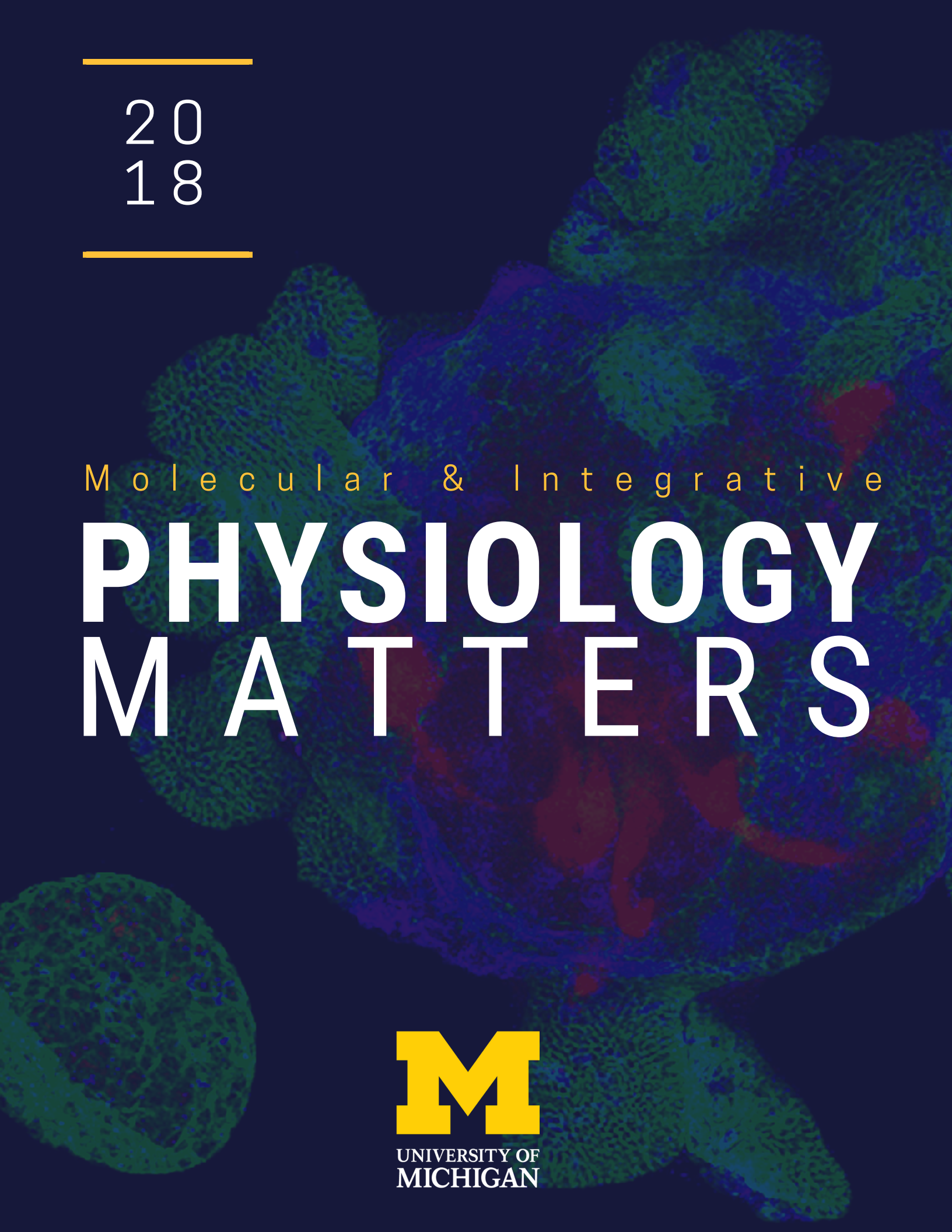
2018

Molecular & Integrative

PHYSIOLOGY MATTERS



UNIVERSITY OF MICHIGAN

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Dedication of the sculpture "Arriving Home," honoring 200 years of contributions and dedication by U-M staff, is part of the closing bicentennial celebrations.

PHYSIOLOGY Matters

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NOTE FROM THE CHAIR

Dear Reader,

I am pleased to present you this edition of Physiology Matters. Inside you will find a range of articles offering a sneak-peak at the cornerstones of our programs. Every day the University of Michigan Department of Molecular & Integrative Physiology witnesses countless examples of the dedication and commitment of our faculty, staff and students to our research, training and community outreach mission; this newsletter is our opportunity to share these with you. Many of these activities have made possible thanks to the generosity of our donors.

Since the earliest days, our department has been fortunate to receive generous philanthropic support for its library, educational programs and research. Over the last ten years, our donors have endowed collegiate professorships, scholarships and a new and growing outreach program to underserved K12 students. In today's deeply uncertain world, the need for such support remains strong. Philanthropic investment will enable us to continue to offer the very best in teaching and research, and retain our preeminence as one of the best physiology departments in the world.

