

AGAR ART + DR. GROSE DEVOTIONAL + STUDENT SPOTLIGHTS

MMBIO

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Pg. 14

RESTORING SIGHT

Dr. Jason Croskrey, ophthalmologist

Jason Croskrey, a BYU graduate and ophthalmologist, has restored sight to many patients. He relates his experience as an eye surgeon in Afghanistan and how his faith in the gospel helped him to persevere during those trying circumstances.

CHAIR'S CORNER



Joel Griffitts
Department Chair

THINGS AS THEY REALLY ARE

I've been contemplating the upheaval of 2020 in light of our quest as life-long learners to see things clearly — to see things as they really are.

I'll always remember the day when, as a knowledge-thirsty graduate student, I visited with the eminent biologist Bruce Alberts. On his laptop, he showed me what was then a new computer-generated animation depicting the bacterial DNA copying apparatus known as the replisome. I was spellbound by the thing so clearly depicted on that screen: an intricate bionanomachine capable of synthesizing new DNA of precise template-informed sequence at the astonishing rate of 1000 nucleotides per second. The replisome coordinates leading-strand and lagging-strand synthesis with seemingly decisive cycles of primer deposition and polymerase handoff — all of this orchestrated by molecular robotic arms, undeterred by Brownian jitters, to secure extreme localized order in a universe moving relentlessly toward randomness.

That 60-second video, with all its flaws and oversimplification, was the product of five decades of meticulous

scientific investigation. Clarity only came after an enormous amount of work. The questions we all grapple with today go beyond the esoteric matter of DNA replication: What should I do to help shore up this deadly pandemic? How am I supposed to respond to injustices in the world? How should I deal with my financial distress? How do I bolster my faith when some sources of strength have retreated for a season? Our need to resolve these conundrums and get a clear view of things requires the willingness to ask, the resolve to search, and the courage to go where the evidence points us. Sometimes the evidence is raw data, sometimes it is expert opinion, and many times it is an inner voice that whispers truth. Trust data, listen to experts, and most importantly, follow promptings even when they take you in uncharacteristic directions. That's all part of the thrill of life-long learning and progression.

Like the replisome expending energy to enforce order over chaos, our diligent application of science-inspired principles will help us to find clarity in a world buzzing with conflicting ideas.

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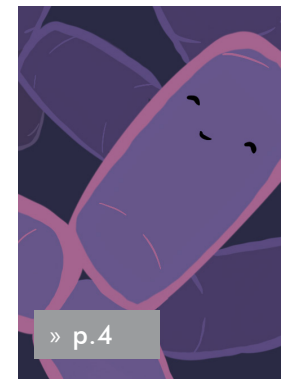
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FEATURES



» p.4



» p.10



» p. 10

4 FINDING YOUR PURPOSE

MMBio professor Julianne H. Grose discusses the process of finding our own individual talents and purposes, and how our testimony aids in this search.

12 WHAT'S NEW

Discover new changes made to BYU MMBio's organization.

14 RESTORING SIGHT

Jason Croskrey, a BYU graduate and Opthamologist, has restored sight to many patients. He relates his experience as a surgeon in Afghanistan and how his faith in the gospel helped him to persevere during those trying circumstances.

18 UNDERGRADUATE SPOTLIGHTS

Our undergraduate students have many abilities and talents. Learn about how they use these gifts to extend scientific frontiers.

PLUS...

10 Agar Art Festival

24 History of MMBio

26 MMBio Events



» p.23

BYU Devotional Address

FINDING YOUR PURPOSE



Julianne H. Grose
May 21, 2019

My great academic interest in life has been biology. I am not certain if it stems from my love of the outdoors or the fact that I was raised as one of ten children in a house teeming with life. There are many big questions encompassed by the study of biology. For example:

- What exactly is life?
- How do living things function?
- How was the great diversity of life created and how is it evolving?
- With the challenge of the great diversity of life, how do we classify life?

I love each of these questions, but my favorite question is a combination of them: What is the unique role of each diverse form of life? I believe that every species has an important role to play on our planet.

In All of Their Variety

The diversity of life is astounding. One measure of diversity on our planet, referred to as the species number, is estimated at about 11 million species of cellular life (life that is composed of cells). We have begun to catalog and understand only a small fraction of these species, and there is life beyond cellular life. The most abundant biological entities on the earth are viruses, estimated to be greater than ten to the power of thirty-one! In fact, Costa P. Georgopoulos, a virologist at the University of Utah, compared the mass of all viruses on the planet with the mass of all humans. Although viruses are microscopic, if we were to pile them up on a giant scale, viruses would weigh more than all of the 8 billion humans on the planet, even if we were all sumo wrestlers.

The abundance and diversity of life means that biologists will always have something to do. It also means that in order to succeed on the planet, a species must have a purpose and place—much like trying to find a place at the family dinner table amid nine hungry siblings.

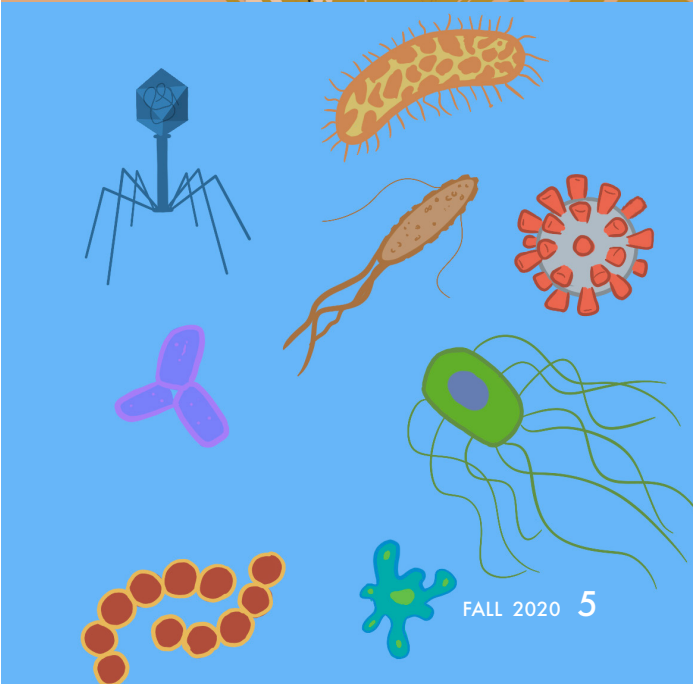
There are many examples of the unique and essential function that a single species plays and its ecological impact. For example, several studies show that removing the sea otter from a habitat may lead to an increase in sea urchins and a corresponding disappearance of kelp beds. This alters wave action and siltation, having dramatic impacts on the species present in the habitat. In these studies the effect the sea otter had on the ecology was more substantial than what was expected from their sheer number.



I study bacteriophages, which are viruses that can infect and kill bacteria. The word bacteriophage literally means “to eat bacteria.” Most people think of a virus as something bad or something that makes them sick, but viruses also contribute to the health of our planet by regulating the levels of bacteria in an ecological system. In addition, viruses have useful purposes. They have recently saved the lives of individuals infected with antibiotic-resistant bacteria. In these cases the viruses could infect and kill bacteria that are resistant to antibiotics, providing an alternative form of treatment when there are no other treatment options.

In fact, some of the viruses isolated by students here at BYU are being used to treat a sea turtle, Shelly, who has an antibiotic-resistant bacterial infection. Viruses can be very specific for the type of bacteria they kill, seeking out the bacterial pathogen and leaving the rest of our body full of other bacteria that are actually helping us—and Shelly. And there are a lot of those “good” bacteria. Research shows that we have as many bacterial cells in us and on us as we have human cells. This is referred to as our microbiome. Our microbiome is essential to our health.

