Molecular & Integrative Physiology

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SCHOOL OF MOLECULAR & CELLULAR BIOLOGY

WINTER 2021 NEWSLETTER

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ABOUT THE NEWSLETTER

The Molecular and Integrative Physiology Newsletter is an annual publication of the Department of Molecular and Integrative Physiology in the School of Molecular and Cellular Biology at the University of Illinois, Urbana-Champaign. The newsletter is written by MIP faculty and friends, and designed by MCB Communications.

Our alumni are important to us. We want to hear from you. Send us your latest news, and we'll include it in the next newsletter's MIP Family News. We also welcome articles and suggestions for future newsletters. Here's how to reach us:

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GREETINGS FROM THE HEAD: Claudio Grosman

Welcome everyone to the 2021 edition of the MIP Newsletter! I hope 2021 has been a productive and happy year for all of you, as we learn to coexist with a pandemic that refuses to go away. I feel that we are still a long way from returning to full normalcy, and perhaps, the very meaning of "normalcy" will have to be re-defined. Certainly, it seems as though the future of work and study will never be the same. Instead, hybrid home/on-site—modalities are likely to be here to stay. In my particular case, I have to admit that I have enjoyed attending seminars and meetings remotely, and now that I have gotten used to Zoom, I barely use the phone to communicate with colleagues anymore!



On a personal level, 2021 will always be remembered as the year in which we sadly lost two beloved colleagues and friends: Al Feng and Eric Jakobsson. From these lines, I would like to send, once again, my warmest wishes to Al's and Eric's families and close friends on behalf of the current faculty and staff of the department.

The year, however, also had some very happy highlights. Indeed, an MIP junior faculty (Dr. Catherine Christian-Hinman) was promoted to associate professor with indefinite tenure, a new assistant professor (Patrick Sweeney, came to us from a postdoctoral position at the University of Michigan–Ann Arbor) joined our department, associate professor Erik Nelson was named an Era of Hope Scholar by the Department of Defense Breast Cancer Research Program, several of our graduate students completed milestones, faculty were awarded many grant proposals, and many papers were published.

This issue of the MIP newsletter features an interview with our newly promoted associate professor, an interview with me, an introduction to our new assistant professor, highlights of life-after-graduation from some of our most recent graduate students, and a list of student and faculty academic achievements.

Finally, I hope that our alumni and friends remain actively committed to MIP. Such support is crucial to our scientific enterprise, and it helps us achieve our goal of keeping our department as one of the most prestigious places to do research and receive education in modern molecular and integrative physiology.

I wish you all a happy, productive, and healthy 2022!

PROFESSOR CATHERINE CHRISTIAN-HINMAN: CONNECTING ESTROGEN TO EPILEPSY

by Anjana Asokakumar (Sayee Anakk's lab)

Dr. Christian-Hinman's lab focuses on understanding the neural mechanisms linking epilepsy and comorbid reproductive endocrine disorder.

How did you first get interested in science?

Dr. Christian-Hinman first became aware of neuroscience during her time in high school, when she was deciding where to go to college. Even though her family was not from a scientific background, exposure at Smith College in



Massachusetts encouraged her to dive into the neuroscience field. She said, "I didn't think I would be a scientist when I was growing up. Smith had major strengths in physiology and neurophysiology, and this enabled me to have a solid base of knowledge and interest particularly in the physiological side of neuroscience."

How was your doctoral and postdoctoral experience?

Dr. Christian-Hinman's doctoral experience in the Neuroscience Graduate Program of the University of Virginia helped her to interconnect different fields such as neuroscience and endocrinology. She was excited to learn and utilize different techniques, such as patch-clamp electrophysiology to see the firing activities of neurons, and that drove her more into the field. For her postdoctoral training at Stanford University, she focused on studying epilepsy, which is a disease of neural circuit dysfunction that produces recurrent seizures. To record seizure activity in mouse models of epilepsy, she learned how to perform electroencephalography (EEG) and other techniques that her lab now uses regularly. She says, "At UVa, I was lucky to have a very supportive mentor and to live in Charlottesville, which is a really beautiful place. At Stanford, I was able to see science conducted at the absolutely highest level in the world. This was exciting and helped to broaden my perspective on various opportunities and modes of investigating brain function."

