creativity and flexibility, are what has created such a unique and ever-evolving program. Every event at a school is a chance to learn from different types of students and their communities, a chance to develop new teaching techniques, a chance to have fun and prove that science is something anybody can do. ●

LITTLE SHOP OF PHYSICS

THE MISSION THEY FINALIZED IS FOURFOLD

1. Find creative ways to share the wonder of science with people of all ages, backgrounds, and interests.
2. Present a unique hands-on science experience to a diverse range of K-12 students.
3. Involve undergraduates in significant and meaningful service.
4. Share ideas and insights with current and future teachers.

PSYCHOLOGY STUDENT HELPS COMMUNITY
AFTER PERSONAL HEARTACHE

BY ALLIE RUCKMAN

Jim Fox, a master's student in the Addiction Counseling Program in the Department of Psychology, didn't initially know that he wanted to pursue a career in addiction counseling. It was only after seeing the effects of addiction in his own family that Fox discovered his passion for helping those with substance issues.

"My brother-in-law had a lot of (those) issues," Fox said, "and it didn't end well for him; he actually died about six years ago. There was always a part of me that wanted to do more, and I felt like with this program I could reach and try to help people who may be struggling. It was an unfortunate event that has really turned into some positive motivation for me, and what I want to do."

"There was always a part of me that wanted to do more, and I felt like with this program I could reach and try to help people who may be struggling."

This year, Fox received the Minority Fellowship from the National Board of Certified Counselors, which is designed to provide substance use treatment for people who typically don't receive it. These groups include children and adolescents, geriatric groups, people with marginalized identities, people in lower-income areas, people in the LGBTQ+ community, or those who are veterans or are from military families. Fellows must commit to providing such services for the duration of two years postgraduation

FILLING CRUCIAL ROLES IN LARIMER COUNTY

"Nationwide, we see about a 30 percent workforce shortage in addiction treatment; Larimer County tends to be running at about 36 percent to 40 percent workforce shortage," said Brad Conner, director of the Addiction Counseling Program.

When people in the county seek assistive services, they tend to come to Fort Collins to find that help, he added. "We are sort of a county seat for service provision. Colorado in general, and Fort Collins and Northern Colorado more specifically, are in desperate need of addiction counselors."

Many students are first-generation college students, have a marginalized identity, or are returning to school after a long period of time.

For this reason, it is critical that the program at CSU continue to be successful and to train passionate students like Fox.

AN IMPRESSIVE TRACK RECORD

The Addiction Counseling Program is an applied, terminal master's program, focusing on hands-on learning and meaningful work out in the community. Students take one year of classes and complete an internship in the field their second year.

A large number of students who have participated so far have been nontraditional. Many students are first-generation college students, have a marginalized identity, or are returning to school after a long period of time. Nontraditional students made up 65 percent of the 2019-2020 cohort.

The program has been offered at CSU for only three years but already has an impressive track record. Fox is the second consecutive student from the program to be selected for the Minority Fellowship.

"In a brand-new program, the fact that two students back-to-back have been awarded this fellowship says a lot about Brad Conner and the whole staff, and I think this is a testament to their hard work and what they've done with this program," Fox said. ●

MATH JAM CAMP TAKES
INCLUSIVE LEARNING ONLINE

BY ALLIE RUCKMAN

In response to the COVID-19 pandemic, the Department of Mathematics' Math Jam summer camp hosted a free, virtual camp in July for students in middle school and early high school.

The summer camp focuses on making math fun and sharing the creativity and curiosity that make up its foundation. Volunteers teach "non-curricular math" that doesn't require high levels of algebra, and there is no minimum math requirement to participate. The camp usually focuses on providing experiences to students who may not usually have the resources to enjoy or thrive in math.

Math Jam "is really about showing the joy and beauty of math to as many people as possible," said Justin O'Connor, a graduate student in the department and a co-director of the camp. "We do a lot to make sure that we are being inclusive and cognizant of people's different mathematical backgrounds."

The new virtual format of the camp, though different from the usual programming, opened new doors and welcomed participants from New Jersey to California.

"The online format forced us to do a lot of activities that we had not thought of doing before," said O'Connor. "Being pushed out of our comfort zone a little bit caused us to take some risks, and they seem to have really paid off. For example, we did a virtual escape room this year that was a huge hit."

ACCESSIBLE AND FLEXIBLE

This year's camp included both synchronous and asynchronous events to make it as accessible as possible. The virtual camp was designed so that there was flexibility in the students' schedules, and so they wouldn't be limited by materials. All the problems could be done with just a pencil and paper.

"We're really trying to find ways to build a sense of community, especially while that has been somewhat lost during this time," said Shannon Golden, a graduate student and co-director for the camp.

According to organizers, Math Jam is meant to break down barriers, not enforce them, and the graduate students involved with the camp worked to maintain this standard during the virtual sessions.

"Our goals for camp this year were the same as every year: To spread our love of mathematics to the masses," said Pat Rosse, the third co-director for the camp. ●

GOING VIRAL: NEW STEM KIT
FOCUSES ON PATHOGEN SPREAD

BY ALLIE RUCKMAN

Delaney Worthington, a Spring 2020 graduate from the Department of Biology, had been studying viruses and diseases long before any mention of COVID-19. However, the current pandemic has made the science kit she developed to educate local middle- and high school students all the more relevant.