Thus both viruses and bacteria—which most people have thought of as bad for so many years—have an important place in our individual health as well as in the ecological health of our planet. This interrelated nature of life is complex and highly variable, as are the individual and essential roles that each form of life plays.



A Unique Role

I have taught biology at BYU for eleven years now, interacting with hundreds of students each year. What has impacted me the most are these same truths: each student has an individual and unique role to play and each student has unique talents and gifts that are not quite the same in any other person. A well-known but beautiful example of this is found in the life of Anne Frank.

On a recent trip to Amsterdam, I was able to visit the secret annex in which Anne's family hid for more than two years. Although I had read Anne's diary in school when I was young, there were many aspects of her story that I had never heard about before. These aspects display how Anne came to recognize the role she could play through the use of her talents.

Anne's family lived in Germany and fled to the Netherlands in 1933, due to the threatening political climate. As the Nazi army moved toward Amsterdam, Anne's father, Otto Frank, built a small annex in the back of his shop in which the family would live for more than two years, along with the van Pels family and Fritz Pfeffer. The eight of them had to rely on the bravery and generosity of six other individuals who risked their lives to help the family hide and to bring them food rations. These individuals were their friends Johan and Bep Voskuijl, Miep and Jan Gies, Victor Kugler, and Johannes Kleiman.

On Anne's thirteenth birthday she was given a notebook that she immediately began using as a diary. During the two years of hiding in the cramped space, Anne's outlet was writing. She wrote many things, including her thoughts, feelings, poems, and tales. While in hiding, the Frank family also listened quietly to the radio for news and plotted the path of the Allied forces as they moved toward Amsterdam. In 1944, while listening

to the radio, Anne heard the following advice given by the Dutch cabinet minister Gerrit Bolkestein:

"History cannot be written on the basis of official decisions and documents alone. If our descendants are to understand fully what we as a nation have had to endure and overcome during these years, then what we really need are ordinary documents—a diary, letters from a worker in Germany, a collection of sermons given by a parson or a priest. Not until we succeed in bringing together vast quantities of this simple, everyday material will the picture of our struggle for freedom be painted in its full depth and glory."¹

Anne immediately had a purpose. She was inspired to rewrite her diary into a book that she hoped to share with the world. Over the next four months, she worked tirelessly to abridge the last two years of her writings. She rewrote her diary for clarity and replaced real names with pseudonyms for publication. Anne expressed to her family her purpose: after the war, her book on the experience of living in the annex would be published, giving the world a piece of the story of World War II. Somehow, through pathways still unknown today, the police became aware of the family's hiding place in August 1944. All eight of the individuals in the secret annex were sent to concentration camps. All of the items from the annex were also confiscated. However, Otto Frank's secretary, Miep Gies, visited the annex shortly after the family's capture and was able to retrieve Anne's diary.

Of the eight people in the secret annex, only Anne's father, Otto, survived the concentration camps. After the war, he returned to Amsterdam to look for his family and Miep Gies gave him Anne's diary. Anne's father worked hard to get it published. He was rejected several times and it took him two years to get it published, but he never gave up. Today, millions of people have read the diary. It has inspired countless individuals, including

survivors of similar unimaginable difficulties.

I am inspired by Anne's story, her writings, and her belief that one person can make a difference. But I also know that it is not just her story. It is the story of her family, including her father, who worked to keep the family safe for so many years and who, after so much sorrow, was blessed to fulfill his daughter's wishes and to publish Anne's diary. It is the story of the six other individuals who risked their lives to hide the family in the annex, including Victor Kugler and Johannes Kleiman, who were also taken captive by the police. It is the story of one person's great talents—Anne's—interacting with many other great talents.

Our Own Individuality

The big question of life is this: How do we find our own individual talents and purpose in life? During my time at BYU, I have spoken with many students who feel unsure of their future and the path that they should take. Too often we compare ourselves to the one person who seems sure of their path rather than to the twenty who, like us, are searching for their path. What I do know is that in all cases our ability to utilize our time, energy, and talents is completely dependent upon our Father in Heaven and on our Lord and Savior, Jesus Christ.

Not only are we dependent on Them to become our best selves, but this is Their greatest desire for us. They have literally done everything that can be done in order to help us succeed in this life and in the next. Our Savior has given His life in the single most powerful act of love to ever occur: the Atonement. Through the Atonement, each of us can find the best use for our talents and develop those talents beyond what we would ever be capable of alone. I believe that there is no greater gift than to help someone develop to the fullest of their potential, to become the person they want to be, and to use their talents to the fullest extent.

I bear my testimony to you that our Father in Heaven cares for each of the students at BYU as individuals and that He will help you find your place in life. Some of the greatest spiritual experiences of my life have come from praying for students who have discussed a problem with me. I would like to share an example with you.

On three separate occasions, I was searching for funds to enable a student to be trained in scientific research. Each one of these students had approached me with a unique position as well as a great desire to be trained and to use their talents. However, in each case I did not have the funding to accept another student. Knowing that each student needed the funds immediately and considering that it usually takes six to twelve months for me to get grant funding, I turned to prayer.

On each of these rare occasions, a funding opportunity came to me out of the blue with little effort on my part and within a few days of my praying for these students. Let me tell you that this does not happen! Nor is it likely to happen to me again, unless the Lord is moving mountains on a student's behalf. Scientific research funding is exceptionally difficult to come by. Normally I spend several months and many long hours searching out appropriate grants, writing proposals, and obtaining the necessary preliminary data for funding. I know that it was the Lord's hand in each of these three instances and that when the students and I had done all we could, doors were opened to allow the students to develop their talents. These remarkable experiences and several others have given me a strong testimony of our Savior's great love and personal interest in each of you.

Having said this, I don't want to mislead you by saying that life will be easy or that all of our prayers will immediately be answered in such an obvious way. But what



