

MICHIGAN STATE UNIVERSITY

Broadening Experiences in Scientific Training

five years of exploration

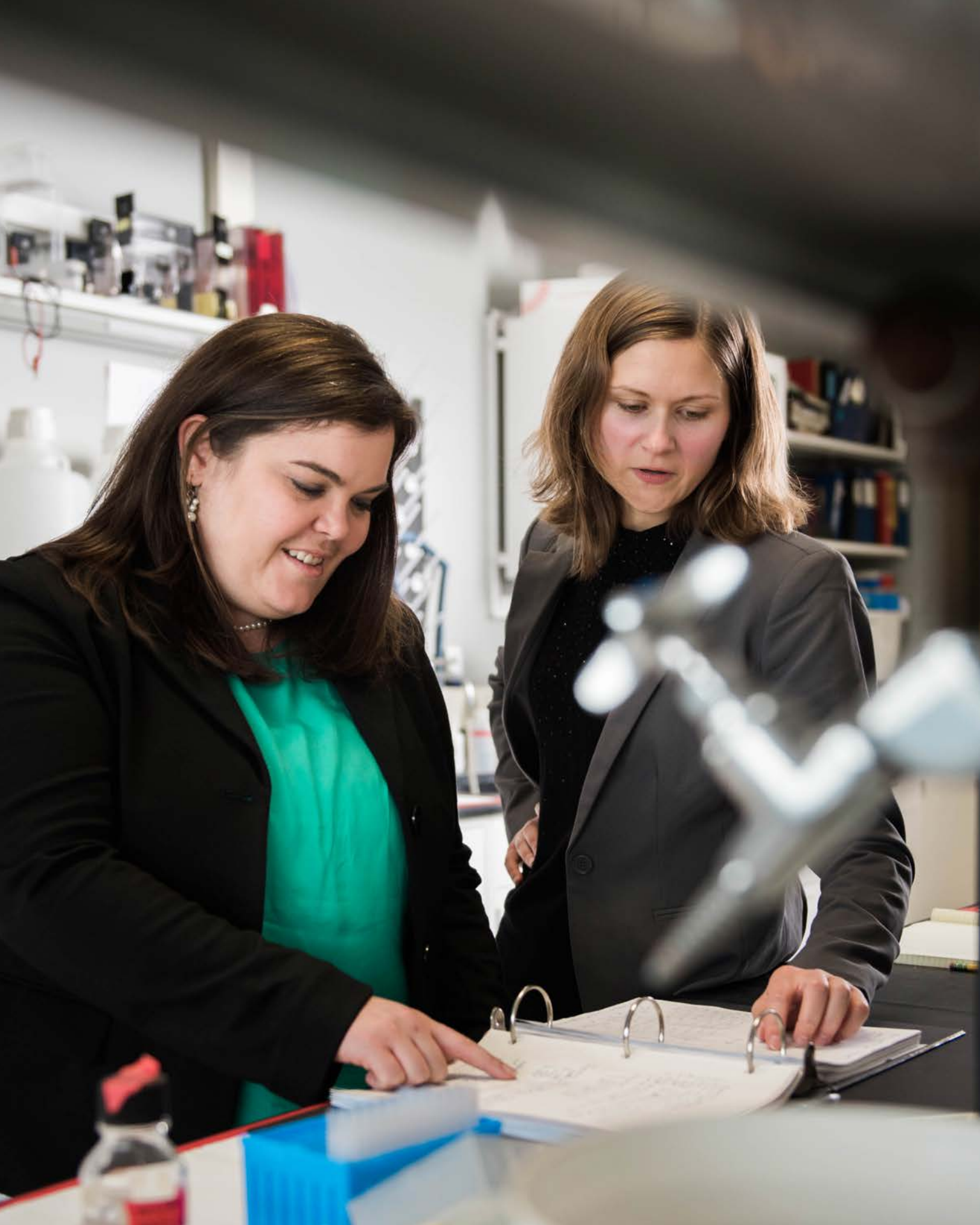


TABLE OF CONTENTS

3	Introduction
5	Letter from the Principal Investigator
6	About MSU BEST
8	Guest Speakers
9	Accomplishments
12	Externships
15	Profiles
82	Trainees
84	Acknowledgments
87	Reflection



MSU > **BEST**

An experimental program dedicated to empowering biomedical trainees to develop professional skills and experiences.

**At the
root of
our field is
curiosity.**

As scientists, we have an innate desire to explore. We question the norm. We pioneer new terrain. We fail fast and fail often but, at the end of the day, we come out with a solution backed by empirical truths.

So it's only natural that we'd be drawn to the unending horizon of diverse career opportunities—and here at MSU Broadening Experiences in Scientific Training (BEST), we give students opportunities to do just that.

Research in the lab is critical. But it's those real-world experiences—connecting with professional partners, helping communities live healthier or safer lives, inspiring the next generation of innovators—that help make a scientist the best they can be.

For five years, we've empowered graduate students and postdoctoral scholars to explore new paths across a number of sectors: innovation, legal, regulatory government, public affairs and academe. We aim to lead trainees to careers that are both personally and professionally meaningful, with potential to spark widespread change.

Now more than ever, it's important to go forth and apply our research from the lab to real-world contexts, and share our inventive minds. Here's to five more years of embracing curiosity. Rolling up our sleeves. Shifting mindsets. Exploring.





THE POWER OF EXPERIMENTATION

The BEST experiment was just a dream. Over seven years, we—you, your mentors, our faculty, our externship providers, The Graduate School and the Office of the Vice President of Graduate Research—made it a reality. For me, this has been a true labor of love. Coming into BEST, I knew I loved science, trainees, the scholarship of training and MSU. The foundation of career development that The Graduate School had built made it possible for us to do MSU BEST, a very real synthesis of the many things I love.

A big reason for doing MSU BEST was because it was an experiment. That made so much sense to me as a scientist. Can you really prove what helps a trainee get to the place they want and hope to be, such that they get to love science in their own way? What an excellent experiment to do! I am forever grateful to the National Institutes of Health (NIH) for letting us do it. Along the way, I have learned so much and met people who have changed my world in spectacular ways. To know you, to have worked with you, shared with you and learned from you makes me lucky.

I am even more enthused about the future of our biomedical trainees than ever before, because I know that the engaged MSU trainee will be self-aware, savvy and ready to take on a multitude of different careers—and, most importantly, to be happy in them. It has been my absolute privilege to be the principal investigator of MSU BEST. I was fortunate to start something good, that will continue to enrich MSU Biomedical trainees and science as a whole.

Know that you are a part of something that is groundbreaking here at MSU. Help us continue to build—we can't do it without you. Thank you.

Yours in science and MSU,



Stephanie W. Watts
Principal Investigator

WE STARTED WITH A HYPOTHESIS

Five years ago, we asked: How can we allow biomedical science Ph.D. students and post docs to explore the full breadth of career options?

At the beginning of a scientific career, it can be difficult to imagine the range of possibilities available now and in the future. Many Ph.D. students and post docs in biomedical fields feel that their graduate training has aptly prepared them to pursue conventional academic research careers, but they are often eager to consider careers in other areas as well.

In founding MSU BEST, we sought to enhance trainees' abilities to develop the confidence and competencies useful for navigating and choosing from diverse career opportunities. We built upon MSU Graduate School's long history of supporting graduate students with a variety of career goals.

WE ENDED UP WITH DECISIVE RESULTS

Since our founding, our trainee cohorts have demonstrated the power of holistic learning by applying research across sectors. As one of 17 programs around the country funded by the National Institutes of Health (NIH), we continue to support biomedical trainees (Ph.D. students and post docs) in developing the skills and experiences needed to find and succeed in careers of their choosing. The program moves at students' individual paces and allows them to develop a path that serves their personal definition of success.

Because more than 60% of biomedical Ph.D.s work outside academia, MSU BEST has given 125 trainees opportunities to explore their professional options over the past five years. We offer student participants intensive and supportive mentoring, professional development experiences and specialized professional experiences to enhance traditional Ph.D. training.

THROUGH BEST, BIOMEDICAL TRAINEES:

Discover and test out possible biomedical careers in the sectors of innovation, legal, regulatory government, public affairs and academe through externships.

Attend workshops to learn skills in teamwork, communications, wellness, resume writing and networking.

Leverage self-assessment tools such as the Myers-Briggs Type Indicator, The Birkman Method, Resilience and StrengthsFinder to clarify their unique skills and goals.

Join a group of MSU scholars dedicated to making the most out of their graduate and postdoctoral career.

Work with a mentor to help identify and support their vision of success.

Build professional networks early in their graduate career by collaborating with individuals across a variety of fields.

Set a clearer path for the use of their biomedical degree.

Look how far we've come.

MSU BEST believes it is important for trainees to understand and appreciate the broad and exciting career landscapes available to them. To this end, MSU has hosted professionals from across the spectrum—from industry to government to academia to law and others—to share important career advice and perspectives. They have donated their time and their expertise to share the passion they feel for their work, as well as to offer sage advice to MSU BEST trainees who are preparing to launch their own careers.

WE ARE INFINITELY GRATEFUL TO ALL OF OUR BEST GUESTS.

Tom Adams, Ph.D.

VP Global Biotechnology, Monsanto

Reid Baldwin, J.D., Ph.D.

Patent Attorney, Brooks Kushman, LLC

Deandra Beck, Ph.D.

Associate Dean for Research, MSU International Studies and Programs

Erin Bell, Ph.D.

Lead for the Compositional Biology Team, Monsanto

Alison Bernstein, Ph.D.

Assistant Professor of Translational Science and Molecular Medicine, MSU

Anastasia Bodnar, Ph.D.

Policy Director, Biology Fortified, Inc.

Diane Bouis, Ph.D.

Innovation Manager and Venture Accelerator, University of Michigan Tech Transfer

Cindy Brown

Executive Director, Hello West Michigan

Leon Brunner, DVM, Ph.D.

Executive Vice President for Science & Regulatory Affairs and Chief Science Officer at the Grocery Manufacturer's Association

Lyle Burgoon, Ph.D.

Technical Leader in Artificial Intelligence to Solve Military and Civilian Challenges, Ethics of Artificial Intelligence, U.S. Army

Mark Burnham

VP of Governmental Relations, MSU

Jenny Carter Johnson, J.D., Ph.D.

Associate Professor of Law, MSU College of Law

Rich W. Chylla, Ph.D.

Executive Director, MSU Technologies

Dirk Colbry, Ph.D.

Director of HPC Studies, Department of Computational Mathematics, Science, and Engineering, MSU

Katy Luchini Colbry, Ph.D.

Assistant Dean for Graduate Student Services, MSU College of Engineering

Noel Day, J.D., Ph.D.

Pharmaceutical and Biotech Patent Attorney, Honigman, Miller, Schwartz, and Cohn LLP

Patrick Doran, Ph.D.

Associate State Director, the Nature Conservancy

Holly Falk-Krzesinski, Ph.D.

Vice President, Research Intelligence, Elsevier

Greg Fink, Ph.D.

Professor of Pharmacology & Toxicology, MSU

Charles Hasemann, Ph.D.

Assistant VP for Innovation & Economic Development, MSU Technologies

JR Haywood, Ph.D.

Assistant Vice President for Regulatory Affairs, MSU

Tom Herlache, J.D., Ph.D.

Assistant Director for Commercialization, MSU Technologies

Tom Hollon, Ph.D.

Professional Grant Consultant, Science Sherpa Communications

Ryan Jankovic

Enterprise Sales Consulting

Layla Katirace, Ph.D.

Principal Scientist for Reagent Development, Roche Sequencing Solutions

Sheril Kirshenbaum

Author, Television Host, and Founder, Science Debate

Arjun Krishnan, Ph.D.

Assistant Professor of Computational Math, Science, and Engineering, MSU

Brendon Ladd, Ph.D.

Research Scientist, C4 Therapeutics

Ji-Eun Lee, Ph.D.

Chief Toxicologist, Kellogg Company

Marsha Matyas, Ph.D.

Director of Education, American Physiological Society

Laura McCabe, Ph.D.

Professor of Physiology, MSU

Matthew Miller

Editor, Lansing State Journal

Mark Moorman, Ph.D.

Senior Director of Global Scientific & Regulatory Affairs for Kellogg Company

Stephanie Ogren, Ph.D.

Director of Education, Grand Rapids Public Museum

Tamara Reid Bush, Ph.D.

Associate Professor of Mechanical Engineering, MSU

Sandra Rempel, Ph.D.

Director of Research, Spectrum Health Grand Rapids

Jennifer Rossi, Ph.D.

COO, Kerafast

Kavin Senapathy

Author and Science Writer

Timothy Shafer, Ph.D.

Research Toxicologist, Environmental Protection Agency

Jenny Splitter

Food, Science, and Health Writer

Stephanie Vasko, Ph.D.

Managing Director of the Center for Interdisciplinarity, MSU

John A. Vasquez, Ph.D.

Career Services, MSU

Gesine Veits, Ph.D.

Research Scientist, C4 Therapeutics

Chris Waters, Ph.D.

Associate Professor of Microbiology and Molecular Genetics, MSU

Candice Winslow

Trainer, Office of the Vice President for Research and Graduate Studies, MSU

Erik Wong, Ph.D.

Management and Career Consultant

HARD WORK PAYS OFF

A sample of original research emerging from MSU BEST:

Watts, S.W., Chatterjee, D., Rojewski, J.W., Reiss, C.S., Baas, T., Gould, K.L., Brown, A.M., Chalkley, R., Brandt, P., Wefes, I., Hyman, L., Ford, J.K. (2019). "Faculty perceptions and knowledge of career development of trainees in biomedical science: What do we (think we) know?" *PLoS One*. 2019; 14(1). <https://doi.org/10.1371/journal.pone.0210189>

Chatterjee, D., Ford, J.K., Rojewski, J.W., Watts, S.W. (2019). "Exploring the Impact of Formal Internships on Biomedical Graduate and Postgraduate Careers: An Interview Study." *CBE—Life Sciences Education*, 18(2). <https://www.lifescied.org/doi/10.1187/cbe.18-09-0199>

Watts, S. and Rojewski, J.W. (2016). MSU BEST: Integrated Biomedical Training for Multiple Career Options. A paper presented at the Midwest Council of Graduate Schools, April 7, 2016, Chicago, IL.

Watts, S. and Rojewski, J.W. (2016). Introducing MSU BEST: What We Do and How Your Campus Can Do It Too. A paper presented at Wayne State University, August 16, 2016, Detroit, MI.



Through externships, some of our BEST trainees had opportunities to explore science journalism at The Lansing State Journal (LSJ) and WKAR.

“Researchers want to treat high blood pressure earlier. Your doctor might not agree.”

(LSJ, Dec. 20, 2018)

David Ferland, BEST trainee in Pharmacology and Toxicology wrote a piece for The LSJ exploring how a more aggressive approach to high blood pressure treatment could avoid outcomes such as stroke, heart attacks and kidney failure.

“Obesity poised to overtake smoking as leading preventable cause of cancer.”

(LSJ, April 30, 2019)

BEST trainee in Pharmacology and Toxicology Vanessa Benham's LSJ article discusses the link between obesity and cancer, sharing the recent finding that obesity ranks the second leading cause of cancer.

“When you touch a countertop in a store, you could be leaving behind your DNA, and so could a robber.”

(WKAR, Jan. 21, 2019)

Taylor Dunivin, BEST trainee in Microbiology and Molecular Genetics wrote a piece about using new DNA analysis software in Michigan courts, how this has felt and the limitations behind it.

EXPERIENTIAL LEARNING OPPORTUNITIES THAT MATTER

Real research goes beyond the lab. In Year 2 and beyond, each BEST trainee completes two externships focused on professional skills development at partner organizations or companies in relevant industries. We encourage trainees to pursue opportunities across at least two of our MSU BEST Spheres of Success: Academe, Government and Public Affairs, Legal, Regulatory and Innovation.

Meredith Frie, Ph.D.

MSU Innovation Center and MSU Office of Government Affairs

I did my first externship at Spartan Innovations to create a commercialization plan for MSU-Developed Technology. My second externship was with the MSU Office of Government Affairs to advocate for state funding for MSU. Both externships required me to use my scientific knowledge in ways I had never done before: to discover how to move research away from the bench and out to the public; to communicate the purpose of research on a broader scale to diverse audiences; and to think about research in a larger social and political context. These externships were invaluable (and fun!) opportunities to engage and work directly with others, especially non-scientists, to accomplish our goals. However, the most important thing that I learned was, while I enjoyed thinking and discussing research in these different contexts, I still loved being a researcher more and knew that my career would focus on continuing to do research.

Nadia Ayala-Lopez

MSU Technologies and Pfizer

I traveled to Pfizer to shadow safety pharmacologist Dr. Carrie Northcott, meet 10 other Pfizer scientists across departments, and give an oral presentation on my research. I was impressed to learn from Dr. Bernard Fermini, who led the Safety Ion Channel Group, that he and other scientists at Pfizer work closely with regulatory agencies to establish better standards and guidelines for evaluating the safety of drugs. I hope that, like Dr. Fermini, my research one day has an impact on healthcare. Being able to present my research to an industry audience was a learning experience in communicating my research to an industry audience.

Vickie Ruggiero

INDS and Food@MSU

I participated in two externships through the BEST program: one with the Food@MSU program, a community engagement program, and the other at INDS, Inc., a pharmaceutical consulting firm. I was already interested in non-academic careers because of my work at MSU In Vivo, where our research scientists worked less like academicians and more like Ph.D.s in industry. These experiences gave me a chance to learn more about many other opportunities and speak to people who are in those careers. I have no doubt that the people I have met, connections I've made and experiences I've had in the BEST program will benefit me regardless of the next phase of my career.

Nguyen Truong

Wayne State University-Department of Emergency Medicine and Zoetis, Inc.

I did my first externship as a remote clinical research assistant for the Department of Emergency Medicine at Wayne State University. The research project investigated the correlation of frequent marijuana usage and abdominal pain and intractable vomiting, so-called cannabinoid hyperemesis syndrome (CHS). During the first three months, I was involved in the validation of the criteria to include or exclude patients for the research project. With my contribution, the research project was finished and provided a three-year window into CHS pre-legalization of marijuana for future comparison. This externship has brought me valuable perspectives on clinical research, such as the regulation of data management, good clinical practice, etc. For my second externship, I will switch gears and work for the R&D department at Zoetis to validate immunologic targets for animal vaccines.

Sina Parsnejad*Spartan Innovations, Venture Fellows*

As a Spartan fellow, I helped develop a business plan for an up-and-coming MSU startup. Working for these folks made me understand the intricacies of managing a company and treating investors. I realized that having a flashy product is not a goal but the means to an end, and that we need a group of diverse folks with a mission plan to have an impact on the world.

Mariana Desir e Reale Batista*Ford Motor Co. Research and NASA*

During my Ph.D. in Materials Science and Engineering, I moved to California for a fall internship at NASA. Working with polymer composites at MSU, I got involved in a new field of expertise at NASA working on a project entitled Nanotechnology in Electronics and Sensor Development. I investigated carbon nanotubes (CNTs) as a sensing material to detect ultraviolet (UV) radiation to develop a flexible sensor. The intense exposure to this radiation can cause damage to human skin, and can lead to cancer. UV sensors are also widely used in many applications, including space communication and climate changes. I designed a flexible UV sensor tailored for wristband, and sunglasses proving efficacy under natural sunlight.

