

# DISCOVERIES

DEPARTMENT NEWS

“The current graduate education system in many countries is based on an apprenticeship model, wherein lab heads train younger researchers in the craft of research.”

-Julia Gould, author of “How to build a better PhD,” published in *Nature*, 2015

## Oh, the Places You'll Go with a PhD in Science!

The priority for most PhD programs is for research scientists to train their mentees in their own image. In the United States more than 12,000 students obtain a PhD in the life sciences each year. Of these, however, only 15 percent acquire a tenure-track faculty position in academia with an additional 18 percent matriculating into non-tenure track jobs in academia.<sup>1</sup> The vast majority of students who obtain a PhD do not follow an academic career path.

In spite of this trend, graduate programs and faculty mentors are firmly grounded in an academic culture that promotes a research-training regime and a mentor apprenticeship model that focuses almost solely on skills useful for the academic researcher. Most graduate training programs fail to recognize the post-graduate reality that these PhD students face and neglect to provide the training and mentorship for their students for nonacademic careers. As a result, PhD trainees are ill-prepared to successfully transition to a wide array of nonacademic careers. Nevertheless, the critical thinking skills and independence that PhD students in the STEM fields develop are highly desirable and transferable to diverse careers where they can be very competitive and highly successful.

To help address this issue, Professor Maitreyi Das developed a seminar series and graduate course to introduce and promote the exploration of nonacademic

career opportunities for BCMB doctoral students – Oh! The Places You'll Go with a PhD in Science! The seminar series and course featured experts representing diverse PhD fields with an emphasis on nonacademic career paths, such as patent law, scientific writing and editing, start-up companies and entrepreneurship, business and life science consulting, science policy, STEM jobs in the government sector, and pharmaceutical and biotechnology industries.

The seminar included a discussion about each career track and a seminar and open forum with the speaker. Professionals discussed their career tracks, life events affecting their careers, and how to get started in a nonacademic specialty. Students also had the opportunity to network with the speakers, which resulted in internship invitations to interested students.

Additionally, Das, Dan Roberts, and Gladys Alexandre provided students with tools to plan and prepare for the career of their choice. Topics discussed included networking, crafting an elevator pitch, creating and maintaining an individual development plan for goal setting and career planning, postdoctoral training strategies in various settings, and an assessment whether a postdoc is required for a specific career. The students also engaged in group activities where they had to role-play various career tracks as part of the discussion exercise.

<sup>1</sup> “Addressing Biomedical Science’s PhD Problem,” Catherine Offord, *The Scientist*, Vol 31



**GLADYS  
ALEXANDRE**  
Professor and  
Department Head



## *Change is in the Air*

The start of a new academic year is always a time of excitement and change. This year is no exception, though it is more than what we typically experience.

First, I am replacing the esteemed Professor Dan Roberts at the helm of the department. Dan is returning to the faculty after five years of dedicated service to the BCMB department as head. Having worked with him, I know how much he is dedicated to BCMB students and faculty! For those who are not familiar with me, I am a microbial cell biologist interested in deciphering how cells, specifically bacteria, make decisions. My research is relevant for agriculture, medicine, and the environment. For example, research from my lab has potential for designing novel antimicrobial drugs and new biofertilizers for economically important crops. I have a passion for undergraduate teaching. As an instructor of 100-level biology courses for more than a decade, I have witnessed the change in students' attitudes toward higher education. Students now look for more experiential learning and for opportunities to build professional skills for a variety of potential careers during their education. These changes require a thoughtful redesign of the curriculum – a project I foresee the department embarking on in the near future.

In addition to the change in leadership, roughly 70 percent of BCMB faculty members have moved to the new Ken and Blaire Mossman Building. All faculty located

in Walters Life Sciences were relocated to Mossman between June and August of 2018. The new Mossman building is a masterpiece. It is a 21st century building that boasts collaborative study and research spaces. I invite each and every one of you to come and visit our new workplace.

We are also welcoming Rajan Lamicchane a new assistant professor. Lamicchane's research focuses on elucidating how single molecule dynamics contribute to function and organization of complex biomolecular systems. His research will bring new expertise to the BCMB research portfolio while synergizing with ongoing research in the department.

BCMB is constantly evolving and in this issue of our annual newsletter, you will learn about the cutting-edge research conducted by Keerthi Krishnan, a neuroscientist whose work focuses on Rett syndrome, a rare neurodevelopmental disease. Research into this type of disease provides an opportunity to learn how the brain works.

I also invite you to read about some of our undergraduate and graduate students and their achievements. The BCMB Graduate Student Organization, led and run graduate students, hosts regular events and engages in outreach activities, which are spotlighted in this issue as well.



