Cultivate Spring/Summer 2019

Utah State University
Before astronauts reached and then walked on the moon, scientists and engineers in the United States had been hard at work for decades making discoveries and creating new technologies. That effort was inspired, in part, by words President John F. Kennedy had spoken less than 7 years before Apollo 11 landed on the moon.

“We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone…”

I’m proud to work with the faculty, staff, and students in the College of Agriculture and Applied Sciences, with colleagues around the world, and to associate with alumni who work to accomplish hard things every day. Our goals are not all focused on exploring far-away parts of our solar system—though some are, as you’ll see on page 11. Daily in CAAS, people explore the inner workings of cells, the complexities of soils and climate, the realities of feeding a growing population on shrinking agricultural land, and challenge emerging pest and disease threats to our health and food supply. We do hard things because these issues create challenges we are willing to accept and unwilling to postpone. ▲

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Dean, College of Agriculture and Applied Sciences; Vice President, Extension and Agriculture
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ON THE COVER: Professors Bruce Bugbee and Lance Seefeldt (front, l to r) lead USU’s participation in a NASA-funded project focused on missions to Mars. The team currently includes (back, l to r): Matthew Hardy, student research associate from Duke University; Paul Kusuma, graduate student researcher, and Shuyang Zhen, post-doctoral researcher in Bugbee’s lab. Photo by McKay Jensen.
Utah State University Extension’s “Ride Utah!” program is proving to be a success in the 4 years since its creation. Military veterans and their families benefit from the therapeutic effects of being in the saddle. The program was created to help veterans and active military personnel who live with PTSD and other adversities.
Utah State University hosted one of three Intercollegiate Horse Show Association (IHSA) Western National Semi-Final shows in March at the university’s Sam Skaggs Family Equine Education Center.

USU’s Western Equestrian Team has been a top competitor in the region for more than a decade. Until now, there hasn’t been a team in the region with the facilities or access to enough show-quality horses to host this caliber of event. In recent years, the USU equine science program has developed immensely, making hosting a possibility. According to Kelsey Romney, USU Extension professional practice associate professor, “The stars aligned for this opportunity and it is a huge honor and responsibility to host IHSA Western National Semi Finals.”

The show was a national IHSA qualifier and USU organizers worked closely with IHSA administrators to ensure that the event followed all standard protocols. Two American Quarter Horse Association judges and four show stewards came from various states to ensure proper judging and scoring. IHSA Founder and Executive Director Bob Cacchione also attended the show.

Hosting required the timely completion of the center’s new 50-stall barn and arranging to bring in more than 40 horses to fill 22 classes. And because riders do not bring their own horses to the competition, organizers used a system to randomly match horses to riders. Additionally, there were the logistics of helping arrange lodging, parking and seating for more than 300 event attendees.

In total, 111 riders from 31 colleges and universities participated in the show and feedback from participants and spectators was overwhelmingly positive about their experience at USU. The show was livestreamed and drew over 6,500 views, allowing family and friends to support riders from across the country. The livestream included commercials highlighting USU and the equine science program, putting USU...
2019 CAAS NEW FACULTY

Animal, Dairy and Veterinary Sciences
Fernanda Batistel, Assistant Professor

Applied Economics
Tanner McCarty, Assistant Professor

Plants, Soils and Climate
Lance Stott, Lecturer
Amita Kaundal, Assistant Professor

Landscape Architecture and Environmental Planning
Brent Chamberlain, Assistant Professor
Keunhyun Park, Assistant Professor

School of Applied Sciences, Technology and Education
Scott Greenhalgh, Professional Practice Assistant Professor
Kent King, Professional Practice Instructor
Andrea Olsen, Professional Practice Assistant Professor

2019 CAAS RETIRED FACULTY

Lyle McNeal
Professor, ADVS

Phillip Waite
Associate Professor, LAEP

Tamara Steinitz
Professional Practice Professor, NDFS

Betty Murri
Lecturer, ASTE

Congratulations to faculty members who are retiring from CAAS this year and to those who have joined the college’s faculty in the past year.

Among volunteers for the event were members of the USU Western Equestrian Team who devoted much of their spring break to preparing for and running the show. The entire team was there to prepare horses, clean stalls and sweep throughout the show. Four team members also qualified to ride in the show, including team co-captain Camille Bthers.

Bethers, who has been riding horses since she was 6, joined the USU Western Equestrian Team as a freshman. She shows in horsemanship, which involves maintaining proper riding positions and techniques while guiding the horse through a series of maneuvers. Bthers and her teammates Caitlyn Davis and Aurora Quinn, qualified to compete at the IHSA National Championships in Syracuse, New York, in May, where Bthers placed 8th in Advanced Western Horsemanship and Davis placed 3rd in Open Reining.

IHSA offers a unique opportunity to all undergraduate students who are interested in showing horses because riders don’t need to own a horse to train and compete, making a cost-intensive sport more accessible, Romney said.

Bthers said being part of USU’s Western Equestrian Team has helped her to become a better rider under the direction of coach Jason Romney, who was a top competitor nationally when he was a student and was named the College of Agriculture and Applied Sciences’ 2017 Teacher of the Year.