ANNE FRANK STICHTING, AMSTERDAM, PUBLIC DOMAIN, WIKIMEDIA COMMONS

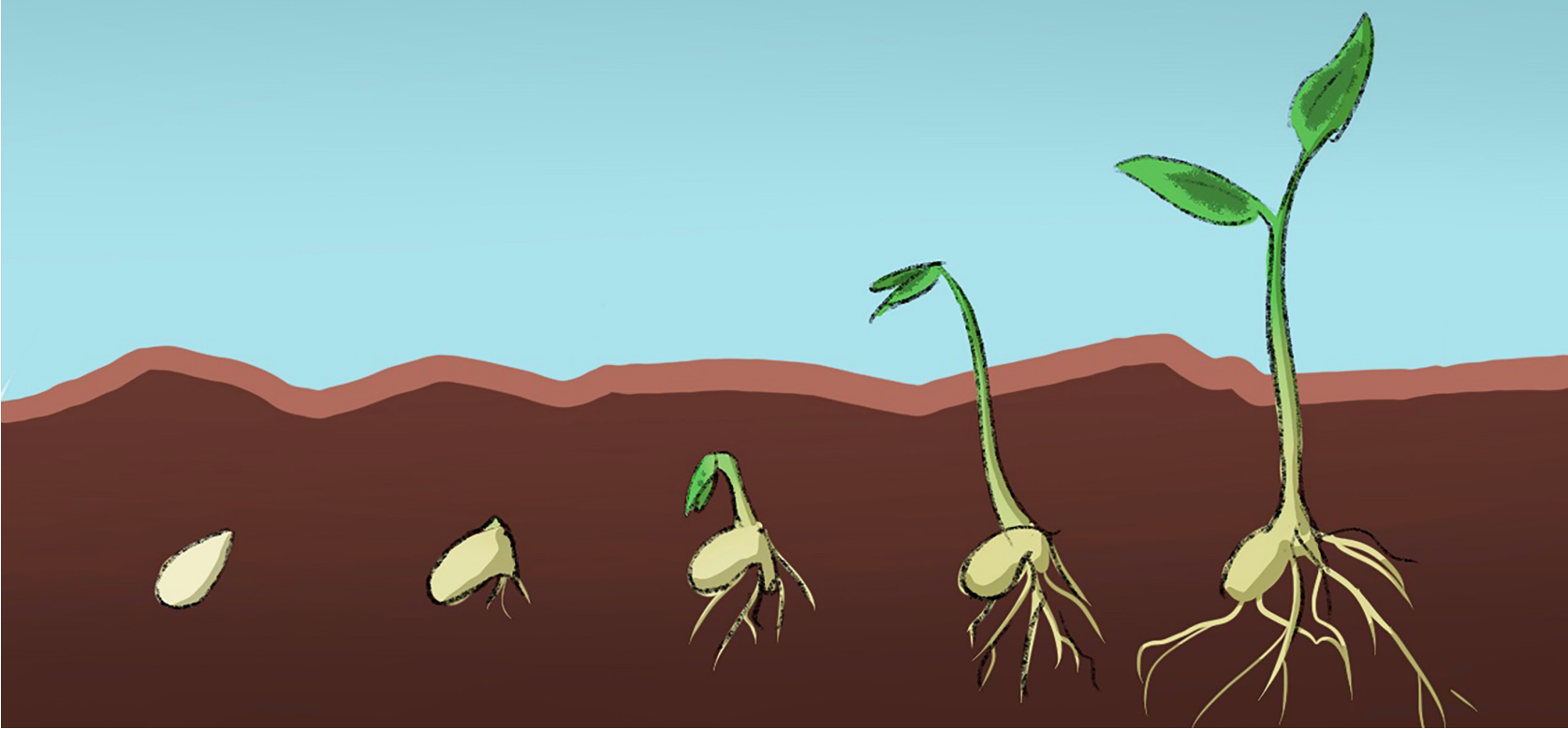
What has impacted me the most
are these same truths:
each student has an individual
and unique role to play and each
student has unique talents and
gifts that are not quite the same
in any other person.

I do know is that when we rely on our Savior and ask for His help, He will help us, and we can have our “peace [be] as a river, and [our] righteousness as the waves of the sea” (Isaiah 48:18). Recently, I have noticed the choice of words used in this scripture. It does not say our peace will be as a still pond. I believe this is on purpose. I believe that if we are trying to develop and use our talents, we will have help from our Savior but will still encounter difficulties. In addition, we are not perfect and we make mistakes. This is perhaps the flowing of the river of which Isaiah spoke. If we are continually moving forward—over all of the rocks and through the twists and turns—and relying on the Savior, He will be there for us to help us and guide us. I bear my testimony of this. The Holy Ghost has warned me away from poor decisions. He has warned me from pathways that lead to sin and unhappiness. Our Heavenly Father is most generous, forgiving, and merciful. He will help us to overcome our weaknesses. They are never too great, and it is never too late, but we need to seek Him.

The Effort of Seeking

A few years ago, I was in the grocery store when I felt a little bit of pressure on the side of my pant leg. It was a young child of two or three who had obviously gotten my pant leg mixed up with his own mother’s. He had instead grabbed my leg and was walking by my side. When I stopped and looked down, the young child of course looked up. I could see the moment in his expression when he recognized his error, and he immediately panicked. Just like this young child, we too can be deceived and lose our way. We need our Heavenly Father, Jesus Christ, and the Spirit of the Holy Ghost. Jesus Christ is the “author and the finisher of [our] faith” (Moroni 6:4). Only by the Spirit will any of us receive confirmation of the truth of any matter, including our individual worth and the love that our Father has for us. Our Father is no respecter of persons; He loves each and every one of us. He knows our potential and unique talents better than anyone. There is no substitute pant leg.

Seeking out truth through the scientific method of observation, hypothesis, and experiment is what biologists do. I leave everyone, including myself, with the admonition of Alma to experiment upon the word—or, in other words, to ask the Lord about our individual worth, our talents, and the pathways that we should go on to become our best selves. I challenge us to plant a seed, to nourish it, and to let it grow.



“But if ye will nourish the word, yea, nourish the tree as it beginneth to grow, by your faith with great diligence, and with patience, looking forward to the fruit thereof, it shall take root; and behold it shall be a tree springing up unto everlasting life.

And because of your diligence and your faith and your patience with the word in nourishing it, that it may take root in you, behold, by and by ye shall pluck the fruit thereof, which is most precious, which is sweet above all that is sweet, and which is white above all that is white, yea, and pure above all that is pure; and ye shall feast upon this fruit even until ye are filled, that ye hunger not, neither shall ye thirst.

Then, my brethren, ye shall reap the rewards of your faith, and your diligence, and patience, and long-suffering, waiting for the tree to bring forth fruit unto you.” [Alma 32:41–43]

Notice how many times Alma entreated us to have patience. If you find yourself struggling at times, or if you are in the midst of your long-suffering, take heart and have faith. Believe that you have a divine purpose. Believe that you have unique talents that are unmatched in the world. Work hard and pray. The Lord will help. He will direct you to your best self—to your own ecological niche. He will open doors for you. You will find what He wants you to do, and you will bless countless others in doing it. In the name of Jesus Christ, amen. ■

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Notes:
1. Gerrit Bolkestein, radio address, Radio Oranje, 28 March 1944; quoted in The Diary of Anne Frank: The Critical Edition, ed. David Barnouw and Gerrold van der Stroom, trans. Arnold J. Pomerans and B. M. Mooyaart-Doubleday (New York: Doubleday, 1989), 59.

SUGGESTED READING

Anne Frank, *The Diary of Anne Frank* (New York: Random House, 1956).

Anne Frank House, annefrank.org/en.

Melissa Müller, *Anne Frank: The Biography*, trans. Rita and Robert Kimber, 2nd ed. (New York: Metropolitan Books/Henry Holt and Company, 2013).

“75 Years Ago: Announcement of Establishment of Institute for War Documentation,” Netherlands Institute for War Documentation (NIOD), 28 March 2019, niod.nl/nl/nieuws/75-jaar-geleden-aankondiging-oprichting-instituut-voor-oorlogsdocumentatie.

Biodiversity and Bacteriophage Abundance

Alessandro Minelli and Lucio Bonato, “Diversity of Life,”

Curtis A. Suttle, “Marine Viruses—Major Players in the Global Ecosystem,”

Impact of the Sea Otter

Jessica L. Clasen and Jonathan B. Shurin, “Kelp Forest Size Alters Microbial Community Structure and Function on Vancouver Island, Canada,”

James A. Estes, Alexander Burdin, and Daniel F. Doak, “Sea Otters, Kelp Forests, and the Extinction of Steller’s Sea Cow,”

James A. Estes, M. Tim Tinker, and James L. Bodkin, “Using Ecological Function to Develop Recovery Criteria for Depleted Species: Sea Otters and Kelp Forests in the Aleutian Archipelago,”

James A. Estes, M. Tim Tinker, Terrie M. Williams, and Daniel F. Doak, “Killer Whale Predation on Sea Otters Linking Oceanic and Nearshore Ecosystems”

AGAR ART



The MMBio Department hosted their annual Agar Art Competition in March. This joint event with BYU's Art Department encouraged students to participate in creating art through scientific techniques. Having an event that merges two completely different interests is not only fun, but allows for students to learn and experience something completely outside of what they usually do.