# Tackling *Leptospirosis* in Argentina

**Rena Abdurehman** began her first semester of research learning general lab tasks, various lab techniques, and common protocols in Barry Bruce's lab. During a UT Summer Research Institute, she continued research in Bruce's lab and studied how proteins move from cytosol into chloroplasts.

The vast majority of chloroplast proteins are encoded by nuclear genes. Proteins have to be imported into the chloroplast through membrane-localized translocons. This process is mediated via N-terminal extension of chloroplast proteins known as transit peptide and, despite discovery more than 40 years ago, the transit peptide function is still poorly understood. Transforming onion epidermal cells and pea protoplast, Rena explored whether particular mutations in the transit peptide will alter ability of proteins to move inside chloroplasts.

Rena participated in the SAEOPP National McNair Conference and won third place for her poster presentation. She also presented her research at Posters at the Capitol, the Women in STEM Research Symposium, EURECA Symposium, and the 26th and 27th Western Photosynthesis conferences. Rena was awarded second place for Outstanding Poster Presentation at the 26th Western Photosynthesis Conference and won an Arts & Sciences Award at the 2018 EURECA Symposium.

During summer 2017, Rena received a competitive UT-funded exploration grant to conduct research in Rosario, Argentina. She collaborated with Eduardo Ceccarelli, who studies enzyme function in the bacterium *Leptospira interrogans*. Rena learned about the prevalence of Leptospirosis, a disease caused by this bacterium, which is classified as the world's leading cause of hemorrhagic disease. Its prevention and remedy in humans is difficult because of the similarity of its symptoms to those of other diseases. The disease is easily transmitted from animals to humans. Runoff from ranches, feedlots, and slaughterhouses enables the bacterium to enter rivers that flow along the coast of Argentina. Traditionally, water cleanup is performed through wastewater treatment plants, but those processes are costly and can be overwhelmed in periods of high rainfall.

Last spring Rena was awarded a United States Fulbright Research Award to return to Argentina for nine months. Rena has proposed a novel low cost water treatment method using the aquatic plant duckweed to help alleviate the spread of the disease. Duckweed can effectively filter numerous contaminants, such as bacteria, nitrogen, phosphates, and other nutrients, from water. Adding different duckweed strains to the water, she will be testing the viability of *Leptospira interrogans*. She will also investigate efficient ways to add duckweed into wastewater treatment plants across the country.

Read her entire story online at [tiny.utk.edu/Rena](http://tiny.utk.edu/Rena).



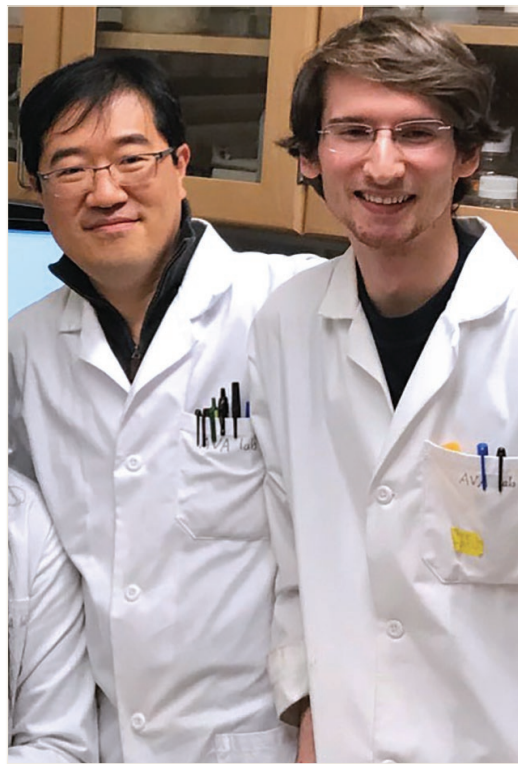
# Using Real Intelligence for N-P Hard Problem

A voracious reader growing up, **Charles Barnes** (*photo, right*) came across many books related to environmental problems, which led him to consider a career in environmental science. His first encounter with research was in the field studying bluebirds. As he progressed through courses at UT, however, enjoying the challenge and content of organic chemistry (crazy, right?) and genetics, he realized molecular biology was a better fit for him. In order to gain research experience, Barnes joined the von Arnim lab where he studied plant responses to nutritional stress.