Kayla Conner*Girl Scouts Heart of Michigan and MSU Plant Genomics REU Program*

My first externship is an ongoing outreach project with the Girl Scouts Heart of Michigan. I am visiting local troops to talk about life as a scientist, how to become a scientist, what being a scientist means, etc. Additionally, there is a hands-on component to my project, where the girls are able to see bioluminescent bacteria, and we are able to talk about how most of the bacteria around us are good, despite most people thinking they're all bad. It's fun to answer the girls' questions and watch their interest grow as I present!

Chelsie Boodoo*Impact 89 FM, The Sci-Files*

I helped start *The Sci-Files*, a new show on Impact 89 FM (the MSU student radio station) where I interview MSU students on their research, along with another MSU graduate student. A goal of the *The Sci-Files* is to focus on the students and give them experience with speaking about their science to the public while showcasing the scientist behind the research. During these episodes, I've enjoyed interviewing students on their various research topics and learning about the diverse science topics studied at MSU. The show has been so successful that this summer it is being extended for an hour-long series every Sunday from 9 am to 10 am.

Kristin Jacob*MSU Technologies*

I worked at Michigan State University Technologies (MSUT) as an Intellectual Property Commercialization Intern. This position allowed me to gain an understanding of how new technologies developed by researchers at MSU are reviewed for patentability. My role as an intern was to collect background knowledge in many scientific areas, along with prior art (information) on similar technologies related to previous patents, primary literature and marketability information. The technology managers at MSUT were amazing mentors and provided an alternative career experience for a Ph.D. holder that's not well-promoted.



Scientists are everywhere.

TRAINEE PROFILES

Sure, we all know the archetype of a biomedical science Ph.D. student: lab coat, safety goggles and a beaker or two in hand. Our trainees disprove that theory. (Though safety goggles are important, of course.)

Spanning across a wide range of academic backgrounds and research areas, our trainees apply diverse passions and interests to various professional opportunities. Our cohorts prove that there's no singular type of scientist—because scientists are everywhere.

We are honored to highlight some of our BEST trainees, providing a look at their contributions to diverse areas of science and their passions outside of academia.

Jacob Bibik

MAKING AN ENVIRONMENTAL IMPACT WITH SYNTHETIC BIOLOGY

Jacob Bibik always knew he wanted to study science to find a way to help others. Like many students with similar passions in biomedical science, he considered going into medicine, but wasn't excited about going to medical school. "As soon as I experienced lab research, I knew this was the path I was more interested in," he explains.

PURSUING A PH.D. FOR THE GREENER GOOD

Bibik started his college career in pre-nursing at Schoolcraft Community College. When it came time to transfer, he came to MSU as a biochemistry and molecular biology student. "In my first year, I realized nursing was not the way I wanted to help people," he says. He was lucky enough to get a job in Dr. David Kramer's lab doing undergraduate research in algal biofuels. "I ended up staying on and working as a lab tech at MSU, before I decided to do a Ph.D.," says Bibik. "I pursued a Ph.D. to dive deeper into research, take on bigger responsibilities and develop my own projects."

In particular, Bibik was drawn to working in science that has positive environmental impacts, in part as a way to have a broader impact on society. "I work in synthetic biology, engineering plants for production of terpenoids, which are natural compounds used as biofuels, pharmaceuticals and other bioproducts," he explains.

Poplar, for example, is one useful production organism to actively make biofuels. "Poplar is one of our targets because it grows quickly and is biomass dense. This biomass can be used as feedstock for biofuels, and engineering terpenoid production adds further value," explains Bibik.

A SYNTHETIC BIOLOGY CAREER ON THE HORIZON

Bibik has his eye on a career in industry. "There are a lot of new companies working in synthetic biology," he explains. He says that may take him to the Bay Area, San Diego or Boston.

Bibik can't say enough good things about the peers with whom he works. "The camaraderie is great. My cohort has stuck together throughout our training, which really helps handle the stress," he says. Many of his friends even work on the same floor in the same building.

"We all work in and near MPS; lots of late nights working and studying together. Plus, we get a fair stipend and the cost of living is low," he says, so that leaves time for hanging out, playing soccer and figuring out what's next. BEST is helping him discover that and to prepare for that next move.

**I pursued a
Ph.D. to dive
deeper into
research.**

Heather Blankenship

GOING THE DISTANCE IN THE LAB AND ON THE TRAILS

Heather Blankenship is a competitive person. Competitive in the best sense—she's willing to put in the work, be patient for the results she seeks and trust that her perseverance will pay off. And, it turns out, she is an incredibly fast runner.

Blankenship was a college athlete in Virginia, where she excelled in the 800 meter race. She loved track, but her scholarship required her to also participate in cross country, a sport she never really loved. After college, when Blankenship decided to get her Ph.D. at MSU, she took a break from running to focus on graduate school. "I gave my spikes to my sister. I was done," she says. "Until, that is, my (now) husband and I started getting competitive in stupid ways." Both she and her husband were track athletes, and found that taking a break from racing transferred their competitive drive to other areas. "We started competing over who could fold the laundry faster or walk the dog more miles in a day. It was always really stupid stuff!" These domestic races inspired them to start running again.

ENDURANCE AND ENJOYING THE RIDE

After joining a local running group, Blankenship said she began to truly enjoy her sport. Even though she claimed she never wanted to be a distance runner, she fell in with a group of runners who challenged her to run long-distance. This new focus on having fun on her runs had her seeing success. "I was running more and more miles, and my times were great, but I wasn't getting injured," she explains. She signed up for a long race: a 50K.

At her first ultramarathon, the 50K Trail National Championships, Blankenship was seconds away from the national podium. At her second 50K, she won first place and set the course record. She ran a 100K ultra in the desert of Arizona on her birthday. "I'll be training all winter in Michigan to run 100K in the desert with no tree canopy," she says. "I joke that it's like running a marathon, turning around and running the marathon course again—and then doing another half marathon after that. The irony is that I've never done a marathon!"

A PASSION FOR MICROBIOLOGY AND PUBLIC HEALTH

While her talents on the trail have earned her accolades—including ambassadorships and a place on the elite team at Playmakers, the local running store—they are second to Blankenship's real passion: science and public health. As a microbiologist, Blankenship is interested in tracking infectious disease outbreaks. Through BEST, she discovered an incredible opportunity: leading a new initiative at the Michigan Department of Health and Human Services (MDHHS).

Blankenship's first externship was at the Detroit Zoo, participating in community outreach events where she was able to talk to the public about bacteria, and demonstrate how bacteria grow and spread. She loved that kind of work with the public, but was drawn to opportunities to work in the intersections between the research of microbiology and the world of public health. That brought Blankenship to MSU to work with Dr. Shannon Manning, who not only had work in both

domains herself, but also supported Blankenship's ambition to combine these two interests.

"I was talking with a friend from lab, and she and I share ideas and leads for the careers we want. We were talking about public health

It's very exciting that Michigan is working to fully develop [bioinformatics resources] in-house and share it with other states in the region. I'm really grateful that I get to be a part of it.

and contacted Dr. Marty Soehnlen, the director for the MDHHS Infectious Disease Division. We thought, 'Let's just see if they'll let us come for a visit!' So we contacted her," Blankenship says. BEST encourages trainees to pursue these types of informational interviews, and when Blankenship was able to meet with Dr. Soehnlen, she said

there was not really an internship available that would work. "But she said, 'If you can come up with a project, let me know.'"

AN EXTERNSHIP THAT MAKES A DIFFERENCE

Together, over a period of back-and-forth idea sharing, they developed an idea that would allow Blankenship to work at MDHHS on her own project. "We really wanted something that would be beneficial for them and for me, and Shannon was really supportive of a long-term project that went beyond two weeks so that I could gain a better understanding of public health and make a difference," Blankenship says.

Continuing the conversation over several more months, they finally realized that Blankenship would make a perfect bioinformatics intern for the State of Michigan—a position she helped build from the ground up. At two conferences, the International Conference for Emerging Infectious Disease hosted by the Centers for Disease Control and Prevention in Atlanta and the American Society for Microbiology Rapid Applied Microbial Next-

Generation Sequencing and Bioinformatic Pipelines Conference, Blankenship was introduced to other state public health bioinformaticists (StaPH-B).

"Now, I'm in a monthly phone call and chat group with other state bioinformaticists to help us figure out how best to work together and use whole genome sequencing to identify outbreaks or examine other genetic factors such as antibiotic resistance," she says. "Many states do not have the bioinformatics resources to perform all of the analysis, so it's very exciting that Michigan is working to fully develop this resource in-house and share it with other states in the region. I'm really grateful that I get to be a part of it."

DETERMINED TO MAKE CONNECTIONS

It took almost eight months for Blankenship to move from initial contact with Dr. Soehnlen and starting her externship. "I just had to keep working at it, being patient and continuing to go after a project," says Blankenship, as a sign of her commitment and endurance—and, not to mention,

tenacity. She is grateful to have the support of her mentor. "I deliberately tied any projects to my dissertation work, which is the easiest way to convince your mentor that it's worth your time," she explains. Blankenship's dissertation work explores the genetic diversity of Shiga toxin-producing *Escherichia coli* (think romaine lettuce and Chipotle!) in Michigan, which is a foodborne pathogen that will benefit from whole genome sequencing for outbreak identification and surveillance.

Going forward, Blankenship will spend a few days a week developing the new Bioinformatics office and protocols at MDHHS, while her other days are spent finishing up her dissertation and running unknown miles out on the trails, building a national reputation as an ultramarathoner. For this driven and competitive woman, it's just another day at the office—an office that she's developing. Or on the trails, where she dominates.

A portrait of Anne-Sophie Bohrer, a woman with shoulder-length dark brown hair, smiling warmly at the camera. She is wearing a light grey crew-neck t-shirt and a thin necklace with a small white pendant. The background is a solid, muted grey color.

Anne-Sophie Bohrer

BIOFUEL RESEARCH AND PREPARING THE PERFECT CAKE

In her lab, Dr. Anne-Sophie Bohrer is known for her famous chocolate cake. Her dream is to one day open her own coffee shop and bakery, where she could serve her concoctions. Her passion for food is impossible to ignore.

Dr. Bohrer thinks her parents recognized her love of both cooking and science early when her dad gave her a book that described the science behind cooking and baking. Her dream is to prepare the perfect chocolate cake. “I want to master the experience of eating a chocolate cake from the moment it comes out of the oven” accounting for moisture and humidity, she says. Because, to Dr. Bohrer, food is not just food, “I’m French. We talk about food as an experience. It’s a universe,” she says. “Food is so good.” Mastering all of the pieces is, to her, deeply scientific.

FROM CUISINE TO SWITCHGRASS

Dr. Bohrer is a postdoctoral Fellow in plant science for the Great Lakes Bioenergy Research Center (GLBRC), studying switchgrass. The GLBRC is a cross-disciplinary effort to develop sustainable biofuels and bioproducts from all usable portions of dedicated energy crops grown on marginal lands. Marginal lands are areas whose ground is not well-suited for agriculture, and since switchgrass requires low amounts of fertilizers, it grows well in such environments. That means scientists like Dr.

Bohrer are focusing on developing biofuels and other bioproducts from environments that do not compete with food production. This stands in contrast with ethanol, an energy product derived from corn; unlike switchgrass, corn requires fertile soil—which could be used for food production—to grow.

I want to get involved in developing education programs to help with career development and professional coaching of grad students and post docs.

Dr. Bohrer’s work in this initiative focuses on the metabolic profiling of switchgrass, with an emphasis on nitrogen and water use efficiency. They hope to better understand how switchgrass adapts to its environment to tolerate drought or cold, and otherwise collaborate with their environment to promote optimal plant growth and yield throughout North America.

“Our goal is to explore how plant growth is affected by environmental stresses, and how the plant adapts at different levels to cope with such stresses,” Dr. Bohrer says. “We

are also focusing on the reciprocal interaction between switchgrass and its microbiome: how the microbiome affects plant growth and how plant root exudates, a substance secreted by the plant in the soil, can specifically affect the microbiome in the soil. I study how the primary metabolism of switchgrass is impacted by stresses to identify key compounds that allow switchgrass to adapt to stress. In the long run, we hope to be able to breed varieties of switchgrass that would thrive under different conditions, from Texas to Michigan!”

Dr. Bohrer’s prior work also explores sulfur metabolism in the plant model *Arabidopsis thaliana*. She explores how this plant would sense sulfur and use it for either primary metabolism—the regular metabolic processes a plant undergoes for growth—or secondary metabolism.

A PATH TOWARD OUTREACH

Dr. Bohrer also completed project management work for the BEST program and the East Lansing Fascination of Plants Day. The event is an international effort to get the public enthused about plant science. She enjoys the chance to work directly with different people who know little about plants. “I feel like it’s easier to explain other research, especially when it has a human element to it. But when I’m talking about plants at the

molecular level, it’s hard to get people excited.” Dr. Bohrer says. “But thanks to BEST, now I know what I want to do: I want to get involved in developing education programs to help with career development and professional coaching for grad students and post docs to help them be the best they can be beyond the bench and their science.”

As she thinks about the practical steps for moving from bench science to a successful café owner, you’ll find Dr. Bohrer in the lab, mastering the metabolism of switchgrass. Somewhere in the mystery of how switchgrass thrives in its environment, is the solution to how she will incorporate her science mastery to her passion for baking—so she can one day discover the protocol for the perfect chocolate cake.

Kyle Card

STUDYING ANTIBIOTIC RESISTANCE TO PROPEL PUBLIC HEALTH

In some ways, Kyle Card has lived a life of consistency. But he is far from boring. Growing up, he wasn't sure if he would turn out to be a doctor, an archaeologist or a comic book artist, but he was always captivated by science and the world around him. "When I was seven, I got a book called 'How Things Work.' It set me on a path of curiosity," says Card. He adds, "My dad had an old Mac with an astronomy program. I would listen and watch animated videos about science phenomena; nuclear fusion, what comets are made of."

Card has lived all his life in Greater Lansing. He attended Lansing Community College, where he began searching for the kind of science he wanted to pursue. "I majored in chemistry but ultimately found it uninteresting, so I switched to pre-med," he says. "Then I happened to take a microbiology lab class during my last semester at LCC, and I instantly fell in love. I was given a bacterial isolate, and it was my job to figure out what it was. I got to be a detective. This is what I was looking for all of those years!"

OVERCOMING OBSTACLES AND FINDING A COMMUNITY

After transferring to MSU, Card majored in microbiology. He continued to think about what he wanted to do with his science passion and training. He was drawn to healthcare and antibiotic resistance, and loved the creativity of doing research as an undergraduate. Card therefore decided to pursue a Ph.D.—but he had some doubts.

Card has a rare neurological condition called Moebius Syndrome that manifests itself in some physical disabilities. It requires him to approach daily life—and science—in different ways. "I was concerned that others, especially senior scientists, would draw unfair conclusions about my ability to practice science because of my disabilities," he says. "Similar fears are common in underrepresented groups, in general. The imposter syndrome we feel is oftentimes made worse because of our minority status."

Card has a unique place to explore some of these fears and concerns. He earned a Gilliam Fellowship for Advanced Study from the

Howard Hughes Medical Institute, a prestigious award for graduate students that focuses on increasing diversity among scientific leaders. Once a year, Card attends a meeting with other Gilliam Fellows where they network, share their research and talk to others with shared concerns. "It's wonderful to be a part of a community that is there for each other," says Card. "I have had nothing but positive experiences during my time as a graduate student. I have fantastic and supportive advisors, friends and colleagues. And I get to do research that I love. I count myself very lucky. Over the past couple of years, my confidence has soared."

INVESTIGATING ANTIBIOTIC RESISTANCE

Card studies the evolution of antibiotic resistance. As he narrowed down his scientific interest, he was consistently curious about antibiotic resistance and its impact on public health. He looks at "how antibiotic resistance evolves after a long period of relaxed selection."

"That means conditions when there is no environmental pressure to maintain resistance," he says.

“We would expect that resistance traits would be lost, or decay, over time and over many bacterial generations. Our research shows that this trend indeed occurs in strains isolated from our lab’s long-term evolution experiment. So we then examined the capacity of these bacteria to evolve increased resistance when drugs are introduced into the environment. We are curious about whether resistance evolution is predictable: Do independently evolving strains follow similar evolutionary paths? Or instead, is evolution contingent upon prior history, making the paths it takes unpredictable?”

Card’s dream job is “to work in a capacity to help others by combining evolutionary theory and public health in the realm of antibiotic resistance.” He says he would like to work in government, maybe in Health and Human Services, for the Centers for Disease Control and Prevention or an NGO. “I’m not sure if that would be working at the bench, or in an administrative role. Maybe consulting,” he says.

LEVERAGING A MEANINGFUL EXTERNSHIP

Until he has to decide what’s next for his career, Card is taking advantage of the BEST externship requirement. He recently began an externship with the Michigan Department of Health, where he will “combine his dissertation work and conventional antimicrobial susceptibility testing as part of surveillance.” This is a process by which scientists work in the service of public health to “determine the presence of resistant bacterial strains in a population or region.”

“This information is used to investigate outbreaks and create meaningful policy,” explains Card. For example, a hospital might regularly sample bacterial isolates from patients and send these samples to the Department of Health. Scientists there, like Card himself, can test those bacterial isolates for antibiotic resistance and perform whole genome sequencing to determine its underlying genetic basis. “I would like to utilize the techniques I developed during my dissertation in this overall process to predict the capacity of bacteria to evolve resistance in the future,” he says.

He is also passionate about life outside the lab. Card is an avid outdoorsman. “I like to hike and camp. Most summers I explore the Upper Peninsula with friends and to get away from the lab,” he says. “My favorite place on earth is probably the Pictured Rocks Lakeshore—it’s gorgeous!” He is also a voracious reader. “I read mostly nonfiction. For example, I just read about the life of the physicist Richard Feynman. He was very eccentric—a trait that I really

We are curious about whether resistance evolution is predictable.

appreciate. I’m also a huge fan of science fiction books, TV shows and movies. And I’m big into bar trivia and Hamilton!” says Card.

Card is nearing the end of his doctoral program, and he knows that his next step will likely take him out of the city where he grew up. Though he’s not sure where, he knows he will continue to follow his passion: studying antibiotic resistance in service of public health.

A portrait of Debrup Chakraborty, a man with short dark hair, glasses, and a goatee, wearing a dark pinstriped suit jacket over a light blue checkered shirt. He is smiling slightly and has his arms crossed. The background is a plain, light grey.

Debrup Chakraborty

STUDYING CANCER CELLS AND EXPLORING INDUSTRY CAREERS

POST DOC

PHARMACOLOGY & TOXICOLOGY

Program

“Biogen was a great experience,” says Dr. Debrup Chakraborty, a postdoctoral fellow and BEST trainee from the Department of Pharmacology and Toxicology. He and fellow BEST trainee Sarah Keaton were selected for a highly competitive internship at Biogen in Boston, Massachusetts. “I’ve never been in industry. I’ve never been outside the academy!” says Dr. Chakraborty. “It made me realize big companies have multiple branches that relate to neurology and inflammation: neurology, immunology, regulation, protein regulation, production,” he adds.