When did you decide to become a professor?

"In college, I knew I was interested in research, and at Smith I was fortunate to join a good lab with an encouraging PI. I realized I loved the process of coming up with a question, formulating a hypothesis, designing experiments to test this hypothesis, interpreting the data, as well as the process of writing papers. Also, I could see myself teaching classes. And that's when I decided to pursue becoming a faculty member."

What is an average day in the life of a PI?

According to Dr. Christian-Hinman, an average day can change considerably whether she is teaching a class or not. If she is teaching, she will prepare lectures, writes exams for the class, and answer various questions on the class material from students. She meets with each of the students and researchers in her lab at least once a week, reads research articles, writes and reviews grants and manuscripts, and prepares seminars and talks for meetings. She also provides advice in troubleshooting problems with lab equipment if something isn't working right.

What is the latest scientific focus in your lab?

"Epilepsy is a neurological disorder that causes seizures. My lab studies epilepsy and neuroendocrinology, the interactions between the brain and the endocrine system. The lab focuses on how epilepsy impacts reproductive endocrine function and dysfunction. This is an area of epilepsy research for which the clinical aspects have been known for quite some time, but there is still much to be done on the basic science research side. A new aspect in the lab is to examine the role of estrogen synthesized within the brain (and not from the ovaries) in neural excitability and seizures. Estrogen has strong effects on neural activity, and estrogen synthesis in the brain has long been known, but it is still unclear how this may affect seizure susceptibility and epilepsy severity."

How did your earlier work lead to this new area of research?

"During my graduate studies, I learned a lot about hormonal actions in the brain, the hypothalamic control of reproduction, and techniques required to investigate neurophysiology at a cellular level. For my postdoctoral work, I wanted to connect the cellular physiology experience gained during my PhD to understand more about how neurons work as a circuit. This led me to the field of epilepsy. Since joining MIP and starting my own lab, I've been able to put these experiences together. With MIP's strengths in neurobiology and endocrinology, it is the perfect home for my lab's research."

What is your advice to young scientists and trainees?

"I think one aspect that is often underappreciated for an academic career path is that there will be a lot of writing involved. You need to produce good writing to get funding for the lab and to share your work in papers. If you don't enjoy writing, then the job becomes more difficult." For Dr. Christian-Hinman, she enjoys writing as it gives clarity to the topic at hand. She says the waiting period and results for grant applications and literature reviews can be stressful, but it enables the projects to move forward. It also helps in conveying ideas and result to a larger audience. "As a lab head, one of your main focuses is to gain research funding and resources and it is intertwined with a lot of writing."

"For graduate students, one must train to be a rigorous scientist, learning how to formulate a hypothesis and test it. Also, they need to learn and practice the art of working in a diverse group and getting the project moving. As for postdoctoral training, one needs to be strategic about the type of research and the skills to add to your toolkit. If you are hoping to be a PI, one needs to start creating an area that is a bit unique and that is not redundant in the field." She emphasized that this point of view can differ slightly if you are moving away from the academic field, but strategic thinking is one key factor irrespective of career path.

Fun fact: Apart from the lab, what do you enjoy?

Dr. Chistian-Hinman enjoys spending time with her husband and three dogs. If there is a stressful day, her dogs' hugs are the most relaxing therapy for her. She also enjoys cooking, watching comedy TV shows and reading books, especially novels and books on history. "Before the pandemic, I played oboe in bands at UIUC and Parkland College, and I'm hoping to get back into that when the time is right. I also enjoy traveling and I'm looking forward to doing that again when it is safer."

PROFESSOR CLAUDIO GROSMAN: FROM ARGENTINA TO THE USA -CHANNELING THE IONIC JOURNEY

by Steven Hobbs Jr. (Sayee Anakk's lab)

The Grosman lab focuses on the relationship between structure and

function of neurotransmitter-gated ion channels, with a special emphasis on nicotinic acetylcholine receptors.