This year, the MMBio Department encouraged students to create agar artwork related to the Restoration of the Gospel as we celebrate the glorious work that began 200 years ago in 1820. Students demonstrated their artistic abilities on a gelatin-like canvas using nothing but pigment-forming bacteria that have to be inoculated onto the medium and grown up before the brilliant results emerge as literal human-bacteria artistic collaborations.

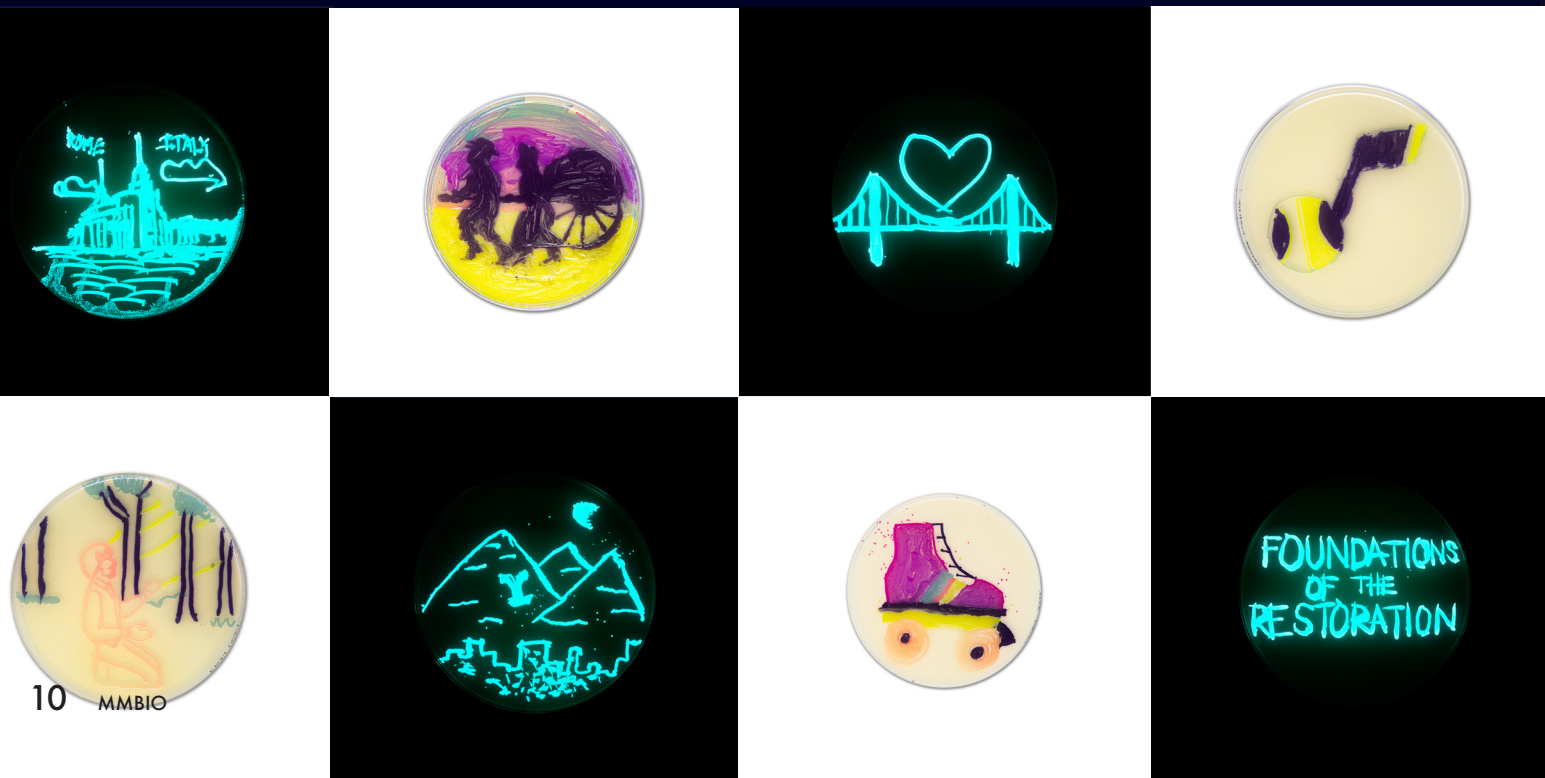
Winners

Allison Michas (Emma), Rachel Skabelund (Charles Darwin) and Lynette Juarez (First Vision)



Runners Up

Rachel Cannon, Emma Steimle, Joshua Teasdale, Tsz Yin Chan, Chrissy Egbert, Megan Biesinger, Maddie Frey, Andrey Chou, Dallin d'Huart, Candice Ward



What's New?

New MMBio Chair

Dr. Joel Griffiths accepted the position of Department Chair for the Department of Microbiology, Molecular Biology in July of 2020. Dr. Griffiths has served as the MMBio Graduate Chair since 2012. An excellent faculty member and researcher, Dr. Griffiths will continue the legacy Dr. Richard Robison, the former department chair, has helped create.

For the past six years, Dr. Robison has expertly led the MMBio Department. The number of students enrolling in this department steadily increased

under Dr. Robison's leadership as he inspired an engaging environment for students and faculty alike. His ability to mentor, teach, and lead has greatly improved the MMBio Department.

While we will greatly miss Dr. Robison, we look forward to a tradition of continued excellence under the leadership of Dr. Griffiths.



Richard A. Robison



Joel S. Griffiths

New Staff



Terri Moser

Terri Moser, the MMBio Department's newest Business Manager, was born and raised in the High Desert of Southern California. She recalls, "It was a place where building forts out of tumble weeds was our idea of a tree house." As the department's Business Manager, Terri's responsibilities include managing department budgets and financial transactions, scheduling courses, and providing general administrative support to the department. She helps the department run efficiently and loves that she can solve problems and help others. "Every task that I do is to serve someone in the department—professors, staff, or students," said Terri. She particularly enjoys working at BYU because people are kind and strive to do what's right. She also appreciates the sense of community she finds here where people support and love each other. Additionally, Terri appreciates being able to attend BYU devotionals and wellness classes, which help her "feel enriched and continually inspired to be [her] best self professionally and spiritually". Terri loves spending time with her family, watching movies, reading, and exercising.

New Faculty



Brett E. Pickett

Brett Pickett, originally from Sandy, Utah, is the newest faculty member in the Department of Microbiology and Molecular Biology. Dr. Pickett is "in awe of how we're created and how everything works the way it should". This awe led him to pursue his interest in the subject and obtain a degree in Microbiology from BYU.

He shared the following, "I think it's interesting to see how things work, how DNA works, and how our bodies work". Dr. Pickett loves sharing his enthusiasm for the subject with his new students. As a professor, Dr. Pickett enjoys seeing the "aha" moments of students when they learn something new and really understand how it applies to our every day lives. He is especially excited to help students understand the world around them and to arm them with the tools necessary for their future careers.