To learn more about USU’s Equine Science program and events, see advs.usu.edu/equine.
USU student’s developed an award-winning proposal for revamping segments of campus landscapes and streets to provide better stormwater management and enrich the campus environment.

The U.S. Environmental Protection Agency (EPA) announced that a group of students from Utah State University have won third place in the annual Campus RainWorks Challenge. The group competed against 39 other teams from across the nation.

The Campus RainWorks Challenge is a green infrastructure design competition that engages the next generation of environmental professionals. It challenges students at American universities and colleges to propose an innovative green infrastructure project for their campus that manages stormwater pollution and provides additional benefits to the community and school.

USU’s entry was created by an interdisciplinary group of students from the departments of Landscape Architecture and Environmental Planning (LAEP), and Civil and Environmental Engineering; Dallen Webster, Briana Kistler, Avery Holyoak, Dani Delahoz, Sarah Tooley, Josh Quigley, Nicholas LeSchofs, Kali Clarke and Chris Brown. Their faculty advisor, Jake Powell, is an LAEP assistant professor and they worked closely with professors Ryan Dupont, Department of Civil and Environmental Engineering, and Nancy Mesner, Department of Watershed Sciences.

The project, “A New Heart,” proposed a concept plan to make Aggie Boulevard the new heart of campus by converting the road into a permeable plaza featuring stormwater treatment areas running the length of the project. The project focused on reducing stormwater flows and addressing the division 700 North creates on campus. The project balanced pedestrian and bicycle transportation routes, open space needs, and existing transportation routes. Their design aims to recharge groundwater with treated runoff, reduce areas of impermeable surfaces, meet requirements of local municipalities, and eliminate the need for supplemental irrigation in a climate where water is in short supply, by emphasizing native landscaping and ultimately creating a new campus gathering place with green infrastructure at its heart.

“I think this recognition only highlights the top tier, nationally competitive talent and skills of our students at Utah State University,” Powell said. “This student team showcases the best of what an interdisciplinary group can accomplish when they bring big ideas, hard work, and a tremendous skill set to bear on a complex project. This team’s competition entry was completed entirely by a team of volunteer students, faculty and staff – in their free time, after hours and during weekends. I can’t say enough about the students, our university partners and other faculty members who assisted this team. Everyone really went the extra mile to make the project stand out.”

To view the team’s video presentation online, visit tinyurl.com/RainWorksUSU
Department of Landscape Architecture and Environmental Planning (LAEP) faculty members Sean Michael and Caroline Lavoie were honored this spring by the international Council of Educators in Landscape Architecture (CELA) during the organization’s annual meeting.

Professor Michael is among the five educators inducted this year into the CELA Academy of Fellows. Michael received CELA’s Outstanding Administrator Award in 2015 and served terms as the organization’s president-elect and president.

Regarding Michael’s work as department head, former LAEP faculty member Bo Yang wrote, “He led the expansion of the department’s full-time faculty from eight to 14 members, improved its financial situation, which led to new lab and video conferencing facilities, established two new endowed lectureships, helped quadruple appearances by guest speakers, and raised faculty morale.”

Michael oversaw establishment of the university’s first Ph.D. program in landscape architecture, new initiatives for fundraising and alumni relations, and a professional landscape architect-in-residence program.

He has studied and written extensively on landscape design’s impact on crime, and his research findings have informed safety strategies in urban parks and other land uses. His work has assisted trail development in Washington, Montana, Idaho and Colorado, and he serves as a park and open space consultant to numerous municipalities, states and federal agencies.

Associate Professor Lavoie was honored with the 2019 CELA Faculty Award of Excellence in Design Studio Teaching at the Senior Level.

The award recognizes a nominee’s ability to direct design studio projects that demonstrate outstanding quality and/or emphasize the critical thinking and creative process. Lavoie’s students have been honored in recent years by the American Planning Association’s Utah Chapter and the American Society of Landscape Architects for projects that partnered them with municipalities and land preservation organizations. In 2018, Lavoie’s students were honored for work with the City of Pocatello, Idaho, to re-envision and design the city’s public spaces while considering environmental impacts, economic growth, transportation, politics, and funding. Learn more about the project at laep.usu.edu/news/Pocatello.
Scientists at Utah State University are studying various growing practices to optimize the yield and quality of hemp for botanical medicines.

Professor Bruce Bugbee, who specializes in the use of controlled environments like growth chambers and greenhouses, leads the research project. Bugbee obtained permits to grow hemp from the Utah Department of Agriculture and Food and began the studies under LED lights in controlled chambers in February. Rooted hemp cuttings of federally approved low-tetrahydrocannabinol (THC less than 0.3%) cultivars of *Cannabis sativa* were provided by growers in Colorado and Kentucky. Pineae Greenhouses in Ogden, Utah, provided growing media and additional support for the research.

“The 2018 Farm Bill legalized the cultivation of hemp, and it makes sense for USU to be involved in this research, just as we have done with crops for more than 130 years,” said Ken White, Dean of USU’s College of Agriculture and Applied Sciences. “It is a potentially important crop for Utah growers, and our mission as a land-grant university is to do research that helps people in agriculture.”