How did your first get interested in science?

Growing up in Argentina, I was always serious about academics and naturally drawn to science. I had a passion for biology but gained an interest in chemistry and physics in high school. From that point on, I knew I wanted a career in the sciences.

How were your doctoral and post-doctoral experiences?

I obtained my PhD at the University of Buenos Aires, which was also my alma mater for my bachelor's degree, so as to remain close to my family. During my PhD, I studied ion channels in parasites that were infecting sheep in Patagonia, Argentina. With few people working on projects like mine, I didn't have much pressure to produce results quickly. Therefore, I had ample amount of time to read and think conceptually about ion channels. This ability to think critically has helped me throughout my career as an ion channel researcher. After receiving my PhD, I moved to the United States for my postdoctoral work at SUNY-Buffalo to start studying the muscle nicotinic receptor, a prototypical ion channel. I consider my postdoctoral career as a "golden age" in my life, as it was very eventful. During my postdoc, I experienced the United States for the first time, published the first Nature manuscript from the lab, and my two sons were born.

When did you decide to become a professor?

After my PhD and postdoc, it was clear to me that I was better suited for a career in academia, not industry. When I was interviewing for faculty positions at universities across the country, a pharmaceutical company reached out to me with a generous offer to develop drugs that target ion channels. The job would be very demanding as I would be given deadlines for the drug development, and possibly be assigned to a different project if adequate progress was not made. It was a tough decision, but I decided to have more of a say in the science that I was doing. So, I chose to take a faculty position here at U of I. Looking back, it was the best decision I could have made!

What's a day in the life of a PI?

As a PI, I am very hands-on with my students and trainees and actively participate in the science that is happening in my lab. Therefore, I like keeping my lab small in terms of the number of people. An average day consist of conducting experiments on my own, writing, and thinking conceptually about my science, and doing routine lab duties such as glassware washing and autoclaving materials. Things need to get done regardless of who does them.

What is your latest area of research?

Recently, my lab has been working on the coupling between the ligand-binding and transmembrane-pore domains of nicotinic receptors. Upon binding to a ligand at the extracellular domain, ion channels undergo a conformational change that opens a pore domain through the plasma membrane. This is an example of allosteric communication between two distant domains on the same protein, and we are interested in finding out how this works. At a molecular level, synaptic transmission hinges on this phenomenon.

How did your previous work lead to this new area of research? Ever since my postdoctoral career, I have worked on the muscle nicotinic receptor and its "cousins" of the Cysloop receptor superfamily. Despite decades of research on the structure and function of these macromolecules, there are still fundamental questions waiting to be answered. Ion channels can be studied in higher detail than enzymes or GPCRs, for example, owing to the high sensitivity of currently available approaches. It is this in-depth analysis that I enjoy the most.

What is your advice to young scientists and trainees?

From my experience, my advice to young scientists is to always put time aside to simply read and think conceptually about the problem at hand. I believe time spent in the lab reading and thinking, is time spent well. Science isn't all about producing results. Rather, it is more about uncovering concepts with results being a means to investigate and prove or disprove those concepts.

Apart from your research, what do you enjoy?

I'm a huge fan of music and enjoy listening to music in my free time. My one regret is not having learned music theory and how to play an instrument. Music is truly wonderful.

If you had to choose a different field of research, other than your topic, what would that be?

Molecular Embryology, without a doubt. In my 20s, I was fascinated by the question as to how a single cell can develop into a complex multicellular organism. Actually, the first gift I received from my then girlfriend (now wife, mother of my kids, and labmate) was a book on human embryology. As a graduate student, I wanted to join a lab working on developmental biology, but that lab was full. So, I ended up joining an ion channel lab simply because they had an opening, and I had a fellowship. I was fortunate to fall in love with the science of ion channels, but I am still very interested in developmental biology.

NEW ASSISTANT PROFESSOR: DR. PATRICK SWEENEY

My lab is focused on understanding how the brain regulates both feeding and emotion, and how the neural circuitry involved in these processes overlap in both physiological and pathological conditions, such as anorexia nervosa. The feeding circuitry is remarkably well conserved from mice



to humans, and these conserved neural circuits communicate closely with a diverse set of brain structures, including many involved in emotional behavior.