Dr. Pickett's research primarily focuses on host cell responses to infection, using genome-wide monitoring to observe how gene expression is altered when cells are attacked by viruses and bacteria. His research also includes comparative genomics where he looks at the sequences of viruses and bacteria to discover how and why they mutate in an attempt to predict where they will act.

Dr. Pickett particularly enjoys working at BYU because he believes that it has the perfect blend of science and the gospel. "There are lots of institutions that do one or the other, but doing them both at the same time and doing them well is something that is unique to BYU." Working in the life sciences at BYU allows him to show students that not only are science and the gospel compatible with one another, but they actually enhance each other. He believes working in an environment like BYU, not only blesses his life, but allows him to share knowledge and understanding with students that will go on to positively impact the world.

In his spare time, Dr. Pickett enjoys spending time with his family, water skiing, golfing, and has recently become interested in archery. He is excited to be in a place like Utah where there is a wide variety of outdoor experiences he could incorporate into his schedule.

Restoring SIGHT

Jason Croskrey was educated at BYU as a student majoring in Molecular Biology. He became interested in DNA and how various molecules affect other organisms. While at BYU, he participated in researching the DNA of various plants. His time as a molecular biology major instilled in him the lifelong skills of dedication, inquisitiveness, and a thirst for knowledge. Dr. Croskrey affirms that his time at BYU prepared him for his future career in medicine. He credits his ability to analyze scientific data and papers with the skills he developed as a student. He recommends for all students to get involved and fully utilize the resources that both BYU and the MMBio Program have to offer. His interest in the sciences led him to pursue a degree in medicine. After graduating from the Medical College at Wisconsin (2013), Dr. Croskrey became an ophthalmologist where he primarily performs surgeries, including cataract removals, Lasik, and laser surgery to treat glaucoma. The knowledge that enlightened his mind prepared him for the tasks he would face as an ophthalmologist.



Dressed in not only scrubs and gloves but full body armor, Dr. Jason Croskrey begins an open globe eye operation unlike any he has previously performed. As he selects his surgical instruments, a siren blares alerting the base to the presence of enemy fire. Located 7,000 miles from home, it seemed more than a million miles from where his journey as a college student began.



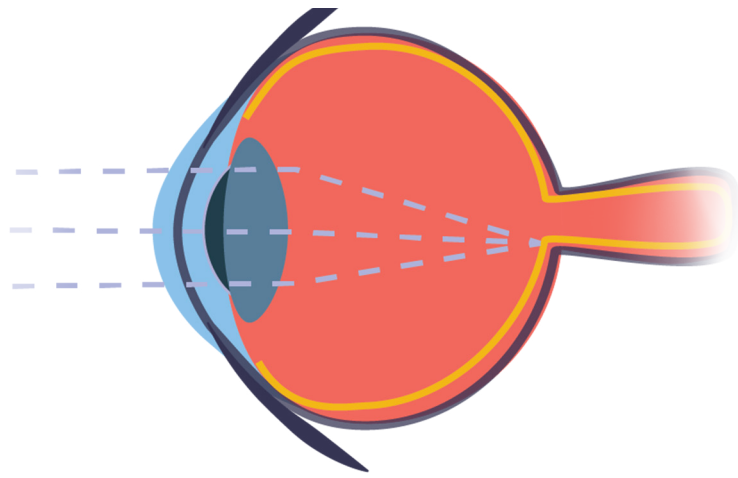
Dispelling the Darkness

His journey to becoming an ophthalmologist was not unmarred by difficulties. As a freshman at BYU, he recalled times when despite his best efforts to prepare for class and go to tutoring labs he was unable to complete his chemistry homework successfully. After questioning if he should remain in college or return home, he resolved to redouble his efforts and work as hard as he possibly could to be a successful student. Dr. Croskrey's efforts enabled his admittance into the Medical College of Wisconsin. Although his medical school days were arduous, they were also some of his most rewarding because he could see the future he had fought so hard for. In his times of darkness, Croskrey found light through determination and his belief in God.

A promise given at a fireside for the Spokane Washington Temple Dedication particularly impacted his thinking and behavior. President Gordon B. Hinkley declared to those in attendance that if they would refrain from doing schoolwork on the Sabbath day and work as hard as they could, their efforts and time would be magnified as if they had that extra day. Dr. Croskrey's observance of the Sabbath day remained extremely important as he began his career as an ophthalmologist and during his time in Afghanistan.

Dr. Croskrey asserts that he has been able to find balance and peace as he has prioritized the Sabbath day especially in Afghanistan. It was on Sunday that he was able to spend time talking with his wife and four children and attend church with a few dozen others at a servicemen's group.

Despite the challenges of being away from his family, serving as the chief eyecare provider in Afghanistan was a spiritually strengthening experience. He was able to set aside time to reflect on his family and to truly study the scriptures, particularly the "Come, Follow Me" curriculum. Dr. Croskrey says, "taking time away from family, gets you to think about them more and to pray more." His ability to find light even during dark and difficult times enabled him to light the lives of others in both a physical and spiritual sense.



Spreading Light

As an ophthalmologist, Dr. Croskrey performs various surgeries all of which enable his patients to more fully process light without obstruction. During his time in Afghanistan, he served as the primary provider for all eye care of United States citizens in the country. He was responsible for any trauma to the eye or area around the eye. Croskrey typically treated open globe injuries, which occurs when the eye is broken from blunt force trauma or sharp projectiles.

While serving in Afghanistan, there were times when they would come under enemy fire. During times such as these, individuals who were outside would take cover and run to a bunker after the all clear was given. Dr. Croskrey is particularly grateful for the technology which detects when incoming fire may be coming. Even in the midst of uncertainty and danger, he felt that he was safe. Dr. Croskrey is grateful for the opportunity he had to serve his country where he was able to protect and heal members of the United States military. His respect and admiration for all who serve in the military for the cause of their country is immensely strong.

Dr. Croskrey loves giving sight back to patients and seeing the joy they experience when they are healed. He particularly loved his time in Panama as part of several humanitarian trips with the Air Force. Utilizing the Spanish he learned as a missionary in Guatemala, he helped bring sight to individuals whose cataracts were so severe, they were blind. Dr. Croskrey lights the way for both students and fellow alumni alike with his example of dedication both to his country and to healing people. ■



