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DEAN PORTER'S LAST MESSAGE


I am amazed at how often the work of students from the College of Life Sciences is featured by various campus and off-campus communication outlets. For example, a paper recently published in the journal *PLOS One* by a group of faculty and students from our Department of Microbiology and Molecular Biology was recently the lead article on the BYU homepage and was covered by several local media outlets. These researchers found that the virus responsible for COVID-19 was very unstable when placed on paper money but was more stable when placed on a credit card. This work suggests that our shift to cashless transactions during the height of the COVID-19 pandemic to limit the spread of the virus may have been ill-advised.

When President Worthen announced his “Inspiring Learning” initiative in 2016, our college had a head start because of our long-time culture of student mentoring. The types of scholarship our faculty pursue naturally provide opportunities for significant student involvement. Whether in a laboratory or out in the field, whether in basic research or applied research, whether in writing a journal article or a health policy statement, students have a myriad of possibilities for involvement in experiential learning. I hope that many of our readers had wonderful

experiences as mentored students at BYU. Perhaps they were life-changing experiences; perhaps they just provided the confidence to carry on to completion of a degree.

This issue of *Impact* continues with the tradition of reporting on some of our student experiences. Look for the lessons learned that could not have happened in a traditional classroom setting. Look for the potential impact of the work to make a positive difference in the world. Look for the ways students are blessed by engaging in inspiring learning opportunities.

This will be the last issue of *Impact* where I am the publisher. My time as dean will come to an end on June 30, 2022. I cannot sufficiently express how meaningful the past seven years have been for me. I leave the Dean's Office with confidence that our students' experiences will only get better. I thank those of you who have helped with this work, whether with your time, talents, or means. Your consecrated care for the College of Life Sciences is truly appreciated. May God bless you.


James P. Porter

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JAMES PORTER:

by Jenny Carpenter

The Mediator's Meaningful Impact

At the University of Louisville in Kentucky, a student approached then-professor James Porter and said, “You must be a Christian.” This surprised Porter; he never talked about his religion in the public education sphere. The student continued, “I could tell by the way you act that you must be a Christian.”

“That was one of the greatest compliments I’ve ever received,” Porter smiles. Knowing that his Kentucky-based students felt his Christlike love for them brings him joy.

After teaching at the University of Louisville for thirteen years and at BYU for twenty-four, Porter has left an indelible impact on thousands of students and fellow faculty. He doesn’t just love what he teaches; he loves who he teaches—and it’s this love for his students that’s prompting him to step away from his position as dean of the College of Life Sciences and move back into teaching for his last year at BYU.

Even during his busy tenure as dean, Porter continues to find time to teach a physiology class. He has taught physiology throughout his career, particularly with an emphasis on endocrinology. Each class usually has over a hundred students, creating a challenging environment to

foster relationships. However, Porter still finds a way to connect with them.

Prior to administering each of the five exams Porter schedules for his classes, he offers additional office hours to help his students master the material. “Anywhere from half a dozen to a dozen come,” Porter says. “It’s a closer interaction, which I really enjoy. It’s more time consuming, but it’s gratifying, especially if I see the students who came [to the help session] do well on the test.”

Emma Christiansen (’23), one of Porter’s current students, talks about how much his office hours have helped her. “It’s not you against him; it’s you against the class material,” she says. “I feel very supported as a student.” As Porter talks with each student, he takes the time to learn their names and get to know their individual needs.

Not only is Porter inspiring his current students, but he has a trail of former students who appreciate how his influence shaped the direction of their studies. One particular BYU alumnus, James Dagleish (’15), remembers how Porter helped him gain a passion for medicine. “He made the human body really interesting. There were all these nifty facts that made you really love the subject,” Dagleish

says. “But more than that, I think he genuinely showed an interest in helping others. When I went to office hours, it was clear to me . . . that was the highlight of his day, where he got to help other people understand something.”

Porter’s individual-focused teaching style—a method he developed as a missionary in South Korea—has added value to his students’ educational experience. Teaching hundreds of students at once, however, is no simple task. Porter has experimented with a variety of styles—from packets to iClickers to PowerPoints—to help his students learn.

“[Porter] developed really great course materials and taught them in a way that was animated and interesting,” Dagleish says. “He made the study of medicine interesting, which was very useful as I applied this knowledge to cancer research.” Dagleish was recently a National Fulbright Scholarship semifinalist and will have the opportunity to continue conducting cancer research in the United Kingdom.

In addition to Porter’s attention to students, he is also known for his focus on faith and science. Whether it’s experimentation or revelation, having multiple origins for inspiration thrills Porter. “It’s actually invigorating . . . to know that there are other sources of knowledge,” he says.

College Priorities

The dean’s office implemented the following five college priorities during James Porter’s tenure:

- Foster a student-centered culture.
- Provide faculty support for student mentoring and teaching.
- Nurture faith in the college community.
- Promote diversity and inclusion within the college.
- Enhance the influence of the college through communication.

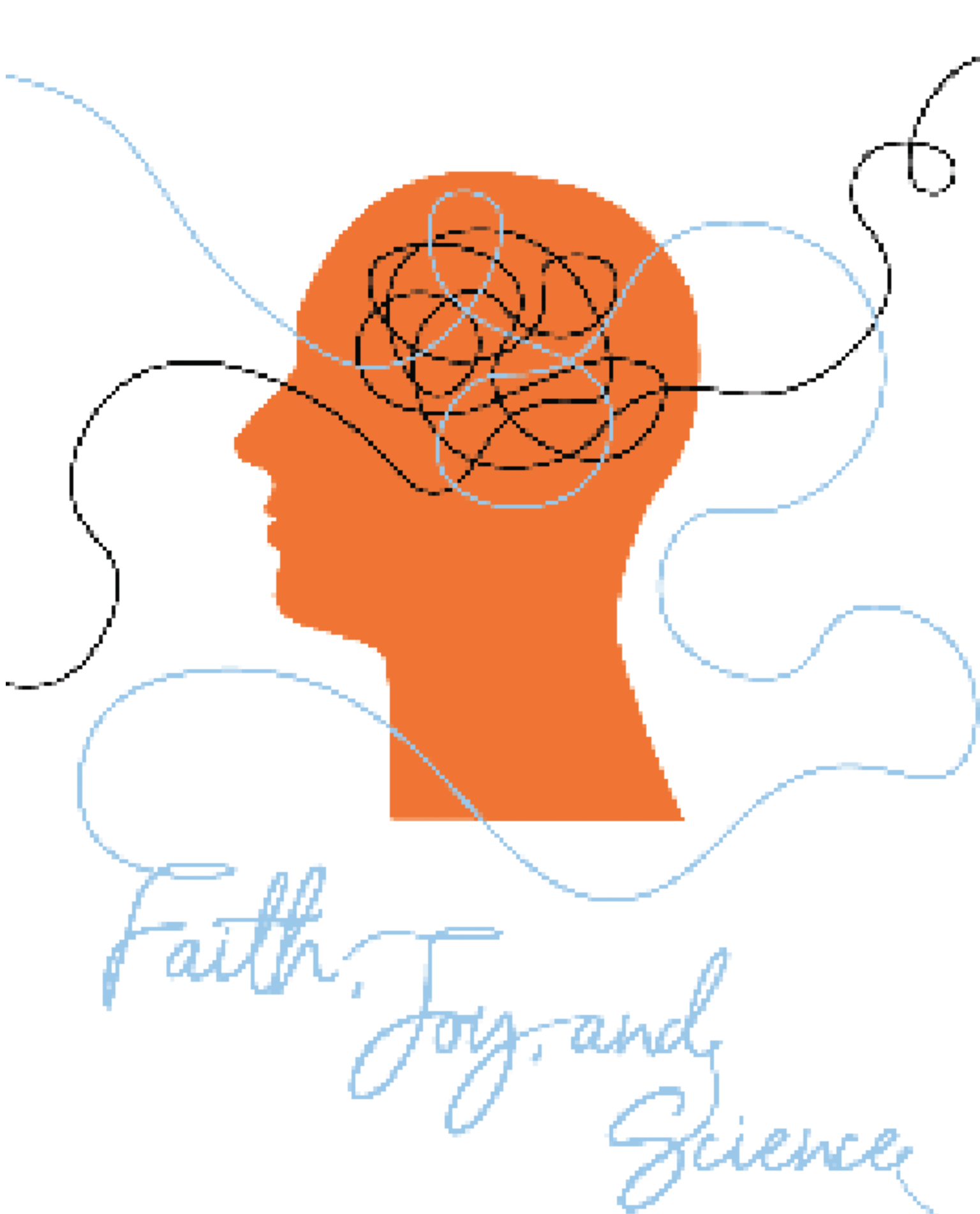
DEAN’S OFFICE

“I know that in my work, my research, and my teaching, the Spirit has been able to help me.”