The internship let Dr. Chakraborty—whose primary research studies cancer—approach science differently. Paired with three other scientists with backgrounds in neuroscience or cell biology, Dr. Chakraborty worked on a project that they presented to Biogen leadership and for which they won second place. The group acted as consultants on a drug discovery project, where they designed experimental protocols and developed creative ideas to treat traumatic brain injuries.

“I realized that people from industry aren’t aliens. We saw them in their offices, in their labs. I couldn’t believe it: we have two flow (cytometry) machines. They have 12!” says Dr. Chakraborty. “They’re focused on production, so they will invest in products where they can earn money.”

EXPLORING CANCER CELL PROLIFERATION

At MSU, Dr. Chakraborty studies cancer biology. Specifically, he studies how obesity and excess abdominal fat can interfere with normal cell function. “We look at how a normal cell can turn into a cancer cell, and if we can prevent it,” he says.

We look at how a normal cell can turn into a cancer cell, and if we can prevent it.

Using mouse models, Dr. Chakraborty and his colleagues look at a particular growth factor, FGF2, which helps cancer cells proliferate aggressively. “No one has shown that this factor can merge a non-cancerous cell into a cancerous cell, so we try to understand the connection between FGF2 and cancer growth,” he says.

In his home country of India, Dr. Chakraborty studied naturally occurring compounds in ginger that improve the function of normal cells and can negatively impact cancer cells. “I drink ginger tea every morning,” he says. “My tea routine inspired my science.” Not surprisingly, he’s also an avid cook and is particularly good at cooking Bengali dishes with freshwater fish, chicken and meat.

AN EARLY INTEREST IN RESEARCH

“I’ve always wanted to be in and near research,” he explains. Starting in middle school, he sought out every opportunity to be involved in research, from plant science to physics to animal science. “Some were more exciting than others, but all of them made me realize that I can do research in different areas—academia, pharma, health systems.”

BEST not only helped Dr. Chakraborty during a nationally competitive internship hunt, but also helped him discover his dream career. “After interacting more with non-academics, I think I will go into industry,” he says. “But I couldn’t figure out how to get beyond the ads. BEST helped me learn how these things work: how to package myself to get these jobs.”

Dr. Chakraborty was also inspired to take advantage of other professional development opportunities through MSU BEST. “At the Society of Toxicology meeting in San Antonio, I got a travel award and won ‘Paper of the Year’ in Carcinogenesis. I was able to interact with people, and make my intention clear about what I needed to focus on to achieve my goals.” And with his experience, we’re confident that he will.

Kayla Conner



EXPLORING BIOSAFETY THROUGH ESSENTIAL TB RESEARCH

Kayla Conner, a Ph.D. student in Microbiology, came to MSU specifically to study tuberculosis (TB). Not only does she have a passion for research and for understanding the fundamental basis of disease, but she's also drawn to the technical challenges of doing work with a deadly pathogen that is considered to be a Biosafety Level (BSL) 3 organism.

Her previous lab studied *Cryptococcus neoformans*, which is a BSL 2 organism. It is prevalent in

developing countries and affects many people, especially those immunocompromised with HIV. It is a fungus that can be transmitted in the air and cause meningitis.

INFECTIOUS ORGANISMS COMPLICATE LAB LIFE

Doing research on highly contagious organisms like TB or *Cryptococcus neoformans* requires sophisticated approaches to prevent the accidental transmission of disease. "You have to wear

a disposable respirator at all times. You have to change out of your street clothes and into scrubs when you come into the lab; you wear two sets of gloves every time," explains Conner. "Everything takes twice as long. All of your equipment is bleached and autoclaved, and you have to do all of your work in a biosafety cabinet to keep everything contained." Even the floors are sealed with a special sealant so nothing can leak through the tiles.

Aside from her passion for studying infectious organisms, Conner says that “having BSL 3 training and experience is good for working in industry, or to work in a health department.”

SHARING HER PASSION THROUGH OUTREACH

Conner’s not exactly sure where she’ll head after she leaves MSU. But she does know that, if she keeps working with TB, she will stay in academia. “TB research is entirely in academia. This work is not funded by industry at all,” she says.

A drawback of academia for Conner? “I don’t like teaching,” she says. “I’ve done recitation and two sections of lab, and I’m just

not good at explaining things.” On the other hand, she loves teaching when doing science outreach. “Outreach is like teaching, but I get to pick what I’m talking about!” she says.

Conner has done medical outreach in Honduras and Nicaragua, where she volunteered at an orphanage for medically disabled children with obscure diseases. There, she learned about their ailments and how they are managed. Conner is also passionate about increasing the numbers of women in science and research. As an undergrad, she participated in a program called “Expanding Your Horizons,” where she mentored middle school girls who came to the university to learn about science.

In Lansing, Conner innovated a program for science outreach among Girl Scouts to inspire them to share her love for science. She volunteers with Science Olympiad,

Having BSL 3 training and experience is good for working in industry, or to work in a health department.

moderating competitions and helping design the exams that are a part of that program. “I love to see other people love science,” she says.

When she’s not in the lab or taking her research outside the lab to other

communities, Conner loves to bake and she recently adopted a cat. “I went to the shelter, and he literally jumped in my lap,” she says. She kept him, and named him Louis, after Louis Pasteur, of course, who loved research and cared about using science to serve people. *Almost* as much as Kayla Conner does.

Janice Diaz-Otero



PAYING TRIBUTE THROUGH VASCULAR DEMENTIA RESEARCH

Janice Diaz-Otero is the kind of woman who is always well-prepared. Sometimes she may not know what she's prepared for but somehow, in the end, her life ends up appearing to be a well-orchestrated series of choices that lead seamlessly from one to another.

"Everyone from my high school did extremely well in college," she laughs when describing the rigorous college preparatory curriculum she experienced at her private Catholic high school near her hometown of Cayey, in Central Puerto Rico. "High school was way harder than college."

AN EARLY LOVE FOR SCIENCE

Diaz-Otero's high school's high standards also taught her another thing: how much she loved science. She was originally drawn to pharmacy, but the rigor of her science education led her to discover a passion for research. In college, at the University of Puerto Rico at Cayey, she was accepted to a prestigious research position where she started doing plant research. "The research opportunities were not as abundant there as they are here," says Diaz-Otero. Even though plants were not her primary

interest—studying the brain was her passion—she was eager to get lab experience and gratefully worked with plants.

She was accepted to the Bridge to Ph.D. program in Neuroscience, which brought her to MSU for two summers in college. There, she met the faculty in the Pharmacology and Toxicology department. She even got to spend a full semester of college in East Lansing, taking classes at MSU as part of a student exchange program. And when it came time to applying for a doctoral program? "I only applied to MSU," she says.

“I love the research. I love reading articles, meeting new people who do work in this area. I love to mentor undergraduates and I love teaching,” she says. “I love to think about science and come up with my own experiments. Ask Anne,” she laughs, talking about her respected mentor, Dr. Anne Dorrance.

“I’m always coming up with crazy ideas.”

FROM THE OPERATING ROOM TO THE LAB

But research was not always the focus of her efforts. For a year between her undergraduate and graduate programs, Diaz-Otero spent a year working, doing electrophysiology recordings in the operating room at a hospital and working closely with neurosurgeons. “It was interesting work and I learned a lot about neuroscience, but that wasn’t for me forever,” she says. But being at home was the right choice. Her beloved paternal grandfather was diagnosed with Alzheimer’s disease while she was an undergraduate, and she wanted to stay home before the disease progressed much further. But she knew she had talents that would serve her professional interests and pay tribute to her grandfather.

Diaz-Otero intended to enroll in a traditional neuroscience program but, after doing a rotation with

Dr. Dorrance in Pharmacology and Toxicology, she decided that was the right lab for her. Even though the lab didn’t have room or study Alzheimer’s disease, she was not daunted. Instead, she applied for numerous fellowships to fund her training, and grew passionate about Dr. Dorrance’s line of research: vascular dementia. A

Diaz-Otero’s work with Alzheimer’s disease, previous work in different research labs, and expertise in brain science all prepared her well for the rigors of graduate work in Pharmacology & Toxicology.

separate diagnosis from Alzheimer’s disease, vascular dementia is a form of dementia that shares some symptoms as other forms, but is physiologically different.

Diaz-Otero’s work with Alzheimer’s disease, previous work in different research labs, and expertise in brain science all prepared her well for the rigors of graduate work in Pharmacology & Toxicology. “Grad school is hard,” she says. “There is no script. You

have to improvise, spending time on things that don’t work and having to learn when a setback is just a minor issue, and when you have to move on from an experiment.”

USING RESEARCH TO BETTER COMMUNICATE ABOUT DEMENTIA

Going away for graduate school, especially to the mainland United States, was also a sacrifice. But her work on vascular dementia also has opened up communication with her grandmother, since Diaz-Otero can explain what is happening with her grandfather’s brain in a way that her grandmother can understand. She says of her grandfather, “He recognizes us, but he forgets everything. His mood changes a lot, which is hard on my grandmother, but I explain that his brain—that’s not him.”

During her years with BEST, Diaz-Otero did two externships: one with the Office of Regulatory Affairs at MSU, and one as a clinical science liaison for Takeda Pharmaceuticals, where she worked with the private firm to do pre-clinical analysis. “There are a lot more deadlines in that world than there are in academia,” she says. Ultimately, Diaz-Otero would like to work with the Federal Drug Administration, ideally back home in Puerto Rico.

She also knows that she is well-prepared. Tenacious and persistent are two words that are often used to describe Diaz-Otero. “You set a goal, and you have to work for it,” she explains. When the lab she wanted to work in didn’t have funding support for her, she applied for scholarships and fellowships until one finally came through. Eventually, two did at the same time: one with the American Heart Association, and one through the National Institutes of Health. “You just get used to finding your own funding, talking to anyone about your research,” she says.

Luckily, she loves talking about research. And if anyone can find a way to have the career she wants in a place near her family, it will be Janice Diaz-Otero.

Update: Janice graduated with her Ph.D. and accepted a position as Medical Science Liaison at Janssen Pharmaceutical for Johnson & Johnson.

Taylor Dunivin

STUDYING ARSENIC TO BENEFIT HUMANITY

GRADUATE STUDENT

MICROBIOLOGY - ENVIRONMENTAL TOXICOLOGY

Program

Taylor Dunivin has been away from East Lansing for much of this year, launching her career in science policy with the Christine Mirzayan Science & Technology Policy Graduate Fellowship Program. Now in its 21st year, the program

Arsenic is the 55th most common element in the world. Microbes have evolved mechanisms to change the state of arsenic to change its volatility.

provides early career individuals with the opportunity to spend 12 weeks at the National Academies in Washington, D.C. learning about science and technology policy and the role that scientists and engineers play in advising the nation.

Leading up to this work, Dunivin worked as a program manager with Science Debate, an organization that encourages candidates for

public office to engage with scientific issues. She also developed science communication skills, writing a story on DNA analysis technology for WKAR radio.

Dunivin is a Ph.D. student in Microbiology and Molecular Genetics, where she studies antibiotic resistance and arsenic. “Arsenic is the 55th most common element in the world,” she says. “It’s toxic to people. Microbes have evolved mechanisms to change the state of arsenic to change its volatility.” Given its prevalence and toxicity to humans, understanding these mechanisms has the potential to benefit humanity.

“Growing up, I had stomach problems,” says Dunivin. “I’m not sure if it was food, water or something else, but something sparked high levels of arsenic in my system. That is what really sparked my curiosity, and made me interested in toxicology, as a result.”

A PASSION FOR POLICY

Dunivin came to MSU after completing an undergraduate degree at the University of Michigan. She was drawn to her current project after her boss gave

a talk on underground coal mine fires. “I thought, ‘There’s probably arsenic there!’,” recalls Dunivin. “I approached her, she told me to come up with a project, and I did. I feel a lot of ownership over the work as a result.”

Dunivin toyed with a career in medicine, but decided she much preferred research. She also toyed with doing work on plant bioremediation, bringing together her love of research and her environmental work, “but it didn’t work out that way. So I stuck with arsenic. It’s the devil I know!” she explains.

Increasingly, though, Dunivin sees her research as a means to serve her real passion: policy work. “I haven’t explored the whole world of it,” she says, despite many experiences working in the area. She aspires to work as a Fellow with the American Association for the Advancement of Science, a position that will allow her to work directly in a federal agency to support sound science policies. In the meantime, she has already been selected to be the Tri-Societies AAAS Congressional Fellow for 2019-2020, continuing her impact on Washington D.C. in service of science.

Sylmarie Dávila-Montero



STUDYING ELECTRICAL ACTIVITY IN THE BRAIN

“I research to optimize biomedical and social signal processing algorithms for the enhancement of brain machine interfaces and social interactions,” says Sylmarie Dávila-Montero, a BEST trainee and Ph.D. student in Electrical Engineering.

“I started graduate school working to enhance the quality of life of people with physical disabilities, like quadriplegics, whose brain is fully functional. It is possible to implant a device in the brain that communicates with the parts of the body you want to control. This work also uses algorithms to enhance our understanding of

the brain as a whole in the hopes of understanding and helping diagnose conditions like epilepsy,” she explains. “Even the study and improvement of social interactions are related to the cognitive processes going on in the brain that affect the human body and our behaviors.”

MATHEMATICALLY BASED WORK

Growing up in Cagüas, Puerto Rico, Dávila-Montero’s mother worked for a medical device company, and her father was an engineer. When she graduated from high school at

16, she attended the University of Puerto Rico at Mayagüez. They did not have a biomedical engineering program; instead, she focused on electrical engineering and looked for research opportunities that aligned with her interests. “I was talking to professors, and got introduced to someone who works in digital signal processing,” she says. “He did work with hearing aids. The goal was to improve signal amplification and noise cancellation features in hearing aids.” She worked with the faculty member for the last three years of college, and jumped at the chance to come

to MSU for the Summer Research Opportunity Program (SROP) for a summer research opportunity with Dr. Andrew Mason. When it was time to apply to graduate programs, MSU was in the top three. She immediately accepted her first offer: MSU, to resume her work with Dr. Mason.

“My work is more mathematically based than many others,” she explains. “Many of my colleagues are focused on device fabrication and electronic design. My work is more abstract. I work on extracting information from digital signals in a hardware-efficient way.” When she finishes her Ph.D. in a few years, she hopes to get a post doc in industry, and then will look for a position in academia.

STUDYING BRAIN NEURONS

Nudged by BEST and with the support of an NSF GRIP Fellowship, Dávila-Montero earned funding through the competitive NSF Graduate Research Fellows Program. She spent a summer in North Carolina, working in the Research Triangle Park area in an EPA lab. Dávila-Montero was unique in her lab at the EPA, because she was the only engineer and the only one whose typical work is primarily mathematically derived. The lab did *in vitro* work studying the signals of healthy brain neurons when exposed to chemicals that harm brain cells.

“I learned how to do cell culture, how to do neural cell recordings, how to manage data and what other labs were doing related to physiological testing on rats,” she says. “I attended many seminars for people to talk about research.”

The PI in the EPA lab, Dr. Tim Shafer, is an MSU grad from the Department of Pharmacology and Toxicology. “He took his time to explain everything,” says Dávila-Montero. “I didn’t think I would like it that much, especially since this was my first exposure to toxicology. But I got to learn about the effects of different chemicals on the brain, and how those chemicals affect communication of neural cells.” She plans to return next summer to continue her work with the lab, and do a post doc with them once she has graduated from MSU.

Even though she’s a few years away from finishing her Ph.D., she has a plan in place for the next step. This ability to do excellent work in the present while also putting plans in place for the future? Not only is that an impressive life skill, it is one that Dávila-Montero seems to have been honing her entire life.

A COMMITMENT TO EDUCATION

When she was 10, in 6th grade, Dávila-Montero started her own business. Her aunt had her own bakery and used a long-admired, and fiercely protected family recipe.

No one else was interested in taking over the recipe, and Dávila-Montero remembers thinking, “I’m ten; I have no money.” So she started baking. She was hired to make birthday cakes for her mother’s colleague and was hired to make a wedding cake. She also learned how to do acrylic nails and manicures. She remembers thinking, “I don’t know what I’m doing, so I wanted to have other options. If this bakery thing doesn’t work out, I can do nails.”

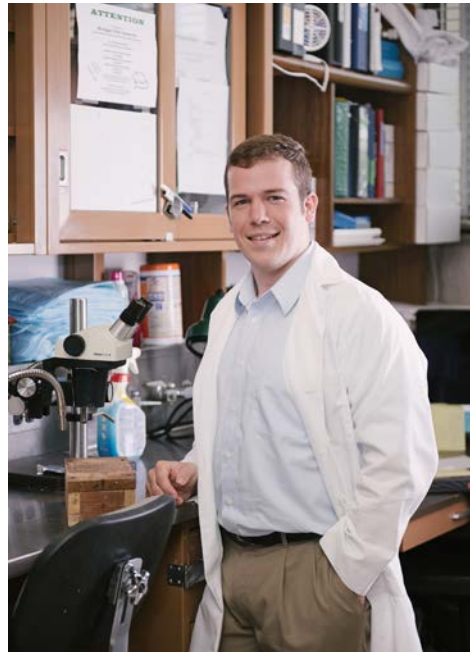
My work is more abstract. I work extracting information from digital signals in a hardware-efficient way.

This drive extended to school, too, of course. Having graduated from boarding school at 16, Dávila-Montero spent her first years in college too young to drive or to go out with her college friends, and focused solely on studying and doing research on digital signal processing. The rigor of her boarding school prepared her for this level of focus. “I was used to going to classes, and going back to my room and studying. Everything was strict and I was used to that. I just kept it up in college,” she says. This discipline prepared her well for graduate school, but also taught her that she would benefit

from finding some more balance in her life. In Lansing, she spends a lot of time with friends and dancing salsa. “Lansing has a cool group, Salsa Capital, that gets together twice a month or so to dance salsa. And there’s a great group, Orquesta Ritmo, that plays around here,” she says.

Dávila-Montero is a skilled researcher, and knows what she wants—after she does her post doc with the EPA, of course. She eventually wants to be a faculty member somewhere where she can do more teaching, and not exclusively research. She loves working with young scientists and giving back to Puerto Rico. This guided her to return to Mayagüez earlier this year to work with some of her old mentors and conduct a workshop for women in computing. This was a two-day conference sponsored by Google, where she talked with prospective students about graduate studies. While she would like to return to Puerto Rico, she said that’s uncertain. Still, she is committed to finding a position where she can focus on teaching and mentoring. “It amazes me how we can make an impact on someone, whether by what we know or what we don’t know,” she says.

David Ferland



HYPERTENSION RESEARCH AND THE WORLD OF SCIENCE COMMUNICATION

David Ferland studies hypertension in the lab of BEST PI Dr. Stephanie Watts. In particular, he explores the relationship between obesity and hypertension. “For a long time, some patients were not responding to blood pressure medication, and chemerin is a protein that we think could be causing hypertension in

people who are obese,” he explains. “We’re exploring the possibility of this leading to new medications to treat hypertension in this way.”

