

DISCOVERIES

A Hub for Scholarship at UT

Scientific research is a collaborative endeavor, but physical distance between research groups can hamper collaborations. To overcome this barrier and to promote the exchange of ideas, BCMB faculty have taken the initiative to help form the **Tennessee Plant Research Center (PRC)** and the **Biomembranes Community of Scholars (BCoS)**. Both bring together scientists from across UT and ORNL with similar research interests.

The Tennessee PRC brings together “green” scientists from across the UT and ORNL. UT, as the land-grant institution of Tennessee, is home to more than 60 research groups that investigate all aspects of plant life (and other photosynthetic organisms) from fundamental questions of how plants grow and develop in basic biology labs to highly applied research on farm fields. These researchers are scattered over many departments in several colleges that span two separate campuses, hampering the free flow of information and the opportunity to form fruitful collaborations.

In 2009, our own Andreas Nebenführ (professor in BCMB) together with Neal Stewart of the plant sciences department at the UT Institute of Agriculture set out to overcome this balkanization by bringing all plant researchers together under the umbrella of the Tennessee PRC. With start-up funding from the Office of Research, the Tennessee PRC holds monthly colloquia that introduce our students to the latest plant research

on campus. These colloquia also regularly host high-caliber outside speakers that give our students the opportunity to rub shoulders and network with leaders in the field.

The focus on students is also evident in other activities of the center such as travel grants to support participation in national and international meetings as far away as South Africa and New Zealand. In addition, graduate students and postdocs are able to compete for research grants that provides them with funds to pursue their own ideas, independent of their advisor. In the past, these highly coveted grants led to complete reversals in the direction of dissertation projects as well as in the generation of crucial preliminary data for large external grants. The PRC has also led to fruitful collaborations between researcher groups leading to the publishing of research articles and submission of grants to federal funding agencies. The PRC is currently jointly funded by the College of Arts and Sciences and the Herbert College of Agriculture and proudly serves as a successful role model for the ongoing merger of UT Knoxville and UT Institute of Agriculture.

UT is also home to a large group of scientists who work in the broad topic of cellular membranes. This interest is not surprising, since cellular membranes are fascinating structures of the utmost importance. Barry Bruce (professor in BCMB) recognized UT’s strengths in biomembrane research, and started networking to create a

structure that could create synergies between researchers across the UT and at ORNL and be a forum for scientific collaboration. In 2018, Todd Reynolds (professor of microbiology) formalized this group by filing an application with the UT Office of Research and Engagement to form the Biomembranes Community of Scholars (BCoS).

The BCoS is comprised of approximately 30 researchers spanning seven departments in four colleges, plus several ORNL researchers. BCoS meets three times per semester for graduate student presentations. This is an excellent forum for receiving feedback from an interdisciplinary audience of membrane experts and there is probably no better way of getting scientific suggestions about research that is in progress. The first BCoS annual symposium in November of 2020 was organized by Todd Reynolds and Fran Barrera (professor in BCMB)

continued on page 2...





To read more news and updates, visit us online at bcmb.utk.edu.



MESSAGE FROM THE DEPARTMENT HEAD

It's Good to be Back on Campus

GLADYS ALEXANDRE
Professor and Department Head

BCMB has met the challenges imposed by the pandemic with gusto. While research activities ramped up last fall semester, we were mostly online for classes and for conducting department business, like the rest of the world. With the rollout of vaccines and the faculty and most graduate students vaccinated by early June, we no longer staggered personnel in our laboratories and were able to interact with one another. The vaccines are safe, effective, and remain the best available protection against severe COVID-19 disease.

Thanks to broadly available vaccines and high vaccination rate in the faculty and graduate students, the BCMB community could resume research and teaching full speed this summer. This included hosting the National Science Foundation (NSF) Research Experience for Undergraduates (REU) site grant in person. As part of this NSF-REU, 10 deaf and hard-of-hearing students and two hearing students interested in American Sign Language (ASL) from around the country visited UT and engaged in research projects with several of us. The feedback from this experience remains overwhelmingly positive, both from the students and the research advisors' perspectives.

Other bragging news includes the many BCMB graduate students who defended their MS or PhD theses and the recruitment of the largest incoming class of graduate students in recent years (a total of 17!). The departmental research faculty continues to be successful in securing grants, including prestigious ones. These successes are detailed inside the newsletter.