Bugbee said there are multiple goals for the research, but the primary focus is on the genetics and environmental conditions that produce cannabis flowers with high cannabidiol (CBD) and very low THC content. The Farm Bill defines hemp as cannabis that has less than 0.3 percent THC, the psychoactive compound that makes people intoxicated. It is not possible to become intoxicated from the hemp/cannabis cultivars being used in this research, Bugbee added.

Changes in state and federal laws that have legalized the cultivation of hemp/cannabis for CBD oil production provide opportunities for Utah farmers and growers. But because growing hemp/cannabis has been illegal in the U.S. for several decades, it has been difficult for plant scientists to conduct research.

Flowers, leaves, and stems are being harvested at regular intervals, and Professor Bill Doucette, an environmental chemist in USU’s Department of Civil and Environmental Engineering, is extracting and analyzing the tissues to characterize the cannabinoids. “A central goal is to determine the effect of plant growth stage and environmental conditions on CBD and THC concentrations,” Doucette said.

The professors and their student research assistants will optimize the growth of the plants, extract and characterize the cannabinoids, and make CBD oil. They are also exploring collaboration with the University of Utah’s College of Pharmacy. Professor Karen Wilcox, chair of the U’s Department of Pharmacology and Toxicology, already studies cannabinoids and labs there are accustomed to protocols for working with compounds from cannabis, including in treatments for seizure disorders such as epilepsy. △
Laura Moley, who graduated this spring with a Ph.D. in animal molecular genetics, was awarded third place for her research and presentation at the International Embryo Transfer Society’s annual conference in March.

Moley’s work is focused on improving the success rate in cloning pigs because successfully cloning animals is rare. In fact, cloning efficiency hasn’t improved much since the breakthrough with Dolly the sheep over 20 years ago. Increasing cloning success rates could save researchers time and money and make it a more viable option for people in the livestock industry.

“I’m looking at apoptosis, which is programmed death cells in pig clone embryos,” Moley said. “I’m looking at DNA methylation patterns, which we think could go wrong in the cloning process…I’m examining differences in DNA methylation and gene expression in the embryos with high and low levels of apoptosis to hopefully be able to use that to pick the embryos that will be most successful following transfer to recipient sows.”

Moley was the primary student researcher on the project, but teamed up with professors and other graduate students in the Department of Animal, Dairy and Veterinary Sciences to conduct the research with funding from the USDA.

The road to Moley’s outstanding presentation began a year ago when she submitted her abstract on the study to judges from The International Embryo Transfer Society who selected about 50 abstracts for the competition. Six were then invited to give a 12-minute presentation and poster presentation at the conference.

Moley said the ADVS department gives student researchers opportunities to practice presentations, but when the best scientists in your field from around the world are watching, it can be a little scary – even when the work and the presentation were good enough to win an award. In a competition at this level, third place is a big deal.

“I have to remind myself of that because I’m a little bit of a perfectionist,” Moley said. “It felt good to represent Utah State and show what we are doing here.”

Moley came to USU with impressive undergraduate research experience said Clay Isom, associate professor in developmental genetics and epigenetics. Isom consulted regularly with Moley and saw her skills grow during her 4 years at USU, preparing her award-winning research.

“It really puts us on the map nationally and internationally for having students like Laura, for the quality of her work, and presentations on these big scientific stages,” Isom said. “People from all over the world see the quality work that’s going on here.”

Isom said he was impressed with Moley’s perseverance in overcoming roadblocks during the study.

“People have this idea that science is just a straight shot, you test it, everything goes as planned, and you write it up and it’s all beautiful,” Isom said. “It’s not always like that, as was the case in Laura’s project. We’re training these students to think critically and understand the curveballs when they come.”

Laura Moley earned accolades for her Ph.D. research in animal molecular genetics aimed at improving the success rate of efforts to clone pigs.
In March 2018, International Space Station astronaut Norishige “Nemo” Kanai (above) harvested 33-day-old Apogee wheat which was bred at USU’s Crop Physiology Laboratory specifically to be grown aboard spacecraft. Top Right: Alumnus Ray Wheeler at work on experiments at NASA in 1978, and today (bottom right) is considered a leading authority on growing plants in space. Photo courtesy of NASA.
When Ray Wheeler arrived in Utah to do graduate work in plant ecology, he had a fascination with plants, a love of science and discovery, and no aspirations to be part of the U.S. space program.

“But when I got to Utah State, Professor Frank Salisbury had research funding from NASA and I became involved in that,” Wheeler said. “I stayed with that work all through my graduate program and it introduced me to NASA and the space research community.”

Wheeler is one of several USU College of Agriculture and Applied Sciences’ alumni whose careers include plants and aerospace. An internet search of Wheeler’s name turns up a long list of articles about growing food in space, including a NASA publication, A Researcher’s Guide to: Plant Science, about growing plants aboard the International Space Station (ISS). He co-authored the guide with NASA principal investigator Gary Stutte, and research scientist Oscar Monje, a USU alumnus who earned a bachelor’s degree in chemistry, followed by masters and doctoral degrees in crop physiology with Professor Bruce Bugbee.

Wheeler has been a plant physiologist at the Kennedy Space Center since 1988, long enough to have seen advances made, failures happen, priorities and administrations change, and to observe how technologies from NASA research have become part of life on Earth.