This work on hypertension led him to take advantage of an externship with the *Lansing State Journal*, funded by a grant from MSU’s Science and

Society program. Ferland published an article in the *LSJ* on the debate regarding hypertension diagnoses. He explored how researchers often believe high blood pressure should be treated early on, while many doctors disagree.

Writing like that “takes a lot longer than I thought,” says Ferland. “I’d go in for a few days, and then go home and work on it. The journalism world is just different! I had to get over the fear of dialing someone’s phone number. In science, you can email someone; writing an article, you have to call. They might be a director at the National Institutes of Health, but they don’t mind talking to you. You just have to be a nice person!”

BREAKING INTO SCIENCE COMMUNICATION

Ferland had been nurturing an interest in science communication for some time, attending a writeathon at ComSciCon and connecting with Friends of Joe, an organization for people interested in science policy, coordinated by Joe Palca at NPR. Still, mainstream

journalism was challenging. “The one sentence paragraph! It’s definitely a different way of writing. ‘Am I writing for a newspaper, or anything else?’ I’d ask myself,” says Ferland.

He is intrigued by—and interested in staying in—this world of science communication. He has connected with Nick Wigginton, a former editor at the influential journal *Science*, to explore how his job works. Ferland is interested in careers in research development—helping people write grants, as well as connecting people inside and outside the university. He has written and been awarded his own training grant from the NIH and is currently applying for writing fellowships that would support his professional development.

“It is scary fighting for your own grants,” Ferland says of the current state of science funding. “We have some incredibly bright young faculty members who are fighting for funding.”

We’re exploring the possibility of this leading to new medications to treat hypertension.

Ferland often reflects on the nature of science funding. “My career is judged and determined by someone in another room,” he explains. “In an administrative setting, you have relationships: bosses, coworkers and those people get some say in whether I get to stay around, continue doing research, and get paid.”

Grappling with this funding game, BEST stepped in to help Ferland explore his options. Regardless of where his professional pursuit takes him, Ferland knows one thing for sure: “My priorities will always be my family and my church,” he says.

Meredith Frie

ANALYZING CANCER IMMUNOLOGY ON THE WEST COAST

GRADUATE STUDENT

CELL & MOLECULAR BIOLOGY

Program

For Meredith Frie, MSU BEST was one of the main reasons she considered a post doc after graduating from MSU with a Ph.D. in Cell and Molecular Biology. “Because of BEST, I thought about it a lot,” she says.

Frie is now a research associate at the Salk Institute in San Diego. “They were looking for someone who would be a good fit. I brought the immunology and experience with animal models, and now I get to work specifically on cancer immunology,” she explains. “This experience will set me up well for future jobs. I still intend to get a job in industry—my boss knows this and is happy to help me achieve that goal,” Frie adds.

NARROWING CAREER OPTIONS

Frie joined BEST because she was drawn to work outside of academic science. Through her BEST externships, Dr. Frie was able to test out different options. She worked as a commercialization

I’m very research-oriented, and am focused on developing new laboratory skills and digging into cancer immunology.

intern at Spartan Innovations and an intern with the MSU Office of Government Relations at MSU, where she once rode the elevator with Michigan Governor Rick Snyder. (She didn’t realize who it was until after he got off the elevator, she recalls.) Through these experiences, Frie learned what paths, personal and professional, she wanted to follow.

For Frie, that included getting back to the West Coast. “I missed California,” she says. “I was done with the cold, and I was looking for something in the Bay Area or San Diego,” where Dr. Frie went to college. “I’m done moving around for my career,” she says, adding, “I’m ready to have a sense of

community.” She applied to many positions, but realized she would not be able to live easily on a post doc salary in the Bay Area. “My parents reluctantly offered that I could live in their basement, but I didn’t want that!” she says.

WORKING IN A RENOWNED FACILITY

“I love my current lab and project,” says Frie. “But it is a post doc, which is a temporary position.” She likes her current work at Salk in part because of their renowned facility with access to cutting-edge research and resources. Her project also allows her to develop valuable knowledge and technical skills. “It will be good for when I apply to the next step,” she says. “The next job won’t be temporary.”

Through her experimenting—in science policy, program management and other areas where she learned new skills to complement her research ability—Frie realized that she didn’t want to teach. “I’m very

research-oriented, and am focused on developing new laboratory skills and digging into cancer immunology and doing that until I’m ready to apply for jobs,” she says.

Until then, she savors being back in California where she still has friends in the area, having attended the University of California, San Diego. She has access to innovative research and—perhaps most importantly—is far from the snow. Despite years spent in Michigan, “I never really mastered winter!” she says.

Colleen Friel



RESEARCH, OUTREACH AND STUDYING PLANTS ON HORSEBACK IN AUSTRALIA

How do you go from a horse-crazy girl (with no horse) in an economically depressed Pennsylvania steel town to talking science with two ranchers who together farm 20,000 acres on the shores of Western Australia?

According to Colleen Friel, pretty seamlessly.

Friel finished her Ph.D. in Plant Biology in Spring 2018. She studied the relationship between plants and rhizobia, a bacteria that fixes nitrogen molecules so that plants can access this essential nutrient. Most plants need nitrogen to thrive

but, because the element is not abundant or easily accessed in the natural environment, growers rely on large amounts of fertilizer to encourage high growth and crop yields. This reliance on fertilizer is linked to many problems that have made their way into public consciousness, including tainted water sources and algal blooms in lakes, rivers and oceans.

That is why environmentally minded plant biologists like Friel are so eager to figure out the mechanisms used by a small number of plants—

mostly legumes—that are able to effectively tap into their own natural, bacterial source of nitrogen: by symbiotically partnering with rhizobia bacteria. Such plants have nodules in their root systems that house rhizobia, and the bacteria give back to the host plants by breaking down N₂ molecules for plant use. “We probably won’t be able to figure out exactly how that works, not in my lifetime,” Friel says. “But it’s exciting to think about it; if we can find the mechanism, then we can explore how other plants could develop this capability. Plus it’s

fascinating to see two unrelated specimens rely on each other to thrive.”

ANIMALS TO PLANTS

As for how she got into this area of science, it starts with horses. “I was horse-obsessed as a girl,” explains Friel. She decided that the best way to be around horses would be to become a large animal vet. “But after I did a rectal exam on a cow, I realized this was not the job for me,” Friel explains. The agronomy and plant classes in the Agricultural Sciences program, however, held her interest.

When she started attending Allegheny College for her undergraduate studies, she picked biology—and, more importantly, selected the only faculty member in biology that she knew at Allegheny. That faculty member studied plants, thus cementing Friel’s move to plant science. And, despite not growing up with horses, Friel was able to join the Allegheny College Equestrian Team.

EXAMINING AUSTRALIAN SOIL AND PLANT LIFE

When it came time to attend graduate school Friel was drawn to MSU because of its top program in plant biology and also because it offered her a chance to embrace science as a truly worldwide pursuit. As a participant in MSU’s

program for Plant Biotechnology for Health and Sustainability, she was interested in opportunities to work with growers and community members to find ways to translate the basic science of her graduate lab work to an applied science that would benefit people working in agricultural environments. These twin interests eventually led to a three-month internship at Murdoch University in Perth, Australia, at the Center for Rhizobia Research.

It’s fascinating to see two unrelated specimens rely on each other to thrive.

“I had heard about funding available from NSF through the East Asia and Pacific Summer Institute program, and got interested in going abroad to do research,” she says. “Australia has generally poor soil. They raise legumes as forage crop for livestock, and they don’t fertilize much. It wouldn’t be worth it. They also have something called ‘non-wetting soil,’ a unique soil that has an oily film on top, so when it rains, the water just runs off.”

Studying how legumes and rhizobia behave in this landscape introduced Friel to a world of scientific research, but also to the important work of outreach: getting these

scientific innovations in the hands of growers who can improve their agricultural practices. Friel traveled thousands of miles between farms up and down the western coast of Australia—some of it on horseback, of course—and visited many tiny towns. “The soil is generally so bad they mostly graze sheep,” she explains.

INTEGRATING RESEARCH WITH OUTREACH

Back on campus, Friel also sought out opportunities that merged her academic work in plant science with opportunities to bring science to different domains. As a fellow with Spartan Innovations, Friel joined a team of graduate students who explored how technology coming from an MSU lab could be turned into a business opportunity. They developed a business plan, attended pitch competitions and even attracted attention from an angel investor.

As an intern with Campus Ties, an educational web developer, Friel developed learning modules about plant breeding. “That was good for me to know, as I’m not a [plant] breeder,” she says. She also discovered new skills in doing online research (as opposed to bench research) and how to work on a remote team.

Friel’s dream job would be running a center like the one in Perth, where she could combine her passion for bench research with her desire to see that research make a difference. That integration of research and outreach appeals to her, as does the chance to work with people from around the world who bring different science experience and life perspectives.

“The only thing preventing us from moving to Australia right now is that we have two rescue dogs, and we aren’t willing to fly with them in the cargo hold or quarantine them for months,” which is required to bring animals into Australia, she says. While she imagines how she could sort out the details that might bring her back to Australia, Friel has decided to stay at MSU for a post doc in the lab of Dr. Cecilia Martinez-Gomez. She occasionally rides at a local stable that one of her students recently showed her, and says that’ll do until she can hang out with some koalas again.

Nkrumah Grant



BRIDGING CHILDHOOD CURIOSITY AND PROFESSIONAL SUCCESS

Nkrumah Grant always loved science. And space—aliens, in particular. But after he dropped out of high school in Saginaw, Michigan, aliens seemed like a mere childhood curiosity.

And yet, Grant found his way back to aliens. Sort of. As a graduate student in the lab of Dr. Richard Lenski, he studies “the evolution of metabolism and the effect of relaxed selection on metabolic plasticity.” His project, which

he designed with input from his mentors, explores how *E. coli* bacteria compete in anaerobic environments. Specifically, he looks at how ancestral bacteria—older cells that lived in both oxygen-rich and non-oxygenated growth environments—compete with their evolved descendants, cells that share some of the same genetic components as their cellular ancestors, but have been modified and only grown in oxygen-rich environments.

CONNECTING BACTERIA FINDINGS WITH ALIENS

You might expect that younger bacteria would fail when expected to survive without oxygen—simply because these cells have never been forced to survive in such environments. But according to Grant’s preliminary work, those cells actually do better than you’d expect; not as well as their bacterial “great grandparents” who have been exposed to both types of environments, but they

did not completely fail. And for someone like Grant who loves the idea of aliens—of some life form existing in outer space—this kind of legitimate science is exciting. After all, this work suggests that if bacteria can live in environments without oxygen, and that bacteria can maintain this ability over generations of evolutionary change, then space—itsself an environment without oxygen—might host other life forms, too. Like aliens.

Grant jokes now about his love of aliens, even as he does not joke about his commitment to scientific rigor. Science is a passion he's had his entire life, even when life took him to some unexpected places along the way.

AN UNCONVENTIONAL PATH TOWARD A SCIENTIFIC PASSION

As a young student, Grant's quick and curious mind earned him a lot of attention. Throughout his earliest years, Grant routinely won awards for his academic achievements. But in middle school, he says, he stopped caring. Grant's mother was busy working and raising six children, so when he

saw that no one was celebrating his achievements, he felt less proud of them. He says that, by high school, he had given up on his own education. He eventually dropped out and started hanging out, spending his days “on the streets” in Saginaw with friends and others who were also not working or in school.

Science is a passion he's had his entire life, even when life took him to some unexpected places along the way.

One day, one of his friends invited him to come to her graduation celebration. Grant was struck by how much joy her achievement brought her family and how much pride she had for earning her diploma. Grant enrolled in the same program she was completing, this time at an alternative high school. He quickly made up for lost time, testing out of classes he missed and racing through others. “I was always a really good student,” he says.

In his high school science class, his teacher showed him a video called “Alien Planet.” This sparked an interest in astrobiology, and how microbes survive on Mars.” This reignited his love of aliens and science. After he graduated only six months behind his original high school class, Grant enrolled at Ferris State University before transferring to Grand Valley State University, where he was a McNair Scholar. There, he found research opportunities that inspired and challenged him and, more importantly, a community that supported him and his academic goals.

A FAMILY AFFAIR

Grant has always known that a Ph.D. was in his future. He loved research and knew that a doctorate would serve his career—but his first years in graduate school were not without their challenges. Raising children, going through a divorce and other family challenges added complexity to a rigorous academic and research plan. But by 2017, things were falling into place. Grant likes to spend time with his two older children (his son Genesys

and his daughter Umoja). Both of his children love his work. “They like going into the lab, spreading plates,” he says. “If I'm talking to myself, they know I'm talking about work.” Umoja, his daughter, is particularly like her dad. “She wants to be a scientist in space,” Grant says. “She's like a twin. She's very inquisitive.” Additionally, his family grew, with a new wife and baby girl, Imani.

Grant is looking forward to graduating in a few years, and hopes to find a position as a faculty member at a liberal arts college. While he loves research, he finds that his real passion is mentoring and teaching, and wants to dedicate his life to nurturing the talents and goals of young scientists. Outside of work, Grant loves to cook, specifically Afro-Caribbean cuisine drawing on his Guyanese roots. One day he even hopes to have his own restaurant—on earth, most likely.

Siomara Hernandez-Rivera

BALANCING CRITICAL DRUG RESEARCH WITH A PASSION FOR DANCE

Dr. Siomara Hernandez-Rivera is a postdoctoral scholar in Physiology who studies the effects of Pyridostigmine Bromide, a drug that was administered to on-the-ground personnel during the Gulf War as a prophylactic treatment against possible nerve gas attacks. Such soldiers were also exposed to pesticides and insect repellents as a precautionary measure. Unfortunately, many of these veterans now suffer from Gulf War Illness, a medical condition that includes GI problems, neurological and respiratory issues, pain and trouble sleeping.

In her work, Dr. Hernandez-Rivera looks specifically at the effects of Pyridostigmine Bromide on the enteric nervous system among affected veterans. The drug had not yet been approved by the Food and Drug Administration (FDA) in the United States when it was administered to soldiers heading to the Middle East in the 1990s, and now the Department of Defense is funding research to attempt to find out the root causes of the illness,

including possible connections between Pyridostigmine Bromide and Gulf War Illness.

A LIFELONG LOVE OF SCIENCE

When she was attending college at the University of Puerto Rico-Mayagüez in Western Puerto Rico, Dr. Hernandez-Rivera received funding from a different source: a dance scholarship. At age 9, she started studying dance—jazz, contemporary, salsa and hip hop. In college, she competed with the dance team at her university, and was part of a team that won a national championship.

But dance was never her primary goal. “I always wanted to be a professor,” Dr. Hernandez-Rivera says. Science was a natural area of focus. “My parents knew I was into science before I did. They bought me microscopes as a gift, and we had a big backyard, always playing in nature and participating in the science fairs,” she says. Science maintained her interest.

She knew that, to be a professor, she would ultimately need a doctorate. So after graduating from college, she decided to attend Ponce Health Sciences University. She was drawn to this institution because a scientist there worked on endometriosis, a disease that had affected Dr. Hernandez-Rivera’s family. “My mom has endometriosis and there is not much work done on it,” she explains. “It’s such a taboo condition, no one wants to talk about it.” With support from a MBRS-RISE fellowship from the National Institutes of Health (NIH), Dr. Hernandez-Rivera conducted research that used animal models to study endometriosis. The fellowship that supported her graduate training also gave her opportunities to participate in different conferences, network with professionals from industry and academia and present her work throughout the world.

A RETURN TO DANCE

Despite her success and support, the rigors of graduate study took their toll. Dr. Hernandez-Rivera realized that she still needed something she thought she left behind in college: She needed dance. “When I don’t dance I have anxiety and panic attacks. It’s my outlet for stress, and now I train and teach dance,” she says. She was drawn to the challenge of pole dancing. “I have strong legs from dance, but didn’t have the upper body strength, at first,” she says.

Dr. Hernandez-Rivera teaches classes in pole dancing, which is considered “an extreme sport, not an art form,” she says. “I’m a certified instructor and have to carry my own liability insurance when I teach.” Last December, she competed in a national competition for pole dancers in Chicago in which she won first place in her category.

She also found other ways to cope with the stress of scientific work and, after moving to East Lansing to

work on Pyridostigmine Bromide, found the winters to be a brutal contrast to the weather of her beloved home island. “I taught myself to knit and crochet. I don’t really have time, but I wasn’t going to spend \$30 on something I could do myself, so I learned,” she says. “One of the first things I made was some fingerless gloves so I could work in the lab.” She also

In her work, Dr. Hernandez-Rivera looks specifically at the effects of Pyridostigmine Bromide on the enteric nervous system among affected veterans.

finds it a nice distraction from the challenges of work and dancing. “Relaxing doesn’t have to mean my entire body,” she says. She hopes to one day create an Etsy shop to sell her crocheted animals, which she makes and often gives as gifts.

In her post doc, Dr. Hernandez-Rivera also jumped at the chance to work more closely with students, especially students like her. She served as a writing coach for MSU’s Summer Research Opportunities Program (SROP). Just as the MBRS-RISE Fellowship from NIH proved instrumental in supporting Dr. Hernandez-Rivera’s science training and professional development, she also wanted to support the research aspirations of other students from underrepresented populations.

In the future, Dr. Hernandez-Rivera wants to continue to do bench research, either in a faculty position or for a government lab. If her various passions suggest one thing, it’s that the scientific enterprise benefits from people who use their brains and bodies in creative ways—seamlessly moving between the lab and the studio.

A portrait of Alessandra Hunt, a woman with long, dark, wavy hair, smiling warmly. She is wearing a black zip-up jacket over a blue ribbed top and a necklace with a small blue pendant. The background is a plain, light gray.

Alessandra Hunt

FROM DENTISTRY TO CANCER IMMUNOTHERAPY RESEARCH

POST DOC

MICROBIOLOGY & MOLECULAR GENETICS

Program

Dr. Alessandra (Ale) Hunt is a senior postdoctoral associate in a biofilm lab in the Department of Microbiology and Molecular Genetics. In this role, she has worked on many projects developing treatments for biofilm-related diseases. Lately, she has been working on creating adenoviruses to treat cancer, a groundbreaking approach to cancer immunotherapy.

“There are cyclic dinucleotides produced by bacteria that we were able to engineer into viruses making them little factories. These molecules trigger the immune system to fight back against the virus and the cancer,” she explains. “I have never studied cancer before, and my previous work on biofilms was really ‘sciencey’ and I would have to relate it to health. Now, when I say ‘I study cancer,’ people perk up.”

GETTING STARTED IN DENTISTRY

And yet, this is not the first time Dr. Hunt has worked in health. She is a D.D.S., Ph.D. who specialized in prosthodontics in her home country of Brazil. The road to dentistry in Brazil is slightly different than in the United States, she explains. “Everyone takes the national exam at the end of high school. It’s one day, and if you don’t get into the program you want, you have to wait a year and take it again the following year to try again.” In her case, her high score on the national

exam admitted her to the top dental school in Brazil. They accept only 80 students annually, and that program was four years. “The first two years were pretty much basic science, the last two years are intensive clinics in dentistry,” she explains. The program is intense, years of constant studying and high stakes. “In the clinics you realize if you don’t like dentistry. And if you don’t like what you picked, you have to go back and take the national test for another profession and start over,” she says.