My lab is currently focused on understanding how hunger and satiety is sensed in the brain, and how this information is communicated to downstream brain regions involved in emotion. To accomplish this goal we use both behavioral and molecular neuroscience approaches to map and manipulate the neural pathways connecting energy homoeostasis to emotional circuitry.

There is perhaps no less well understood disease in human biology than anorexia nervosa. Further, there are no effective pharmacotherapeutic strategies for patients with anorexia nervosa. At its core anorexia nervosa is characterized by a persistent restriction of energy intake, accompanied by co-morbid neuropsychiatric conditions such as anxiety and depression. Thus, we hope that a more complete understanding of the neural circuitry at the intersection of feeding and emotion may provide new therapeutic options for patients suffering from this devastating condition.

ALUMNI HIGHLIGHTS - DR. DAVID PAPKE (GROSMAN LAB)

Your current position and title:

Instructor in Pathology, Harvard Medical School, Boston, MA Associate Pathologist, Brigham and Women's Hospital, Boston, MA



Your career arc and key accomplishments:

After completing the MD/PhD program at the University of Illinois,

I entered the Anatomic Pathology residency program at Brigham and Women's Hospital. During residency training, I maintained an active interest in clinical and computational research. In my computational pathology research, I developed a novel computational tool to aid in the localization of endometrial pre-cancerous lesions. This work was supported by an institutional research grant, and it resulted in multiple publications and a patent application (pending). During residency training, I also developed diagnostic interests in gastrointestinal and soft tissue pathology, and I have worked on several clinical projects related to the molecular diagnostics and classification of gastrointestinal tract and soft tissue tumors. After residency training, I undertook two years of fellowship training in Gastrointestinal Pathology and Soft Tissue Pathology, which I completed in the summer of 2021. I was recently hired to the faculty of Brigham and Women's Hospital and Harvard Medical School, where I work as an academic gastrointestinal and soft tissue pathologist and where I continue to conduct research in computational pathology and in the diagnosis and classification of rare gastrointestinal tract and soft tissue tumors.

How MIP training got you where you are:

My training in Dr. Grosman's lab was formative in shaping me into the scientist that I am today. The quantitative and computational skills that I learned were necessary for me to be able to conduct computational pathology research, and these skills were helpful for developing new immunohistochemical tests to aid in clinical diagnostic practice. Dr. Grosman was instrumental in helping me develop my scientific writing skills, which I've put to good use in writing research papers and literature reviews related to gastrointestinal, soft tissue, and computational pathology.

Your favorite memory related to the time you spent in MIP:

I loved spending time in the lab with Claudio and his wife, Giselle. Their dedication to science and to helping the people around them have been inspirational to me!

Fun Fact about yourself:

I enjoy playing classical piano and playing racket sports, especially racquetball.

ALUMNI HIGHLIGHTS - DR. BHOOMIKA MATHUR (ANAKK LAB)

Your current position and title: Postdoctoral Researcher, Mangelsdorf-Kliewer Lab, UT Southwestern Medical Center, Dallas

Your career arc and key accomplishments:



I started my postdoctoral career in September 2019 after graduating from MIP, where I am focusing on understanding the role of FGF15 in gut-liver axis. I have been busy these past two years generating mouse lines and data, publishing research articles, and staying safe amidst the COVID-19 crisis! In addition to research, I have helped organize several career development workshops, and was recently promoted to Co-Chair of the Career Development Committee with the Postdoctoral Association here at UTSW. In the future, I plan to organize workshops and events that will focus on international students to help improve not only their skillset for alternate career paths, but also their profiles for green card application. I am excited to see where my career goes from here!

How MIP training got you where you are:

The training I received at the Anakk lab in the MIP department taught me the skills that are necessary for my career as an independent scientist. From Sayee, I learned the best attitude towards research and science as well as the ups and downs in the life of a young scientist. I also taught anatomy and physiology classes and served on the departmental student committee, which not only taught me time management and organization skills but also allowed me to network with my fellow scientists.