"Going Viral: a hands-on look at vaccines, microbes, and the immune system," is a self-guided activity kit available through the College of Natural Sciences Education and Outreach Center that walks students through a basic understanding of pathogens, diseases, and immune responses in the human body.

Worthington graduated with a bachelor's degree in biology, a concentration in microbiology and immunology, and minors in chemistry and Spanish. When she was first developing the kit and planning to utilize it for her senior thesis, she wanted to be sure she researched something that would have lasting impact.

HANDS-ON LEARNING GOES VIRTUAL

"Students are on a path to self-discovery as soon as they open up the kit," said Worthington. "They're kind of walking through this on their own and teaching themselves these concepts."

- The first activity models the spread of a pathogen in an unvaccinated population. "That shows students a little bit of what we're experiencing right now, actually," she said, "how quickly a disease can spread."
- The next activity helps them understand what a pathogen actually is and its scale as related to small objects, such as a human hair.
- The third activity asks students to sort microbes into different categories, helping them distinguish among bacteria, viruses, and "other." The students get to discover that not all germs are inherently bad and to explore healthy gut bacteria as well as bread yeast.
- The fourth activity models the immune response to a pathogen, "which is really a very, very complex process," Worthington explained. "Through this hands-on activity, students get to learn something that really would be so difficult to teach them otherwise. So that's one of my favorite activities in the kit, because I think it's cool that they can basically teach themselves the immune response."
- The fifth activity promotes the concept of herd immunity and models the spread of a pathogen through a vaccinated community, showing how vaccines slow the spread of viruses.

"There is so much misunderstanding about the spread of disease and how our immune system works coming from all over the place – from leadership, from the Internet, from everywhere," Worthington said. "I think that these ideas that the kit is talking about are so, so important; maybe even more than when I first created it. I'm really excited to get this into the classroom and start helping people have a deeper understanding of what's going on."

Worthington will be continuing her education at CSU in the fall as a student in the Master's Plan B in microbiology and immunology, and she will continue her virology research in the Ebel Laboratory. She also plans to spend the coming year working to translate the Going Viral kit into Spanish to help make the information accessible to more students. ●

VIRTUAL STEM FAIR CONNECTS STUDENTS
DURING STAY-AT-HOME ORDERS

BY ALLIE RUCKMAN

For middle- and high school students who are drawn to science in the way that others are drawn to sports, the science fair is their arena. The Colorado Science and Engineering Fair is their qualifying event, and the International Science and Engineering Fair are their finals.

The 2020 international competition, typically held in the spring, was canceled in response to the COVID-19 pandemic. Because of this, it became even more essential to the CSEF team in the College of Natural Sciences Education and Outreach Center that a virtual fair still take place; this year on April 2.

When the CSEF team announced that the event would go on, they were inundated with grateful messages from parents, students, and teachers.

"These students have already had so much canceled on them. If there was a way to do this, I wanted to make it happen," said Courtney Butler, executive director for CSEF and assistant director in the education and outreach center.

When the CSEF team announced that the event would go on, they were inundated with grateful messages from parents, students, and teachers.

"I just wanted to say THANK YOU for not canceling this event," wrote Karen Kralios. Her son, Cosmo Mitchell, a senior at Monarch High School, was planning to present in the Medicine and Health category. "At least the kids have something to look forward to during these crazy times. Your dedication to making this happen is very much appreciated!"

Of course, this transfer to an online format had to happen on a tight timeline. The CSEF team had just three weeks to get all the systems up and running.

VIRTUAL EVENT SUCCESSFUL

Thanks to hours of work, the virtual Colorado Science and Engineering Fair was a smashing success.

"The judging went very well and was successfully executed," said Kristen Rasmussen, an assistant professor in CSU's Department of Atmospheric Science and a grand awards judge for the fair. "Overall, everything worked well, and we were able to provide a similar judging experience for the participants compared to regular years."

This transfer to an online format had to happen on a tight timeline. The CSEF team had just three weeks to get all the systems up and running.

Mitchell, whose team successfully used gold nanoparticles to denature the protein thought to be associated with Alzheimer's disease, placed first in the Medicine and Health category. Mitchell and team members Cooper Hanley and Liam Barnes had been testing his hypothesis since the start of the 2019-2020 school year and had already qualified for the international science fair. With their sights set on taking this research to a clinical trial, it was exciting to be able to present to a panel of judges, even remotely.

"The fact that we did our research still reigns, regardless of whether or not we went to the fair," said Mitchell, "but it's a great place to get recognized for what you've done. It was a little bit tougher answering questions when you can't see the person, but overall, it went pretty well. I think they did a pretty good job of doing what they could in a virtual setting."

After the event, Butler felt relieved and glad to have pulled it off. "It went really well. Considering how many interviews we had going at once, it really wasn't all that bad!"