Porter particularly enjoys taking an authentic approach to his beliefs: in his mind, you don’t have to choose sides to be a religious scientist. One can appreciate science while also being Christian, as the Kentucky student noticed all those years ago. “The things that really touched the students are seeing people who wear their faith on their sleeve, without being ostentatious, but just being so real,” he says.

This authenticity inspires the students and faculty members Porter works with. Acting as a dean over eight departments and units, Porter has found a way to unite students, faculty, and administrators as a harmonious team. Dixon Woodbury, a fellow physiology professor, comments that Porter helped smooth out rough edges between different departments. “I appreciate the way he organized the college,” he says. “Some new committees were developed that helped focus on minorities, less-heard voices, the needs of faculty, and needs of students.”

Porter has influenced many through his mediatory work, whether that be between student and teacher, faculty and administrator, or faith and science. He will continue to have a rippling effect after he retires in the summer of 2023. When talking about what he’ll miss, he says, “I worry about not having this huge, meaningful piece to my life.” Truly, Porter has brought meaning to many lives—and he will continue to do so even after he leaves the College of Life Sciences.



illustrations by Emily Tribe

The following is an abridgment of Dr. Glenn Schiraldi's presentation given on September 9, 2021, as part of the College of Life Sciences Faith & Science seminar series.

I am so delighted to return to this university that helped a tentative, but eternally grateful, new convert get his spiritual feet on the ground and to be with people whose light reflects God's love and testifies of the Savior even before you speak.

Around the turn of the century, I traveled the country over a five-year period to interview resilient World War II combat survivors to learn how they coped. To be in the study, survivors had to have returned from war well adjusted, happily married, and lived fruitful lives. They were eighty years of age when I interviewed them. They included prisoners of war, a Navajo code talker, Tuskegee Airmen, amputees, and combatants from nearly all theaters of the war. All but one of the forty-one interviewees were people of faith. They spoke of belief in a loving God who gave them comfort and strength. They were also a highly moral group. They spoke of chaste courtships and fidelity in marriage.

I became intrigued with the link between stress, health, and happiness, with the latter's close connection to spirituality. It seems, as I tried to put happiness together with stress and trauma, there was a two-step pathway to happiness, a process that applies to all of us:

1. **Heal the inner wounds that make and keep us miserable.** For all suffering, Jesus and his Atonement are the solution, sometimes with the aid of support people, like skilled mental health professionals and wonderful new treatment strategies.

For example, one of the honors of my life was interviewing Louis Zamperini, a wonderful man. You might recognize his name if you saw the movie or read the book *Unbroken* [by Laura Hillenbrand]. In WWII, his bomber went down in the Pacific. He survived forty-seven days on a life raft through sheer grit. After his raft drifted to a Japanese-held island, he was tortured and threatened with beheading every day. The movie made it seem like he made it home and all was well. It wasn't. He was angry and getting into

Glenn R. Schiraldi, PhD, Lt. Colonel (US Army Reserve, retired), graduated from BYU in 1976 in health education. He has served on the stress management faculties at the Pentagon, the International Critical Incident Stress Foundation, and the University of Maryland School of Public Health, where he received the Outstanding Teaching Award and other teaching/service awards. His fourteen books on stress-related topics have been translated into seventeen languages. He has trained high-risk groups (such as the military, police, and firefighters), mental health professionals, and laypersons around the world on various aspects of stress, trauma, and resilience.

fight, drinking, squandering his savings, and his marriage was on the rocks. His wife pleaded with him to attend Billy Graham's first revival in a tent in Los Angeles. He went, but bolted, saying, "I already know I'm a sinner. I don't need someone else telling me I am." She prayed him back the next night. He was again bolting from the tent, when he heard Billy Graham say:

"There are problems that will never be solved unless we bring them to the Lord Jesus Christ and turn our lives over to Him. There are marital problems, physical and financial problems, problems with sin and habit. When people are in serious trouble, they almost always turn to prayer."

And Louis thought, "I'm in trouble. I haven't prayed since I was a prisoner." He walked back and committed his life to the Savior. That night, he said, he threw out his alcohol, tobacco, and distasteful magazines and didn't have a nightmare for the first time in five years, and never had another thereafter.

2. **Once unstuck from emotional and spiritual misery, we are freed to progress to the happiness we are created for,** by following Him who called himself The Way, and learning the process and practicing the skills of happiness.

At the University of Maryland, we piloted skills-based resilience courses, combining skills from traditional psychology (which brings us from negative to neutral) with positive psychology (which brings us from neutral to positive, using skills consistent with age-old spiritual practices). We found that practicing such skills led to improvements in all the indicators we measured: happiness, resilience, self-esteem, optimism, curiosity, depression, anxiety, and anger. It was very good news to find that such indicators could change in a semester's time.

Religious Research

If religious faith is beneficial, and I'm suggesting it is, then we'd expect the data to show it. Harold Koenig, a psychiatrist at Duke University, is the foremost religious researcher. He found that the majority of thousands of studies show that religiously committed people on average experience:

RELIGIOUSLY COMMITTED PEOPLE

MORE

OPTIMISM

HAPPINESS

RESILIENCE

SELF-ESTEEM

ALTRUISM/CHARITY

MEANING AND PURPOSE

ON AVERAGE EXPERIENCE:

LESS

DIVORCE

EXTRA-MARITAL SEX

DEPRESSION

ANXIETY

ALCOHOL/DRUG USE AND ABUSE

CIGARETTE SMOKING

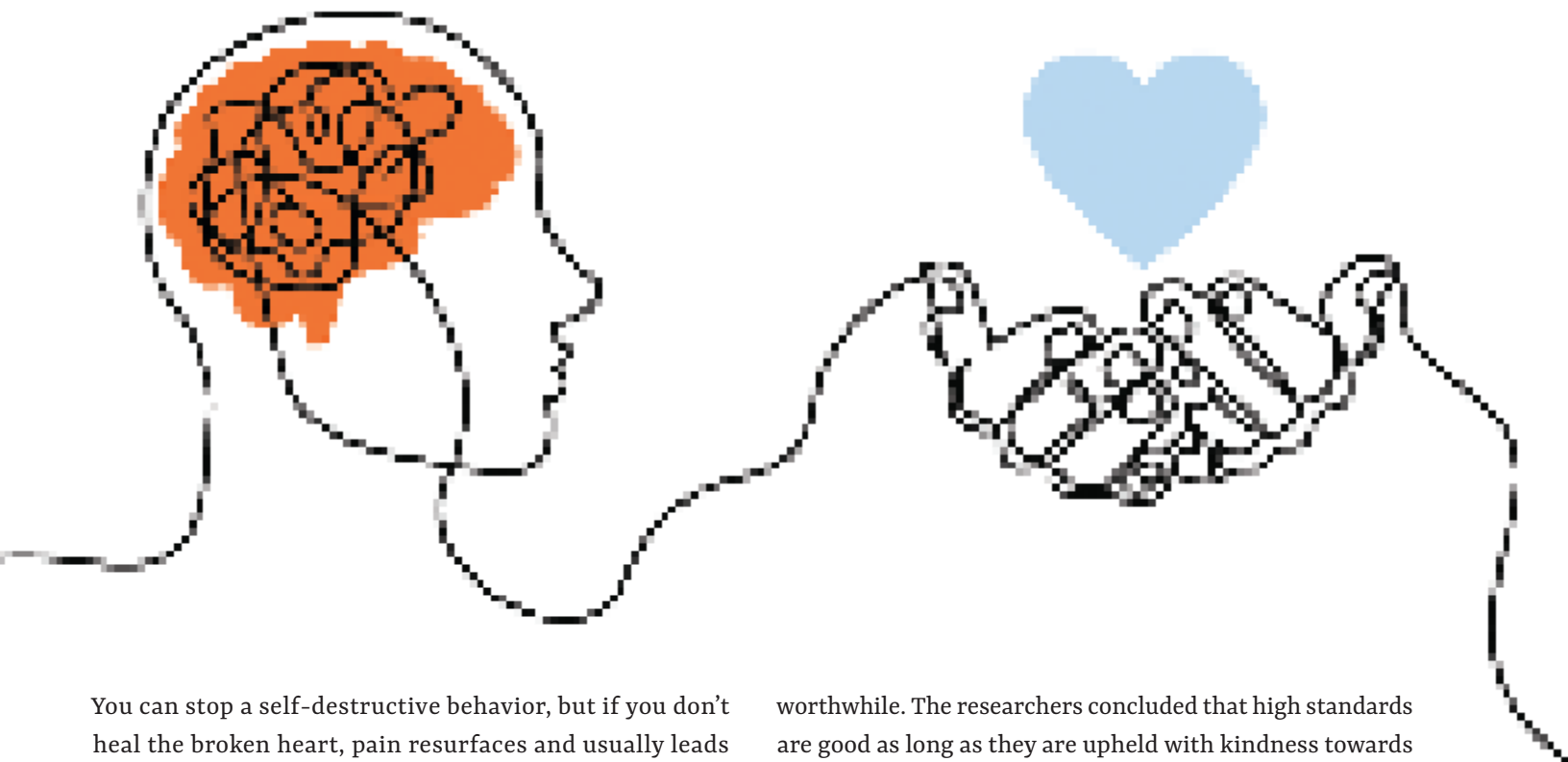
WORRY AND STRESS

Koenig concluded that religion is not a panacea. As believers, we still have challenges and suffer. But religion and spirituality provide resources that are strongly associated with greater well-being and better coping.

I'd like to take a closer look at some of the deeper themes encouraged by religion that often are not discussed in the literature.

Love

In studying resilient survivors of trauma, depression, anxiety, suicide, and addictions, I've concluded that love is at the very core of resilience. Marty Seligman, the father of positive psychology, wrote: "The capacity to love and be loved was the single strength most clearly associated with subjective well-being [happiness] at age eighty." This was exactly what I determined after interviewing my WWII octogenarians.



You can stop a self-destructive behavior, but if you don't heal the broken heart, pain resurfaces and usually leads to relapse. But faith gives us sublime truths that can constantly nourish and speak peace to our souls. One such truth is that God loves us with a love that never changes. Elder Holland testified that “no one of us is less treasured or cherished of God than another. . . . He cheers on every runner.”

Perfection

I love that our faith teaches us to be patient with imperfection—our own and that of others. As long as we are baptized, repenting, and trying our best, we will become joint heirs with Christ (Rom. 8:17). For me, that took the weight off my shoulders, and I no longer feel the frenzied race to fix everything immediately and on my own.

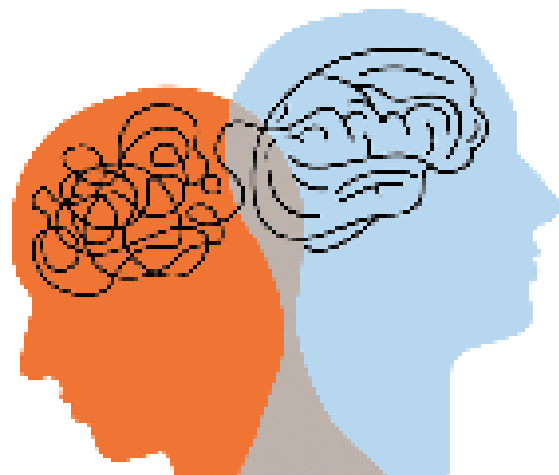
G. E. Kawika Allen, a BYU researcher, and his colleague found that just over 75 percent of LDS adults are perfectionists, meaning having high standards. For most, high standards were positive and associated with higher life satisfaction, self-esteem, and religious commitment, as well as lower depression and anxiety. However, a minority of the perfectionists with high standards fared less well comparatively. This group was motivated by fear, not love and security. They feared disappointing family and God, never being good enough no matter how hard they try, and failing to measure up to expectations, making them feel less

worthwhile. The researchers concluded that high standards are good as long as they are upheld with kindness towards imperfections and with no harsh judgments.

Character

Connection to high standards is another area researchers have begun to explore—how character and inner peace are protective against stress. Interestingly, Dutch research recently found that self-worth strongly and inversely correlates with post-traumatic stress symptoms. Self-worth was operationalized as the individual's assumption that one is good, decent, and unashamed of their personal character.

And when we stumble morally, faith gives an answer that allows us to rise again, including forgiveness.



CONCLUSION

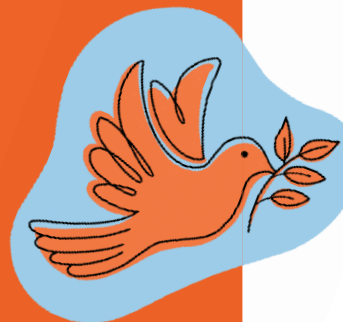
I hope you'll take away just a handful of things from our few precious moments together.

1. Know that God loves you—right now, just as you are.



2. Test whether or not obedience, nourishing your spirit daily with the good word of God, and seeking His inspiration lifts your spirit.

3. In an age of declining faith, never be ashamed of your faith in Christ or your membership in His Church, and never be surprised by persecution.



4. Be an influence for good, for God—not for your glory but His.



5. Remember that God promises the faithful all that He has, including the fruits of the spirit, like peace and joy. As we say, “Don't quit before the miracle.”



I hope you will enjoy and pursue scientific inquiry, but “seek ye first the kingdom of God” (Matt. 6:33), and everything will fall into place.

HUDDLED UP FOR HEALING:

WORKING WITH THE BYU FOOTBALL TEAM TO ADDRESS A DEGENERATIVE BRAIN DISEASE

by Tanner Sandberg, guest writer

“THE FIRST VIABLE TREATMENT FOR CTE—PHOTOBIO-MODULATION.”

In 2002, the death of legendary NFL center Mike Webster introduced the world to the degenerative brain disease known as chronic traumatic encephalopathy (CTE). The disease is marked by depression, rage, substance abuse, cognitive dysfunction, and dementia, and diagnoses are rising rapidly among retired football players.

Research on the effects of CTE is ongoing, but the available data already paints a sobering picture. A 2017 *JAMA* study found CTE in 99 percent of NFL players examined postmortem, and there are nearly four hundred confirmed cases in the Boston University Brain Bank. But despite the severe threat CTE poses, there is still no clinically accepted

treatment that can slow the progression of the disease or offer protection to current athletes. However, a team of students and professors at BYU recently conducted a pioneering study to investigate what may be the first viable treatment for CTE—photobiomodulation.

Photobiomodulation (PBM) is a low-cost, noninvasive therapy that delivers red and near-infrared light exposure to areas of the head and nasal sinuses to stimulate brain tissue. The light passes directly through the intervening bone and tissue and activates neural healing and growth. While the exact mechanisms of healing are uncertain, the therapy appears to work by improving blood flow to damaged areas,



photo by Nicholas Rex

counteracting inflammation, and increasing mitochondrial function. Because of this new treatment option, many people with CTE have already experienced life-changing relief from their symptoms.