“There is intrinsic value in discovering new things through basic research,” Wheeler said. “I came to appreciate the value of how findings from basic research are a product to give society and the scientific community...there are controlled environment agriculture questions that we are asking that transfer to terrestrial applications.”

For example, some of Wheeler’s early work included experiments with plants grown hydroponically (grown without soil and with roots in nutrient solutions). Hydroponics is common in commercial production of some foods, like tomatoes that have been in grocery stores for decades, but Wheeler’s research included root crops like potatoes, sweet potatoes, and peanuts. Tubers did not develop well when submerged, but when potatoes were grown in containers on a thin film of nutrient solution, they thrived.

“So you lift the tray lid and pick potatoes that are nice and clean,” Wheeler said. “No soil to clean off or transport. It has caught on with seed potato growers, but who’d have thought NASA would develop something to use like that?”

Keeping plant roots bathed in fluids on Earth is one thing, but fluids don’t behave the same way in space. On the ISS everything is weightless as the spacecraft and everything aboard are constantly free falling in orbit. And in planning for missions to the moon and Mars, scientists must account for how solutions will behave when there is less gravity than governs their behavior on Earth.

Some of what we know about irrigating plants in reduced gravity comes from USU researchers’ experiments aboard the ISS and NASA’s now-retired research aircraft, the KC-135A. The plane was a laboratory for studying weightlessness, flying a rollercoaster-like path, climbing and diving to give passengers and their experiments about 25 seconds of weightlessness during each 65-second parabola, and repeated 40-60 times during each flight. The sensation of weightlessness, followed by the pressure of double the Earth’s gravity during the climbs, earned the plane its nickname: the Vomit Comet.

USU Professor Scott Jones, experienced more than 300 parabolas with experiments he worked on as a graduate student with emeritus professor Gail Bingham.
and soil physicist, Professor Dani Or, who preceded Jones on the faculty of the Department of Plants, Soils and Climate.

Bingham, who graduated from USU and earned a Ph.D. at Cornell University, used his knowledge of atmospheric physics to link climate work on this planet with creating growth chambers aboard spacecraft. Jones was a graduate student and part of a diverse team Bingham assembled at USU’s Space Dynamics Laboratory. They worked on measuring carbon dioxide and other elements in the atmosphere of plant growth chambers and studied how liquids moved through material that held the plants’ roots.

Managing liquids in space is not a trivial matter. It is critical in keeping plant roots healthy and edible leaves and fruits growing. Some of the sensors Jones and others now use to measure how water moves through soils on Earth are the result of experiments Bingham’s group did aboard the Vomit Comet, even (or especially) when they didn’t work as planned.

“We had some small experiments and naïve ideas about how they would work,” Jones said. “We injected water into small containers of a media for growing plants and had cameras and sensors to see how it moved. After the first couple of parabolas we figured out it wasn’t going to work, but we were set to fly and collect data the rest of the week. We sat down that night and had to figure out what we could do.”

Scientists routinely go back to the drawing board when things in the lab don’t work, but there is usually more time to devise alternatives because they don’t have a week of valuable flight time scheduled. That first experience was valuable because they learned from the failure. Later, three more weeks of flight experiences helped refine the creation of hardware and experiments that were conducted by ISS and Russian Mir space station crews.

While sophisticated and small “space greenhouses” were being refined at SDL, Monje worked in Bugbee’s lab developing crops for space flight, including USU-Apogee wheat, the first crop developed specifically to grow in space with constant light, no soil, short time to maturity, and only half the height of wheat grown on Earth.

Monje was a post-doctoral fellow in Bingham’s lab when he was hired by a NASA contractor at the Kennedy Space Center as a scientist on the Photosynthesis Experiment and System Testing Operations (PESTO) mission.

“PESTO’s goal was to study the effects of microgravity on photosynthesis and metabolism in Apogee wheat plants, so it’s like I was made for the job,” Monje said. “All the experiments I had been involved with up to then were shuttle experiments, so they were limited to a week or 11 days maximum. The PESTO mission was pretty complicated and took 73 days. It was exciting, but you do run out of adrenaline after the first couple of weeks.”

That 73-day mission will seem quick by comparison to a Mars mission though, and that means crews will need to produce some of their own food. Food processed for long duration storage doesn’t retain its qualities and nutrients lose their potency.

“People who work on food systems recognize that we will supplement crew diets with fresh foods, like salad crops,” Monje said. “Crews won’t get all their calories from salads, but they’ll get important vitamins and other nutrients. And when you get them in a non-pill form, those nutrients are more bioavailable because we have evolved for eating them.”

Wheeler said scientists have a sort of “shopping list” devised by NASA dietitians that focuses on some specific needs. Monje said beyond lettuce, kale would provide vitamin K, and crews may want something like tomatoes, peppers, or microgreens that taste like wasabi to perk up what could be an otherwise bland diet.

“We won’t grow wheat or rice on spacecraft because it needs too much preparation, threshing or dehusking, and cooking,” Monje said. “There’s not enough...
Get Away Special

Oscar Monje has been fascinated by space exploration since he was a child, so in addition to taking his required classes and being a student researcher at USU, he was part of the Get Away Special (GAS) team, a group of students who designed and built small experiments that flew aboard space shuttles. Most team members were engineering or physics majors, but that never dissuaded Monje.