Whether conducting cutting-edge research into the physiological systems, training the new generation of biomedical scientists, or teaching science to elementary school children, the ability of our faculty, scientists, and trainees to effect lasting positive change is significantly enhanced through philanthropy. Your support enables us to deliver tangible results which have a positive impact on the local, national and global stage.

I hope that I will have the opportunity to thank you in person during the course on this year.

Yours faithfully,

Santiago Schnell
Interim Chair, Department of Molecular & Integrative Physiology
John A. Jacquez Collegiate Professor of Physiology

PHILANTHROPIC UPDATES...

GRADUATE EDUCATION FUND

One of the unique features of our Molecular & Integrative Physiology (MIP) graduate program is the Graduate Education Fund. This endowment has provided ~40 scholarships to our graduate student allowing them to present their research at national and international scientific meetings. These conferences are integral to their professional development since the students not only have the opportunity to share their work, but also to meet and interact with other scientists from around the world. The graduate education fund also sets us apart from other physiology departments nationally, and helps us recruit the best and brightest predoctoral researchers. Started almost 10 years ago, the fund has largely been based on grass roots donations, and a 1:1 matching grant from the Dean's office. We are very close to our original goal of $1 M. While initially this goal seemed beyond any of our wildest dreams, due to the enthusiastic and continuing financial support from our alumni and other friends, we have achieved an unprecedented success in this regard. Our plans now are to keep fundraising to a goal of $5 M, to ensure the financial stability and success of our graduate program. We anticipate providing small research grants and ultimately student stipends for recruitments independent of Program in Biomedical Sciences. The graduate education fund provides critical support for our students' exploration of the mechanistic underpinnings of basic physiological and disease processes and when possible, the translation of these findings to human health care. **Donate online at http://victors.us/mipgraduate**

LOUIS G. D'ALECY COLLEGIATE PROFESSORSHIP

In January 2018, we launched a fundraising campaign to establish the Louis G. D'Alecy Collegiate Professorship in Physiology at the University of Michigan. Dr. D'Alecy rose to the top of his field by pursuing classical physiology research, investigating fundamental mechanisms in cardiovascular function using challenging in vivo and in vitro experimental approaches. Through his passion for and commitment to his work, he made critical contributions in implant telemetry technology; these technologies are widely used today both in the clinic and for research. Beyond his science, Dr. D'Alecy was and remains an exceptional educator and mentor for generations of medical and doctoral students.

We have raised $474,541 thanks to the contributions from Dr. D'Alecy's family, Michigan Medicine and over 59 donors. We are very close of meeting our goal of $500,000. Collegiate professorships allow our department to honor and recruit world-class scientists, while also providing financial support to its holder to think creatively and boldly with autonomy that most research grants do not provide. **Donate online at http://victors.us/louisdalecyfund**

APPOINTMENTS...

NEW FACULTY

Ethan Able, PhD
Research Investigator

Christian Burgess, PhD
Assistant Professor

Gregory Gage, PhD
Adjunct Assistant Professor

David Garcia Galiano, PhD
Research Investigator

Geun Hyang Kim, PhD
Research Investigator

Ho Joon Lee, PhD
Research Investigator

Peng Li, PhD
Research Assistant Professor

David Olson, MD, PhD
Associate Professor, Joint

Subramaniam Pennathur, MD
Professor, Joint

Juilee Rege, PhD
Research Investigator

Guojun Shi, PhD
Research Investigator

Matthias Truttmann, PhD
Assistant Professor

Sei Yoshida, PhD
Assistant Research Scientist

Deqiang Zhang, PhD
Research Investigator

Nathan Qi, PhD
Associate Research Scientist

PROMOTIONS

Carol Elias, PhD promoted to Professor with Tenure

Lisa Larkin, PhD promoted to Professor with Tenure

Yatrik Shah, PhD promoted to Professor with Tenure

Anthony DeFazio, PhD promoted to Associate Research Scientist

Christi Gendron, PhD promoted to Research Assistant Professor

Myungjin Kim, PhD promoted to Research Assistant Professor

...ACCOMPLISHMENTS

FACULTY

Peter Arvan UM Distinguished Faculty Lectureship Award

Christin Carter-Su Women in Endocrinology Mentoring Award

Carol Elias Editorial Board of *Physiological Reviews* – 2018-2021; Executive Committee Neuroscience Program

Jun Hee Lee AASLD Pilot Research Award in Liver Diseases

Malcolm Low UM Distinguished Faculty Lectureship Award

Santiago Schnell elected Foreign Corresponding Fellow of the Latin American Academy of Sciences; Editor-in-Chief *Mathematical Biosciences*

Jessica Schwartz Director of the Office of Training Grant Support for the Med School

POSTDOCS

Callie Corsa American Diabetes Association Postdoctoral Fellowship award January 2018 - December 2020

Wylie Stroberg 2018 University of Michigan Outstanding Postdoctoral Fellow Award

Charlotte Vanacker MIP Teaching and Service Award

STUDENTS

Alexandra Cara 2018 Outstanding Poster Presentation Award Michigan Physiology Society Annual Meeting

Eden Dulka 2018 Winner Three-minute Thesis competition at the International Congress of Neuroendocrinology