She liked it well enough, graduated with her dental degree, and then tackled a two-year dental residency

When I say ‘I study cancer,’ people perk up.

that allowed her to specialize in prosthodontics. “I can make crowns, bridges, veneers, that kind of thing,” she says. But the residency also exposed her to research on microbiology. Because she liked research so much, a four-year Master’s in Dentistry followed. After working in microbiology for a while, she realized she really loved the research side of science and spent five years earning her Ph.D.

“I still consider myself a dentist, even if I don’t practice,” says Dr. Hunt. “The research bug is just bigger. I’ve always been curious, and dentistry is just the same thing

every day, more or less. Science is unpredictable—you can bang your head against the wall for different problems.” Research, she realized, offered her the variety and creativity she wanted for her career.

GROWING TO LOVE RESEARCH

During Dr. Hunt’s residency program in dentistry, she was introduced to research on biofilms, a living system that is formed when various organisms like bacteria and fungi stick to each other and to another surface. Dental plaque is a common example of a biofilm. Her advisor in Brazil did not have much experience in biofilms, and encouraged her to find another advisor who could bring this expertise. She kept on with her research, finished her Ph.D. and then got a flyer from the Pan-American Advanced Studies Institute (PASI) that was offering a chance for American Ph.D. students to come to the U.S. for a workshop on biofilms. It was funded by the National Institutes of Health (NIH), and Dr. Hunt decided to pursue it even if she did not think she fit the precise target demographic. “I was not a basic science researcher,” she says. When she inquired about the program she was encouraged to apply and was accepted as a participant. The workshop took place at the prestigious Center for Biofilm Engineering at Montana State University. There, she met a professor who had short-

term funding to develop a small business plan via a Small Business Technology Transfer grant to work on biofilms in dentistry and invited her aboard. Dr. Hunt found herself moving to Bozeman, Montana.

She joined another project after that grant ended, and grew to embrace life in the American West. “I really loved that place,” she says. “I still do. It makes me cry thinking about it.” She moved to Michigan after she met and married her husband. “He’s from Michigan. He got a job here, so I packed my bags.”

“I’ve grown to love Michigan,” she says. She especially loves Mackinac Island, in large part because she has loved the movie “Somewhere in Time” since she was a child. Visiting the island lets her see the places where that movie was filmed.

Of course, most of her days she spends doing what she loves most—metaphorically hitting her head against the wall in trying to solve scientific mysteries and issues, currently in the pursuit of finding a cure for cancer. And if she were to ever tire of that path? There’s always dentistry.

Kristin Jacob



CAMPING, PHOTOGRAPHY AND STUDYING MICROBIOMES OF THE MIDDLE EAR

Kristin Jacob, a Ph.D. student in Microbiology, discovered her project because of ear infections. The son of her mentor, Gemma Reguera, often had ear infections, and sometimes those infections stopped responding to antibiotics. Jacob had always been drawn to pathogenic work, and she started to wonder: What is going on in the microbiome of the middle ear that is affecting infection, and the treatment of middle ear disease?

It turns out, there was little research looking at this question. Additionally, this study allows her to work with the U.S. Navy in order to explore how bacteria from the middle ear microbiome could be engineered to help treatment of barotrauma, or damage of the middle ear caused by pressure, in divers.

EMBARKING ON A CAREER IN SCIENTIFIC RESEARCH

Jacob came to MSU after graduating from Northern Michigan University. “I studied biology with a microbiology concentration. I thought I wanted to be a vet, but when I graduated from college and didn’t get into vet school, I decided to do a master’s degree and try again. I came to realize during my master’s that I really enjoyed

research,” she explains. She didn’t reapply to vet school, but rather continued to explore a career in scientific research.

After earning her master’s degree, Jacob worked as a lab tech at the University of Michigan, where she researched gene regulation of *Streptococcus pyogenes* in a pediatric infectious disease laboratory. The work also involved mentoring undergraduate and graduate students. Having the ability to teach students about scientific research has influenced her interest in working with multiple mentoring programs while attending MSU.

Jacob is actively preparing herself for her eventual career; she worked a BEST externship as an intern with MSU Technologies, where she learned about patents, consulting and the challenges of bridging academic research with industry,

specifically in how researchers start small companies from technologies they developed.

LIFE BEYOND THE LAB: CAMPING AND PHOTOGRAPHY

But work is not her only priority. An avid outdoorswoman, Jacob spent weeks traveling and camping her way through the American West with another friend who was leaving Ann Arbor. “We went to Zion and Bryce Canyon National Parks,” she says. She always loves returning to the Upper Peninsula, and would like to backpack through Europe someday. “Maybe that will be a treat when I’m done. Maybe I’ll go to British Columbia; it’s so beautiful.”

Additionally, Jacob enjoys traditional black and white film photography. She routinely attends a community dark room in East

Lansing developing film and photos she has taken. “There is something that is very peaceful about working in the darkroom and getting to see your image come to life on paper,” she says.

Jacob also makes time to go out with friends and encourages “leaving science at the bench,” as she says. “When my friends and I go out, we have a rule: We can only talk about science for about ten minutes. This started while I worked at U of M, where we gave

Sometimes, in our field, it seems it can be easy to forget that we are more than just our science.

ourselves just enough time to talk about work and get anything off our chest. We talk about science all day; it is nice to have a chance

to learn more about each other and our interests outside of science.”

In everything she does, Jacob is sure to see the bigger picture. “Sometimes, in our field, it seems it can be easy to forget that we are more than just our science.”

Shruthi Kumar Raj



CHEMISTRY RESEARCH AND SEEING THE WORLD

Shruthi Kumar Raj did not want to come to the United States. And yet, two years after moving to East Lansing, she has visited “almost all” of the National Parks. Denali National Park in Alaska? Yep. Zion, Rocky Mountain, Glacier National Parks? Of course. “Yosemite is my favorite,” she says.

“I feel like I’ve attained the purpose of life” by traveling through the U.S., says Kumar Raj. “Mind-blowing landscapes, it humbles you. The Grand Canyon, waterfalls in the middle of nowhere. We’re nothing compared to nature.”

WORK-LIFE BALANCE

Of course, Kumar Raj did not come to MSU simply to savor the landscape. She came to study chemistry, a field she has always loved. “In Dr. Greg Swain’s lab, we’re developing coatings to prevent airplanes from corroding,”

she says. But while she loves the research, it's the lab culture she appreciates more. "I love my lab. There's great rapport, a 9-5 place," she says. "It's not morning 'til night, and we have an understanding professor."

She wanted to see a different model—not to mention, more of the world.

Having a life is especially important to Kumar Raj. "I still like research," she says. "But I take as many breaks as I want. I want to write my own thesis in the Himalayas. I want a garden of my own and I definitely want to stay in chemistry."

Kumar Raj grew up in Bangalore, India, "a high-tech city," she explains. "I worked in a

National Lab to do research as an undergraduate, and I was always oriented to chemistry," she explains. That experience helped her realize she wanted to do research for the rest of her life. But life in India did not always suit Kumar Raj. "In India, there is intense competition, and you always have to be on top to even meet your basic needs," she says. She committed to chemistry, and even more to research. But Kumar Raj wanted to see a different model—not to mention, more of the world.

AN INTERNATIONAL EDUCATION

Kumar Raj decided to pursue an internship abroad. She was offered a position in a lab in Rolla, Missouri, which was her first introduction to the United States.

"The tallest building in town was only two stories, and it was a 30-hour flight from home," she says. The rural nature of that part of the country was a significant departure from her urban upbringing in India.

"At first, I did not want to come to the U.S. for grad school," says Kumar Raj. "I applied and was accepted to Oxford, but I didn't get funding, so when I was accepted at MSU, I figured, apparently I have to come here. Now? I love it."

Much of that has to do with connecting with other international students, many from India, who share her wanderlust and desire to travel as much as possible. "At home I'm more limited by money," she says. But as a grad student, she finds plenty of time, energy and money to travel. "I mostly sit at home, planning my next trip.

I'm a peaceful person," she says. "I just save money, save money, save money" for the next excursion.

She was drawn to MSU BEST because she knows what she wants—a research career with good work-life balance—and the "main idea of BEST" helps with that. "I've gotten much better at networking," she says. "I don't know what's next, but I'm glad you can branch out like that."

Ramya Kalyana Kumar

PHARMACOLOGY AND LEARNING TO LOVE DOGS

Ramya Kalyana Kumar has always been fascinated by science and engineering. Growing up in India, she knew she would pursue a career in these areas, but some options were out of reach for her. In India, admission to medical school is controlled by both one's score on the national exam and on one's membership in a caste: she scored a 95% on the exam. But for her caste, only a score of 99% would have allowed her admission to medical school that year. "They said I could be a dentist," explains Kumar.

For college, she decided to enroll in a prestigious private university and pursue bioengineering. "They admit students based on merit, not caste," she explains. During this time, she became a fellow at the Indian Institute of Sciences, a position that allowed her to do research in a lab. "I studied human influenza. It was an amazing experience," says Kumar. "My first step into research!"

FROM CAMBRIDGE TO EAST LANSING

After graduation, Kumar moved to Harvard University to continue her studies and work as a research associate. "The research I did there definitely made me a competitive candidate for graduate school. The papers and good research gave me the confidence to pursue a research career," she says.

When she decided to leave Harvard to do her Ph.D., her advisor steered her to MSU. "My PI in Boston was a toxicologist. He told me to look at pharmacology," says Kumar.

"They are two sides of the same coin. And he said that MSU was a place that did hard-core research in Pharmacology and Toxicology."

EXPLORING NEW HORIZONS BEYOND THE LAB

In Michigan, Kumar engaged in all sorts of activities to broaden her horizons. She's an avid cook and an aspiring baker. "The BEST cookie exchange was the first time I ever made cookies," she recalls.

A huge turning point in her life was when she began renting a room from a retired East Lansing schoolteacher and her husband—and their two big dogs. "I was always scared of dogs," says Kumar. "I didn't know anyone who had one. I never even thought about dogs!" Enter Patch and Balto, two malamutes who enthusiastically greeted Kumar on their first meeting. She was not scared off. "I touched him, and he looked at me, and then he ran downstairs. He will always be special to me," says Kumar.

"Never in my wildest dreams did I ever think I would live with a dog," she adds. "And if I can be okay with a dog, anyone can." Spoken by a woman who lives with an open mind and a constitution of bravery.

**Toxicology and
pharmacology
are two sides of
the same coin.**

A professional headshot of Haley Lynch, a young woman with long, straight brown hair, smiling warmly at the camera. She is wearing a dark blazer over a maroon top. The background is a solid, muted blue-grey color.

Haley Lynch

BALANCE AND ALZHEIMER'S DISEASE RESEARCH

GRADUATE STUDENT

PHYSIOLOGY

Program

“Going into grad school I knew I wanted to study depression,” says Haley Lynch, a BEST trainee in Physiology. “It runs in my family, and it really hits home. I met AJ Robison and really liked his mentor style. He studied addiction and depression so it was the perfect fit.”

SEARCHING FOR A WAY TO IMPROVE TREATMENTS

Over time, the lab’s research focus evolved due to different funding opportunities. Ultimately, Lynch settled on a project: studying how reduction-oxidation (redox) imbalance in the brain can drive altered gene expression seen in Alzheimer’s disease. She explains that “many disease states are caused by increases in oxidative stress, and understanding the link between this stress and diseased phenotypes is imperative to developing better treatments.”

She adds that her work is particularly focused on the role of FosB, a transcription factor that has been found to be redox-sensitive and also can lead to learning and memory impairments when too much or too little is expressed. This finding, in addition to the increases in FosB found in Alzheimer’s disease, suggests that FosB could be a key therapeutic target linking oxidative stress to the alterations in gene expression seen in Alzheimer’s.

“Although it’s not the direction I thought I would be going, I am learning invaluable skills and have the opportunity to work with collaborators outside of MSU that are experts in their field,” she says.

CAMARADERIE AND A POSITIVE LAB CULTURE

Lynch earned her B.S. in Biology from Hope College in only three years. “It was not my original plan to graduate early, but I took the majority of my general education courses at community college and transferred them in,” she says. “This ended up working out to my advantage because, once I took my first physiology and neuroscience classes, I was eager to take the next step in my career and dive into research.” When she came to interview for her doctoral position at MSU straight from undergrad, Lynch was a little intimidated being the youngest person to be interviewed. (She says she was even too young to “go out” with the other prospective students.) Still, she was immediately drawn to the community MSU offered. She says coming to MSU was the best decision she could have made. “I came into grad school thinking it was going to be a lot worse than it actually was because of all the horror stories I heard,” confides Lynch. “But now I love it.”

Some of the main reasons why Lynch loves being at MSU is because of the people in her lab and

I am learning invaluable skills and have the opportunity to work with collaborators outside of MSU that are experts in their field.

her mentor. “I have such a great lab,” she says. “There are many different personalities, but that’s what makes it so much fun. Because our relationships go beyond labmates and we are all friends, we are each other’s biggest supporters and we are always there for each other to vent when something is going wrong with experiments, and to celebrate when something goes right.”

Lynch adds, “The lab atmosphere is very laid-back, but we are the hardest working people. It also helps to have a lab mentor who really cares about his students—not just as employees, but as people. AJ’s always encouraging us to have a good work-life balance so we don’t get burned out and can enjoy life.”

STRIKING A BALANCE BETWEEN WORK AND LIFE

That work-life balance is particularly important to Lynch, who is very close to her family.

They live nearby, about a half-hour drive from East Lansing, and she goes home often to see her parents and siblings. She also visits her dogs—two English cream retrievers named Milo and Mia. “Lord knows you need stress relief from graduate school!” she says. “It’s so nice to go home, decompress and play with the dogs.” Having MSU close to her hometown was another big reason why she came to MSU. She also continues to make time for other activities outside of work including playing soccer, working out, reading, spending time with friends and watching her guilty pleasure TV shows.

Since starting at MSU, Lynch has started to put more effort into figuring out what she wants to do once she graduates. Through BEST, Lynch has narrowed her post-doctoral sights to a career in industry. “I don’t really like teaching,” she says. “I like being at the bench, doing the research. When I was a TA, I was always itching to get back to the lab.” Adding to that, Lynch’s exposure to careers beyond academia drew her to industry. “When I’m out of the lab, I don’t want to take work home with me,” she says. “That’s a draw of industry: You go to a job, you do a project and then you go home.”

Ryan Marquardt



STUDYING ENDOMETRIOSIS WITH A GOAL OF LIFELONG RESEARCH

For Ryan Marquardt, science and outreach go hand-in-hand. When the Grand Rapids Public Museum announced an upcoming “Bodies Revealed” exhibit, Marquardt jumped at the chance to work with Dr. Stephanie Ogren. He wanted to make sure the educational materials supporting the exhibit

were as robust and accurate as they could be to serve the student groups that came through. He also got to develop activities to engage the students.

“There were three different exercise stations where students could get data on their bodies, including

measuring heart rate and blood pressure, building a spirometer to see how lung capacity works, and a grip strengthener to explore muscle fatigue,” explains Marquardt.

He found the work thrilling and challenging. He was excited by “the idea of how much work it

takes to distill scientific data into something that kids and the general public can understand without reducing the truth and validity of the information,” he explains.

AN UNEXPECTED RESEARCH PATH

Marquardt studies endometriosis and infertility in his lab and intends to focus on research for his career. He’d like a job in academia, probably at a research-intensive institution. “My research topic is not at all what I was thinking I would be studying, but I am excited to be in this field,” he explains.

His undergraduate college, Cedarville University, does not have a lot of grants funded by the National Institutes for Health (NIH). “They try to give a solid research experience with limited resources,” he says, “and I did research one summer at Cincinnati Children’s Hospital. There, we looked at ALS and related neurodegenerative diseases like ‘floppy baby syndrome.’”

A COLLABORATIVE ENVIRONMENT

These research experiences propelled Marquardt to a Ph.D. program at MSU. “I liked that MSU

felt like a friendly environment,” he says. “It felt authentic, collaborative, more interested in students” than some other places

It’s thrilling and challenging to distill scientific data into something the public can understand.

he’d explored. He eventually found his way to a small lab—just him, an assistant professor and his PI as

full-time members—where he gets to collaborate widely with other labs and other experts around the world. “I’m really happy. It’s a great research environment, and I have a great mentor.”

He decided to join BEST to complement his satisfaction in the lab. “I’m really happy I joined when I did,” he explains. “I was overwhelmed and wanted to explore available opportunities.” He also has two other opportunities important to him: as a youth leader in his church, as a husband and as a dad to his son, Ezra, and his daughter, Ellison.

Natalia Martin



MICROBIOLOGY AND REINVENTING ONESELF

Natalia Martin once swam from one country to another. An avid swimmer and triathlete, she and a friend were training for an open water race in her native country of Argentina, when they accidentally found themselves in their bathing suits in Uruguay, having crossed the river that separates the two countries. “We were just warming up for a race the next day,” recalls Martin.

Growing up in Argentina, the only child of a therapist and an architect, Martin knew by age 18 that she would study microbiology. In Argentina, “when you get in a track, you stick in a track,” says Martin. “People don’t reinvent themselves as much as they do in the U.S.”

And yet, Martin did just that: She recently finished her post doc at MSU and started a career as a

project manager in the Graduate Students & Postdoctoral Scholars Office of the American Chemical Society (ACS).

A FASCINATION FOR MICROBIOLOGY

Martin decided to pick a biotechnology track in college, and was planning to pursue a career doing research in Argentina. “When

you're done with college, you end up doing what you study for. You study with a very focused and in-depth curriculum, and you end up loving what you study because you have dedicated so much time and effort to it," explains Martin.

"I was always interested in microbiology," she adds. That eventually led to a Ph.D. in Bacterial Physiology, a Pew Fellowship for Latin American Fellows and a post doc at Duke University, where she studied host-pathogen interactions.

When that project ended, Martin jumped at the chance to work with Dr. Vic DiRita, a Rudolph Hugh Professor & Chair of the Department of Microbiology and Molecular Genetics. He was then starting his tenure at MSU, and Martin joined his newly established

lab. "His work was exactly what I was looking for, and he is a great mentor. He will ask, 'What do you want to do? Figure it out and I will help you get there,'" says Martin.

THE IMPACT OF BEST

Throughout all of this, and with a greater appreciation for the U.S. custom of "reinventing yourself," Martin realized that a career in academia was not what she sought. She joined BEST, served as a leader with the MSU Postdoctoral Association, and did two internships: one with the MSU Office of Ph.D. Career Services and another working on professional development resources for microbiologists at the American Society of Microbiologists (ASM). "Vic, my post doc mentor, connected me with colleagues

[Dr. Vic DiRita's] work was exactly what I was looking for, and he is a great mentor. He will ask, 'What do you want to do? Figure it out and I will help you get there.'

working on professional development at ASM. That led to us working out a project that matched my interests and contributed to increase ASM's career resources for trainees," she says.