In other words, the department is growing both in visibility and in productivity and continues to

produce excellent instruction to our undergraduates. This growth benefits current students and alumni as it continues to add value to a degree in BCMB at UT. The BCMB faculty also continue to innovate in the undergraduate curriculum and we are now piloting or developing several new courses:

- BCMB 200 level cell biology course with laboratory
- BCMB 411 cell biology course for majors
- New molecular biophysics minor that was developed by BCMB faculty members.

Biophysics degrees are typically hosted in physics departments, but BCMB has leveraged our faculty's expertise to develop a minor in molecular biophysics in our biology BS degree. The biophysics minor provides students with foundational knowledge in molecular biophysics including current approaches to discover and design drugs against a variety of diseases.

Our undergraduate majors continue to lead. In addition to many graduates now attending professional schools, BCMB undergraduate majors are entrepreneurial. In this issue of the newsletter, you will learn about how BCMB major Allison Campbell turned her ambition to help children with chronic health conditions into a start-up business that led her to win a first-place cash prize during the spring 2021 Graves Business Plan Competition.

As always, I am looking forward to hearing from you. Please, stay in touch and stay safe!

...continued from page 1

and included plenary talks by Miriam Greenberg (Wayne State University) and Scott Hansen (Scripps Research Institute), and a popular poster competition.

In the short time since BCoS was formed, it has had a big impact. In particular, it served as the kernel that resulted in the recent award from the NIH Integrated Membrane Program (IMP) of a T32 graduate training grant. The NIH study section valued highly the strength of an active BCoS in awarding this important grant. T32 training grants have been conspicuously lacking from UT for nearly two decades, so this award is certainly a happy and overdue development that will contribute to interdisciplinary graduate education at UT. First year students from different departments will be competitively evaluated for acceptance in the IMP cohort by a steering committee of seven members. IMP trainees will receive funding, training and support typically for a two-year period. You can learn more about the BCoS activities at cos.utk.edu/biomembranes.



Having a Gas in Science

Lauren Donnelly is a senior in BCMB and has been conducting research in the lab of Brad Binder for just more than a year and a half. She is studying the role that the gas ethylene has in regulating the attachment of the plant-associated bacterium *Azospirillum brasilense* to the roots of plants. *A. brasilense* is used agriculturally to promote plant growth and yield. Ethylene is a plant hormone well known for its role in fruit ripening, but very little research has examined its roles in bacteria. This project represents an opportunity to understand cross-kingdom communication important in establishing host-microbe interactions.

Donnelly won a Summer Undergraduate Research Fellowship (SURF) from the UT Office of Undergraduate Research which allowed her to carry out more complex and time-consuming experiments this past summer. Donnelly recommends other undergraduate students find a lab and participate in research.

"Faculty mentored, independent research is a unique academic experience that challenges you differently than the classroom," she said. "Participating in research allows you to conduct experiments outside of the perfectly curated experiments seen in other lab classes. As a result, you have the opportunity to think through problems and create solutions. My time in the lab has allowed me to form friendships and create memories throughout my undergraduate experience."

Helping Children, One Teddy Bear at a Time

BCMB students follow many paths. A recent graduate of BCMB, **Allison Campbell**, won a first-place prize at the 2021 Graves Business Plan Competition from the Anderson Center for Entrepreneurship & Innovation in the Haslam College of Business for her business Fluffy Friends for Children with Chronic Conditions.

The goals of this program are to:

1. Foster healthy psychological development in children who have experienced traumatic medical episodes by promoting compassion in the medical field
2. Improve patient education by facilitating crucial age-appropriate conversations in health communication
3. Circumvent the barriers caused by related stigmas that prevent these children from being comforted.

"I envision a world in which all patients feel safe and secure," said Campbell, whose program does this by providing children with chronic conditions a uniquely designed teddy bear (FluffyFriends™) that has a secret pocket holding a symbol representing the child's diagnosis.



The inspiration for this idea came from the Teddy Bear Wellness Clinic activity at the Fantasy of Trees, which is East Tennessee Children's Hospital's annual fundraising event. Her experiences working as a Children's Miracle Network Ambassador and Teen Advisory Council member for East Tennessee Children's Hospital led her to form this program to address the issues surrounding the adverse psychosocial effects of chronic illness and to support these children when they return home from the hospital to lessen the negative effects of lifelong illness on the child. She is currently working on prototyping the first FluffyFriends™ and accompanying storybook and organizing a pilot research study to measure the impact of FluffyFriends™ on the first recipients. To find out more about Fluffy Friends for Children with Chronic Conditions, visit their website at fluffyfriends3c.org.