“I couldn’t do orbital mechanics or design trusses, but I could figure out payloads, figure out what we needed to measure, what data to gather, what sensors we needed,” he said. “I was always the plant guy working with the physicists and engineers. Then I came to the Kennedy Space Center and I was the plant guy who could work easily with engineers. In the GAS program I learned to do electronics, how to get parts machined, how to integrate a payload, how to fail. Failure is an important part of science. Here we say we ‘fail forward.’ You’ve got to learn from what didn’t work, learn why it didn’t work, and keep moving forward.”

Besides providing food for the body, growing plants may provide food for the mind. Not every crew member cares about growing plants aboard the ISS, but some have referred to plants as fellow explorers.

“Living on the station, with all those hard surfaces, is like living long-term in an elevator,” Monje said. “Think of that all the way to Mars and back, and imagine then there is a window to a small compartment full of bright light and growing plants and earthy smells.”

Bruce Bugbee recalls that on July 20, 1969, his mother called him and his friends to come inside because Apollo 11 astronauts Neil Armstrong and Buzz Aldrin were about to become the first humans to walk on the moon. It was possibly the only thing that could have enticed Bugbee and his friends away from water skiing that day, and those fuzzy images on the television and the wonder of what he saw were engraved in his memory. Lance Seefeldt was an elementary school-aged kid when he watched that first “giant leap for mankind” and is among the many scientists of his generation who trace their enthusiasm for science and discovery back to the rocket-fueled days of the space race.

Now, 50 years later, Bugbee is a professor of plant physiology and Seefeldt a professor of biochemistry at Utah State University and both are involved in NASA-funded research aimed at long-term space exploration on Mars. Their participation in NASA’s Center for the Utilization of Biological Engineering in Space (CUBES)—a $15 million, 5-year program that began in 2017—is just one of many connections USU faculty and alumni have with the space program.

THERE’S NO PLACE LIKE HOME

Flight and space exploration can be romanticized as gravity-defying realizations of breaking the “surly bonds of Earth,” but humans developed with Earth’s atmosphere, chemistry, biology, and are governed by familiar laws of physics. Exploring space comes with a daunting array of limitations and risks, even if you just consider the ones we know about. So how does agriculture fit into space exploration when it is so closely tied...
to soil and natural systems on Earth? The short answer: everyone has to eat.

For years, NASA has analyzed how long space explorers could be sustained by “box lunches” and vitamin supplements before they need a space farm. The space farm is expensive, but provides fresh food, regenerates oxygen, and purifies water—in a miniature copy of the systems on planet Earth. But food production needs to be highly efficient.

“The basic idea that CUBES put forward is ‘How do we get what we need to sustain life on Mars with what is available on Mars,’” Seefeldt said. “That means getting the nitrogen, carbon, the right nutrients, and enough water to grow plants for food and also to make pharmaceuticals. Nearly everything has to be made on site because the real expense of going to space is in moving things there.”

In addition to the costs, distances between Earth and Mars also mean no quick deliveries of crucial supplies. Bugbee often uses an analogy to illustrate the distances involved in space missions.

“Based on the distance, getting supplies from Earth to the International Space Station is like going from USU’s main campus to downtown Logan,” Bugbee said. “Going to the moon is like a trip from Logan to the Salt Lake airport. Going to Mars is a trip from Logan to Antarctica.”

Antarctica is a good stand-in for other aspects of a Mars mission. For example, plants have to be grown in an engineered system of chambers because the local “soil” and temperatures can’t support growing plants or people, and supplies can only arrive and depart in specific windows of time due to weather in Antarctica and planetary orbits in the case of Mars. Both places are cold and inhospitable, but Antarctica has breathable air and ample water to irrigate plants.

FARMING AND PHARMING

Some researchers on the CUBES team focus on growing food and others are at work on ways explorers could produce pharmaceuticals on-site, perhaps by inserting the genes for acetaminophen or an antibiotic into a bacteria that would then produce a needed medicine. Why not just pack an extra-robust first-aid kit? Mars pioneers will have some medicines with them, but every milligram of weight adds to launch costs and medicines lose potency over time.

“When someone on Mars gets an infection, there will be no time to ship medicine to them,” Seefeldt said. “By the time you got it there the person would be dead.”

The CUBES team is investigating modifying fast-growing plants like lettuce that can provide an anti-inflammatory like acetaminophen, or even inserting a hormone that stimulates bone growth to combat the known problem of humans losing bone density while they live in space.

Barriers to growing food on Mars include the soil, which isn’t soil at all.

“People talk about the ‘soil’ on Mars, but there is no soil,” Bugbee said. “Regolith is the term used to refer to mineral particles that have no life and no organic matter. Mars is covered with a non-living dust. Soil is alive with microbes and is a dynamic system.”

Seefeldt’s research focuses on nitrogen, a critical element for growing food everywhere. All living things require nitrogen for survival, and it is abundant in our atmosphere, but must be processed before living things can use it. Mars crews will not be constructing a sophisticated and energy-intensive fertilizer production facility to feed the plants.