In hindsight, all of these experiences launched her to her new position at the ACS, where she

manages programs aimed to help graduate students and postdoctoral scholars find and be prepared for satisfying careers. "This position is a great fit for me," Martin says. "It not only allows me to do what I love on a daily basis, but also to pay forward all the help I got—from career advisors, BEST, my mentors, and friends—to help me find a fulfilling career path."

Hossein Mazaheri Kouhani

EXPLORING ELECTRICAL ENGINEERING AND SEEING THE WORLD

“I grew up an anomaly. It became a part of my personality,” says BEST trainee Hossein Mazaheri Kouhani. He was the only boy with two sisters. He spent much of his childhood Tehran, but his physician father moved the family to a smaller city in Northwestern Iran. There, Mazaheri Kouhani spent three years in school and learned Azeri, a language similar to Turkish that is spoken in areas of Iran closest to Azerbaijan.

Mazaheri Kouhani spoke Farsi, learned English along the way and eventually added Turkish when he pursued a master’s degree in Istanbul. He spent several months in Poland, teaching students about Iranian culture. Later, he traveled around the United States for a year, couch surfing and making friends everywhere he went. “I never paid for a single night in six months traveling through the U.S. I will never replace that way of traveling. I’ve made so many close friends along the way,” he says.

TEACHING ABROAD

All of these paths brought Mazaheri Kouhani to MSU. During his last year of high school in Iran, he participated in a physics course that introduced him to the work of Albert Einstein, his theory of relativity and nuclear physics. He loved it all. “Just the progress of discovery in the 20th century—Planck, Einstein—the level of enthusiasm around physics was really inspiring,” says Mazaheri Kouhani. When he took the national entrance exam for university, his ranking permitted him entrance to the program he wanted: physics. But his older sister, Taherah—herself studying physics and now a post doc in New Orleans—encouraged him to study electrical engineering. It was, as he says, a more prestigious program and would offer him more job opportunities as an applied field. So Mazaheri Kouhani studied electrical engineering during his undergraduate years at the University of Tehran.

After graduation, Mazaheri Kouhani started his travels. “I

was excited to travel the world. I just wanted to experience living abroad,” he says. “In Iran, university is free, but study abroad programs are really expensive so it’s not common. Instead, I joined the river of students going abroad after earning my bachelor’s. You just jump in and go with the flow.”

He joined a program through AIESEC, a French organization that accepts young people for volunteer positions teaching children the goals and agenda of the United Nations, and spent a month in Poland teaching children about Iran. He then earned a Schengen Visa that permitted him to continue traveling around the European Union, worked as a research scientist at his undergraduate university and traveled on a tourist visa to visit his two sisters in the United States.

FINDING A PH.D. PROGRAM

Mazaheri Kouhani figured he would eventually work toward a Ph.D. He was always interested in the intersections between the

brain and machines, and how brain sensors communicate information. “I was tired of computers and working on cars,” he says. He was drawn to research at MSU, and decided to apply. “I talked to Sina

I love doing research, learning, keeping up on the state-of-the-art technology, and solving new problems with creative technology.

[Parsnejad, another BESTie], who is an old friend from Istanbul. I told him, ‘I’m paying \$60 to FedEx my transcript to MSU, and it’s a cheap application. You could apply, too.’ We both applied and I saved \$30. He got in, but I didn’t,” recalls Mazaheri Kouhani. Despite this setback, when Mazaheri Kouhani visited his old friend in East Lansing, Parsnejad told him he knew a faculty member looking

for a student, and that Mazaheri Kouhani might be a good fit.

It worked out. “I love my work,” says Mazaheri Kouhani. “I make a contact lens with a pressure-sensitive component for glaucoma patients, to help them manage their condition.” Being in the Biomedical Engineering department, having new friends from all over the world, and talking about work in pharmaceuticals and molecular science and sensor engineering is what Mazaheri Kouhani describes as “a perfect spot to be.”

AMBITION AND LONG-TERM GOALS

Mazaheri Kouhani joined BEST because he one day hopes to be a chief technical officer or work in industry. “I love doing research, learning, keeping up on the state-of-the-art technology, and solving new problems with creative technology,” he says. As a BESTie, Mazaheri Kouhani participated in a fellowship funded by MSU’s Science and Society program, which allowed him to write a piece for *The Lansing State Journal*

on brain-machine interface. He also participates as a panelist on a podcast called “Let’s Make the Future.” On top of it all, Mazaheri Kouhani is learning to play the guitar at MSU Community Music School, building upon his childhood mastery of the sitar, an instrument common in the Iranian folk music he listened to in his childhood home.

Mazaheri Kouhani’s creativity and interests are always evolving—not much like his perpetual wanderlust. Mazaheri Kouhani says, “I would like to be in an English-speaking place. Honestly, I don’t want to go through another cultural adaptation and learn another language. I’m 30 and there’s so much I want to learn about science and philosophy and the economy, I don’t want to have to learn another language too! I want time to focus on the conceptual realm.” With bright ambitions and diverse skill sets, he’ll likely do just that.

Jose “Pepe” Montero

CHEMISTRY, MOLECULES AND A DESIRE TO TEACH

In short, BEST trainee Jose (Pepe) Montero tries to make new molecules from other molecules. “I research methodology. The purpose is to try to change as much as you can in a molecule,” he explains. “If we can change atoms, we can make new atoms. We change Boron into other things, and Boron is very versatile.” The goal is to create molecules that can join other molecules in more efficient and predictable ways.

STUDYING CHEMISTRY IN PERU

Growing up in Peru, Montero always excelled at chemistry. In high school he participated in the International Chemistry Olympiad, a highly competitive international competition that allowed Montero and several of his peers to travel around the world studying and competing in chemistry challenges. The program is organized by the University of Cambridge and supported by professors in local universities around the world who help write and translate the exams.

This experience exposed Montero to teaching and training from professors at the Pontifical University Catolica of Peru, where he met an organic chemistry professor who inspired his passion for chemistry. When it came time to pick a university and program of study, Montero was awarded a scholarship to attend University Catolica of Peru and study with his mentor. “In Peru, public universities are free but the private universities cost a lot of money. But they have more machines and resources for research,” says Montero.

Montero was able to do some research during his undergraduate training. When he decided to pursue a Ph.D., he was drawn to MSU. Part of the appeal was being in a small town, a stark departure from the major city where he grew up. “I love camping, being outside, grilling, going to the beach and visiting small towns,” he says. He was drawn to faculty member Dr. Robert Maleczka’s lab team, where he finds a lot of camaraderie. “There are many Peruvians at MSU and many who study organic chemistry are in Maleczka’s lab.”

WORKING WITH STUDENTS

When he finishes his degree, Montero would love to teach. He worked as a teaching assistant at MSU, and has taught high school students through Chemistry Olympiad. “Students bring me things I had never seen before,” he says. “It is great working with them.”

He also likes drawing upon his own schooling at a prestigious high school that emphasized learning over testing, and exploration over studying. “We were studying there just because we loved learning, not taking tests,” he says. “We controlled our own time and followed our passions.”

Montero’s desire to learn has not only carried him through his studies, but will continue to propel him throughout his future career.

**The goal is
to create
molecules that
can join other
molecules in
more efficient
and predictable
ways.**

Sean Nguyen



DATA SCIENCE, REPRODUCTIVE IMMUNOLOGY AND SOUS VIDE COOKING

Sean Nguyen is a master at sous vide. Like many BEST trainees, Nguyen enjoys cooking, and in particular the method of cooking food in a water bath. He has the tools. He has an app. He could teach a course on sous vide. This commitment to mastering and sharing a somewhat uncommon method of cooking makes sense for Nguyen. He is someone who not only dives into his interests with mastery as the goal, but he is also a gifted educator who seeks to share his mastery with others.

ANALYZING REPRODUCTIVE IMMUNOLOGY

Take, for example, his mastery of R software, an open-source data analysis programming language. A few years ago, he decided to learn this statistical program so that he could do “interesting things” with his own data. As he taught himself how to master the program, he started blogging about his efforts. That led to a following among other BESTies who were inspired by Nguyen, so he agreed to teach several cycles

of a four-part workshop on R programming to other graduate students who wanted to learn the skills to manage their own data. Through this process, he affirmed a talent for teaching, and a passion for data. His goal after graduation is to become a data scientist, where he hopes to work with large data sets and manipulate the data in different ways.

In the meantime, however, he’s a traditional graduate student. “I study reproductive immunology,” he explains. In particular, he looks

at how mother mice are able to tolerate a fetus that is semi-foreign. A typical immune response is for a body to reject a foreign tissue, but “pregnancy is an event where the foreign tissue is not rejected,” he explains. “It’s called the ‘immune paradox’ of pregnancy.” Nguyen’s research focuses specifically on the role played by the placenta: it’s a temporary organ that is “fetally derived and in direct contact with maternal blood. It is tolerated by the woman’s body,” he says. One explanation for this paradox is the presence of “exosomes, or microscopic nanovesicles that

I love the visualization of data ... How to communicate data beautifully, with good design.

are 1/10 the size of a bacteria and may act as a form of extracellular communication that modulates maternal immune responses,” he explains.

REAL-WORLD DATA SCIENCE EXPERIENCE

This type of research has long appealed to Nguyen. As a student at University of Michigan—Dearborn, he spent a summer at the Ann Arbor campus through the Undergraduate Research Opportunity Program (UROP) in microbiology, “which got my foot in the door for a life in research,” he says. He knew science was in his future, but took a year after graduation to travel around Costa Rica preparing to return to the U.S. to work as a lab technician in a lab at U of M—Dearborn. After a few years of that work he decided he needed a Ph.D., so he moved to East Lansing to attend MSU.

Early in his graduate training, he joined BEST. Having been involved in academic science for a few years, he knew about the realities of the job market. “I liked BEST because a lot of people have that twinkle in their eye and say, ‘I’ll do research!’ but there is a finite number of jobs for faculty. Not enough spots, and too many competing for too few spots,” he says.

At a BEST event with leaders from Oystir, a firm dedicated to helping Ph.D.s find jobs, someone told Nguyen, “You should look into data science. Learn R programming.” So he learned R programming and ran with it, mastering it and then teaching the program to others. Learning these new skills made for a great chance to talk to his advisor, Peggy Petroff, about his career goals. She was supportive of him looking outside academia. “I want to get as good as I can in data science,” he says. “When I talk to data science people, I used to say I had zero business acumen.” But after a BEST externship with MSU Technologies working on patent issues and tech transfer, “I learned more about how the business field works.”

Through a local data group, Nguyen also learned how to package himself with his expertise. He has partnered with some MSU faculty to serve as a data scientist. “I love the visualization of data,” he explains. “The aesthetics. How to communicate data beautifully, with good design.” He also reads widely on behavioral economics, another subject that makes sense of

big data. It also brings him back to one of his undergraduate majors—he studied both psychology and biology—by integrating his passion for data and human behavior.

And why sous vide? Because it, too, allows Nguyen to not only appreciate an outcome—in this case, delicious food—but to savor the technical input that is required to get there. It’s not enough to just know that something is cool, or delicious, or interesting; as a scientist, Nguyen wants to master the process that makes it such. And along the way, he’ll teach everyone else about it, too.

Beth Norman

DISCOVERING A PASSION FOR BIOLOGY AND EDUCATION

“I was interviewing all over,” says Dr. Beth Norman, a former MSU post doc who is now Director of Science at the Lacawac Sanctuary in the Poconos, in rural Northeastern Pennsylvania. “RIs, small colleges, research stations. When I thought about taking this position, I had to ask myself, ‘Is this settling?’ And I realized, ‘No. Not really.’”

In her studies and in exploring career options via her participation in BEST, Dr. Norman came to the realization that she did not aspire to be a PI in an RI institution. “Doing two post docs, you spend a lot of time thinking, putting thoughts down and wrestling with what you want,” she recalls. “It wasn’t a position title. I wanted to stay in the field. I wanted a good work-life balance. I wanted to work with students.” And Dr. Norman does all of those things in her current role.

LIFE AT LACAWAC

Today, Dr. Norman works with researchers at Lacawac Sanctuary and Biological Field Station, located on the former country estate of a wealthy industrialist named Arthur Watres, a man who had a deep appreciation for nature and science. After his death, Watres’s estate

donated the land to the Nature Conservancy for the purpose of creating an outdoor laboratory. Lacawac is now run as a biological field station because it offers unique features including a large glacial lake that has been protected since colonial times from development and agricultural runoff. Two experimental enclosures permit scientists to study the natural flora and fauna of this part of the country; Dr. Norman says that several rare plants have come up in the enclosures, since there are no deer to eat them.

Researchers from many different institutions (Miami University in Ohio, Drexel University, Penn State University and others) run experiments at Lacawac. As Director of Science and Research there, it is Dr. Norman’s job to work with those researchers, consulting on the experiments and ensuring their integrity while they run on-site. That means running the lake monitoring program, and adjusting buoys that float on Lake Lacawac and capture information about the lake. Scientists can remotely access the data from these buoys and Dr. Norman makes sure everything is working appropriately. The work also means keeping up the fences protecting the deer enclosure and maintaining those fences. Staying

in the field? This job gave her that, literally and figuratively.

“I like the idea of keeping something important running,” she says. “You feel you are much more integral to the running of the place. Everyone is pulling together.” She explains that, unlike bigger institutions with the resulting bureaucracy, working in a smaller environment like this means everyone has to work together to finish the work. “Summer is crazy. Long days,” she says. With her expertise in lakes, she also consults with different lake associations in the area, and conducts water quality studies on local lakes. “I’m not as used to talking to non-scientists about this kind of stuff. I’ve had to learn how to communicate differently. It’s not that they don’t care about their lake. They do. We just care differently, and I have had to find ways to talk that bring our interests together,” says Dr. Norman.

VALUABLE COMMUNICATION SKILLS

That expanded communication skill—something emphasized in MSU BEST—comes in handy when Dr. Norman works with the foundation’s board of directors. “They are businesspeople. They

come at this work from a different direction. They don't understand that we can't just 'get' money from NSF to support our research," she says. "Some of them think NSF just sends checks and you do the research. We don't have the infrastructure needed to support federally funded research, so we have to go through our foundation partners. We still do the science, we still write the papers. I work with people who are good stewards of our money. I have to be able to connect with them in ways they understand, without them feeling like I am talking down to them."

A big part of that, she says, is a willingness to let some things slide. "You have to be able to let go of them understanding the nitty-gritty. They might think that 'ducks eat algae.' That's fine. They don't need to know every single detail; you just have to correct any actual misconceptions" that jeopardize the science or the organization.

Dr. Norman also finds these skills helpful when working with the many students who come to Lacawac Sanctuary. Prior to earning her Ph.D., Dr. Norman taught Biology at a private high school in New England, earned a master's at James Madison University and a Ph.D. in biology from Virginia Tech.

For one of her BEST externships, she worked at MSU's Kellogg Biological Station (KBS), and these collective teaching experiences helped her develop strong skills in communicating with people who have different or emerging expertise in her areas. The externship at KBS was particularly helpful as Dr. Norman made the transition to Lacawac. "I particularly liked talking to Kay [Gross] about the

I like the idea of keeping something important running. You feel you are much more integral to the running of the place. Everyone is pulling together.

students who worked for her, what processes she had for selecting, hiring and evaluating them, just picking her brain," Dr. Norman says. These mentorship skills come in handy for Dr. Norman for Lacawac's large program for high school students, who come to the sanctuary to learn skills and science in natural environments.

Work-life balance is about as integrated as it gets in this role. Dr. Norman gets housing within

the sanctuary as part of her compensation. That means zero commute, and more time with her infant daughter, Maya. "Just recently, I gave a presentation while holding her the whole time," says Dr. Norman. "The job is very laid-back." Her husband is also a Ph.D. scientist who teaches microbial science at a local college. "Free time is non-existent," says Dr. Norman, "but we are a lot closer to family" in New England. "It's not a long drive to go see them."

Dr. Beth Norman joined BEST, in part, so that she could be part of a community of people wondering—together—what kinds of careers they might want. For her, that meant a job rooted in science, working with students and a balance between work and life. At Lacawac Sanctuary, she found it.

Ariadna Ochoa-Bernal

STUDYING ENDOMETRIOSIS TO IMPROVE LIVES AND ENACT CHANGE

For Ariadna Ochoa-Bernal, a Ph.D. student in Animal Science, it's impossible to pinpoint one favorite thing about the field of science. "I have a problem and that problem is that I like too many things about science," she says.

Ochoa-Bernal loves living in Grand Rapids, where she works at the Grand Rapids Research Center in the Obstetrics, Gynecology and Reproductive Biology department studying endometriosis. "The labs are great and the people are very collaborative," she says. "It's very green and reminds me of my hometown" in Spain, she explains. Ochoa-Bernal earned her bachelor's degree at the University of the Basque Country in Leioa, Spain.

SCIENCE FOR THE GREATER GOOD

Ochoa-Bernal has a passion for using science to help other people. After graduating from college, she worked in a hospital doing pediatric medical research, focusing on early lung development in premature babies. The goal was to develop strategies to "help

improve oxygen intake in the lungs of premature babies," explains Ochoa-Bernal.

Being in Grand Rapids, Ochoa-Bernal had the great opportunity to work at the Kent County Health Department as an outreach liaison focused on women's health. "Informing women about the importance of mammograms and teaching them about the services available was a very rewarding experience," she says. "Talking with all of those women made me realize the power of research." Through that position, she also had the opportunity to work with fantastic leaders from the Susan G. Komen Foundation, American Cancer Society and MSU Extension among other organizations which further improved her experience.

HELPING WOMEN THROUGH RESEARCH

During this period of time, and just after she finished her master's degree, Ochoa-Bernal decided to pursue a Ph.D. focused on the study of endometriosis. "I didn't

know how common this disease was and how much these women go through during endometriosis," she explains.

Ochoa-Bernal would love to stay in academia when she finishes her work. She anticipates a career in academia doing research in service of human health.

"It's hard to anticipate what comes after the Ph.D. and where my journey will take me, but I would love to spread my passion for science to future generations," she says. And with her broad knowledge and determined mindset, we're confident that she will.

**Talking with
all of those
women made
me realize
the power
of research.**

Sina Parsnejad



EXISTENTIAL THOUGHTS ABOUT ARTIFICIAL INTELLIGENCE AND CATS

Sina Parsnejad just got a cat. Morpheus, a black male cat, came to live with him earlier this year. “It’s an exercise in empathy,” he explains. “It’s training me to get to know myself better, to live my life for something other than myself. I’m single, so it’s really nice.” Luckily, Parsnejad’s roommate (and his roommate’s live-in girlfriend) also love Morpheus. “The bond is deep,” he says, of his cat. “Cats are so cute; they’re a little cool, similar to humans. A human has their own

personal life, you’re never with someone who is the same as you. Cats are like that too.”