At the end of the day, Butler was grateful for the students, teachers, and judges who all rose to the occasion to make the event happen. ●

REMOVING THE LANGUAGE BARRIER

BY LISA STREEB CASE

During a STEM Friday session at the College of Natural Sciences Education and Outreach Center, Director Andrew Warnock noticed something was wrong.

While most of the students in grades 4-12 were hard at work, engaged with their self-paced, age-appropriate science kits, two were quiet and looked confused. He discovered that they were struggling because the booklet in the kit they were using was written in English. When Warnock brought them each a Spanish-language booklet, their faces lit up and they were excited to dive into the hands-on college-level science activity.

This is just one of the many times that Warnock has experienced the power of providing science education materials in multiple languages. Removing that barrier for students whose first language is not English allows them to focus on the most important part of the kit: learning science.

"One of our main missions is to increase the diversity of students who are coming into the STEM fields and choosing STEM majors at CSU, particularly in the College of Natural Sciences," said Warnock. "It is important that all people have access to science because we need everyone's perspectives on global problems. The problems we face today are so significant that we don't want to miss opportunities for everyone to participate in helping to solve those problems."

TRANSLATING SCIENCE KITS

The Natural Sciences Education and Outreach Center has recently been able to achieve its long-standing goal to translate science kits into Spanish.

"We work with faculty and students to design the kits. And typically, we have found that students who can speak Spanish have a passion to translate the kit into Spanish," said Warnock.

Through collaboration with faculty and students, the center has been able to create 18 different kits, four of which have been translated into Spanish.

In the future, Warnock would like to see translations expand beyond Spanish.

"There is a growing need for other languages as well," said Warnock. "We have seen this need at our STEM Friday programs. I have had school principals say that they have a need for Arabic and Somali translation."

CONNECTING SCIENCE TO CULTURE

Beyond language translation, the center uses many tools to increase access to their science kits.

"It is not just translating the words that helps increase access to the kits, it's the images that go along with it," said Warnock. "All of our kits have custom-illustrated pictures in the booklets, and we're very conscious of skin color and skin tone in drawings of hands or fingers."

Kit developers also ensure that each kit has an authentic connection to either real-world events or a specific culture. An example of this is the Vital Ice kit that was created with the National Park Service in Alaska.

"We start the Vital Ice kit with a Native Alaskan story and artwork," said Warnock. "We then weave together this story that has been passed down for generations in Alaska with the science that is being taught in the kit."

These cultural hooks are another way that the center ensures that their kits are accessible to students with many different identities. Access is a critical part of the center's mission: to increase scientific literacy by making science more accessible and encourage students with diverse identities to see themselves in science. ●

AMPLIFY: NEW NAME REFLECTS
LEARNING COMMUNITY'S MISSION

BY ALLIE RUCKMAN

The College of Natural Sciences Learning Community is undergoing transformative change this year, starting with a new name: Amplify.

The new name reflects the mission of this residential and academic community designed specifically for College of Natural Sciences students: to create a space where students can uncover more about themselves and discover how their unique perspectives are powerful and important for moving science and society forward.

Amplify seeks to provide a space for transformation, where students who are traditionally marginalized in STEM can discover how their perspective and history can be used to advance science and lead to the betterment of society.

"Our new name and revamped mission statement redefine what we are trying to amplify," said Alexandra Keller, director of the program. "We want to be really mindful of what voices are usually the loudest in science and how we can celebrate and find brilliance in the places that we don't usually look."

NEW NAME, NEW LOOK

The new mission is symbolized in its new logo. Visually, it represents the small amphitheater outside of Laurel Village on CSU's campus, one that the community often uses for events and shared space. More metaphorically, the logo represents the idea of amplifying individual and communal growth as a means to amplify science.

"The learning community was definitely a big help for me," said Garrett Poitra, a psychology major and Amplify leadership fellow. Poitra was homeless for a year and a half leading up to college. "I didn't have any family support, so being able to go to them for advice, being able to have study groups, and having a community that was on a similar path to me was helpful, for sure. The seminar helped me figure out who I want to be and who I am in this particular moment, and it was helpful to have other minority students around me. In the learning community, there is a very deliberate effort to acknowledge barriers and to not work around them, but to address them head on."

Jonathan Ibarra, a sophomore double majoring in psychology and computer science and an Amplify leadership fellow, was also grateful for the diverse community.

"I went to a really small high school with a largely Hispanic population, so I felt really out of place at CSU," he said. "There were so many people, and so many people who didn't look like me. Having that community of people who were also diverse was something I could really appreciate."

Amplify, equipped with new branding and a refocused mission statement, will continue the important work of building an inclusive community and amplifying all voices to create more representation in science. ●

COMPUTER SCIENCE MAKES
CODING MORE ACCESSIBLE

BY ALLIE RUCKMAN

As technology becomes more and more central to our way of life, it has become essential that all students, no matter their major, be equipped with basic coding and computing skills before they enter the workforce. Computer science, however, is often seen as a daunting field for STEM and non-STEM students alike.

The new All-University Core Curriculum class, Computer Science 150: Culture and Coding, is meant to address this issue.