Mathangi Soundararajan, a Ph.D. student in Seefeldt’s lab, works on using bacteria to capture nitrogen in forms that plants can use on Mars, and identifying the most sustainable and efficient ways to do that.

“There are several bacteria that can capture nitrogen, but we have to consider the really harsh conditions that we would face in outer space,” she said. “So we work to choose the right bacteria and the right conditions to reach the best system to capture nitrogen to provide fertilizer for plants.”

Seefeldt sees how overcoming food production problems on Mars contributes to solving some problems on Earth. He is an advisor to the Bill and Melinda Gates Foundation in its efforts to improve food production in developing countries, particularly in central African countries.

“We are exploring how we get nitrogen to grow food in the

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middle of the continent,” Seefeldt said. “It’s not a trivial problem because we don’t have transport systems to use there. We can’t build fertilizer plants near the coast like we have here and transport it because there are not sufficient roads and other infrastructure. So how do we get the nitrogen they need from what is available there? The Gates Foundation is investing millions trying to solve this problem on Earth and NASA is trying to figure it out for Mars. It’s all interconnected for me.”

Farming Mars is sort of the ultimate example of trying to grow crops on marginal land, Seefeldt said, and Bugbee added, “The Sahara Desert would be like the Garden of Eden by comparison.”

WHAT DOES YOUR GARDEN GROW?

A number of plants have been on the list of possible Mars crops. The CUBES proposal included rice, lettuce, and potatoes, all of which have been previously studied in growth chambers.

“I said rice is very hard to do in growth chambers, so let’s attempt something hard,” Bugbee said. “Potatoes have been well studied and can be genetically transformed to be a more important staple of the diet.”

“We should also add that The Martian did not factor into our selecting potatoes,” Bugbee quipped. “Our proposal was done before the movie was out.”

Seefeldt added that lettuce, which has been grown on the International Space Station, is relatively simple, it grows fast, and can be genetically modified, which is a big factor. Bugbee said the CUBES team will work out what other plants to focus on in collaboration with NASA plant scientists, including some CAAS alumni (see related story) and dieters. Getting the right mix of important nutrients in a limited, strictly vegan diet, will not be simple.

“We need about 3% lipids (fats) in our diet,” Seefeldt said. “But lipids are hard for plants to make and we won’t be growing avocado trees.”

Bugbee said soybeans are a potentially important staple and protein source because they can be made into other products. Seefeldt added that spirulina, a single-cell organism that is dried and used as a powder, is easy to modify and could be used to produce important lipids such as omega-3 and omega-6 fatty acids.

But transporting living things from one planet to another is also complicated by the fact that biology is constantly changing. So, for example, we could use a bacteria to produce a specific hormone, Seefeldt explained, and then find a year later that it doesn’t work anymore. What genes will do in space over time is one of the unknowns.

THE TRIP TO MARS

One possible mission scenario is that when crews land on Mars they’ll live on food similar to MREs (familiar to members of the military) that were delivered by an unmanned spacecraft years earlier. They will begin constructing a habitat that includes plant growth chambers and every part of a plant that is not eaten will be used to gradually create soil.

Bugbee, who has done space-related plant experiments for nearly 30 years, said artists create illustrations of greenhouses on Mars that look habitable, but reality is far more complicated.

“You could pressurize a greenhouse on the surface,” Bugbee said. “But with no atmosphere, basketball-sized meteorites come in at high speed. How does a transparent greenhouse covering withstand that? Humans and plants also need to be shielded from cosmic radiation, so you tunnel underground, inflate a sphere, and use the regolith to provide protection.”

But this also blocks the sunlight and crop plants require a lot of light. Paul Kusuma, a Ph.D. candidate interested in vertical farming on this planet, is evaluating lighting solutions. Bugbee said CUBES has helped USU attract outstanding graduate students like Kusuma and Soundararajan.

A Mars greenhouse could get light in a few ways, including a large array of solar panels connected to electric lights, but most promising is using curved mirrors and fiber optics to concentrate and transmit light directly to the plants. This method allows scientists to get light directly to leaves and tune the wavelengths to suit different plants. In the lab, Kusuma and Bugbee are learning how adjusting light waves is the difference between increasing leaf area or burning a plant, growing stems too long to be structurally sound or slowing photosynthesis.

“I still can’t believe I’m doing this,” Kusuma said. “About 3 years ago, I was unsure if I even wanted to go to grad school and here I am working on this interesting project. I really enjoy working on this because it has applications beyond just Mars. It has plenty of applications here on Earth.”
For over 8 years I have had the privilege of working with our College Alumni Council. It has been a wonderful experience to work with dozens of individuals over that time who all share a love for the College of Agriculture and Applied Sciences. Each council member brought a depth of maturity and a wealth of knowledge that was absorbed and used in various capacities while they served and that continues to shape our efforts to support CAAS students. Over the years, the CAAS Alumni Council was involved with the Utah Agricultural Products BBQ, Networking Night, Senior Send-Off and other impactful activities that championed the College of Agriculture and Applied Sciences’ students. How grateful we are to all our council members!

Several years ago, Scott Fuhriman, our council president at that time, initiated an endowed scholarship fund to benefit the posterity of College of Agriculture and Applied Sciences Alumni. Council members supported this effort through the years and today the scholarship fund is over $13,000. Permanent scholarship endowments require $25,000 in order to generate a $1,000 scholarship in perpetuity.