Studying Brain Development Is Cool

From an early age **Dana Layo-Carris** knew she wanted a career in research.

“I grew up on the coast of Massachusetts and from a very young age our science classes were focused on marine biology, the biodiversity that we could find in our back yard, and climate change, specifically erosion, which has significantly changed the coastline of my hometown over the last 30 years.”

Layo-Carris carried out research all four years of her undergraduate degree working in a synthetic chemistry lab and did a summer geochemistry project too. Although she knew she wanted to go to graduate school, she did not know what kind of research to pursue.

“I wanted to apply to graduate schools that had diverse research in the department and had research rotations, since I didn’t know what I wanted to do yet; which is what brought me to UT,” Layo-Carris said. “When I visited the department for interview weekend I was surprised to find such a welcoming community of scientists that were more interested in collaborative research and having an actual graduate student community in comparison to other schools.”

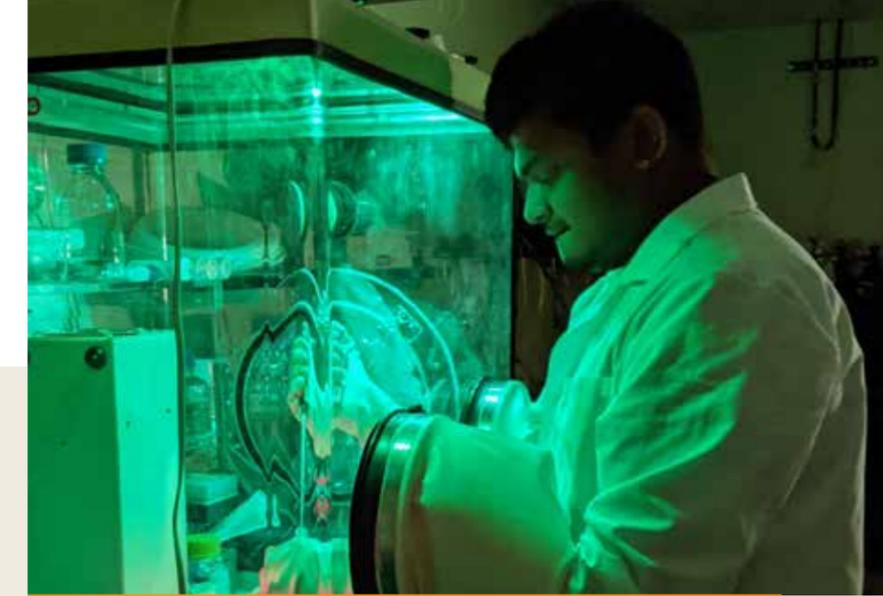
In fall of 2016 Layo-Carris joined the BCMB PhD program at UT and after lab rotations she joined the Krishnan lab which studies brain development. Prior to rotating in the Krishnan lab, she knew nothing about neurobiology, but quickly became interested in studying the cellular basis of behavior and disease.

“We study Rett Syndrome, which is a rare genetic neurological disorder, in a mouse model system,” Layo-Carris said. “I have identified tactile sensory deficits in the female mouse model of Rett Syndrome, in the pre-symptomatic stage showing that sensory deficits precede Rett Syndrome symptom onset in the mouse model, similar to what has been seen in human patients. These tactile deficits are caused by the atypical regulation of perineuronal nets, structures that form around neurons solidifying new neural connections after new learning experiences.”

“One of the coolest things about researching Rett Syndrome, is the community of patients, families, and researchers across the country. We have been involved in many events where we get to meet patients and their families and ask them what they think we should be investigating or what our next research project should be.”

Layo-Carris just finished her doctorate in August of 2021 and has taken a postdoctoral position at Children’s Hospital in Philadelphia.

“I think the best part about our department is the diverse nature of the research that promotes collaboration,” she said. “While there are not many neuroscientists in our department, I have worked with other cell biologists on microscopy, computational biologists on new ways to visualize my results, and molecular biologists on the next steps for this project”



Seeing the Light: Research on Photosynthesis

Jyotirmoy Mondal became interested in mathematics and biology because of his mother.