The class combines history, basic coding, and the human element behind data to make computer science more accessible and interesting to a broad audience. CS 150 focuses on the intersection of technology with the arts and humanities, often with a social justice lens. The only prerequisite for the class is algebra.

"Computer science is using technology to solve real-world problems, and students are asked to struggle with the ethical question: 'How do we design technology for a diverse world if we don't have diverse representation on our development teams?'" said Albert Lionelle, a curriculum specialist and instructor in the Department of Computer Science.

"Unlike most beginning science courses, learning to code is much closer to learning to play an instrument," said Lionelle. "You can't just memorize a solution. Instead, you learn the basic building blocks, and use your creativity to assemble them into a song – a concert between the student and the machine. It takes practice and repetition."

The class is part of the All-University Core Curriculum, which promotes competencies essential to student success, because these skills can be applied in many different areas.

"Students who take CS 150 open doors for themselves," said Elisa Cundiff, an academic success coordinator for computer science. "Students emerge from CS 150 as creators, designers, and problem-solvers. You will be ready to ask questions and explore problems that you encounter in any field of study, in a future job, and even in everyday life. Now that CS 150 counts as an All-University Core Curriculum course, every student should take it." ●

EXPANDING ACCESS FOR
STEM TRANSFER STUDENTS

BY ANNE MANNING

Colorado State University and Front Range Community College secured a grant last year from the National Science Foundation for a new program to help students successfully transfer from Front Range to CSU to earn bachelor's degrees.

The $4.28 million grant funds the Wolves to Rams Scholars program. W2R supports transfer students, helping them graduate and go on to careers in science, technology, engineering, and math fields. The program's broader goal is to increase participation of low-income, first-generation, and underrepresented students in STEM.

"Community college transfer students are a vibrant and diverse part of our community at CSU, and this NSF grant will continue to support that population and set them up for success," said Paul Laybourn, professor in the Department of Biochemistry and Molecular Biology and CSU's principal investigator on this new NSF grant. "We welcome and look forward to a continued partnership with Front Range Community College, in which we work to integrate our efforts on behalf of our students."

Through W2R, this past year, Front Range Community College funded 48 scholars of diverse backgrounds, and 21 of them are attending CSU this fall. CSU funded 38 scholars in 30 different STEM majors. The program also welcomed a new Rams Scholar success coach, Orlando Cruz.

The W2R Scholars program has combined with the previous work of a National Institutes of Health-funded partnership between Front Range and CSU called Bridges to Baccalaureate and expands opportunities for Front Range transfer students pursuing STEM degrees. The W2R program includes a "Becoming a Scientist" course that helps students develop a science identity, leadership skills, and career purpose.

W2R will strengthen collaborations with the CSU Access Center and Alliance Partnership for greater outreach to underserved high school students throughout Colorado, Laybourn added.

Sixty percent of the $4.28 million W2R funding over the next several years will provide scholarships to Front Range students upon their transfer to CSU. Students will be awarded up to $10,000 toward their two years at Front Range and then have the opportunity to continue funding upon their transfer to CSU at up to $10,000 per year for two more years, for a total of $30,000 toward their degree. The grant aims to support at least 150 students who are pursuing associate and bachelor's degrees in mathematics, life sciences, physical sciences, engineering, computer sciences, and science education.

The W2R project will build a community of scholarship by providing students mentoring, academic coaching, and opportunities to learn outside of the classroom. This project will implement national best practices that are proven to improve student retention, support transfer students, and help them complete their four-year degrees. •

INCREASING THE REPRESENTATION
OF WOMEN IN COMPUTING

BY LISA STREEB CASE

The Department of Computer Science is making major investments to increase the representation of women in computing through a gift from the Center for Inclusive Computing at Northeastern University. The gift, totaling nearly $600,000, is shared between computer science and the Department of Computer Information Systems in the College of Business.