Your favorite memory related to the time you spent in MIP:

I absolutely loved the Anakk lab potlucks and random Cocomero/Brothers outings. I also enjoyed the MIP retreats and Halloween parties. It was great hanging out with everyone outside of the lab-setting.

Fun Fact about yourself:

I dance anywhere and everywhere - in the lab, washrooms and even elevators, or on YouTube!

ALUMNI HIGHLIGHTS - DR. ROSA YU (TSAI LAB)

Your current position and title:

Technical Support Scientist at ABclonal Technology



Your career arc and key accomplishments:

After graduated from MIP in December 2019, I continued my postdoctoral training in Dr. William Klein's lab at Northwestern University, where I studied the neurotoxicity of amyloid-beta oligomers in Alzheimer's disease. I mentored four graduate students throughout the course of their respective research projects, assisting in the overall research and organizational development process. Meanwhile, I worked as a part-time lab manager at Safeguard Surveillance to help perform same-day COVID-19 saliva screening for Chicagoland area schools to provide a safer environment for in-school instruction. I led a team of 15 people and supervised the process of sample prep and test run of more than 10,000 samples per day.

In early April 2021, I switched my career path to industry, where I work as a technical support scientist at ABclonal Technology for custom antibody production. I provide scientific expertise, establish and monitor external scientific studies, and offer critical assessment to each project. So far, I have helped many academic and industrial researchers successfully develop custom antibodies to meet their specific research goals.

How MIP training got you where you are:

Throughout the training at MIP, I obtained multiple skills that help me get where I am today. 1) Problemsolving: seeking different resources to come up with your own ideas when there is no protocol to follow. 2) Critical thinking: foreseeing potential problems and always having an alternative strategy (learned from Qualifying Exam!). 3) Presentation skills: being able to express your thoughts (both scientific and non-scientific) clearly to any audience in a precise and logical way.

Your favorite memory related to the time you spent in MIP: The annual MIP retreat at Allerton Park.

Fun Fact about yourself:

I am a self-trained long-distance runner: I completed three half-marathons and three full-marathons, and even qualified for Boston Marathon once!

PUMPKIN PICKING AT CURTIS ORCHARD



MIP JACK-O-LANTERN CONTEST WINNERS!



IN MEMORIAM: PROFESSOR AL FENG - FROM RADIO TINKERING TO ADVENTURES IN ULTRASOUND

MIP lost a great friend, mentor and leader. Al Feng passed away August 31, 2021, at the age of 78. Al's humble scientific roots stemmed from his early days as a child in Indonesia, tinkering with radios as a vocation and hobby. This love of knowing how things work brought him to the US to study electrical engineering. However, after working as an electronics engineer for a few years, his passions drew him back to academia, to study neuroscience at Cornell. After completing postdoctoral work with Ted Bullock and Jim Simmons, two of the most well-regarded neuroscientists of their era, Al embarked on a 33-year successful career in MIP. Al served as department head from 1992-1997 and was an early director of the Neuroscience Program. Al was also a leader on the international stage, serving as president of the International Society for Neuroethology, significantly broadening its membership during his tenure. Al's scientific discoveries continue to move the field of auditory neuroscience forward. Early in his career, he was the first to discover combination-sensitive neurons in the auditory system (published in Science in 1978) while later in his career he was part of the team that discovered ultrasonic hearing in frogs (published in Nature in 2006). Long after his "retirement," Al was traveling the globe to wade through wetlands for all-night recording sessions to eavesdrop on his beloved torrent frogs. In fact, Al was still planning trips once the COVID-19 pandemic faded. Al even found a way back to his engineering roots – founding a company to develop hearing aids based on the principles of auditory neuroscience that he uncovered through decades of basic science work.

Beyond his scientific achievements, Al was gentle and kind human being. He had a genuine interest in the well-being of others and went out of his way to support his students and colleagues. As one of his trainees,

I was witness to his warmth and generosity, particularly as he gave us the freedom to explore our own scientific interests. Although it has been 20+ years since I have finished my PhD, I have never stopped learning from Al. He leaves a legacy of scientific achievement and mentorship that will shape the careers of all those that he encountered for many years to come.



by Dan Llano

PHD GRADUATES

Connor Courtney (Christian-Hinman Lab), "Modulation of hippocampal synaptic transmission by the peptide diazepam binding inhibitor and optogenetic manipulation of astrocytes."