MMBIO at BYU



BYU MMBIO



BYU Department of Microbiology
and Molecular Biology

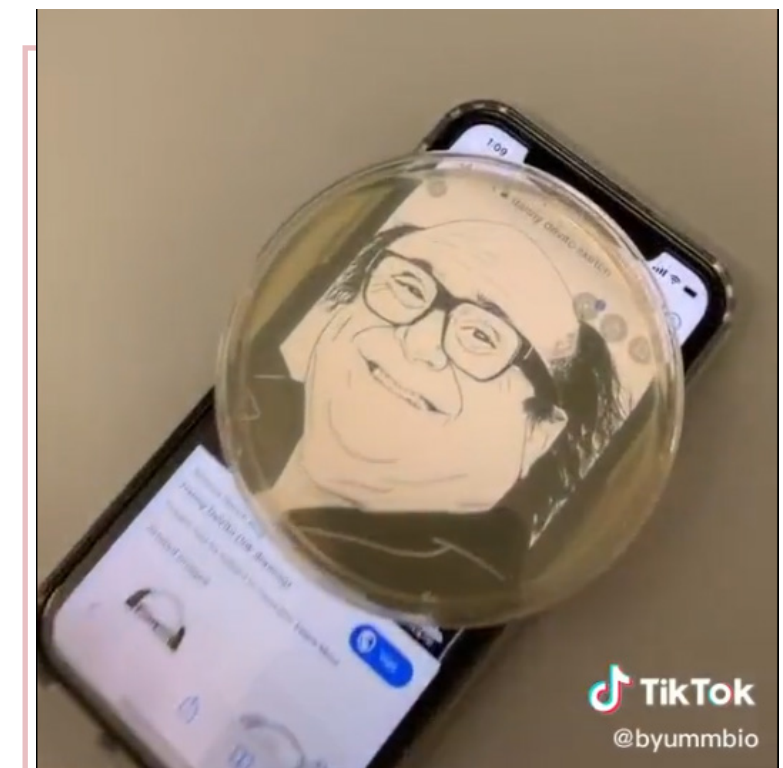
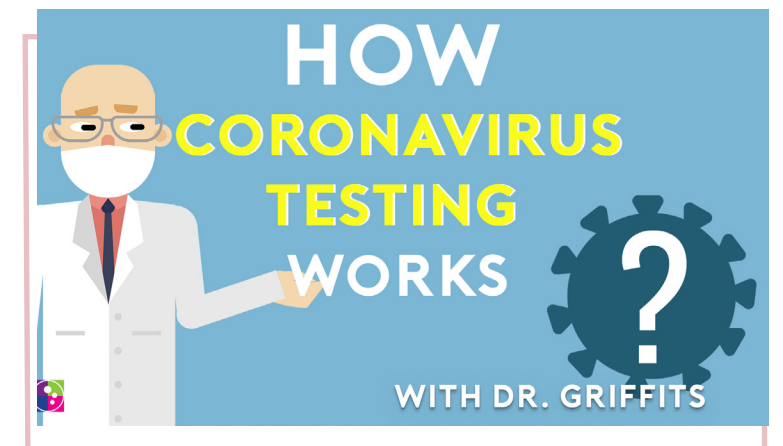


byummbio



BYU MMBio Department

CONNECT WITH MMBIO



Emily Doxey is from Modesto, California. She is a Junior in Microbiology. She works in the Robison lab researching antibiotic resistant bacteria. They are working with the Engineering Department to develop faster methods of identifying resistance to better treat patients. She also works as a TA for Phage Hunters under Dr. Breakwell. In Phage Hunters, she is helping undergrads study phages to learn more about their genomes and infection patterns.

Emily enjoys playing board games and is quite a competitor when it comes any classic card game. Emily is a triplet with a sister at ASU and another at UCLA. She enjoys visiting Yosemite National Park with family and can be commonly found at the Coliseum watching an Oakland A's baseball game. After graduation, she hopes to get a PhD in Microbiology studying infectious diseases. One day, she hopes to work in a government lab researching ways to improve people's lives with better treatments.

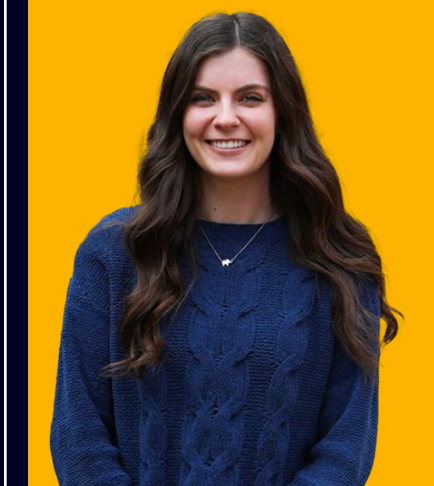


Stephanie Melendez is a senior in Medical Laboratory Science from Houston, Texas. As a first generation student and one whose parents are both from Central America, she is honored to be a student in the limited enrollment MLS Program. She is currently an intern at Timpanogos Regional Hospital and is enjoying the new pace and hands-on lab work. As an intern, she has the opportunity to work with patient samples and perform a variety of tests to discover what is causing the ailment. After Stephanie finishes up her internship,

she hopes to work full time as a certified medical laboratory scientist. Stephanie's studies and internship occupy the majority of her time, but with the little free time she finds, she enjoys playing volleyball, board games, or basically anything competitive. Stephanie is recently married and couldn't be happier. Stephanie enjoys the MLS major because she likes being able to help patients and enjoys working in the lab of the hospital. She encourages anyone who might be interested in a challenging yet rewarding major, to give MMBio a shot.

Rachael Ochsner is from Las Vegas, Nevada. She is a junior in the Microbiology major. She has been working in the Erickson lab for about a year and loves researching immunology. She is looking at the genes and regulatory factors associated with capsule production for a mastitis strain in *E.coli*. This capsule allows for the *E.coli* to evade the immune system and cause infection. She wants to figure out how to disrupt the capsule production for the immune system to effectively annihilate the pathogen.

Rachael really enjoys nutrition and exercise, which is one of the reasons she enjoys studying about immune health. When she isn't in the lab she can be found hiking the mountains of Provo or circling the roller skating rink at Classic Skating. She also likes rock climbing, skiing, and making her famous avocado cookies. After graduation, she wants to participate in the field of epidemiology either through medical school or graduate school.



Jessica Townsend is from Laurel, Montana and is a senior in the Microbiology Program. Jessica is in the Weber Lab, which focuses on immunology research. Specifically, she is researching CD5 which is a T-cell co-receptor, in order to find better treatment options for those who have periodontal disease. She is using oral mucosal and gingival epithelial cells co-cultured with splenocytes to compare T-cell activation levels between CD5 knockout and wildtype mice.

When Jessica isn't busy with schoolwork and research, she enjoys playing pickle ball, soccer, and doing basically anything outdoors with her husband. Jessica enjoys visiting family in Montana with the added benefit of riding ATVs in the Big Sky Country. After graduation, Jessica looks forward to working with patients as a Physician Assistant.

Erin Gill is from England's Northeast region. She is currently a senior in Microbiology and will be graduating this December. She has been in the Poole Lab for about two years studying the Nalp1 gene and how it affects autoimmunity. She spends a lot of time taking care of cell lines. She loves the practical side of science and genuinely enjoys working in the lab.

Erin enjoys spending time in the outdoors with activities such as rock climbing, kayaking, and hiking. Some of her favorite hikes have been around Southern Utah. After graduation, Erin plans on working in industry and eventually wants to go into medical research.



Talom France is a senior in Microbiology from Heber, Utah. Talom is in the Edwards lab performing experiments on mice and PTSD to see if certain drugs affect the memory retention of dramatic events. He is trying to find out if certain drugs administered prior to trauma can ameliorate the severity of PTSD

Talom enjoys running, spike ball, and volleyball. Talom runs on the track and field team at BYU and recently completed a sub-four-minute mile. After graduation, Talom plans on either going to medical school to become a podiatrist or running track professionally.

OUR GRADUATE STUDENTS

Jessica Hawkins

PhD Student
McCleary Lab

I am interested in studying how PhoE-dependent phages interact with their hosts. PhoE is an outer membrane porin that allows for phosphate to be transferred across the inner membrane of *E. coli* and has been shown to be a receptor for a few known phages. Little, however, is known regarding which PhoE sites are necessary for phage attachment and which phage genes encode for the receptor binding protein. We also want to

analyze the impact phage receptor binding proteins have had on their evolution. Better understanding how phages attach to their hosts, and what tactics they use to evolve, could aid in the development of more advanced phage therapeutics.