I had the opportunity to research PBM therapy with students and professors from a range of disciplines, including psychology, biochemistry, exercise sciences, and statistics. We conducted a study over the course of the six months surrounding the 2021 football season, collecting data before and after the season to investigate potential benefits of PBM therapy for players. We analyzed the structure and function of players' brains, tested their blood for biomarkers of brain injury, and measured their strength, balance, and endurance. The players' mouthguards were even equipped with accelerometers to measure the force of collisions on the field. We also administered cognitive tests to determine the players' psychological functionality and sleep quality. In fall of 2022, BYU and Utah State University researchers will continue to collaborate with the BYU football team to study our findings.

As students, we had remarkable opportunities for participation and leadership in the study. Each student developed skills related to their major. Exercise science students tested leg strength using their department's new Bio-Dex machine, psychology students learned how to read MRIs and evaluate psychological status, and physiology students assessed aspects of the athletes' balance and agility. As a premed student, I received certification as a phlebotomist, performed blood draws, and learned how to extract plasma for testing.

These hands-on experiences provided an exciting taste of professional life in medicine and academia and helped us gain a clearer picture of our capacities and passions. One of the team leaders, nutritional science student Margaret Hancock ('24), says her favorite part of the research was "working with people, not test tubes or Petri dishes."

It's not every day that you can participate in a scientific study while laughing and talking about football with nationally ranked players. "Working with the football players was so fun!" says biology student Natasha Petters ('22). "We always loved chatting with them, and I learned a lot about communicating with people in an experimental setting."

Even the professors had fun: psychology professor Michael Larson says, "It was exciting to be participating

"AS STUDENTS, WE HAD REMARKABLE OPPORTUNITIES FOR PARTICIPATION AND LEADERSHIP."

in cutting-edge research, and it was fun to teach students how to properly conduct this type of study."

Irrespective of our different roles, we all felt lucky to be involved in a study that offered such a variety of opportunities in an engaging environment. And through this research, we have performed one of the first expansive studies of PBM therapy, placing BYU on the frontlines of CTE research. We plan to complete our full analysis and publish the results by the end of 2022.

In my future medical career, I hope to treat and study neurological disorders. This cutting-edge treatment study has opened my eyes to the exhilaration of conducting good



photo by Nicholas Rex

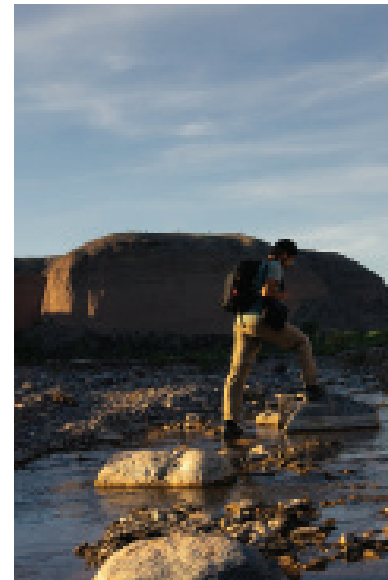
"[WE WORKED] WITH PEOPLE, NOT TEST TUBES OR PETRI DISHES."

research and the hope produced by new medical discoveries. I've also become aware of the continued suffering of those for whom effective treatments are not yet available, which has further fueled my desire to seek solutions for current

medical issues. I believe I speak for all my fellow researchers when I say that we can't wait to see how our prospects will grow from here.

LEARNING FROM THE LAND ON LYTTLE RANCH

by Allie Richael



photos by Nicholas Rex

Old, clunky generators from the '80s sustained just enough power for the lights to flicker on and reveal twin beds on metal frames. It was Christmas Day 2021, and the Leota family had spontaneously packed up all their belongings and driven nearly 300 miles to Utah's southwestern corner. As they drove, Christmas trees shriveled into cacti, and white snow melted into red dirt.

The Leotas now stood in the doorway of the former bachelor pad that would become their new desert home. "My family are troopers," Dallin Leota says. "This is our life outdoors."

Leota is the manager of BYU's Lytle Ranch Preserve, located thirty-six miles west of St. George, Utah. Its unique placement at the intersection of the Mojave Desert and the Great Basin makes the ranch a hotspot for biodiversity found nowhere else in Utah. The Lytle Preserve manager lives and works on the land full-time to preserve the area's natural diversity and share its beauty with BYU students and faculty.

Several months have passed since Christmas Day, and Leota's seven-year-old son and five-year-old daughter are adjusting to homeschool in the middle of nowhere. The same backup generators that provide power to cooking stoves also provide internet access for the kids' schooling. Because of the lack of power, the kids' schoolhouse expands to the great outdoors, where Mother Nature is their teacher.

"My son loves birdwatching," Leota says. "We got some binoculars so he could enjoy looking at different kinds

of birds, and it's part of his science work that he does for homeschooling. My daughter loves being outdoors with her bike." Per her special request, the Leotas also have two dogs.

Leota and his wife, Amilaina, are also adapting to life at the Lytle Preserve. Both are completing their master's degrees while maintaining the preserve and raising their children. The couple spends ten hours a week driving to and from Salt Lake City for classes.

Despite the unique challenges these living conditions present, Leota feels he has found his purpose in conservation and preservation work.

MOTHER NATURE IS THEIR TEACHER.

Conservation and Preservation

Both Leota and his wife received bachelor's degrees from BYU-Hawaii. Leota finished classes in 2017 but waited to graduate with his wife in 2020. Leota studied business, though he had already worked in several managerial positions for about a decade. By the end of his degree, Leota felt he had hit a wall.

"One thing I've really felt in going through this [educational] experience is that I don't want to make money for the sake of making money," Leota once told his wife. "There's no value, no purpose in that."

After graduating from BYU-Hawaii, Leota started looking for jobs that would involve living off the land. He found great fulfillment in working at Kualoa Ranch in Oahu, Hawaii. To Leota, Kualoa Ranch is much more than the Jurassic Park filming site. The ranch taught him about his own passion for conserving and preserving Hawaiian culture.

"I really felt that this is what I want to do," he says. "I want to preserve land. I want to take care of the land to a point where I can teach people about it and continue that conversation."

The Leotas moved from Hawaii to Provo in 2020 to pursue master's degrees in public administration at BYU. Leota felt drawn to the opportunity to impact local communities and governments through nonprofits. He was studying and working as the Bean Life Science Museum store manager when the Lytle Ranch manager position opened.

Leota says the opportunity at Lytle Ranch was his dream job. He loves that this work allows him to live self-sufficiently and make an impact in BYU students' lives.

Enriching the Lives of BYU Students

While studying business and gaining experience in the field, Leota saw students occasionally graduate with textbook knowledge and a diploma in hand but without hands-on

experience. He usually preferred hiring people who had experience in the field over those who only had a degree.

With that in mind, Leota hopes to provide invaluable hands-on experience for students to supplement their degrees. "I want this to be a place where they can come and apply practical skills from what they're learning in books," he says. "I'd love to expand the experiential learning opportunity to all BYU students."

The Lytle Preserve currently houses orchards of pomegranates, persimmons, peaches, and pistachios. Leota plans to add corn and other vegetation to the mix by drawing from the preserve's nearby water source. He hopes to put visiting classes and student researchers to work pruning pomegranate trees and tilling the land. "Hopefully when we get those students going, everyone can gain a sense of the importance of taking care of the land. And then, in turn, the land takes care of us."

Experiential Learning at Lytle Ranch

Each year, several plant and wildlife sciences classes take a field trip to the Lytle Ranch Preserve. One of these classes is Rangeland Plant ID and Ecology. Because of the warm climate, plants at the Lytle Preserve germinate long before plants in Utah County. Professor April Hulet says the preserve even has some species of plants that do not grow in other areas of Utah.