BRAIN-MACHINE INTERFACE RESEARCH

That ability to see the humanity in cats is not surprising; one thing that is striking about Parsnejad is how much he delights in other people and how philosophical he is about his work. He is not a solitary researcher, content

with long nights in the lab. He is very dedicated to his work in brain-machine interface, where he engineers “affordable, easy to implement technology that doesn’t drill into the brain.” He loves this challenge, but is also circumspect about the realities and limitations. Using technology to augment human capability is, in his mind, “the only way to compete with artificial intelligence (AI) if you want to move into the future. AI is getting smarter, no question,

but they lack some basic things humans can do, like sustainability and abstract thought. If AI breaks, you need technicians to fix it. If you break your arm, you'll probably survive."

But he also recognizes that technology is evolving at such a rapid rate that humans will need to harness that evolution thoughtfully. "I've been having a lot of existential thoughts," says Parsnejad. "I want to do something that has an effect. Contribute something that matters. Right now, I think the best way to do that is to work at the edge of technology. That's why I came to the U.S. At home, I would have probably worked to design analog-to-digital chips."

THE PATH TO MSU

For Parsnejad, home means Urmia, Iran, a town that is home to the 6th largest salt lake in the world. He cautions, "Don't let it get in your eyes. It hurts." Growing up in Urmia, Parsnejad always knew he would work in science or technology. "I was always fascinated with building and taking

things apart. I have a creative juice: I liked to sit down with Legos and make things with my cousins," he says. Eventually, Parsnejad's family grew tired of stepping on his Lego creations, and he had to switch gears. "Clothespins became my favorite building blocks. I wasn't very tidy so my parents hated buying more Legos. But they had to buy clothespins," he explains.

Parsnejad's father was an electrical engineer who had a workshop in the basement. Together they tinkered, playing with electronics and an old radio. Parsnejad was always good in physics and math, as well as when he took the national exam which would determine what, and where, he would study in college. "I stayed in my hometown for undergraduate. The university has a very good electrical engineering track, even though my score made me overqualified for that school," he says.

He enjoyed his program of study, but staying home for his college experience was "like an emotional prison," he says. "When you have the safety of family, you don't dare

go out to do daring things." After graduation, "I needed to change and get away from them for a while," he says. "I realized this was stopping me from taking risks and doing great things." Those great things included pursuing a master's degree

I want to do something that has an effect. Contribute something that matters.

in Istanbul—it helped that his native languages, Azeri and Farsi are similar to Turkish. Then he came straight to MSU for his Ph.D. In Istanbul, he fell in love with electronic music when he stumbled upon an underground club; he has also embraced the electronic music scene in Michigan. "I tried DJing one time, but as soon as I started, everyone left the floor. They wanted Taylor Swift, and I didn't know her music!" he says, laughing.

As for his future plans, he muses, "I would love to get involved in

Neuralink," an Elon Musk project designed to develop implantable brain-computer interfaces. More importantly, "I love my music, my personal freedom to work in areas that make an impact. I have a lot of friends who play Dungeons and Dragons, and I am a Dungeon Master." His current game is a mix of Hogwarts, Space Adventures and X-Men.

Overall, his desire is to make a difference, be around people and tie together his passion for problem solving through engineering. (With his cat by his side, we presume.)

Vickie Ruggiero

MAKING A DIFFERENCE WITH BOVINE LEUKEMIA VIRUS RESEARCH

Bovine leukemia virus (BLV) annually costs the U.S. Dairy Industry \$2.7 billion in losses. “That is \$283 per milking cow, a cost that burdens the slim margins earned by dairy farmers in the U.S.,” explains BEST trainee Vickie Ruggiero.

“In the 1960s or so, when about 10% of cows had BLV, we collectively decided it wasn’t that important to address. Now, more than 40% of milking cows carry the virus, and it continues to expand and spread,” she adds. Afflicted cows suffer from decreased lifespan, decreased milk production and immune dysfunction. Worse, the BLV is a retrovirus that appears “generally asymptomatic, unless they develop lymphoma,” explains Ruggiero.

FROM ANIMAL LOVER TO RESEARCHER

Ruggiero has long loved animals—though not necessarily dairy cows—and started her career as a veterinary technician. She was working as a technician at the MSU Veterinary Hospital where she was trained in every area of the hospital, using her undergraduate training and certification to address a wide variety of needs. Though she loved aspects of the work, she had questions about the animals and illness that went beyond providing care for them. She often spent her lunch hour talking with

vet students and others doing research at the MSU care center. “I was having a passionate discussion about vaccine efficacy rates, and a vet student asked, ‘Have you thought about doing a degree in public health?’ She was doing a joint DVM/MPH program and saw I had a passion for this type of work. So I applied,” Ruggiero recalls.

It was not necessarily a perfect fit. “I wish I had known a little more,” she explains. “MPH is great, and the training is great. What I didn’t know is that it’s a professional master’s as opposed to a research master’s so when someone is hiring an MPH, they look for someone with a lot of previous experience. Doors I thought would open, didn’t.”

What did open was Ruggiero’s eyes to her passion for scientific research. Her current graduate advisor, Paul Bartlett, taught an epidemiology course for her MPH degree, which Ruggiero loved. When she decided to pursue a Ph.D., she joined Bartlett’s lab studying BLV and started working closely with dairy farmers to develop and test management protocols with the goal of controlling BLV by reducing BLV transmission between cows. “In these field trials, we showed that some of the common wisdom interventions don’t make as much

of a difference as we’d like to think,” she states. “But we also showed that there are strategies that can be successful.”

REAL-WORLD EXPERIENCE

When she finishes her Ph.D., Ruggiero will begin a third new phase in a successful career. She worked as a veterinary technician, and then throughout her Ph.D. program at the MSU In Vivo Facility, in early drug discovery and efficacy testing. Through BEST, Ruggiero got to bolster her experience in pharmaceutical development with INDS, Inc., a local firm that helps pharmaceutical outfits with the nonclinical aspects of drug discovery.

She has a passion for research and health, so what’s next? “I’m not sure,” says Ruggiero. “I’m at a phase in my life where I’m not sure I want to go gallivanting around,” despite her passion for travel.

Recently, she saw a letter from the FDA to a website that was famous for making spurious claims about beauty regimens, and was intrigued. “I read it and thought, ‘I’d love to write a letter like that, to a person like that!’ I have a strong feeling that something in regulatory affairs would be good,” she says. One thing she knows for sure? “Law school? Don’t do it.”

**More than
40% of milking
cows carry the
virus, and it
continues to
expand and
spread.**

A professional headshot of Irving Salinas, a man with dark hair, a beard, and glasses, wearing a blue suit jacket, a white shirt, and a red tie. The background is a solid, muted blue-grey color.

Irving Salinas

A WINDING JOURNEY TOWARD RESEARCH

GRADUATE STUDENT

PHYSIOLOGY

Program

Growing up with a love of science, Irving Salinas often thought he would like to contribute to the scientific community by developing new ways of treating or preventing disease, whether it was through medicine or science. He studied biology (pre-med) in undergraduate at the University of Texas—Rio Grande Valley (UTRGV), where he was highly intrigued by endocrinology and “hormonal signaling,” he says. After taking a class on the topic, he approached the faculty instructor and asked, “Where can I do more with this?”

There were not a lot of options for research at the university where I did my undergrad,” said Salinas. “So that drove me to start asking around and looking for opportunities. Luckily, my endocrinology professor ended up giving me not only an undergraduate research position in his lab, but also a position in his undergraduate research program called Research Initiative for Scientific Enhancement (RISE),” he says. In this lab, Salinas studied the effects of early puberty on mammary gland development. “Through this experience, I learned that I was a driven, opportunistic person,” he adds.

CHOOSING A PROGRAM

Given his emerging love of research, Salinas grappled with his career aspirations. Undecided between choosing a career in medicine or

research during his junior year, he was offered a position in the Summer Physiology Undergraduate Research (SPUR) program in the University of Texas—Health Science Center in San Antonio. His research project focused in elucidating the cellular mechanisms of a calcium potassium (SK) channel antagonist UCL1684, a

As an aspiring scientist, it’s extremely important to establish your network early on in your career, and MSU BEST has given me that advantage.

potential treatment for asthma, using molecular cloning techniques and live-cell confocal imaging in Primary Human Bronchial Smooth Muscle Cells. “I learned how passionate I was about research,” Salinas says.

“During my undergraduate studies, I was one of those late bloomers in science. When I graduated, I felt this need to acquire more knowledge in biomedical sciences,” explains Salinas. He embraced endocrinology, and decided to pursue his Ph.D. Salinas applied to nine different Ph.D. programs across the country, around half of them in Texas.

“I looked at what different programs offered to students and

ended up obtaining three different offers from Ph.D. programs, one of them being MSU. I was lucky enough to even get those three offers, since I just had one year of research experience in my pocket,” Salinas says. MSU offered options that appealed to Salinas: a T32 training grant position in Reproduction and Development and, of course, MSU BEST. “In my mind, the BEST program seemed like a gateway to experience other careers outside of academia, an experience I wanted as a Ph.D. student,” says Salinas.

FELLOWSHIPS AND PROFESSIONAL DEVELOPMENT

Now, Salinas is in his second year as an MSU Physiology Ph.D. student and works in an Animal Science lab studying the effects of androgens in female metabolism and reproduction. “Androgens are known to be detrimental to female fertility,” explains Salinas. “While the hallmark of PCOS (Polycystic Ovarian Syndrome) is high levels of androgens, low levels of androgens can also be detrimental, leading to premature ovarian failure and diminished ovarian reserve,” he adds. “My project sets to decipher why androgens are detrimental.”

Salinas joined MSU BEST in his first year and was recently appointed a position as a fellow in the T32 Pre-doctoral Reproductive and Developmental Training Program. Additionally, BEST sent him to the 2018 AAAS

Catalyzing Advocacy in Science and Engineering workshop in Washington D.C. “So far, I’ve taken advantage of the opportunities that were available to me at MSU, as I’ve not only managed to be part of the BEST program, but also be appointed for the T32,” explains Salinas.

THE VALUE OF A STRONG NETWORK

“MSU BEST provided me with a network. As an aspiring scientist, it’s extremely important to establish your network early on in your career, and MSU BEST has given me that advantage,” Salinas says. “Initially, I wanted to be a professor; but after experiencing all of what the BEST program has to offer, I’m certain that my career will end somewhere outside of academia. Overall BEST has given the advantage of allowing myself to discover what career options I like and dislike.”

Thomas Turkette

COMPUTATIONAL BIOLOGY AND A DEDICATION TO TAKE SCIENTIFIC RISKS

“As I moved through research, I realized that traditional methods weren’t working. A lot of research on certain conditions have stagnated, and I think it’s because traditional methods only look at one dimension at a time. I think computational models are needed to help elucidate the problems,” says Thomas Turkette, a BESTie and graduate student in Physiology.

Turkette’s research specifically looks at mechanisms and conditions under which a sugar molecule is spontaneously added to a protein, as might happen in diabetes. But he was interested in more than simply understanding the details of this process; he was driven to consider the systemic implications.

“After we eat, where does the sugar go? All over the body, of course. How does that change with different body types? How does that change when someone has diabetes?” poses Turkette. To consider questions like these, he turned to computational biology, a field that draws upon bioinformatics and uses biological data to develop algorithms and models to understand biological

processes. “When you look at a problem like Type 2 diabetes, you can look at changes in protein development and gene expressions. But there are environmental factors that influence these processes,” says Turkette. “There are literally thousands of dimensions. You can’t hold them all in your head at once. We aren’t applying the right tools to the right problems.”

AN UNYIELDING DESIRE TO LEARN

Turkette started college at Northwestern Michigan College in Traverse City, Michigan, his hometown. He eventually transferred to MSU and earned a degree in physiology. But when he decided that computational biology was the right way to explore the problems that interested him, he realized he did not have the math he needed to see under the hood of the programs he was using. To remedy that, he used open courses offered by the Massachusetts Institute of Technology (MIT) to teach himself linear algebra, differential equations and multivariable calculus. “I always have a new topic I’m looking into,” says Turkette. “I come home from the lab, eat dinner and hang

out with my wife—and when she goes to bed, I teach myself machine learning.” He learned this topic from a free course on Coursera.

He says the online math classes were extremely helpful. “So much of machine learning is based on linear algebra,” he says. “To understand machine modeling, you need linear algebra.” Turkette does most of his analysis at home. “I do my wet work at the lab, and then I go home, because I have a more powerful computer at home than at the lab,” he says.

Turkette’s goal is aimed at finding a job in the pharmaceutical or biotech industries. “Originally, I thought I wanted to be an academic. But in its current state, academia probably isn’t right for me,” he adds, “because I like to work directly on problems, and science right now is about managing people, getting grants and writing articles.” He says his advisor even mentioned early on that Turkette might want to consider other options. “He told me, ‘You have the mind of a scientist, but I don’t know that you’d actually enjoy being a [academic] scientist,’” recounts Turkette. Instead, he’s thinking of a career in the

pharmaceutical industry because “their work is project-based and generally more hands-on.”

WHAT IT MEANS TO BE A SCIENTIST

Thinking about this shift is what drew Turkette to BEST. Science happens in different places and in different ways, and Turkette is a person who reads widely and thinks deeply about doing science—but also what it means to be a scientist, and what science is.

“Academic science is going through a shift,” he says. “A large part of this stems from the practices and

Some of the most important breakthroughs come from looking backward, to examine which assumptions we got wrong.

politics surrounding funding. Major advances that often require going out on a limb. But that sort of work comes with an increased risk of

failure. This can make it difficult to convince people that a project is worth funding, especially if that work also conflicts with their own research. So, if an idea is too out there, people won’t agree to fund. It’s risky.”

He spoke of a scientist he admired who was credited with founding multiple new fields in science.

“But even with his track record of innovation he had great difficulty getting funding because his work was deemed too far out there,”

Turkette says. Turkette’s mentor supports his exploration. “He encouraged me to read biographies of famous scientists—Feynman, Einstein, Planck—because we need to not just read the science; we need to study the approach, how they approached science and thought about their innovations,” he says. “Sometimes that means going backwards. People think that science is all about moving forward, but it’s not. Some of the most important breakthroughs come from looking backward to examine which assumptions we got wrong.”

As Turkette continues his program, he navigates it in his own way. “I think it’s good that I do things

like BEST and the GEU,” he says, referring to his work with the Graduate Employee Union, where he is the union representative from Physiology and a member of the budget committee. These resources—and his dedication to finding tools, reading, and teaching himself new skills—will help him as he negotiates graduate education his own way.

Aiko Turmo



MELDING BASIC SCIENCE AND APPLIED RESEARCH WITH BMCS

The 10 years Aiko Turmo has been at MSU are the longest she has ever lived in one spot. “I’ve lived in Seattle, Chicago and the rest was moving around Japan,” says Turmo. After earning her bachelor’s degree in genetics, Turmo stayed at MSU to work as a laboratory technician, where she worked for four years. Then her mentors encouraged her to consider a Ph.D.

A HANDS-ON LEARNER

“I thought I could contribute more to the scientific field if I got a Ph.D.,” says Turmo. “I longed for more independence and intellectual training.” But when it comes to education, Turmo says, “I will always drift back to lab work. I learn better by participating in hands-on activities and actually applying what is taught in textbooks by running experiments.”

Turmo says she was excited to learn about MSU BEST, and that there are a wide variety of options outside of academia. “I realized there is more to the BEST program. They will support you and want to help you broaden your horizon,” she says. “I think [MSU BEST] is freaking amazing. It’s beneficial for bringing awareness that there are many opportunities out there that you can apply the skills you develop in graduate school.”

EXPLORING BACTERIAL MICROCOMPARTMENTS

Turmo's research in the Department of Biochemistry and Molecular Biology skillfully straddles the line between basic science and applied research, an homage to the basic science background that led her this far and a future where her scientific career will take her to new contexts. She studies bacterial microcompartments (BMCs), bacterial organelles that sort things out and keep things organized in the cell.

"There is a lot of mystery around how different BMCs work," Turmo says. In particular, she studied cyanobacteria that have a BMC, called a carboxysome, that is jam-packed with rubisco, one of the world's most abundant proteins. This enzyme is essential in fixing CO₂ during photosynthesis to energy-rich molecules like glucose. But "rubisco has a lot of

problems, not the least of which is its inefficiency. "The carboxysome concentrates rubisco in the same location as CO₂ to help with its inefficiency and that's how cyanobacteria adjust its carbon," she says.

If we are successful, we could use bacteria to help produce rubber which would be a green alternative to the petroleum-derived rubber.

Turmo specifically explores the engineering potential of BMCs for sustainable biotechnology. "Unlike eukaryotic organelles which have lipid membranes, BMCs have protein-based membranes made

of building blocks that can be manipulated," she says. Focusing on this modularity of BMCs, she and her mentor, Dr. Cheryl Kerfeld, are building new synthetic BMCs containing foreign enzymes that are not naturally found in BMCs in nature. "Rubber trees and petroleum are the normal sources of rubber, but the process of getting rubber from these sources are terrible for the environment. We're trying to move the enzyme into a BMC to help with the enzyme's productivity; if we are successful, we could use bacteria to help produce rubber which would be a green alternative to the petroleum-derived rubber," she says.

MAKING A BROADER IMPACT

In the future, Turmo would like to work in science policy, or for an agency like the National Institutes of Health (NIH) or the National Science Foundation (NSF)—She

was awarded a prestigious National Science Foundation Graduate Research Fellowship to support her graduate education funding. "I value groups like BEST and Graduate Women in Science, and would like to work for the promotion of diversity in science," she says.

There's no doubt that she will. Turmo has shown flexibility to move where her life takes her, and—like the bacterial organelles she studies—will work tirelessly to do what needs to be done.

A professional headshot of a young man with short brown hair and blue eyes, smiling. He is wearing a dark suit jacket, a light purple dress shirt, and a dark tie with a light purple grid pattern. The background is a plain, light grey.

Andrew “Ted” Van Alst

CHOLERA RESEARCH, PIG GUTS AND FINDING FOUR-LEAF CLOVERS

GRADUATE STUDENT

MICROBIOLOGY & MOLECULAR GENETICS

Program

“I study *Vibrio cholerae*, the bacteria that causes the disease cholera,” says BEST trainee Andrew (Ted) Van Alst. In particular he’s interested in how it grows within the digestive tract during infection. In causing disease, *V. cholerae* colonizes the intestines and causes disease, whose symptoms include “profuse watery diarrhea,” says Van Alst. “That’s how it’s always written.”

In particular, Van Alst seeks to better understand the mechanism by which the bacteria grows in the system. “This tiny bacteria has to make its way through an incredibly thick mucus layer, and causes disease when it reaches our cell lining,” he explains. “As it is doing this, it is able to degrade and feed off the mucus. My research seeks to understand how it does that, and how to inhibit it.”

DOING WHAT IT TAKES

Van Alst explains that he was drawn to microbiology, but not necessarily to focus on pathology. “Pathogen research is where the money’s at,” explains Van Alst, referring to the research funding that is open to scientists in his field. “Once I got into it, I was into it,” he adds. As an undergraduate in Lyman Briggs College, he first encountered microbiology and realized his interest in the field. “The first couple of years are really a lot of basic biology, since many Briggs students want to go to medical school,” he explains. “But

I didn’t want to do that. I didn’t want to be in charge of someone’s life. I could do it; I just don’t want to do it.”

Instead, he pursued research and found himself some pig guts.