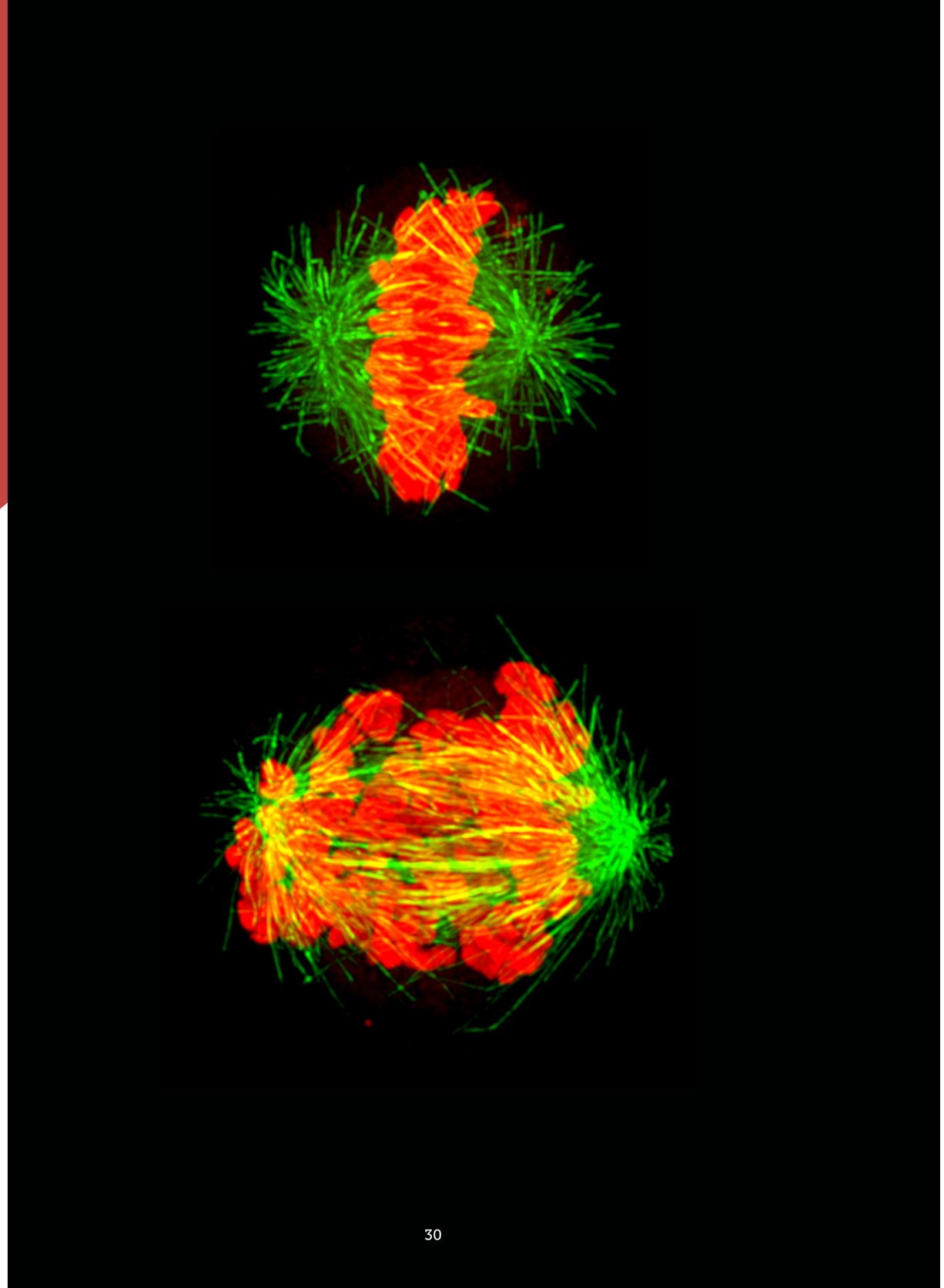
"The gift from the Center for Inclusive Computing will allow us to invest hundreds of thousands of dollars in our diversity initiatives," said Craig Partridge, chair of the Department of Computer Science. "This is a crucial next step for our department after being named a BRAID (Building, Recruiting, And Inclusion for Diversity) Affiliate School in 2019. This gift gives us a roadmap to follow to increase inclusion in our programs and will help us to quicken the pace of moving along that roadmap by adding advising staff and revising courses to be more student-centered."

In recent years, there has been a concerted effort to recruit and retain female students in the computer science field – a field that historically has been male-dominated. With this investment, the Department of Computer Science will be able to hire a new student adviser and revise first- and second-year courses to incorporate best practices in student-centered education.

These efforts build on initiatives that are already in the works in computer science, including more community building through a partnership with the College of Natural Sciences Learning Community and creating courses that are relevant for non-computer science majors. Combined, this important work aims to remove barriers for students to access the computer science field.

"Sixty percent of our graduates stay and work in Colorado. The students who we educate become Colorado's tech workforce," said Partridge. "Everyone should have access to high-tech jobs, and therefore, we must ensure that our programs are accessible and available to everyone."

This work is not done; instead, Partridge sees this gift as an important step in a long process to increase the inclusion of women, and everyone, in computer science. •



A CHANCE MEETING LEADS TO POTENTIAL CANCER TREATMENT

BY LISA STREEB CASE

When Jennifer DeLuca set up her poster at the Pew Biomedical Scholars Annual Meeting in 2009, she didn't see others about mitosis – cell division that results in two identical daughter cells.

That was until Patrick Paddison, a medical researcher from the Fred Hutchinson Cancer Research Center in Seattle, set up his poster next to hers. It turned out Paddison had been studying tumors from patients with glioblastoma, an aggressive brain and spinal cord cancer, looking for proteins in cells that affected the cancer cells' ability to replicate.

"He looked at my poster and said, 'Oh, you work on kinetochores. I did this large-scale screen of thousands of proteins, and my top five hits were all kinetochore proteins,'" DeLuca recalled. "I said, 'Well, we know a lot about kinetochores – that is our thing.' So, from that moment we started a collaboration."

That serendipitous meeting became a decade-long collaboration, which has led to the discovery of two proteins that are promising for a new therapeutic approach to cancer treatment.

INQUIRY LEADS TO DISCOVERY

DeLuca, a professor in the Department of Biochemistry and Molecular Biology and the College of Natural Sciences' 2019 Professor Laureate, has been fascinated by cell biology since she was an undergraduate.