Executive Director of Development, College of Agriculture and Applied Sciences

It feels impossible to summarize a well-lived life in a single obituary, and especially for a life that feels cut short, but Robert “Bob” Adams’ family did a beautiful job describing the “rancher, farmer, horseman, cattleman, soldier, pilot, commander, friend, officer, cowboy, counselor, sportsman, hunter, husband, uncle, brother, father, patriot, gentleman, patriarch, philanthropist, volunteer, and grandpa.”

Bob, who died January 7, 2019, was also a dedicated member of the College of Agriculture and Applied Sciences’ Alumni Council and served as its president in 2017. He was proud to serve as his family’s representative to the college for the Allan N. and Helen Adams Scholarship which honors his parents.

He attended Utah State University from 1964 to 1968 and, like many students do, came away with an education and having met the love of his life. In Bob’s case, it was JoAnn Spencer, and they were married in 1966. Two years later, he graduated and was commissioned a second lieutenant in the U.S. Army through ROTC.

He was assigned to Vietnam in 1970. Within a year, Colonel Adams had flown 766 combat hours accrued during more than 325 combat missions. He served with distinction and among the honors he received were the National Defense Service Medal, Vietnam Service and Campaign Medals, and Bronze Star.

Upon his discharge and returning home, Bob flew 737’s for Western Airlines, was involved in the company’s merger negotiations with Delta, and retired after 30 years in the airline industry.

Bob was never far from military service though, and continued to serve his country with distinction. He earned more honors in the Utah National Guard and Army Reserve and retired in 2006. His devotion to duty and to those who serve in the military, paired with his experiences ranching and riding, made Bob
We have no doubt that every cent we donate to the College of Agriculture and Applied Sciences has an impact on students. We are impressed by every interaction we have with students, faculty and administrators of the college and thrilled to hear about the increasing presence of Extension services in Utah and all that these programs and people do for the communities they reach. We are grateful for the opportunity to give back to the people and institution that have given us so much. Go Aggies!

— Jim and Jennifer Grewe

Companion animals have a very important place in my life, as I learn each day when I go home to my wonderful dogs Benny and June, who share their love unconditionally and help me manage stress. So, I was pleased to help support USU’s Equine Therapy Program, which pairs USU horses with people in our community who need healing and support, such as veterans suffering PTSD or children with special needs.

“I have been so very pleased to learn about the fantastic impact of these horses and the people who run these outreach programs in our community.”

— Abby Benninghoff
HAULING YOUR FOOD & BUILDING YOUR ROADS
Driving through storms is a common task that long-haul truck drivers grow accustomed to doing, but the perfect storm of a different sort is creating a massive roadblock for the trucking industry. Baby boomers are retiring, more freight needs to be moved, and the long hours that come with the job can push some people away. Companies are now working to find ways to attract more drivers.

According to the American Trucking Associations, companies currently need about 60,000 drivers, a number that could top 100,000 in just a few years. Companies have raised salaries to an average of $60,000 per year plus 401(k), health care and paid time off. Other skilled labor jobs like operating bulldozers, backhoes, and road graders go unfilled due to a similar lack of qualified employees. Operators are in high-demand as cities continue to grow along with a need for roads and bridges to connect them.

Companies often train their own drivers, but students in the Heavy Equipment and Trucking program at Utah State University Eastern are qualified operators right out of the starting gate and are able to rapidly advance their careers. Students like Justin Christensen from Salem, Utah, are in high demand with companies looking for skilled labor. He didn’t consider becoming a heavy equipment operator until he started working on a sheep ranch after high school where operating tractors and other machinery were part of the job. Christensen decided to actually get in the driver’s seat to see where this career path could take him.

“You’re nervous the first few times in the equipment,” Christensen said. “You don’t want to do something wrong, but that’s how you learn. The main thing for me was getting familiar with the controls and then realizing, ‘I can do this.'”

Most of the education that students gain in the program involves hands-on work. Almost every day, students like Christensen find themselves behind the steering wheel operating and maintaining heavy equipment. For beginners, state-of-the-art simulators allow students to make mistakes while saving repair and fuel costs. Christensen enjoys using the trackhoe simulator and said he can feel bumps, vibrations, and get a good sense of what it’s like to dig a trench in rocky ground without hitting a pipe.

Students learn more than how to drive semi-trucks and trackhoes though. Christensen said he learned a lot about filling needs in the economy in his entrepreneurship class. While earning a bachelor’s and advanced degrees have their place in today’s world, Christensen said he is happy to invest a year learning to drive both trucks and heavy equipment and developing his potential to earn up to $100,000 after he leaves campus this year to work for an excavation company in Utah County.

Leon McElprang is the director of instruction in the Heavy Equipment and Trucking program at USU Eastern. His father owned heavy equipment so he gained experience in what he calls, “The school of hard knocks.” He said operators from his generation didn’t need certifications and formal training to get a job. But things have changed and companies need to see that potential employees are capable, so USU Eastern prepares students for that reality. McElprang has been known to ask students, “Whose life did you save today?” It’s a question layered with meaning since safety is a prime concern for those training to be drivers and equipment operators, and faculty in the program are well aware that they have a hand in “saving marriages and mortgages” every day.