Hulet plans to create a living herbarium at the preserve with her students, using GPS to develop a story map. The



photo by Nicholas Rex

LYTLE PROVIDES STUDENTS, SCIENTISTS, AND VISITORS WITH AN OPPORTUNITY TO EXPERIENCE THE FLORA, FAUNA, AND ECOLOGICAL COMPLEXITIES OF THIS LIVING SYSTEM.



photo by Nicholas Rex

story map will eventually be made public so visitors can locate specific plants growing at Lytle Ranch.

“That will give the students a legacy, in that every year we go, we can build upon our work,” Hulet says. “Over time, we can create a really nice database.” This project will be an opportunity for students to learn about plants and geographic information system tracking while simultaneously providing Lytle Preserve with an educational tool for visitors.

The ornithology class visits the Lytle Preserve each year to study birds rather than plants. Professor Randy Larsen remembers going to Lytle as a BYU student, and now he provides that same experience to current students. Larsen says the trip to Lytle Ranch culminates everything the students learned about birds in class.

“We’re going to see over 100 different species in three days,” he says. “Out of those 100-plus species, a big chunk of them will be southern birds that we wouldn’t be able to see around campus or in northern Utah in April.” Larsen hopes to open students’ eyes to the world of birds by giving names and histories to these feathered creatures at the preserve.

Outreach to Native Tribes

Part of Leota’s vision for the preserve includes recognizing and connecting with the native cultures. On November 20, 2021, the Lytle Preserve hosted an outreach event with BYU biology faculty Alison and Michael Whiting and about thirty community members. In attendance were members of the tribal chair over the five bands of Paiutes, the Cedar City Tribal Council, and the Shivwits Tribal Council.

Paiute tribe leaders participated in a tour of the preserve, where they identified areas and archeological sites that belonged to their tribe. Leota helps to preserve and restore these areas.

“Our Native American students do a lot of research with ancient Paiute and Moapa tribes that inhabited this area before the polygamists and the settlers came through,” Leota says. He hopes that archeological sites in the Lytle Preserve will be a resource for students at BYU and neighboring universities interested in Native American culture.

Lytle Ranch Preserve Mission Statement

The Preserve is dedicated to providing students, scientists, and visitors with an opportunity to experience the flora, fauna, and ecological complexities of this living system. Brigham Young University is committed to the care and preservation of this unique natural resource so that future generations can enjoy and learn firsthand about the biological and historical features of the Lytle Ranch Preserve.



photos by Nicholas Rex

MAKING WAVES *with* WATER SECURITY RESEARCH

by Allie Richael

Four-year-old Sara Sayedi sits on her mother's bedroom floor in Iran, flipping through images of colorful monkeys and frigid arctic landscapes. The world comes alive to her through the villages pictured in *National Geographic* magazines and the detailed maps in atlases. Her mother helps her sound out unfamiliar words like *Antarctica*. Decades later, Sayedi's fascination with the natural world continues to grow as she engages in environmental conservation work through research that impacts policymaking.

Sayedi earned a bachelor's degree in environmental sciences at the Isfahan University of Technology. She went on to earn her master's degree in environmental management from the University of Tehran, researching water security and ecosystem services. While studying, she noticed several problems with environmental policymaking in her native country. Iran frequently deals with shortages and droughts. According to Sayedi, most people in Iran think these water shortages directly correlate with the amount of rainfall; they aren't aware of how much the government controls the supply. Many government decisions in Iran are not based in science, often causing farmers to lose their jobs because of water scarcity.

"When I was doing my master's, I realized that for years scientists had already known about a lot of the problems we had in our country," Sayedi says. But a general lack of understanding of water systems kept many people from making a change. "Why didn't we use the science at the right time to prevent those problems from happening?" she asks.



photo courtesy of Sara Sayedi

MAKING A MOVE

As she continued her research in Iran, Sayedi learned how gaining a greater understanding of science and policies could significantly impact individual lives. She could not ignore the problems in her community and her chance to make a difference. "That was something I became really passionate about, to make sure that the science is used at the right time by policy and decision makers in order to make a difference in people's lives before it's too late," she says.

After learning about BYU plant and wildlife sciences professor Ben Abbott's hydro science project, Sayedi moved from Iran to Provo to work on her PhD. She currently works with Abbott conducting expert assessments on permafrost carbon emissions, wildfires, and water security. After the assessment, they provide policy-relevant science to decision makers. "We try to be sure the latest science is usable for decision makers and policymakers," she says.

RESEARCH WITH AN IMPACT

CARBON EMISSIONS. According to Sayedi, there is still some uncertainty around the carbon emissions of permafrost and the role humans play in the carbon feedback. The effects of subsea permafrost thawing are sometimes exaggerated to deemphasize the role humans play in slowing carbon emissions. Sayedi and Abbott worked with twenty-five permafrost experts across the globe to gather information on carbon emission speeds and the permafrost's sensitivity to climate change. Her permafrost research ensures that "both the public and the policy makers have the best understanding of the feedback from the earth systems." Sayedi and Abbott's finished study is published online.

WILDFIRES. Sayedi and Abbott asked ninety-eight experts from twenty-three countries about their expectations surrounding fire issues in their biome of expertise. The study examines the patterns in which fires naturally occur in certain areas, also known as fire regimes. Through their research, Abbott and Sayedi search for answers about whether fire regimes can change, how frequent and intense they are becoming, how sensitive they are to climate change scenarios, and what role humans play in them. Their research gathers quantitative data, which is much needed because of an international focus on qualitative fire regime data. Sayedi says that so far, "fire experts believe that in most regions, more greenhouse gas emissions will increase the risk of fire regime changes. These new fire regimes will have a negative impact on biodiversity and other ecosystem services. According to the experts of [their] study, reducing greenhouse gas emissions seems to be the most important step for decreasing the negative risk of fire regime changes." This research will help policy makers and forest managers make educated decisions when planning for future wildfires.

WATER SECURITY. Sayedi has started a literature review examining how climate change will affect water security and shortages on a global scale. She looks at massive water projects around the world that have failed, and she applies

that knowledge to other water supply management strategies. Sayedi examines the negative environmental effects these water management strategies can have. This hydrology-focused study resonates the most with Sayedi because of the issues she has witnessed in both Iran and the United States. "They're all super important topics, but this is the one I can connect with the most because this water security problem is what I grew up with," she says. All three of Sayedi's projects are interconnected, because lowering greenhouse gas emissions will help decrease the severity of wildfires and promote better water security.



photo courtesy of Sara Sayedi

SMALL CHANGES ON A LARGE SCALE

Sayedi hopes her research will have a global impact. "What I love about environmental science is how much it affects people and how much of a role it plays in our daily lives," she says. She wants to promote understanding of science so people can change their lifestyles for the better. Anything individuals do to protect the environment has an impact on a large scale, from minimizing an individual's carbon footprint to voting for relevant policies. Above all, Sayedi believes that education promotes hope. She uses her research to inform others because "the better people understand how things work, the better their actions will be."



FROM PARTNERSHIP TO PATENTED RESEARCH: *UNDERGRADUATE STUDENT INNOVATES GENE-EDITING TOOLS*

by Erin Saito
photo by BYU Photo

CRISPR stands for:

CLUSTERED REGULARLY INTERSPACED SHORT PALINDROMIC REPEATS.

It is a powerful gene-editing tool used to alter DNA sequences and gene function. The CRISPR system was originally discovered as an immune defense system in bacteria. Since then, it has been adapted for laboratory use to allow researchers to make specific changes in DNA.

It's not every day that an undergraduate student approaches you with an innovative idea that significantly impacts the field and leads to developing a patented product, a startup company, and published research," says Jonathon Hill, an associate professor of cell biology at BYU. "[But] I actually think the mentorship aspect is the best story here."

In 2015, Hill was researching genes involved in heart development, but the chemicals typically used for these genetic screens were highly toxic and difficult to work with. To avoid working with these chemicals, he looked into synthesizing a CRISPR library to alter the genes.