"I actually tried many different majors as an undergraduate student – archaeology, Greek classics – I was all over the place," said DeLuca. "Then, I took this biology class, and the professor got up there and did a kind of dance of the chromosomes, and I thought it was so cool and so interesting. I went and I asked him if I could learn more about it, and I joined his lab as an undergrad, and I have not turned back."

DeLuca has spent her career understanding the complexities of human cells.

"Our basic science mission is to understand how mitosis works: how those chromosomes become attached to the fibers of the mitotic cell, how forces are generated, how they line up, and how they are pulled apart," she said.

While DeLuca did not always know the applied future for her research, she knew that having a deep understanding of how our physiology works could lead to a medical breakthrough.

"Many scientific discoveries and medically related discoveries stem from basic science, because you don't know what you will find," she said. "You know the process is important, and by deeply diving into it and studying it, you can exploit it once the opportunity arises. The fact that so many labs are doing foundational research on cells and tissues, all related to our physiology, means there will undoubtedly be a medical connection to almost everyone's research that can be exploited."

That opportunity arrived for DeLuca in 2009 when she began collaborating with Paddison.

FOUNDATIONAL SCIENCE MEETS APPLIED SCIENCE

Paddison had found several proteins in the kinetochore that could have effects on glioblastoma cells. When he combined his findings with DeLuca's deep research of the kinetochore's function in mitosis, they were able to paint a larger picture of how that function could be exploited to kill cancer cells.

"He found one promising protein and, because we have researched that whole pathway, we can hit any protein in that pathway because we have been working on it from the foundational science perspective," said DeLuca. "So, even though there may be just one therapeutic target that pops up, we have 10 other targets that we can look at because they are in that same pathway. With foundational science behind this research, we have a big toolbox that we can work from."

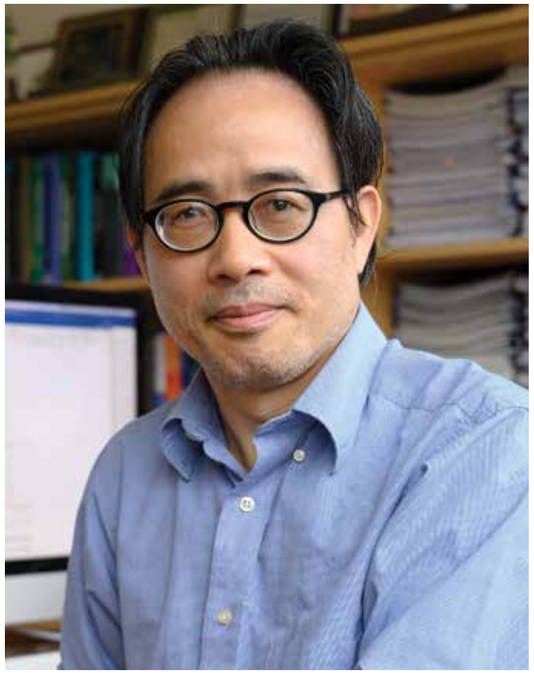
IDENTIFYING NEW THERAPEUTIC TREATMENT FOR GLIOBLASTOMA

DeLuca and Paddison have thus far identified two proteins that seem essential to the replication and survival of glioblastoma cells.

"When we target those proteins in the cancer cell it kills it; however, it does not affect healthy cells," DeLuca said. "This is an example of where total foundational science, just trying to understand the process, and someone coming at the problem from the purely therapeutic angle, can collaborate and hopefully make some progress." ●

EUGENE CHEN NAMED A UNIVERSITY DISTINGUISHED PROFESSOR

BY ANNE MANNING



In recognition of his creative excellence and seminal contributions to advances in green and sustainable chemistry and polymer science, Eugene Chen, professor in the Department of Chemistry, was named a Colorado State University Distinguished Professor this year, the University's highest academic honor.

Chen is the John K. Stille Endowed Chair in Chemistry and is well known for his scholarly work in pioneering chemically recyclable polymers with intrinsic, infinite recyclability. In recent years, Chen has received many accolades for his research, including the 2019 American Chemical Society Arthur C. Cope Mid-Career Scholars Award and the 2015 Environmental Protection Agency Presidential Green Chemistry Challenge Award. Chen is also a fellow of the American Association for the Advancement of Science and a winner of the Alfred P. Sloan Research Fellowship.

Chen has published more than 180 peer-reviewed publications, holds 24 U.S. patents, and has delivered more than 200 invited lectures since 2000. His diverse research areas since joining CSU's faculty in 2000 have attracted many millions of dollars in external funding, and his research has been highlighted in multiple news agencies all over the world.

His diverse research areas since joining CSU's faculty in 2000 have attracted many millions of dollars in external funding, and his research has been highlighted in multiple news agencies all over the world.

"It is perhaps obvious that Eugene Chen is a deep, broad, creative, highly energetic, hardworking, and hugely talented scientist – one archetypal of CSU UDP distinction," stated Professor Richard G. Finke in his nomination letter for Chen.