“I don’t know where in the world you can go to a 14-week training program and walk away qualified to make up to $100,000 a year your
first year at work,” McElprang said. “I’m pretty frustrated when I watch the news at night and it talks about the unemployment rate. I’m angry with that because I have companies across the nation calling me every day begging for drivers. People aren’t willing to work.”

McElprang doesn’t blame anyone for those jobs left unfilled, but he has noticed that parents who worked in blue-collar jobs want their kids to land easier kinds of employment.

“It’s hard work,” McElprang said. “We’ve told our kids to do better than what we’ve done. We’ve paid the money, we’re putting them through programs and in the meantime the blue-collar industry is suffering. There is nobody to build the roads, there is nobody to haul the freight.”

Plenty of challenges come with life lived largely on the road. Sitting for hours and hours can take a toll on health. Spending many hours and days away from family and friends can strain relationships. Often, just taking a shower requires planning. But McElprang believes people are starting to fill more of those open jobs and take advantage of the perks that come with them.

When it comes to public perceptions of blue-collar jobs, Gary Straquadine, USU Eastern’s associate vice president and vice provost for career and technical education, has seen a pattern in the 30-plus years he has worked for USU. When he began working for the university, liberal arts and general education were all the hype. Now, Straquadine is seeing the pendulum swing back toward technical education.

“We have a lot of people who have history degrees that are now coming back for a welding certificate because they don’t know what to do with a history degree,” Straquadine said. “I know a lot of people with just an associate’s degree that make $75,000 a year in a highly technical area. They get to work with their hands and their mind and they make lots of money in a high-demand field.”

Christensen, McElprang and Straquadine all appreciate the work of doctors, lawyers and politicians, but note it is easy to forget about the people behind the scenes who keep the country running.

“For example, when you’re sick in the hospital you don’t see the doctor for very long,” Straquadine said. “You see the nurse, you see the lab tech, you see the physical therapist and we train all of those people. We try to shake up the ways people think about occupations. We talk about number of years of school, we talk about employment outcomes, needs and expectations, and we talk about high wage, high demand occupations.”

We still need people in all kinds of occupations, but Straquadine said when it comes to driving from the airport to a meeting downtown, for example, it’s the handiwork of people with skills learned in technical education programs that make the trip possible, people like Christensen.

“I do enjoy this,” Christensen said. “Because you have to learn every day. It can be rewarding with a sense of accomplishment when you look at where we started and what we’ve built.”"
When I tell my story of "how I got to now," I like to begin with my education at Snow College. I worked as a student leader in the president’s office. I had a fearless mentor who helped me realize my strengths and goals. It was then I knew I wanted a career where I could be that kind of positive influence for others. Marci may not know how much I gleaned from her, but her impact was lasting.

Fast forward 12 years, and I have not stepped away from higher education. A Utah State University bachelor’s and master’s degree later, I have found a career and a passion in academic advising. I believe in higher education. It is transformative. The opportunity to be part of the transformation of students’ lives is magic! The fact that I get to do it at USU in the College of Agriculture and Applied Sciences is icing on the cake. And the students? Surely, aviation students are some of the best around!

It was pure luck and fortune that landed me as the aviation advisor. No, my background is not in aviation. That has been part of the delight! To learn about something so far from my realm of knowledge has been invigorating. It is my pleasure to work with students from across the state, country, and globe. Sure, they test my patience. Explaining how to find a breadth class for the millionth time can get tiresome. But, when I see a student’s face light up as they tell me about their progress in flight, when they beam as they give a presentation about their internship experience, or when their shoulders relax when I tell them academic probation is not the end of their dreams or their education journey, those things never get old.

College is ever changing. Technology, costs, additional responsibilities, and other extrinsic and intrinsic factors that impact students’ lives are not what they have been, even in recent years. This means the type, method, and amount of support students need is also changing. Perhaps the most advantageous way I combat this is by returning to my go-to belief: advising is teaching. It is my role to help students navigate the college world, including many factors outside the classroom that must be considered. I use teachable moments to help students problem solve, communicate effectively, and reframe setbacks so they see ways to move forward.

We promote USU Associate Professor Matthew Sanders’ philosophy of becoming a learner: “The primary purpose of college isn’t learning a specific set of professional skills; the primary purpose of college is to become a learner.” When students don’t have a clearly defined “why” for being in college, they miss out on valuable opportunities to learn. I help empower students to clarify and articulate their “why.” I help them realize their potential and goals, then guide them as they seek tools and develop competencies to obtain them.

What is your “why” for the things you are engaged in?

Students are my “why” for advising. They are why I’m here and why I stay. Helping them gives me purpose and fulfillment. When they are excited to tell me about their latest success—a passing grade, an internship, a job offer—I know I’m on the right track. When we get to celebrate their successes together, I know I have reached my goal of being the positive influence I set out to be. △
*All proceeds benefit CAAS student scholarships through the Utah Agricultural Leadership Endowment.*

**SATURDAY 9.28.19**
2:30-4:30 p.m.

**CRAIG ASTON PARK**
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