At the time of the project's inception, CRISPR libraries could be synthesized by designing the sequences on a computer and ordering them from a company. However, this process could cost up to \$10,000, take approximately four weeks in turn-around time, and require a significant knowledge of bioinformatics.

"We couldn't afford to synthesize a CRISPR library," Hill says. "Another colleague pointed me to an article that had just been published with a method for enzymatically generating CRISPR libraries, so we decided to try it out."

The undergraduate students working in Hill's lab found that the new method took approximately three days, considerably less time than the originally proposed four weeks, and consisted of several steps to create the final product.

However, the method "was still slow and difficult to carry out," says Joshua Yates, one of the undergraduate cell biology students from Hill's lab. "I started looking at the shape of the CRISPR molecules, how they fit together, and decided that it might be possible to tweak things a little bit to create CRISPR libraries more quickly."

Yates approached Hill with his idea. "Josh came to me and said, 'I can do this in four steps and a couple of hours,'" Hill said. "My initial response was, 'No, you can't, what are you talking about? I looked at the protocol, and it takes three days.'"

But after Yates brought in a stack of scientific papers, including some that looked at the structures of the CRISPR protein complexes, and walked Hill through the process step by step, it was clear that Yates had done his research and saw a way to condense the protocol.

The key innovation was to modify a portion of the CRISPR complex, specifically the sgRNA. However, it was essential that the modifications did not hinder CRISPR function. The team ended up testing approximately twenty versions of the protocol before getting it to work. Yates

carried the project into his master's program in physiology and developmental biology, working under Hill's mentorship.

"There were several times when we were going through our twenty different iterations where I thought that we had reached an insurmountable obstacle," Yates reflects. "And there were several times where things just stopped working, and I had no idea why. I went on a little vacation once and it ruined my whole trip because I was thinking about how this thing wasn't working the entire time."

In the end, Yates successfully cut down the long three-day protocol to just three hours with his modifications to the CRISPR molecules.

"This was pretty close to the original goal, I think," Hill says. "I mean, Josh initially said four steps—it's five. He said a couple of hours—it's about three or four, because we had to add a couple of cleanup steps. But really, in the end, I'd say we met our engineering goal."

Almost five years after the project's inception, the research was published in *Nucleic Acids Research*. The article describes the new technology Yates and Hill created to enzymatically generate CRISPR libraries, which they named SLALOM (sgRNA Library Assembly by Ligation on Magnetic beads). This technology improves on previous methods by utilizing the host's DNA to create custom libraries and magnetic beads to speed up the process, drastically reducing the time and resources spent, and massively enhancing the accessibility of the technique.

"I think it's a lot about democratizing forward genetic screens," Hill states. "A typical library can be synthesized by a company, but it can cost you up to \$10,000 and four weeks. Using our method, it's \$100 and less than a day."

"Well, specifically, we got it down to three hours," Yates says.

Overall, CRISPR libraries make forward-genetic screens less dangerous, more targeted, and more efficient. However, still today, synthetically generating CRISPR libraries is

expensive and requires extensive bioinformatic knowledge—making the libraries less accessible to scientists without a background in bioinformatics or without large amounts of research funding.

Hill and Yates believe innovation in the field has been hindered by these roadblocks. Their new technology, SLALOM, helps solve these problems as an approachable and inexpensive advancement. "You can just build it using biology instead of a computer," Yates says. "Being able to do it on the benchtop will hopefully open up CRISPR technology to scientists who maybe wouldn't have had access to it before."



photo by BYU Photo

Essentially, "a [CRISPR] library is a collection of different molecules," says Joshua Yates. "And CRISPR is a way of modifying a gene, so a CRISPR library is basically a collection of molecules that can modify different genes."

Together, Yates and Hill have successfully applied for and obtained a patent for their technology. Yates—now the cofounder and CEO of the startup company Pioneer Biolabs, which is commercializing the technology—has a prototype of the SLALOM kit. He is in the process of ordering more kits for sale and research use.

Hill is still teaching and mentoring other students in BYU's College of Life Sciences. On his experience with Yates, Hill says, "In [that] case, mentoring wasn't just someone working in my lab. This was someone working as a partner with me on their own idea. . . . I hope that more students

can catch on. You're not just a robot in the lab. You're an active part of the research."

Hill believes that partnership is what sets BYU apart. "It's a different paradigm, one you don't see anywhere else," he says.

"I think what undergraduates are exposed to at BYU is very unique," Yates agrees. "Given the opportunity to try to modify the CRISPR molecules as an undergrad? That's not an opportunity a lot of students get. The undergraduate research experience here is phenomenal and is there for anybody who wants it."

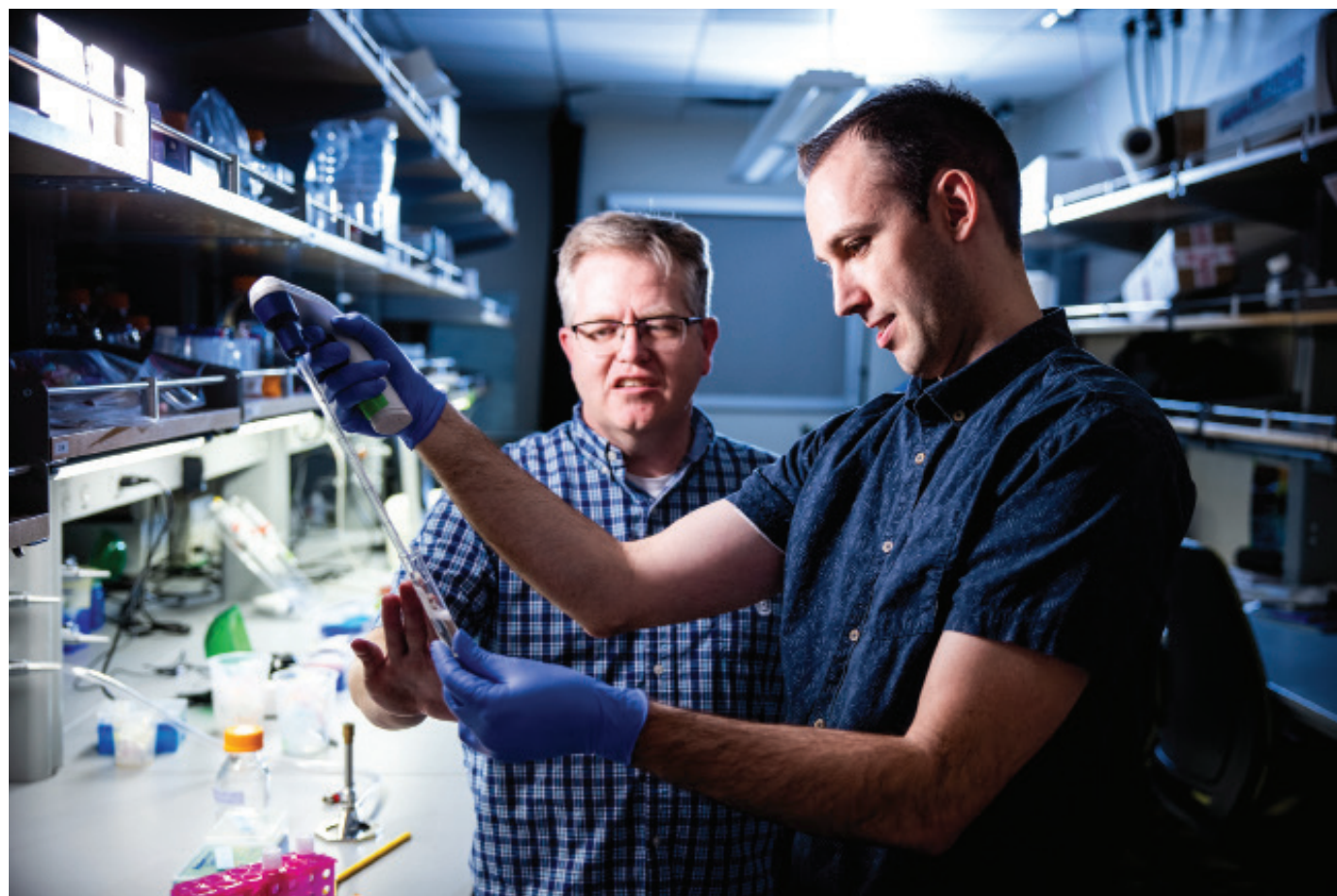


photo by BYU Photo



PAINTING WITH BACTERIA: *Connecting Art and Science*

by Hannah LeSuer



Students across campus combined their creativity skills with their curiosity for science by painting agar plates using harmless *E. coli* bacteria at the semiannual Agar Art Contest, sponsored by the College of Life Sciences Department of Microbiology and Molecular Biology (MMBIO).