*Arabidopsis thaliana* is a weed, but one of the easiest plants to study. Barnes used this model organism to investigate whether biosynthesis of proteins changes in response to varying levels of one of the most important plant nutrients—nitrogen. Plants require more nitrogen than any other nutrient, but its availability is limited in the soil, which is the main reason for fertilizers. Nitrogen is essential for biosynthesis of amino acids, the building blocks of proteins. One would expect that without enough nitrogen, the biosynthesis of proteins would change. In fact, he and his mentor, postdoctoral researcher Sung Ki Cho, confirmed that protein synthesis is repressed when nitrogen is limited. How does this happen? Protein synthesis is typically repressed by a specific phosphorylation event in the translation initiation apparatus. Barnes tested whether this modification would take place when nitrogen is withdrawn from the plant growth medium. Contrary to his initial hypothesis, Barnes observed that limiting nitrogen or boosting nitrogen availability had exactly the opposite effect from what was expected. The back and forth of various working hypotheses during the project was one of the most challenging experiences for Barnes.

“It was a great project for my slightly younger undergraduate self,” Barnes says. “My presence was not dependent on funding and I could get the gears whirring in my head. I had a very unique time as an undergraduate researcher in BCMB.”

Last spring at the Exhibition of Undergraduate Research and Creative Achievement at UT, Barnes received awards for his research poster – the Office of Research & Engagement Bronze Award and an Arts & Sciences Award.





# Passion for Protein Structure

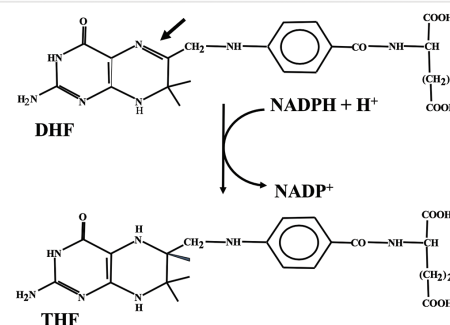
Located where the Gulf of California meets the Pacific Ocean, Los Cabos, the home of **Gabriel Jose Fuente Gomez**, is one of the sunniest locations in the world. Growing up, Gabriel spent most of his time fishing and snorkeling in the world-famous reefs off Los Cabos, but his real passions were math and chemistry. During the last year of undergraduate studies, Gabriel moved from the vacation paradise of Los Cabos to the northern state of Sonora to pursue an internship at a research center in food and development where he worked on a design of new food products based on squid. Gabriel found that experience exciting and when his internship ended he stayed at the research center and obtained a MS in food science while studying triggerfish myoglobin and how its structure changes during ice storage leading to fish discoloration. Still passionate about science and biochemistry, Gabriel spent two years stuffing sausages and making hams (hard work!) in the food industry to save money for exams, school applications, and visa paperwork before starting graduate school at UT in 2014.

In 2015, Gabriel joined Liz Howell's lab. His current work focuses on understanding the effects of macromolecular crowding on the activity of dihydrofolate reductase, an enzyme that helps bacteria to synthesize folate (vitamin B9). Most knowledge about enzyme kinetics comes from assays performed using purified protein in a test tube. But how do enzymes work in the more crowded environment that exists inside of a cell? Studying proteins in their native environment is still in its infancy and Gabriel hopes that in the long term his work in that area can be applied to drug discovery. Gabriel also is participating in a collaborative project with Smith's lab and is a co-author on this year's paper, "Effects of carotenoids on lipid bilayers," published in the journal *Physical Chemistry Chemical Physics*. Doing PhD work is not just gathering scientific facts; the most important lesson that Gabriel learned doing research is perseverance. "Sometimes experiments fail but you need to be patient and ask, why?"

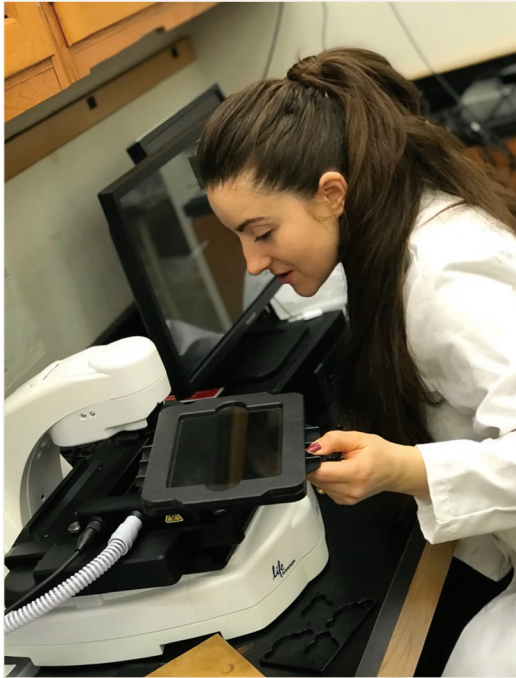
Another lesson Gabriel learned is that giving back to society is important and rewarding. While at UT, Gabriel has volunteered to judge several local science fairs and science demonstrations at elementary schools. Abroad, Gabriel has been selected two years in a row to be an instructor for *Clubes de Ciencia* (CdeC) in Mexico. CdeC is an international nonprofit organization that promotes science education in under-developed Latin American countries. Gabriel developed a one-week, hands-on workshop for high school and college students where they learned about protein structure by purifying and crystallizing lysozyme and by using online databases for protein visualization. At the end of the workshop, students had a better understanding of how the study of protein structure helps researchers design new drugs. Gabriel's goal during the workshop is to have a strong impact on up-and-coming talented students, making their scientific pursuit more tangible.