Chen's efforts and success in teaching and mentoring are also notable. He has mentored a total of 24 graduate students, 17 postdoctoral fellows, six visiting professors or scholars, and 16 undergraduate students.

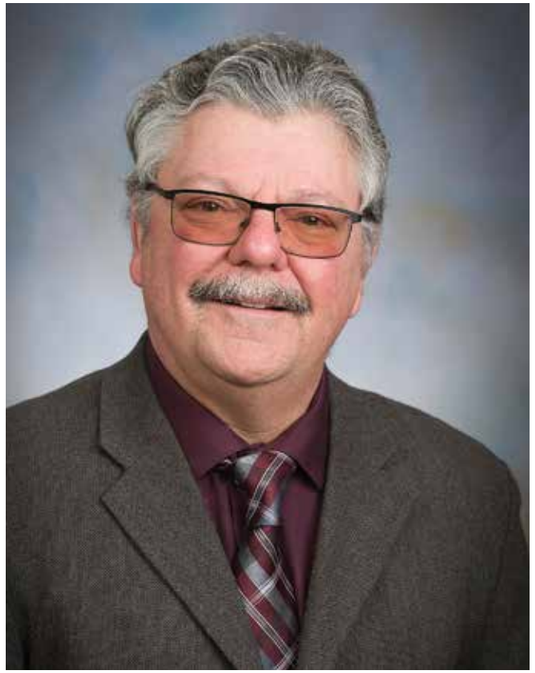
"Professor Chen is a world-renowned polymer chemist and one of the most productive scientists in a very competitive chemistry department."

– Matthew Shores, chemistry department professor and chair

"Professor Chen is a world-renowned polymer chemist and one of the most productive scientists in a very competitive chemistry department," wrote Matthew Shores, chemistry department professor and chair. "He holds his students to the highest standards, and his mentoring has been instrumental in producing young leaders in academics and industry." ●

N. LEROY POFF NAMED A UNIVERSITY DISTINGUISHED PROFESSOR

BY ANNE MANNING



In recognition of his international standing in science, teaching, and outreach, N. LeRoy Poff, professor in the Department of Biology, was named a Colorado State University Distinguished Professor this year, the University's highest academic honor.

Poff has made many contributions in the basic science of aquatic ecosystems and in developing sustainable management practices of aquatic resources in the United States and abroad.

Poff is a river ecologist who actively influences and formulates policy related to freshwater management. Poff has made many contributions in the basic science of aquatic ecosystems and in developing sustainable management practices of aquatic resources in the United States and abroad.

Poff was nominated for the University Distinguished Professor honor by four of his CSU colleagues: Michael Antolin, Kurt Fausch, Barry Noon, and Reagan Waskom. In their nomination, they call Poff "one of the best-known freshwater ecologists in the world," and a "recognized global leader in translating ecological science into water management policy."

His primary contributions have been in melding ecology and hydrology to understand how temporal variation in flow regimes in rivers and streams preserve ecological integrity, biodiversity, and sustainability of aquatic life. "His work has been both conceptual and empirical, and ultimately, transformative," his colleagues wrote.

His primary contributions have been in melding ecology and hydrology to understand how temporal variation in flow regimes in rivers and streams preserve ecological integrity, biodiversity, and sustainability of aquatic life.

Poff's 150-plus publications appear in top journals including *Science, Nature, Proceedings of the National Academy of Sciences, Nature Climate Change*, and *Proceedings of the Royal Society of London*, with more than 26,500 citations. He was elected a Fellow of the Society for Freshwater Science in 2019, a Fellow of the Ecological Society of America in 2016, and a Fellow of the American Association for the Advancement of Science in 2012. In 2019, he received the lifetime Award of Excellence from the Society for Freshwater Science.

Poff was director of CSU's Graduate Degree Program in Ecology from 2008 to 2016, during which time budget and enrollment for the program nearly doubled.

At CSU, he has been recognized as a Monfort Professor (2005-2007), a College of Natural Sciences Professor Laureate (2010-2011), and a CSU Resident Distinguished Ecologist (2016), and he received CSU's Scholarship Impact Award in 2016. ●

SCIENTISTS REVEAL A WHOLE NEW WORLD OF CHEMISTRY BY STEPPING INDOORS

BY ANNE MANNING

More than two years ago, Delphine Farmer, associate professor in the Department of Chemistry, and more than 60 collaborators from 13 universities set in motion a first-of-its-kind experiment attempting to map the airborne chemistry of a typical home, subjected to typical home activities such as cooking and cleaning. The effort was dubbed HOMEChem – House Observations of Microbial and Environmental Chemistry – and was led by Farmer and Marina Vance, a mechanical engineer at the University of Colorado Boulder.

Earlier this year, Farmer and her CSU research team published in *Environmental Science and Technology* on what they learned about chemical reactions from mopping floors with a common bleach solution. Another study, in *Science Advances,* focused on indoor particulate matter exposures during cooking and cleaning activities.

On HOMEChem, her first foray into indoor chemistry, Farmer "became a convert when I heard the statistic that we spend 90 percent of our lives indoors."