Participants use seven genetically modified bacteria that are prepared by the MMBIO lab team. Inserting specific genes—including antibiotic resistance genes—into the bacteria, the lab team cultivates the desired colors. However, at first, the genetically-modified bacteria appear clear against the spongy surface of the agar, a jelly-like substance found in algae.

After students paint the bacteria on the nutrient-rich canvas, MMBIO staff place the tiny masterpieces into a body-temperature incubator. Since the Petri dishes are treated with antibiotics, only the bacteria with the genetically modified gene survive, ensuring that any harmful environmental bacteria do not grow. Overnight, the bacteria

feed on the stiff agar base of the Petri dish, bringing to life the vibrant colors of the genetically altered organisms. This year, more than 200 plates were painted by BYU students. The MMBIO staff chose three winners each semester based on effort, skill, and entertainment value.

Fall 2021 Winning Entries

First place: Sydney Scherbel, *Spooky Scene*

Second place: Lindy Mangrum, *First Vision*

Third place: Trenton Gibson, *Baby Yoda*

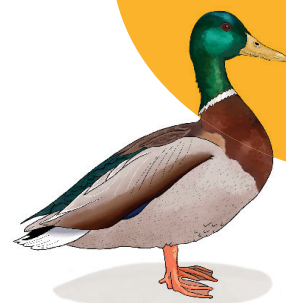
Winter 2022 Winning Entries

First place: Maura Brumbaugh, *Black Panther*

Second place: Lindy Mangrum, *The Mandalorian*

Third place: Asia Whitaker, *Kevin*

Mallard Duck



Mallard ducks can't dive, so they look for food underwater with their bottoms bobbing above the surface.

Also known as the Stanley crane and the paradise crane, the blue crane is the national bird of South Africa. Its long, black "tail" feathers are actually part of the bird's wings.

Blue Crane



Mandarin Duck



In Chinese culture, mandarin ducks represent love because they are thought to have only one lifelong partner. The ducks are often associated with weddings in China.

Pheasants for the President

The late President Boyd K. Packer frequently visited the Bean Life Science Museum and once asked to see a blood pheasant. Years later, Skip Skidmore obtained a magenta-feathered bird while on a trip to Beijing and displayed it in the pheasant exhibit of the museum. As President Packer was leaving the museum one day, Skidmore ran outside and called out to him, "Brother Packer, we've got a blood pheasant! You've got to come see it!" President Packer will always have a special place in Skidmore's heart. His specially requested pheasant still sits inside the Fred and Sue Morris Gallery.

BIRDS AROUND THE WORLD

by Allie Richael
illustrations by Emily Tribe

For Skip Skidmore, assistant curator of animals at the BYU Monte L. Bean Life Science Museum, variety keeps nature exciting. And the Bean Life Science Museum has variety around every corner, including in the waterfowl of the Fred and Sue Morris Gallery. Nearly all waterbird species in the world are on display at the museum, from the extinct Labrador duck to the Canada goose that Skidmore mounted himself.

"Out of 165 waterfowl species, according to ornithologist Frank Todd, we're missing 11," Skidmore says. Many of the remaining eleven species are nearly impossible to obtain. However, the museum overcame one such obstacle with its most recent acquisition: a pair of blue ducks from New Zealand.

"These are very special and sacred to the Maori people, and we're lucky to get these," Skidmore says. "They indicate the health of the environment." These iridescent ducks are usually found in cold mountain streams. They use their rubbery-tipped bill to scrape out larvae from rocks beneath the water's surface. New Zealand's ten-dollar note features a blue duck with three ducklings.

The Fred and Sue Morris Gallery also features a variety of pheasants and other birds. Perhaps the most valuable bird on display at the museum is the passenger pigeon. The species went extinct in 1914 when the last passenger pigeon, affectionately given the name Martha, died in the Cincinnati Zoo. The Bean Life Science Museum has a glass

case containing one mounted pigeon alongside two carvings provided by Fred Morris.

On a museum tour with the BYU Audubon Club, plant and wildlife sciences professor Randy Larsen took club members to the Life Science Museum research collection, which is typically closed to the public. Larsen says the museum stores approximately 10,000 bird specimens from around the world. The museum has more than 2,500 clutches of eggs as well. Many specimens are freeze-dried and kept in drawers for future research purposes, but some go on display throughout the museum.

With the number of natural history collections declining, Larsen recognizes the importance of the bird collection

Spur-winged Goose

Spur-winged geese have bony protrusions on the ends of their wings that they use for fighting during breeding season.



at the Bean Life Science Museum. "Thankfully, we've got good support here at BYU, and I think we'll be able to keep what we have," he says. Visitors are welcome to see this treasured collection of birds from across the world year-round.

CELEBRATING WOMEN IN SCIENCE:

Kamal Ranadive

by Hannah
LeSuer
illustration by
Emily Tribe



Kamal Ranadive

In 1917, when Kamal Ranadive was born in Pune, India, it was rare for a woman to occupy a seat in the local Fergusson College, especially in the sciences. But lucky for Ranadive, her father, who taught in the biology department, encouraged her to pursue an education. She graduated from Fergusson with a bachelor's of science in 1934 and continued her education to earn a doctorate in cytology from Bombay University.

Though Ranadive's parents nudged her toward medical school, her roots in biology were firmly planted. She became a biomedical researcher best known for her research on the links between certain cancers and viruses. She was the first scientist to find a genetic component of breast cancer. Additionally, Ranadive studied and helped develop a vaccine for *Mycobacterium leprae*, the bacterium that causes leprosy.

Ranadive's work was heavily influenced by her fellowship at Johns Hopkins University in Maryland, working with renowned cell biologist George Gey on tissue culture. After the fellowship, she returned to the Indian Cancer Research Center (ICRC) in Mumbai, where she established India's first tissue culture laboratory. As the director of the ICRC, Ranadive was a pioneer in animal modeling of cancer

development. Her research led to further understanding of leukemia, breast cancer, and esophageal cancer.

In 1973, Ranadive and eleven of her colleagues founded the Indian Women Scientists' Association (IWSA). Ranadive retired in 1989 and transitioned to work in Maharashtra's rural communities training women to work in healthcare and advising the population on health practices and medical care.

Ranadive encouraged Indian scholars and students abroad to return to India and use their knowledge to help local communities. Thanks to Ranadive's influence and contributions, the IWSA now has eleven chapters in India and provides scholarships and childcare options for women in science.

Ranadive died on April 11, 2001. Her widespread research continues to contribute to the discovery of improvements in medicine and cancer treatments today.

She received the Padma Bhusan award (third highest civilian award) for medicine in 1982.

Ranadive published more than 200 research papers on cancer and leprosy.

Google celebrated Ranadive's 104th birthday by dedicating a Doodle to her on November 8, 2021.

BYU ALGORITHM Accurately Predicts SUICIDAL RISK FACTORS



photo by Joseph Pearson, Unsplash

By Todd Hollingshead

Researchers from BYU, Johns Hopkins, and Harvard created an algorithm that can predict suicidal thoughts and behavior among adolescents with 91 percent accuracy. The machine learning approach is outlined in an article published in *PLOS ONE*, where researchers detail risk factors that are leading predictors of suicidal thoughts and behavior (STB) among adolescents.