Melinda Moss

PhD Student
Griffitts (MMBIO) & Taylor (NDFS) Labs

Lactose is a by-product of cheese and whey protein manufacturing that is generally considered a low-value ingredient in the food industry. Rare sugars on the other hand are highly valued due to their low-glycemic index and

reduced calories, and in recent years a lot of work has been done to find and understand the enzymes that can convert abundant sugars like fructose to rare sugars. The goal of my project is to optimize the conversion of dairy lactose to rare sugars by cloning and expressing the enzymes required to hydrolyze the lactose and subsequently convert the resulting glucose and galactose into the rare sugars allulose and tagatose respectively.

Deborah Johnson

PhD Student
Weber Lab

Helper T cells are activated when their T cell receptor (TCR) recognizes its specific peptide. I research how TCR-peptide affinity influences T cell proliferation and specificity through a panel of high affinity TCRs. I also investigate the role of CD5—a coreceptor—in T cell activation. This work has application for vaccine and immunotherapy development.

Daniel Arens

PhD Student
Grose Lab

I study two proteins, PAS-Kinase and USF1, and their roles in metabolic diseases. As we learn more about their mechanisms, interacting partners, and how to manipulate them, we will be

able to develop treatments and therapies for diabetes, obesity, and hyperlipidemia.

David Bates

PhD Student
Johnson Lab

I study chromatin architecture by looking at nucleosome positioning and its relation to the underlying DNA sequence in the genome.

Timothy Call

Masters Student
Berges Lab

My research involves the study of *Staphylococcus aureus* and its accompanying virulence factors. Currently, I am researching *S. aureus* biofilm mechanisms and characteristics by investigating the genes and proteins involved in biofilm synthesis. By studying *S. aureus* biofilms, I hope to find novel disruptors that could be used to treat infections..

Michael Olson

PhD Student
Erickson Lab

I am interested in how bacterial pathogens evolve and adapt to survive in different conditions. I study what genes mammary pathogenic *Escherichia coli* needs to survive in the harsh environment of the mammary gland. I have employed genome-wide transposon insertion site sequencing to identify putative virulence factors needed to survive in diverse conditions.

Colleen Newey

Masters Student
Grose Lab

My research is investigating the role of the protein PAS Kinase in the development of stress granules, which are involved in a variety of diseases including ALS and cancer. I hope to better understand this pathway so it could be used as a target against these diseases.



Elizabeth Porter

Masters Student
Robison Lab

I am interested in how *Yersinia pestis* has evolved over time and space. I study the DNA sequence variances of *Y. pestis* in specific regions within a period of time looking at how these changes vary in different regions of the world. I have employed deep sequencing as well as bioinformatic tools to parse through and evaluate the genetic evolution of the bacterial genomes.

Ashley Miller

Masters Student
Nielsen Lab

I study an incredible interaction between alfalfa plants and salt-loving bacteria called halophiles. Alfalfa (like most crop plants) is salt-sensitive. However, when salty soil with alfalfa seedlings is inoculated with special halophiles like *H. Elongata1H9*, the alfalfa grows an average of 8X more plant mass than plants grown in salty soil without bacterial inoculation. In our lab, we seek to find out how this interaction leads to increased growth. I am particularly interested in how 1H9 (bacteria) + salt influences gene expression within alfalfa root and shoot tissues. I hope that our research will be instrumental in improving agricultural productivity in the increasingly salty soils around the world.

Alexander Benedict

PhD Student
Griffitts Lab

Sinorhizobium meliloti is a species of bacteria that is best known for its ability to engage in a symbiotic relationship with legume plant hosts. It also has a remarkable metabolic capacity that enables it to thrive in nutrient-limited soils. My research is focused generally on learning which genes contribute most to the fitness of this organism and, more specifically, on a subset of bacterial genes called peptidases that have the potential to modulate symbiotic outcome.

Jacob Herring

PhD Student
Tessem Lab

Diabetes is characterized by a decrease in functional β -cell mass. Nuclear hormone receptor 4a1 plays a role in the regulation of functional β -cell mass. My research focuses on the mechanism of Nr4a1 in the β -cell.

Abraham Quaye

PhD Student
Poole Lab

Hemorrhagic enteritis is a viral disease of turkeys characterized by bloody diarrhea and immunosuppression caused by turkey hemorrhagic enteritis virus (THEV). An avirulent THEV strain called VAS that does not cause the disease in turkeys but retains some immunosuppressive

ability is currently used as a live vaccine. Due to the immunosuppressive traits of VAS, vaccinated turkeys are more susceptible to secondary bacterial infections than unvaccinated cohorts, leading to substantial economic losses. My research focuses on identifying the VAS genes mediating its immunosuppressive traits and studying the mechanism of action of such genes. Ultimately, we hope to engineer a novel THEV strain with no immunosuppressive characteristics to be used as an improved vaccine.



Taalin Hoj

PhD Student
Robison Lab

It has been estimated at 70% of bacterial infections are resistant to at least one commonly prescribed antibiotic, prompting CDC to announce that humanity has entered the “post-antibiotic era.” Among the most serious of these infections are caused by carbapenem-resistant Enterobacteriaceae (CRE), bacteria resistant to even last-line antibiotics. I study mechanisms of resistance in CREs, the stability and evolution of carbapenem resistance, and methods of treating septicemia caused by CREs.

Khin Zar Win Pyae

Masters Student
Griffitts Lab

For my MS project, I am interested in learning the mechanisms of stress adaptation in soil bacteria, and specifically how specialized genes can result in higher tolerance to heavy metal stress. To answer this question, I imposed heavy metal (nickel) stress to bacteria, and then I employed next generation sequencing to hunt for Single Nucleotide Polymorphisms (SNPs) and other genetic variations in the stress-tolerant mutants.

Daniel Thompson

PhD Student

Grose Lab

I am a third-year PhD student currently researching bacteriophage biology. I received my undergraduate degree in Molecular Biology. I am interested in antibiotic resistant and spore forming bacteria, phage therapy, and microbiome replacement research. I am currently working on novel treatments to improve honey bee health

Edwin Velazquez

PhD Student
O'Neill Lab

I work developing new cell adoptive therapies for cancer immunotherapy and doing tumor target discovery. My work consists of genetically engineering human immune system cells with tumor targeting receptors to selectively eliminate tumor cells.

Kiara Whitley

PhD Student
Weber Lab

My research focuses on studying T cells. One project focuses on studying how altered peptides affect helper T cell activation in response to *Listeria monocytogenes*, a common food-borne pathogen. My other project focuses on the role of CD5, an inhibitory T cell co-receptor, in regulating T cell metabolism.