"It's puzzling, really, that all our health outcomes are tied to outdoor air," Farmer said. "It made me curious as a scientist when I realized just how little we know about chemistry indoors."

Backed by $1.1 million from the Sloan Foundation's Chemistry of Indoor Environments program, the HOMEChem team descended on the Test House at the University of Texas at Austin, a full-size, manufactured "home" that serves as a kind of blank slate for scientific experiments. The team occupied the house for most of June 2018, simulating cooking and cleaning activities in an average Western home while operating sensitive equipment for detecting particles and volatile organic compounds.

For the bleach-cleaning study, Farmer's team recorded the airborne and aqueous chemistry from several consecutive days of mopping a floor with bleach. On some days, they also observed how that chemistry was affected when floors were mopped following a cooking session.

The researchers observed sharp, albeit short-lived, spikes in hypochlorous acid, chlorine, and nitryl chloride in the air, which are compounds more typically associated, at lower levels, with the outdoor air of coastal cities. The team learned that multiphase chemistry – not just the gas phase – controls the production and removal of inorganic compounds in the air during bleach cleaning. When they mopped after cooking, they also observed interactions of nitrogen and ammonia emissions from the food with the cleaning products.

The HOMEChem study was an attempt at establishing a baseline understanding of what a person at home, doing typical home activities, can expect to be breathing. Among the key takeaways was that combining different indoor activities leads to very different chemistry in the house.

Farmer and the team's work will continue: They were recently awarded another $1 million from the Sloan Foundation for a follow-up study they are calling CASA: Chemical Assessment of Surfaces and Air. At a test house in Maryland run by the National Institute of Standards and Technology, they will focus on surface chemistry and how outdoor air pollution impacts indoor air quality. They will also think more about disinfection chemistry and COVID-19-relevant questions. ●

FROM FLOCKS OF BIRDS TO SCHOOLS OF FISH, DATA CAN TAKE MANY SHAPES

BY ANNE MANNING

When Henry Adams thinks about a vast store of data, like a million points in three-dimensional space, or the medical records of 1,000 patients, the Colorado State University mathematics assistant professor thinks about how that data can be represented as a geometric shape.

Considering data as shapes can help mathematicians find new patterns in that data. Though a dataset may be too high-dimensional for the human mind to perceive on its own, the shape of a dataset can be illuminated with the aid of advanced computing.

Adams is at the forefront of an emerging field called topological data analysis, the merger of a pure mathematical field – topology – with an applied one – data science. For much of the 20th century, topology, or the study of shape and space, lived only in the realm of pure mathematics. But in the last two decades, topology has become increasingly quantitative, computable, and statistical, according to Adams. Now a field of its own, topological data analysis describes shapes of data in multiple dimensions and resolutions, with new applications in fields such as biology, materials science, and economics.

An easy way to think about how data has shape, Adams says, is to consider biological systems such as flocks of birds or schools of fish that exhibit collective behaviors. A video of starlings flying in a distinctive pattern, for example, "is an extremely complex dataset, with so many birds and so many time steps," Adams said. "So, even just to get your mind around this dataset and start analyzing it is quite complicated."

That's where Adams' work comes in: He, along with colleagues, have devised methods for taking vast datasets like flying birds and condensing them in ways that are easier to work with.

LENS FOR VIEWING DATA

Earlier this year, Adams and mathematics colleagues, including CSU Ph.D. graduate Lori Ziegelmeier, published a *SIAM News* piece summarizing how computational topology provides a lens through which mathematical modelers can tackle large datasets and glean insights from the shapes and patterns found therein. The researchers, along with recent CSU Ph.D. Rachel Neville, had organized a conference on the same subject the previous year, bringing together pure and applied mathematicians to advance the field of topological data science. ●

MEET OUR DEVELOPMENT TEAM

Ginny Fanning, Executive Director of Development
Virginia.Fanning@colostate.edu

Keith Stout, Director of Development
Keith.Stout@colostate.edu

Ginger Morehouse, Associate Director of Development
Ginger.Morehouse@colostate.edu

Tyler Bowers, Development Operations Coordinator
Tyler.Bowers@colostate.edu

A STATEMENT OF COMMITMENT FROM THE COLLEGE OF NATURAL SCIENCES EXECUTIVE COMMITTEE

As the leadership team of the College of Natural Sciences, we know that science is shaped by the people who study it and therefore, we are committed to building an equitable community and inclusive culture that encourages, supports, and celebrates diversity. We pledge to uphold the University's five Principles of Community: **inclusion, integrity, respect, service,** and **social justice**. We are committed to identifying and removing barriers to provide equitable access to research, learning, and engagement. We will consciously promote acceptance and demonstrate respect, actively listen and learn, center equity in the development of new programs and initiatives, and celebrate differences among all the people in our community.

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Dean

Melissa Reynolds,
Research Associate Dean

Simon Tavener,
Executive Associate Dean
for Academics

Lisa Dysleski,
Associate Dean
for Undergraduate Programs

Laurie Stargell,
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Chair, Department of
Computer Science

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Jacob Roberts,
Chair, Department of Physics

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Chair, Department of Psychology

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Chair, Department of Statistics

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