“I scrape the mucus out of pig guts,” says Van Alst. “I went into the MSU Meat Lab and asked if they needed all their pig guts. They didn’t, so every so often I go over there and pick up some pig guts, and trade them some brownies or a cake or something.”

This tiny bacteria has to make its way through an incredibly thick mucus layer, and causes disease when it reaches our cell lining... My research seeks to understand how it does that, and how to inhibit it.

So, why pig guts? For his research, Van Alst grows *V. cholerae* on the swine mucus to remove the RNA and see how it is responding to the mucus. Better understanding the mechanism by which the bacteria causes cholera can inspire drug development for more effective treatment of cholera, a disease that affects 3-5 million people annually,

according to the Centers for Disease Control. The process is an efficient way to study the microbe. “I scrape the mucus out of the small intestine, purify the mucus and grow bacteria,” he says.

Van Alst will do what it takes to get what he needs for his research. What he does not want to do is spend all of his time looking for grant money to support his research. He is particularly drawn to teaching; he was selected to be part of Scholars of Undergraduate Teaching and Learning Fellowship at MSU’s Lyman Briggs College in the 2018-2019 academic year and part of the Future Academic Scholars in Teaching Fellowship for the 2019-2020 academic year. He has identified some “interesting post doc opportunities at Wisconsin-Madison, UNC-Chapel Hill. . . They have some post docs that allow teaching. I haven’t seen others that have that,” says Van Alst.

TENNIS AND FOUR-LEAF CLOVERS

Van Alst grew up in Cadillac, Michigan, where he was an avid athlete in tennis and soccer. He has continued playing tennis now that he is in graduate school, playing on a local league. “Singles tennis is too lonely,” he says. “It’s more of a self-accomplishment. And I want to have fun, too,” he says. He says that in tennis he finds an outlet for his stress and his desire to be social as well.

Van Alst is also skilled in another unexpected area: finding four-leaf clovers.

“I have over 1,000 lifetime finds,” he says. “I’m great at finding four-leaf clovers. The first time I found one I was on a swing in my backyard. I hopped off and picked it.” He still finds lucky clovers everywhere. He even finds them on the soccer field while he is playing. “People would say, ‘You can’t do that!’ and I would say, ‘Why not? The ball is nowhere near me!’” he recalls, laughing.

Van Alst collects the clovers and presses them in his wallet, and adds them to his book of finds. He likes to keep it in case he ever needs to call upon their lucky powers. His next challenge? To find a four-leaf clover in every state.

If his willingness to scrape pig guts is any indication, Van Alst will do whatever it takes. (And complete the self-designated clover challenge.)

Aaron Welsch



FROM NEUROSCIENCE RESEARCH TO A TEACHING CAREER

For people who work in graduate education, there is no one way to gauge student success. This is especially true for anyone involved in MSU BEST, as we actively support trainees finding the career of their dreams. And, sometimes, that means leaving graduate school without finishing a doctorate.

IDENTIFYING A CAREER PATH

BEST trainee Aaron Welsch is a perfect example of this. He says,

“I remember, when I first started the program, faculty members would say things like, ‘Half of you won’t end up in jobs like the ones we have.’ But they never say what other jobs are, or how to get them. BEST exposes students to different careers. That doesn’t happen often enough.”

Welsch appreciated these efforts, because it seemed to him like young scholars are interested in different careers for themselves, but these paths are not well established.

“I feel like it’s going to be my generation that finds these other jobs, and talks about how to get them,” he says.

After joining BEST, Welsch knew what he wanted to do: teach at a small liberal arts college like the one he attended, Hope College. And guess what he does now? He teaches at a small liberal arts college—Hope College, to be precise.

“I kept in touch with my advisor from undergrad,” says Welsch. The advisor reached out to Welsch when Hope College had a need in the neuroscience program. She also knew Welsch was thinking about taking a master’s degree instead of

I always wanted to use research to teach experimental design, not just research for its own sake.

finishing a Ph.D. “It’s important to reach out and make connections. There’s a lot of effort to keeping connections,” Welsch says, “but it’s important.”

A CALLING TOWARD NEUROSCIENCE

Welsch liked his graduate research, looking at how testosterone affects development, “which studied the SNB nucleus in the spinal cord, which controls typical mating behaviors,” he says. In particular, we looked at Kennedy’s disease,

which is like ALS but only affects males.” During his undergraduate training, Welsch started out as a chemistry major but was drawn to neuroscience, and when he started thinking about graduate school, his mentor at Hope proved to be instrumental. “My Hope College advisor met my MSU advisor on a plane,” he says. “They somehow bonded over kids and science, and they told me to reach out and try this lab to see if it works out.” Welsch worked at the lab for several months as a lab tech before he decided to apply to graduate school.

Welsch still loves research, but less about the research itself and more about using it as a tool for teaching science and other skills. “I always wanted to use research to teach experimental design, not just research for its own sake,” he explains. And while Hope College has many faculty members who have research funding to support their scientific inquiry, he enjoys teaching the skills required to do successful work in the laboratory. “Labs are a good mix of engaging

with students about science and teaching concepts,” he says. “I’m a big believer that lab work teaches important soft skills that students need to learn in college, like professionalism. Turning things in on time, and taking learning beyond what you can learn in a book.”

THE POWER OF A STRONG NETWORK

Before he made the switch to his faculty role at Hope College, Welsch had been questioning his commitment to finishing his Ph.D. “It was so frustrating. I knew what I was doing wasn’t going to make me better at the job I wanted. And that research wasn’t going to appear on a resume or CV for the kind of job I wanted,” he says. As he transitioned from the doctoral program to a master’s program in neuroscience, Welsch began exploring his network which, of course, included his mentor at Hope College.

As Visiting Instructor of Neuroscience, Welsch teaches Introduction to Neuroscience, as

well as a number of lab courses. For others who aspire to roles like his, Welsch says a Ph.D. is not necessarily required.

“I wouldn’t recommend starting on the path I ended up taking,” he says. “However, I was willing to figure out how to do what I loved with a master’s degree, as opposed to finishing a Ph.D. and then figuring out what I was qualified for. And, for me, it’s worked out. There are a number of faculty who only teach, and don’t do research.” Though he adds that Hope College has a research profile that is higher than many teaching-oriented colleges. He says that “more people are being brought on to teach only, not teach and do research.”

For Welsch, there’s little question that his path back to Hope College—and taking a master’s degree instead of a Ph.D.—is clear evidence of student success.

Trainees

COHORT 1

Mark Aupperlee

Advisors: Richard Schwartz,
Sandra Haslam

Nadia Ayala-Lopez

Advisor: Stephanie Watts

Elizabeth Baird

Advisor: Richard Lenski

Kirti Bhardwarj

Advisor: Greg Swain

Lisa Boughner

Advisor: James Tiedje

Jiao Chen

Advisor: Yanni Sun

Janice Diaz-Otero

Advisor: Anne Dorrance

Peter Dornbos

Advisor: John LaPres

Josh Drost

Advisor: Tamara Reid Bush

Matthew Faber

Advisor: Tim Whitehead

Nico Fernandez

Advisor: Christopher Waters

Meredith Frie

Advisor: Paul Coussens

Nkrumah Grant

Advisor: Richard Lenski

Joseph Henriquez

Advisor: Norbert Kaminski

Amanda Herzog

Advisor: Jade Mitchell

Nastassja Imus

Advisor: Timothy Collier

Sarah Kelly

Advisor: Scott Counts

Beth Norman

Advisor: Edward Walker

Geoffrey Severin

Advisor: Christopher Waters

Marisel Villafañe-Delgado

Advisor: Selin Aviyente

COHORT 2

Kevin Baker

Advisor: James Luyendyk

Sarah Bodbyl

Advisor: Andy Anderson

Jonathan Dannatt

Advisor: Robert Maleczka

Sylmarie Davila-Montero

Advisor: Andrew Mason

Megan Duffy

Advisor: Caryl Sortwell

Taylor Dunivin

Advisor: Ashley Shade

Colleen Friel

Advisor: Maren Friesen

Katherine Halievski

Advisor: Cindy Jordan

Alessandra Hunt

Advisor: Christopher Waters

Kristina Kamensky

Advisor: Ranjan Mukherjee

Sarah Keaton

Advisor: Lena Brundin

Jenny Kim

Advisor: Cindy Jordan

Laura Kirby

Advisor: Donna Koslowsky

Erin McKay

Advisor: Scott Counts

Naiomy Rios-Arce

Advisor: Narayan Parameswaran,
Laura McCabe

Rhomi Sellnow

Advisor: Frederic Manfredsonn

Jagganath Silwal

Advisor: Honggao Yan

Joel Soler

Advisor: Lili Yan

Daniel Vocelle

Advisor: Patrick Walton

Aaron Welsch

Advisor: Marc Breedlove

Maggie Williams

Advisor: Syed Hashsham

Di Zhang

Advisor: Karen Liby

Huiqing Zheng

Advisor: Robert Abromovitch

COHORT 3

Sara Adelman

Advisor: James McCusker

Kibrom Alula

Advisor: James Galligan

Aparajita Banerjee

Advisor: Bjorn Hamberger

Vanessa Benham

Advisor: Jamie Bernard

Heather Blankenship

Advisor: Shannon Manning

Anne-Sophie Bohrer

Advisor: Hideki Takahashi

Julienne Brock

Advisor: Jose Teixeira

Debrup Chakraborty

Advisor: Jamie Bernard

Kevin Chen

Advisor: Patrick Walton, Kris Chan

Daniel Claiborne

Advisor: Linda Mansfield

Alyssa Fedorko

Advisor: John Risinger

Aaron Garoutte

Advisor: Kevin Childs

Nomar S. Gonzales-Santini

Advisor: Dr. Fang Zheng Peng

Sandra Hammer

Advisor: Julia Busik

Peter Hsueh

Advisor: Brian Haab

Chao Huang

Advisor: Julia Busik

Bingyao (Crystal) Li

Advisor: Jonathan Walton

Natalia Martin

Advisor: Victor DiRita

Sean Nguyen

Advisor: Peggy Petroff

Amrita Oak

Advisor: Kris Chan

Alberto Perez-Medina

Advisor: Jim Galligan

2014–2019

Thassy Pinto

Advisor: Xiaobo Tan

Mariana Desireé Reale Batista

Advisor: Larry Drzal

Meghan Ruebel

Advisor: Keith Latham

Vickie Ruggiero

Advisor: Paul Bartlett

Peter Schall

Advisor: Keith Latham

Ashley Severance

Advisor: Keith Latham

Andrew (Ted) Van Alst

Advisor: Victor DiRita

Alyssa Vanderziel

Advisor: David Barondess

Liang Wang

Advisor: Zhehui Luo

Kathryn Wierenga

Advisor: James Pestka

Neco Wilson

Advisor: Adam Moeser

COHORT 4**Melanie Noell Bernard**

Advisor: Gregg Howe

Jacob Bibik

Advisor: Bjorn Hamberger

Kyle Card

Advisor: Richard Lenski

Sheryl Chau

Advisor: Ranjan Mukherjee

Kayla Conner

Advisor: Jonathan Hardy

Nicholas Ether

Advisor: Adam Lauver

David Ferland

Advisor: Stephanie Watts

Emily Greeson

Advisor: Chris Contag

Qiang Guo

Advisor: Gregg Howe

Zoe Hansen

Advisor: Shannon Manning

Siomara Hernandez-Rivera

Advisor: Brian Gulbransen

Keren Herrera Delgado

Advisor: Robert Ambromovitch

Kristin Jacob

Advisor: Gemma Reguera

Ramya Kalyana Kumar

Advisor: Stephanie Watts

Shruthi Kumar Raj

Advisor: Greg Swain

Justin (Kun) Lee

Advisor: Jonathan Hardy

Haley Lynch

Advisor: AJ Robison

M. Hossein M. Kouhani

Advisor: Wen Li

Laura Mark

Advisor: Anne Dorrance

Ryan Marquardt

Advisor: Jae-Wook Jeong

Jose Montero

Advisor: Robert Maleczka

Ariadna Ochoa -Bernal

Advisor: Asgi Fazleabas

Sina Parsnejad

Advisor: Andrew Mason

Jingyu Peng

Advisor: George W. Sundin

Neda Rafat

Advisor: R. Mark Worden

Irving Salinas

Advisor: Aritro Sen

Anna Stoll

Advisor: Caryl Sortwell

Clarissa Strieder-Barboza

Advisor: Andres Contreras

Nguyen Truong

Advisor: Karl L. Olson

Thomas Turkette

Advisor: Robert Root-Bernstein

Aiko Turmo

Advisor: Cheryl Kerfeld

COHORT 5**Ehsan Ashoori**

Advisor: Andrew Mason

Chelsie Boodoo

Advisor: Christina Chan

Thomas Dixon

Advisor: Alex Dickson

Yonatan Israeli

Advisor: Aitor Aguirre

Graciелou Klinger

Advisor: Eric Hegg

Alicia Layer

Advisor: Beronda Montgomery

Manoj Madhavan

Advisor: Ripla Arora

Mounira Ozoor

Advisor: Zhehui Luo

Jake Reske

Advisor: Ronald Chandler

Aritra Sarkar

Advisor: Babak Borhan

Kylie Smith

Advisor: Kurt Zinn

Jasiel Strubbe

Advisor: Jason Bazil

Evran Ural

Advisor: Christopher Contag

Muhammad Yasir Nawaz

Advisor: Cedric Gondro

SPECIAL THANKS

MSU BEST has benefited from being a part of the fantastic team at the MSU Graduate School and would like to thank, in particular, the three deans who supported us along the way:

Karen Klomprens

Dean Emeritus, MSU Graduate School

Judith A. Stoddart

Interim Dean, MSU Graduate School

Thomas D. Jeitschko

Dean, MSU Graduate School

Additional thanks to all of the staff, faculty, and professionals who make MSU a leader in graduate education:

Stephanie W. Watts

MSU BEST Principal Investigator

Julie W. Rojewski

MSU BEST Program Manager

Special thank you to the following MSU leaders, who believed in the beginning of MSU BEST, supported every move and have committed to secure its future:

June Youatt

Provost

Doug Gage

Assistant Vice President, Research and Innovation, Office of the Senior Vice President for Research and Innovation

NIH BEST CONSORTIUM

Boston University School of Medicine

Emory University and Georgia Institute of Technology

New York University School of Medicine

University of California, Davis

University of California, San Francisco

University of Colorado Denver|Anschutz Medical Campus

University of North Carolina Chapel Hill

Vanderbilt University School of Medicine

Wayne State University

Cornell University

Michigan State University

Rutgers University

University of California, Irvine

University of Chicago

University of Massachusetts Medical School

University of Rochester

Virginia Polytechnic Institute and State University

MSU BEST INTERNAL ADVISORY BOARD

Katy Luchini Colbry

Charley Hasemann

Alessandra Hunt

Kristina Kamensky

Manooch Koochesfahani

John LaPres

Julia McAnallen

Richard Schwartz

NATIONAL INSTITUTES OF HEALTH LEADERSHIP

Patricia Labosky

Rebecca Lenzi

MSU BEST EVALUATION AND DATA TEAM

J. Kevin Ford

Deepshika "Dia" Chatterjee

Caitlyn Briggs

Evan Beals

John A. Vasquez

Irene Weber

Brenda Hill

Jim Murphy

MSU BEST GRANT APPLICATION TEAM

Stephanie Watts

Karen Klomprens

Katy Luchini Colbry

Shobha Ramanand

J. Kevin Ford

John LaPres

Richard Schwartz

Manooch Koochesfahani

Julia McAnallen

WRITING

Julie W. Rojewski

Redhead Design Studio

EDITING AND DESIGN

Redhead Design Studio

PHOTOGRAPHY

Allie Siarto



**Re-thinking
the age-old
question.**

A REFLECTION FROM JOSEPH HENRIQUEZ, TRAINEE IN PHARMACOLOGY AND TOXICOLOGY

“When I grow up,” is something every child says at some point.

“When I grow up, I’ll be a rock-star.”

“When I grow up, I’ll be an actor.”

“When I grow up, I’ll be a doctor.”
(That was mine)

But I would wager that no child has ever stood in front of their third grade class, their knees shaking from the first signs of social anxiety disorder and their face sticky from lunch, and said, “When I grow up, I want to be a regulatory toxicologist,” or “a scientific writer,” and certainly not “a medical science liaison.”

When I started graduate school at MSU, I started asking myself the same question I was asked as a child: “What do I want to be when I grow up?”

And to be honest, I wasn’t sure.

To be completely honest, I’m still not.

I do know that I have to answer that question for myself and that my mentors and advisors always offered the same solution: academia. They went that route; it has to be the right one. Right?

As I listened to voices of the university discuss complaints about funding agencies, the turmoil of the tenure track, the lack of open positions combined with the glut of qualified applicants, I realized that I needed to consider alternate career routes.

Fortunately, MSU and NIH recognized the need to expose Ph.D. students to fields beyond academia. They realized that there is a gap between how Ph.D. students are trained and where they eventually make careers.

Perfect!

As one of the guinea pigs of the MSU BEST program, I was excited to be exposed to the various fields which would be open to me as a Ph.D. I had visions of being told that I would be able to basically walk into any position I wanted to have. Sure, I knew I would need some additional training. But isn’t that what a post doc is for? I felt confident that I would be able to find the job I want after only one year of professional development! Except...

My coworker asked me, after I finished all of the workshops during my first year in BEST, “Do you feel BEST has helped you?”

And I answered, “Many of the speakers said that if they applied today for the same jobs they have now, with the same qualifications they had when they first applied, some 10+ years ago, they wouldn’t get the jobs.” He looked at me confused as I continued, “After hearing how much more preparation I will need to work in industry, or even government, I wanted to stand up as our final workshop came to a close, calmly push in my chair, walk to my car, drive north until my car ran out of gas, then exit my car and disappear into the woods. Never to be seen again.” In short, it seemed pointless and I felt hopeless.

Though I felt jaded upon first hearing how much more preparation I would need to establish myself in any field, not just the ones I wanted, I now look back and realize that I did learn something. I learned that keeping my nose to the bench, cranking out papers and having the title of “doctor” is simply not enough. I would need to get my name known, have the appropriate experience, apply for post docs in good labs. I would have to (and part of me hates this, but) network.

And so I have.

I have made it a conscious effort to speak with people that have the jobs I want, to get experience in the things I enjoy (including writing about my experience in BEST), and to make peace with the fact that I still have more training before I reach the point in my career where I feel satisfied with my position and pay. In the past year, I have presented my research at two international meetings (one was in Europe!), been an advocate for the AGEF program when I visited Capitol Hill and spoke with program directors at NSF. Whenever I get the opportunity to gain more experience, try new things, or test out the skills I am developing in BEST, I jump.

So, back to that same question: “What will I be when I grow up?”

I’m still working on the answer.

Regardless of what the answer is, I feel that BEST has taught me what I will need to do to get there, I’ll have a whole new set of experiences and skills to offer when I figure it out.

MICHIGAN STATE
UNIVERSITY

BEST.MSU.EDU

The Graduate School
Michigan State University
466 W. Circle Drive
130B Chittenden Hall
East Lansing, MI 48824