Kyson Jensen

PhD Student
Griffitts Lab

The ability of microorganisms to adapt to environmental stressors is the key to their ability to occupy

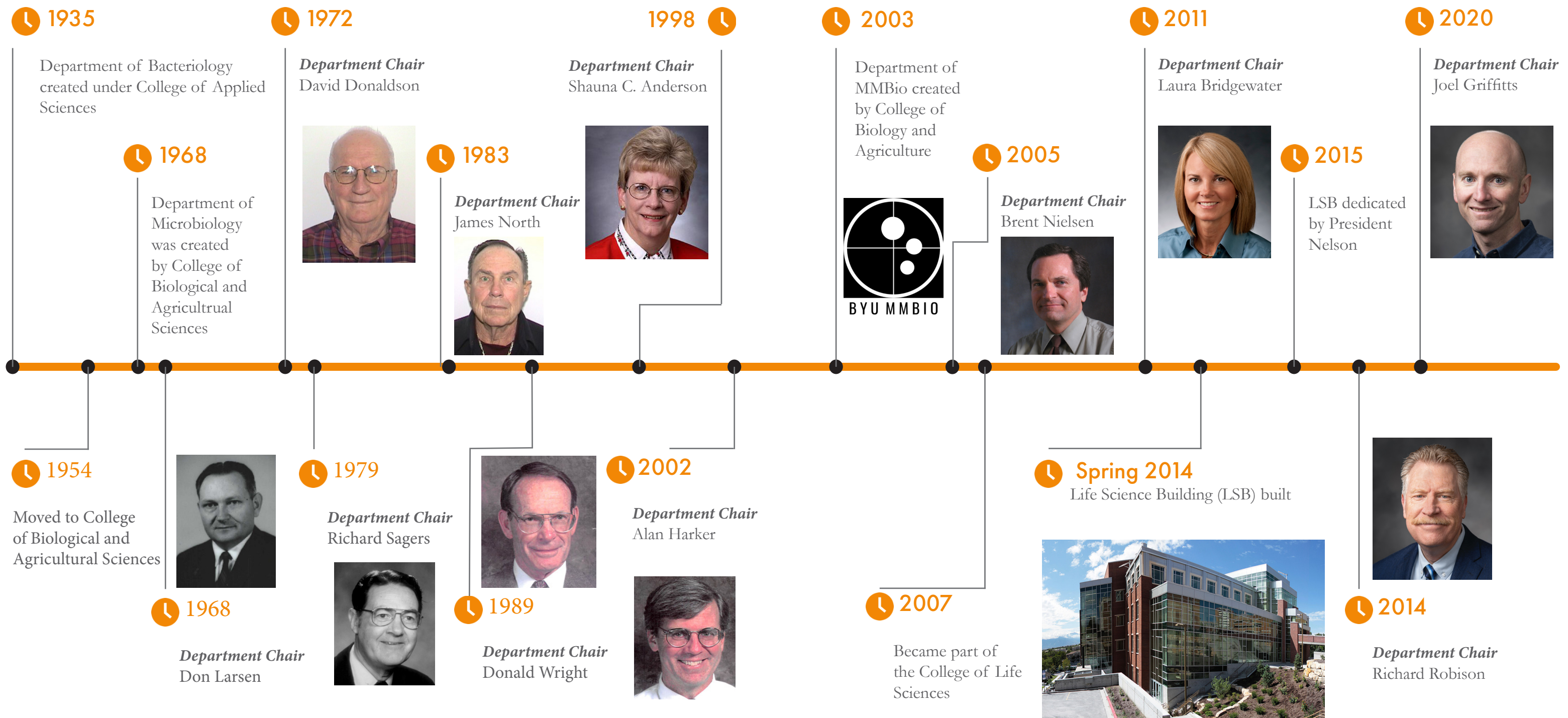
different ecological niches. No one microorganism can specialize to cope with every possible environmental stressor. This principle accounts for much of the diversity and niche specialization we commonly see in bacteria. The overall objective of my project is to understand the mechanism by which microorganisms adapt to environmental stressors, specifically towards toxic heavy metals such as nickel. We have previously isolated closely related bacterial strains of the genus *Mesorhizobium* from both regular soils and heavy metal (serpentine) soils in Northern California. While isolated strains are closely related, those from serpentine soils are significantly more tolerant to Ni. The aim of this project is to examine and identify molecular contributors to metal tolerance and evaluate how these tolerance mechanisms influence fitness in the absence of metal stress. This work will enhance our understanding of mechanisms of heavy metal tolerance and may provide clues about evolutionary pathways giving rise to this trait.

Antonio Solis Leal

PhD Student
Berges Lab

I study a therapy to fight AIDS. To do so, I'm introducing a gene in hematopoietic stem cells, which are the ones that produce CD4 T cells. This gene codes for a nuclease that specifically disrupts the HIV promoter. Thus, when an organism is exposed to HIV, there will be a resistant CD4 T cell population and the organism will be resistant to develop AIDS.

History of MMBio



MMBio Events



■ FALL GRADUATE RETREAT

Every year BYU's faculty and graduate students gather to review the research they have conducted. Each graduate student has the opportunity to present their research and respond to any questions individuals may have about their chosen topic. This full-day event allots time for a variety of informational sessions and outdoor activities where students and faculty can come together for both education and fun.

Pictured Left: A group of graduate students play volleyball with Dr. Richard Robison

■ TURKEY FEST

As part of the Thanksgiving festivities, the MMBio Department invites all our undergraduate and graduate students along with faculty and staff to a Thanksgiving feast! Laura Detwiler, a junior majoring in MMBio said of the event, "Turkey Fest was a really fun experience where I could meet other people from my major in a fun and relaxed environment!"

Pictured Below: Students enjoy a thanksgiving meal at Turkey Fest



■ ALUMNI DAY

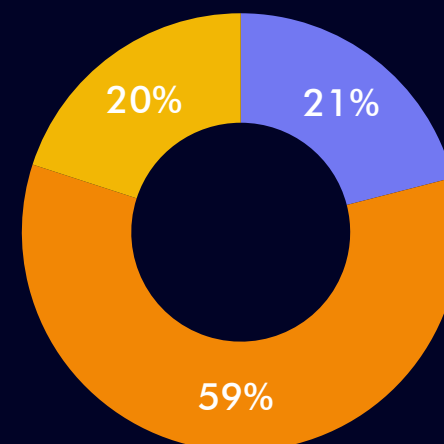
Our Alumni Day gives undergraduate and graduate students an opportunity to interact and connect with several BYU alumni who graduated from the MMBio Department. This past year, our alumni speakers included Julie Blasini, Debbie Forbush, Marissa Frost, Mark Gunnell, and Jeffery Tuttle. Each provided valuable insights into the kind of careers and opportunities our MMBio majors can have.

Pictured Above: Marisa Frost and Debbie Forebush at the Alumni Day event



MMBIO STATISTICS

Students In MMBIO Majors



- Molecular Biology
- Microbiology
- Medical Laboratory Science

1/4

of the students are already employed

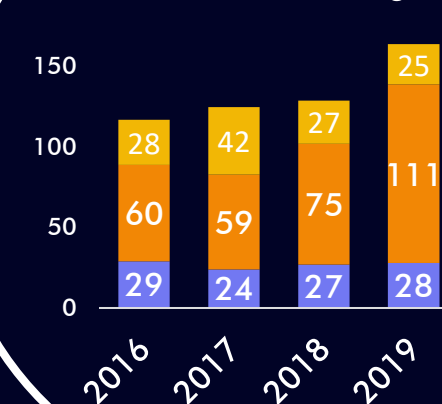
1/2

of the students will be attending future schooling

1/10

of the students have published articles in scientific journals

Students who Graduated with Bachelor's Degrees



Most Helpful Classes (Noted by Students in Exit Survey)

MMBIO 463 - Immunology
MMBIO 294R - Mentored Research
MMBIO 240 - Molecular Biology

Schools our Graduates will be Attending

Baylor
Harvard
Ohio State
UCLA
U of Utah
Marquette
Texas A&M

Schools our Alumni have Attended

Penn State University
Baylor College of Medicine
Ohio State Medical School
Harvard University Law School
Air Force Institute of Technology
The University of Michigan Medical School
Cleveland Clinic Lerner College of Medicine
Mayo Clinic School of Medicine
John Hopkins University
Yale School of Medicine
Georgetown University
Harvard University
Duke University



Your donations to BYU's MMBIO Department makes possible:

- New Discoveries
- Mentored Research
- Improved Education

We appreciate all of your support.

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