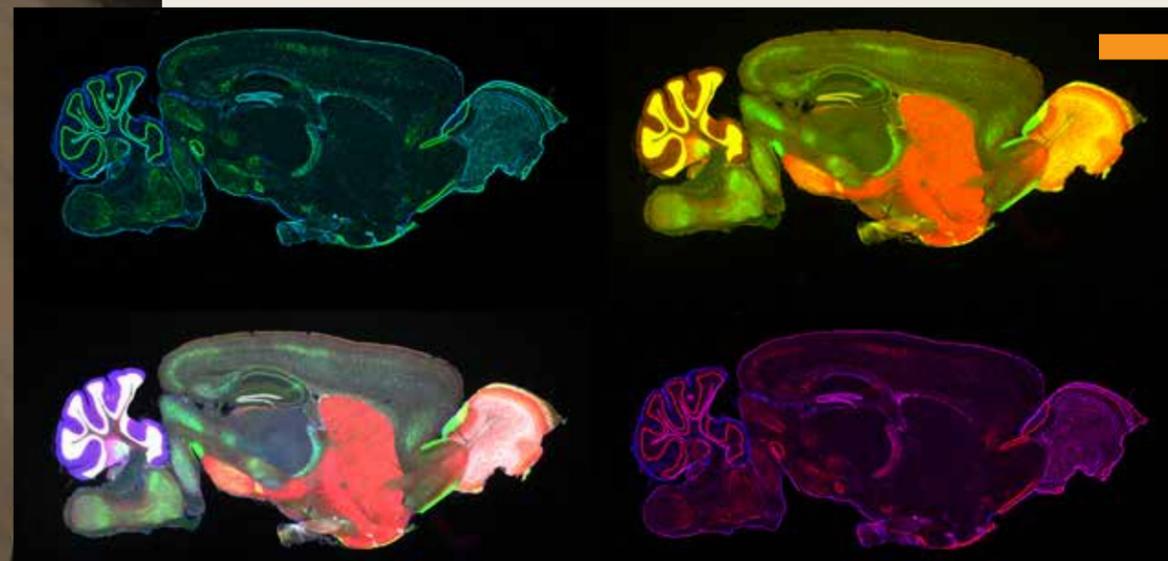
“From a very early age my mother inspired me with these subjects. She studied biology in her undergraduate degree, and I was tutored by her until high school. I remember having a magnifying glass as a kid which I would take around and look at things from sand grains to the veins of leaves. Maybe, that motivated me to get excited about microbiology?”

He became passionate about microbes while earning his bachelor’s degree when he did his first independent research studying multi-drug resistant bacteria with a microbiologist at the Institute of Genetic Engineering in Kolkata, India.

Mondal heard about BCMB and UT when he met Barry Bruce, a professor in BCMB, who gave a seminar in India. In fall 2015, Mondal joined the PhD program in BCMB and after rotating in several labs, joined the Bruce lab which studies both basic and applied photosynthesis. He is currently finishing his doctorate studying photosystem I from thermophilic cyanobacteria. These are photosynthetic bacteria that survive in high temperatures.

“I have always been fascinated by the world of microbes and how omnipresent they are with unfathomable capabilities,” Mondal said. “I am particularly interested in extremophiles, which I think are the most interesting organisms on the planet because they can survive in extreme corners of our planet.”

continued on page 6...



...continued from page 5



One of his most memorable doctorate research experiences was learning crystallography of the photosystem complexes at the facilities in European XFEL (Germany), SACLA (Japan), and PAL-XFEL (South Korea).

“As a trained microbiologist, crystallography was a completely novel technique that I was introduced to,” he said. “The most challenging part of this was making crystals of the photosystem I-ferredoxin complex because it required complete darkness for the entire process and could only be done with night-vision goggles. We would stay in the darkroom for six to seven hours at a stretch and use the night vision goggles for making these crystals. We were able to successfully make these crystals and perform pump-probe serial femtosecond X-ray crystallography on them.”

In addition to carrying out research, Mondal has mentored many undergraduates.

“The most exciting thing about my research was mentoring my army of undergraduate researchers, which taught me to do science better,” Mondal said. “They have been the highlight of my research experience and have helped me tremendously in my research. Four of them are currently in graduate programs in the USA.”