Researchers were not surprised to see some of the risk factors that rose to the top—such as online harassment and bullying—but were a bit taken to see the heavy influence of **FAMILY FACTORS**. Exposure or involvement in serious arguments and yelling at home was a major risk factor. In addition, adolescents without a father in the home were 72.7 percent more likely to experience suicidal ideation.

The research implications are critical for **PREVENTION PROGRAMMING** and policymaking. Specifically, researchers hope policymakers use the STB risk profile and its associate rankings to prepare services, resources, and assessments aimed at school, community, and family settings.

Food STORAGE Practices May Pose SAFETY THREAT

By Angela Larson

BYU researchers assessed household food and water emergency preparedness practices across the United States, including the extent to which government emergency preparedness guidelines were followed. The study aimed to provide a more diverse sample in contrast to previous studies, as well as provide greater insight into specific storage practices.

From the sample of 572 Qualtrics panelists, it was found that many US households in the study met FEMA guidelines of storing a three-day supply of water and food for emergency situations. However, not all households followed these guidelines for the types of containers used to store **WATER**. Many households were using dangerous sanitizing methods in water storage containers. The improper storage techniques pose a **POTENTIAL HEALTH HAZARD** if the water is ingested in an actual emergency situation.

The researchers concluded that additional easy-to-follow, evidence-based information may better help citizens safely implement food and water storage guidelines.



photo by Jonathan Chng, Unsplash

Identifying CELLS that May Contribute to AUTISM

by Jenny Carpenter

Cell biology professor Arminda Suli and her graduate student, Annalie Martin, recently identified and characterized several new cell types that may contribute to autism spectrum disorder—and they’re all located in one specific part of the brain.

The **SUPERIOR COLLICULUS** is a small area of the brain that receives and integrates visual, auditory, and somatosensory inputs. It can influence how individuals perceive and respond to their social environment. To better understand how the superior colliculus works, Suli and Martin examined the homologous structure in the larval zebrafish brain. They discovered cells in the optic tectum can be grouped into 25 unique populations—several expressing **AUTISM-RELATED GENES**.

While identifying the contributing cells is not directly meant to cure neurological disorders, Suli sees it as a way to understand genetic diversity.



photo by Arminda Suli

Changing the Future with QUINOA

by Todd Hollingshead



photo by Pierre Bamin, Unsplash

As soils across the world become less fertile and more desert-like due to climate change, it’s getting harder for farmers, especially those in developing nations, to grow basic life-preserving crops such as corn, wheat, and rice.

Perhaps that’s why quinoa is called **THE MIRACLE GRAIN**. Not only is the tiny, circular seed rich in protein, dietary fiber, and B vitamins, but varieties of the crop like those being developed at BYU can also grow just about anywhere—salty soils, dry soils, high altitudes.

Since helping to first sequence the genome of quinoa five years ago—and subsequently sequence the genome of quinoa varieties from Europe and Asia as well—researchers at BYU have been developing **NEW HYBRIDS** of the crop that are even more heat tolerant, more salt tolerant and more capable of growing in very dry conditions.

“Our goal is to improve the nutritional status of populations of the developing world,” said Rick Jellen, BYU plant and wildlife sciences professor and quinoa expert. “We are at a crossroads, and we need to have crops that are more reliably productive. That’s why we are so invested in encouraging small farming communities to start growing quinoa.”

Poole Lab Wins BEST PAPER Award for VACCINE RESEARCH

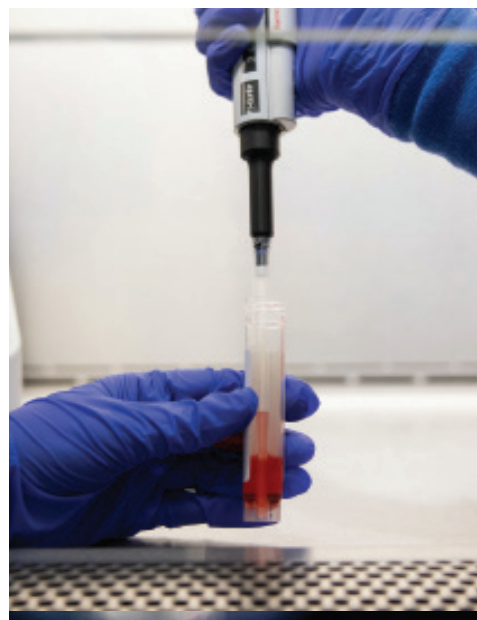


photo by Louis Reed, Unsplash

By Grace Christensen

Microbiology and molecular biology professors Brian Poole and Brad Berges, biology professor Jamie Jensen, and seven students from the Poole Lab were awarded Vaccines 2022 Best Paper Award for their research on **ATTITUDES** towards COVID-19 vaccination in the United States.

In the study, researchers showed that “longer testing, increased efficacy and development in the United States were significantly associated with increased vaccine acceptance.”

Of 316 survey respondents, 68 percent said they supported being vaccinated for COVID-19. But, the survey also revealed that **CONCERNS** about side effects and efficacy were consistent throughout all those who were surveyed. Poole found that messages promoting vaccination should focus on the benefits of vaccines and alleviate the concerns of those hesitant about them.

At BYU, the Poole Lab is focused on virology, and how early intervention is positively effective for most viruses and autoimmune diseases. Since its publication, Poole’s paper has been cited 255 times.

Deep Dive: A Look at HUMAN TRAITS in FISH



photo by Abhishek R, Unsplash

By Angela Larson

Would you consider yourself timid and submissive, or bold and domineering? For humans, determining our personality traits can provide great insights into how we understand our own behavior and how we work in groups. But, as it turns out, these **PERSONALITY** traits and behaviors aren’t unique to just humans.

In his research titled, “Is social dominance repeatable and inheritable? The behavior of social dominance in Convict Cichlids,” recent biology graduate Erik Johnsonn (’22) studies how a **FISH’S BOLDNESS** correlates with their position as a dominant member in group settings. In the study, he classified the fishes’ personality on a “bold to shy” continuum, and quantified the results using four behavioral assays. He chose to study cichlids in particular because they’re known to be very social, with easily observable hierarchical population structures.

Johnson’s work expands upon his previous research which studied behavioral “handedness” in the genus *Xenophalus umbratilis*—a prey species that lives in the same environment as the Convict Cichlids. Both studies explore using a model system of fish to observe traits within the fish and in humans.

Heat Therapy Mimics Some VASCULAR BENEFITS of EXERCISE

By Trevor Jones

Researchers from BYU found new details about mitigating negative effects of inactivity by using **PASSIVE HEAT THERAPY**. Applying heat therapy to limbs during periods of inactivity preserves artery health for individuals with reduced physical activity as if they had continued exercising.

Exercise science professors Jayson Gifford, Robert Hyldahl, and Brad Nelson—along with four students—examined twenty-one healthy, college-aged subjects who experienced disuse of lower limbs over ten days. Half received daily two-hour heat therapy on knee extensor muscles while the other half underwent a placebo treatment.

“Just by not moving for about two weeks, some college-age subjects’ arteries responded as if they were fifty-five or sixty years old instead of twenty years old,” said Gifford, speaking of those who received the placebo treatment. “This contrasted with little to no change in the vascular health of those treated with heat.”

The researchers plan to expand their work to examine other, more accessible methods of heat-based treatment.



photo by BYU Photo

SAYING HELLO

NEW APPOINTMENTS



Laura Bridgewater
College of Life Sciences Dean



Richard Gill
Undergraduate Studies Dean



MacKay Chandler
LSIT Development Architect



Amanda Rees
BYU Sensory Lab Manager



Nancy Morrill
MMBIO Academic Program Coord.



Roberta Larsen
Bean Life Sciences Museum Office Manager