## The DHFR Reaction



# Squeezing Through the Research Labyrinth



How many of you can say that you skipped first grade, not because you were too talented, but because you were trying to avoid getting killed on the way to school? Rosela Gollosi found herself in that situation as a child, and the only means of getting an education was listening to school lessons on the TV. Rosela grew up in Patos, a small town

in Albania, during the Albanian civil war. While it was scary, this experience also taught her she could survive anything and there was a path to a better world by hopping on a helicopter (ubiquitous during the war) or a plane. So, when the time came for college education, Rosela boarded that plane to the United States to attend the University of North Georgia in a small town called Dahlonega. It was not exactly a well-known place, but she had family support in that area.

At first, Rosela's intention was to become a medical doctor, but after many hours of shadowing, she felt dissatisfied with the lack of time and resources doctors have to research and seek meaningful explanations for the many unknowns they encounter. Having understood the importance and excitement of biological research as a senior, Rosela joined a research lab where she assisted with behavioral studies to understand the effects of methamphetamine exposure in mice, worked

in a clinical pathology research lab, and participated in protein engineering research. Upon graduation, Rosela worked for a year and a half at a pharmacogenomics lab at Aeon Global Health. Her team analyzed the impact of patient genetics on drug metabolism to reduce adverse effects, but she soon realized she wanted a deeper understanding of the human genome and mechanisms affecting essential regulatory processes, which motivated her to begin her doctoral studies in BCMB at UT in 2015.

After rotations, Rosela joined the lab of Rachel Patton McCord where she has developed an intimate knowledge of cancer cell nuclei as she investigates the role of 3D genome structure in cancer metastasis. Recent cutting-edge techniques have identified a nonrandom organization of the chromosomes inside of the nucleus that is crucial for gene regulation, replication, and repair of DNA damage. While the morphology of the nucleus has been used for decades to determine the malignancy of cancer, little is known about how the nonrandom organization of the chromosomes inside the nucleus is affected when cancer cells must squeeze themselves through tight spaces to metastasize from primary tumor to distant sites. Rosela's research has the potential to provide a new understanding of genome organization and its role in cancer metastasis that could aid in preventing this deadly phase of the disease. As a third-year student, Rosela has already contributed to three publications that are published or are submitted.

"The graduate school experience has been essential in shaping my critical thinking skills and I realize that there is no limit to creativity in research," Rosela says. "After completing my degree, I would like to provide a platform for science and research education in countries where such opportunities are limited."

## BCMB Graduate Student Organization

The BCMB Graduate Student Organization (GSO) supports graduate students by organizing social, outreach, and professional events. Founded in 2016, the first GSO members were graduate students involved in organizing holiday parties, the fall retreat, and interview weekend. Since then, GSO has undertaken other ventures to help make BCMB an even better place for grad students.

From workshops and facilitating communication between faculty and graduate students to community outreach and mentorship opportunities, the GSO is a great place for all BCMB graduate students. Learn more about current opportunities at [tiny.utk.edu/BCMBGSO](http://tiny.utk.edu/BCMBGSO).



Graduate students Justin Westerfield, Jacob Sanders, and Rosela Golloschi, with Martin Chalfie, a recipient of the 2008 Nobel Prize in Chemistry.

## BCMB FACULTY NEWS

### INTRODUCING *Keerthi Krishnan*

Keerthi Krishnan joined BCMB department as an assistant professor in January 2017 after completing a bachelor's degree at the University of Illinois, Urbana-Champaign, a doctorate at the University of California, San Francisco, and a postdoctoral fellowship at Cold Spring Harbor Laboratory. Her research focuses on Rett syndrome, an incurable neurodevelopmental disorder that affects almost exclusively girls, as affected boys die shortly after birth.