As an international student, Mondal finds BCMB to be a second family with support from the office staff and faculty, especially his mentor Professor Bruce.

“I have been fortunate to have a safe and supportive environment to conduct my research,” said Mondal, who, when not doing science, can be found cooking or gardening. “I always thought if science didn’t work for me that I would pursue cooking as a career. For now, I love cooking as a passion. I also love gardening because it is therapeutic and a stress reducer.”

Programmed DNA Elimination



Jianbin Wang went to graduate school at Zhejiang University in China at a time when the first human draft genome was released. Research on genomics and bioinformatics was booming.

“I was riding the genomic wave and sequenced a few genomes from bacteria and viruses” said Wang, an assistant professor in BCMB.

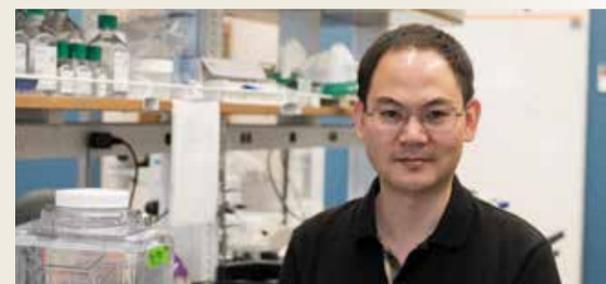
Wang first became interested in cell differentiation and programmed DNA elimination after earning his doctorate. While a postdoc at the University of Colorado he started studying cell differentiation during early embryogenesis in a parasitic nematode, *Ascaris*, that infects close to one billion people. In *Ascaris*, the germline to somatic differentiation coincides with programmed DNA elimination, a process where a large amount of genomic DNA is lost. This is a normal part of cell differentiation in specific cells of *Ascaris*.

“I am continuing and expanding this research, including using genetics and cell biology approaches to carry out research in other multicellular organisms with DNA elimination, such as free-living nematodes and copepods,” Wang said.

“Little is known on the molecular mechanisms of metazoa DNA elimination. My lab is currently working on the molecular mechanisms of DNA elimination in several species, including the parasitic nematodes *Ascaris* (pig and human) and *Parascaris* (horse), free-living nematode *Oscheius tipulae*, and freshwater copepod *Mesocyclops edax*. The unique features from these systems enable us to carry out comparative and complementary studies of DNA elimination in metazoa.”

Students in his lab use both computer and wet lab methods including molecular biology, genomics, bioinformatics, genetics, and cell biology.

“Understanding of the cellular processes involved in DNA elimination, including DNA break and repair, telomere healing, and genome maintenance, may provide novel insights into DNA break and repair mechanisms related to human diseases.”



The National Institutes of Health (NIH) agree that this is important research and recently they awarded Wang a five-year grant to continue his research.

Wang joined BCMB in February 2020 and teaches BCMB 240: Genetics and BMB 608: Journal Club in Genetics and Developmental Biology. His first year of teaching was via Zoom due to the pandemic. He looks forward to the in-person class in this fall semester. When not working, he enjoys travel and photography.



Remembering a Scholar, Mentor, and Teacher

Ranjan Ganguly, emeritus professor of BCMB, and family are honoring the memory and commitment to mentoring and teaching of Professor Nivedita “Nita” Ganguly by establishing the **Ganguly Scholarship Endowment**. Starting in the 1990’s, Nita devoted herself to science education in the Knoxville area, first at Bearden Middle School and then at Oak Ridge High School where she taught for over a decade. Nita received many honors as a high school teacher, including receiving the Presidential Council of Environmental Education Award and the Siemens Award for the Teaching of Science. In 2010, she joined UT and helped launch the VolsTeach program. Even in retirement, she continued her passion for education by running the Tennessee Science Olympiad and as a consultant on STEM programs at UT. Part of this endowment will support the **Nivedita Ganguly Memorial VolsTeach Scholarship Fund** to support undergraduates involved in the VolsTeach program and part will support the **Ranjan and Nivedita Ganguly BCMB Scholarship Fund** to support BCMB graduate student success.

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

FOLLOW US!

 @UTK_BCMB

 @UTKBCMB

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. EOI-1016-013-001-22 JOB 21-145

COVER STORY:

Learn about the collaborative efforts with **Tennessee Plant Research Center (PRC)** and the **Biomembranes Community of Scholars (BCoS)**.

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