Jiaren Zhang (Chung Lab), "The investigation of pathophysiological mechanisms underlying Kv7-related epilepsy and neurodevelopmental delay."

Valeria Sanabria Guillen (Katzenellenbogen Lab), "Characterization of novel small molecule inhibitors of FOXM1 as potential therapeutic agents for breast cancer."

STUDENT AND POSTDOC AWARDS/FELLOWSHIPS

Jiaren Zhang (Chung Lab), Outstanding Thesis Award in the Dept. of Molecular and Integrative Physiology, UIUC

Eric Shin (Chung Lab), C. Ladd Prosser Outstanding Achievement Award in the Dept. of Molecular and Integrative Physiology, UIUC

Jennifer Walters (Chung Lab), National Science Foundation (NSF) Research Traineeship, "NRT-UtB: Training the Next Generation of Researchers in Engineering and Deciphering of Miniature Brain Machinery."

FACULTY GRANTS NEWLY AWARDED

Sayee Anakk, NIH R01, "Biophysical and genetic cues regulating lipid droplet packaging and alterations in obesity."

Sayee Anakk (Cecilia Leal, lead PI), Cancer Center at Illinois Seed Funding Program, "Lipid Droplet Packing: A New Target to Interfere with the Progress of Human Hepatocellular Carcinoma."

Catherine Christian-Hinman, NIH R21, "Differential roles of neuronal and astrocytic aromatase in status epilepticus and chronic epilepsy."

Catherine Christian-Hinman, CURE Epilepsy, Epilepsy Research Continuity Fund Grant

Hee Jung Chung (Paul R. Selvin, lead PI), NIH R01, "Super-Resolution Microscopy of Neuronal Synapses with Small Quantum Dots and Advanced Imaging Tools."

Hee Jung Chung, University of Illinois Campus Research Board, "Unveiling novel roles of STEP61 in hippocampal excitability and the impact of its inhibitor as an anti-seizure drug."

Benita Katzenellenbogen, Breast Cancer Research Foundation, "Genomic Profiling of the Estrogen Hormonal Pathway for Breast Cancer Prevention and Treatment."

Dan Llano, NIH R01, "Synaptic mechanisms of auditory thalamic cross-modal communication."

Dan Llano, NIH R21, "Examination of the bidirectional relationship between hearing loss and Alzheimer Disease pathology."

Erik Nelson, NIH R01, "Impact of cholesterol and its metabolites on breast cancer progression."

Erik Nelson, Department of Defense (DOD BCRP) Era of Hope Award, "Leveraging Cholesterol Homeostasis for the Prevention and Treatment of Metastatic Breast Cancer."

Erik Nelson (Andrew Smith, lead PI), NIH R01, "Hyperplexed Quantum Dots for Multidimensional Cell Classification in Intact Tissue."

Erik Nelson (Kannanganattu V. Prasanth, lead PI), NIH R01, "Characterization of nuclear-retained RNA-mediated gene regulatory mechanisms."

Patrick Sweeney, Brain and Behavior Foundation Young Investigator Award," Melanocortin 3 Receptor Agonism As A Preventative Therapy For Stress-Induced Anorexia, Anxiety, And Anhedonia."

Nien-Pei Tsai, NIH R01, "Mechanism of Gp1 mGluR-dependent Translation and Plasticity."

Nien-Pei Tsai, NIH R21, "Study of Comorbid Seizures in Alzheimer's Disease."

Xinzhu Yu, Brain Research Foundation Seed Grant, "Astrocyte Contributions to Cortical Synaptic Plasticity."

Xinzhu Yu, Whitehall Foundation Research Grant, "Astrocyte-Neuron Coordination in Motor Learning and Memory."

SELECTED MIP PAPERS NOV 2020-OCT 2021

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