Originally from southern India, she has vivid memories of working with plants and insects during school. Her love for brains came from reading Robin Cook medical mysteries when she was 10 years old. After graduate work on the mechanisms of gene regulation in zebrafish, she looked for a postdoctoral position studying neurological disorders and accepted a position investigating the role of GABA inhibition in Rett syndrome at Cold Spring Harbor Laboratory. She was fascinated. Her current research involves understanding how the brain enables us to interact and learn from each other and our environment, using a process called experience-dependent plasticity.

Read the full interview online at [tiny.utk.edu/Krishnan](http://tiny.utk.edu/Krishnan).



To see more faculty news, student spotlights, and notable publications, visit [tiny.utk.edu/BCMB-News](http://tiny.utk.edu/BCMB-News).



**Department of Biochemistry  
& Cellular and Molecular Biology**  
309 Ken and Blaire Mossman Bldg.  
1311 Cumberland Avenue  
The University of Tennessee  
Knoxville, Tennessee 37996-1939

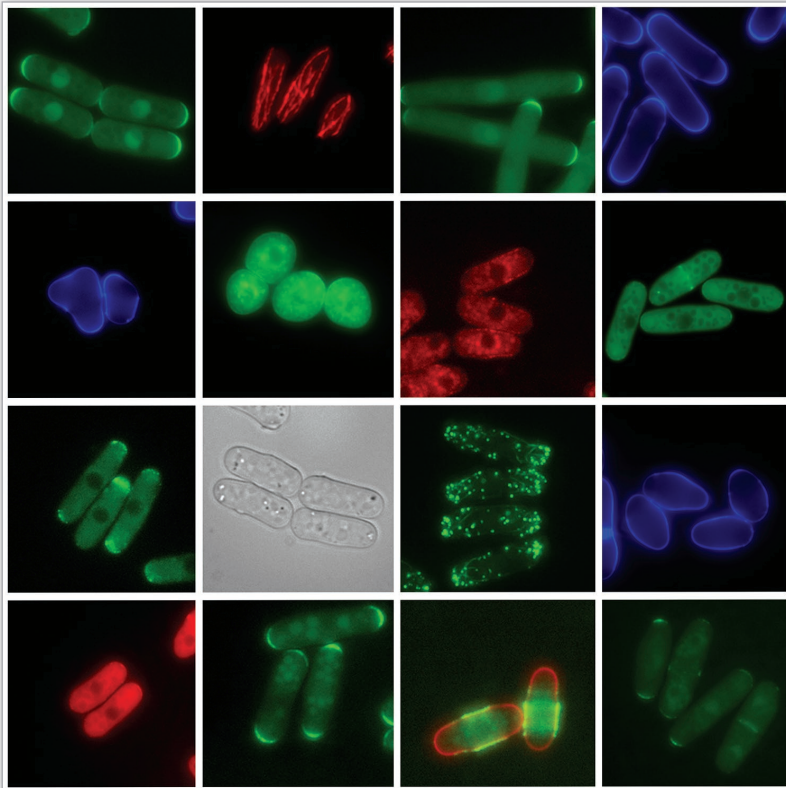
Non-Profit Org.  
U.S. Postage  
**PAID**  
Permit No. 481  
The Univ. of Tenn.  
Knoxville, TN

FOLLOW US!

 @UTK\_BCMB

[bcmb.utk.edu](http://bcmb.utk.edu)

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment and admission without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, gender identity, age, physical or mental disability, genetic information, veteran status, and parental status. PAN xxx-xxx-xxxx-xx-xx JOB 18-175



## Your gifts make a difference!

Over the years, we have been fortunate to receive generous donations from a variety of supporters, including former graduates. These gifts have made it possible for us to offer undergraduate and graduate scholarships. Other donations have been used for Research Incentive Awards to faculty who propose pilot projects that promise to lead to extramural grant funding from national agencies. Our generous donors have made all of these things possible.



To contribute online, please visit:  
[bcmb.utk.edu/support-the-department](http://bcmb.utk.edu/support-the-department)  
and click on "Give to UT."

If you would like to learn more about giving, please contact **Don Eisenberg**, director of advancement, College of Arts and Sciences, at 865-770-1913 or [don@utfi.org](mailto:don@utfi.org).

# DISCOVERIES

The **DISCOVERIES** newsletter is published annually by the UT Department of Biochemistry & Cellular and Molecular Biology.  
Phone: 865-974-5148 • Fax: 865-974-6306 • E-mail: [bcmb@utk.edu](mailto:bcmb@utk.edu) • Web: [bcmb.utk.edu](http://bcmb.utk.edu)