Thomas Vigil 2018 Outstanding Poster Presentation Award Michigan Physiology Society Annual Meeting

PHD PROGRAM GRADUATES

Caroline Adams - "Integrating Network and Intrinsic Changes in GnRH Neuron Control of Ovulation"
Mentors: Sue Moenter & Santiago Schnell
Current Position: Returned to third year clinical rotation at UM Medical School

Tova Berg - "Development of GABA Inputs to Gonadotropin-Releasing Hormone (GnRH) Neurons and Effects of Prenatal Androgen Exposure"
Mentor: Sue Moenter
Current Position: Returned to third year clinical rotation at UM Medical School

David Bushart - "Calcium-Activated Potassium Channels as Therapeutic Targets in Spinocerebellar Ataxia"
Mentors: Vikram Shakkottai & Geoffrey G. Murphy
***Current Position*:** Postdoc Fellow, University of Michigan

Tami Stevenson - "Role of Tissue Plasminogen Activator in Central Nervous System Physiology and Pathology"
Mentor: Daniel Lawrence
Current Position: Postdoc Fellow, University of Michigan

Fangyun Tian - "Mechanism of Corticocardiac Coupling in Sudden Cardiac Arrest"
Mentor: Jimo Borjigin
Current Position: Postdoc Fellow, Harvard Medical School

Daniel Triner - "Hypoxia, Neutrophils, and the Colon Tumor Inflammatory Response"
Mentor: Yatrik Shah
Current Position: Returned to third year clinical rotation at UM Medical School

Keita Uchida - "Mechanisms of Osmotically-Induced T-tubule Remodeling in Mouse Cardiomyocytes"
Mentors: Anatoli Lopatin & Hector Valdivia
Current Position: Postdoc Fellow, University of Pennsylvania

Luhong Wang - "The Role Hypothalamic Kisspeptin Neurons Play in Estradiol Negative and Positive Feedback Regulation of Reproduction"
Mentor: Sue Moenter
Current Position: Postdoc Fellow, Harvard Medical School

MY SUMMER FELLOWSHIP PROGRAM EXPERIENCE

BY THOMAS VIGIL

In the summer of 2014, I was accepted into the Summer Undergraduate Research in Physiology (SURP) program at the University of Michigan. At this time, I had completed my junior year at New Mexico State University pursuing a degree in Biology. Prior to the SURP program, I was fortunate to work in an environmental biology lab assisting in projects, but was not sure if research was something I would want to continue after completing my undergraduate degree or what area of research I would like to pursue.

When applying for summer research experiences, the SURP program stood out to me as an opportunity to explore biomedical research, which was an area of scientific research I was not exposed to at my undergraduate university. During this 12-week summer experience, I was accepted into the lab of Dr. Richard Mortensen in the Molecular and Integrative Physiology (MIP) department studying immune cell modulation in cardiovascular disease. From the standpoint of a student, the SURP program was an amazing opportunity to see what it was like working "full time" in a laboratory setting where the majority of your time was dedicated to basic science research. This allowed me to gain not only hands on experience in a number of lab techniques, but also to have a greater appreciation for biomedical research as a whole from presentations by a number of professors in the MIP department. Along with this, I also got to spend the summer in the beautiful city of Ann Arbor and got to explore a lot of what the University of Michigan had to offer students. After completing my degree in Biology, I knew that I wanted to pursue graduate school in biomedical research to conduct basic science research. When applying to universities, the MIP department at the University of Michigan was my top choice, and I was fortunate to be accepted into their program. I am currently a fourth year candidate student in the MIP department studying the role of immunometabolism in ischemic stroke. The experience the SURP program provided me was what I would consider the first real step that lead me to where I am today. For this I would like to personally thank the SURP program and

everyone involved in it for giving myself, and students like me, the opportunity to come to such a high quality research institute to explore research areas that we otherwise would not be able to.

Physiology Summer Research Fellows Fund: Your gift will support undergraduate students that are interested in research in physiology and/or biomedical sciences. This fund provides financial support to summer research fellows, their research and the summer program activities.
Donate online at http://victors.us/mipsummer

Summer Fellowship Program

Our department offers two NIH-funded summer research fellowship programs: Short Term Educational Program (STEP) towards Digestive and Metabolic Physiology, directed by Dr. Santiago Schnell and funded by NIDDK's R25 grant, and Summer Undergraduate Research in Physiology (SURP) program, directed by Dr. Jimo Borjigin and funded by NHLBI's R25 grant. All of our summer programs have been very popular with students from all over the country. The SURP program, which funded Mr. Thomas Vigil's summer experience in 2014 (see his story above), is focused on supporting students from underrepresented background to conduct intense laboratory research for a 12-week period. This program, currently in its 8th year of funding, has supported more than 80 underserved undergraduate students. The goal of this program is to promote diversity of future scientists engaged in research areas including cardiovascular biology, cerebrovascular biology, pulmonary sciences, circadian biology and sleep sciences.

Our summer programs show our department's commitment to encourage and foster the success of students from all backgrounds to attain advanced degrees, research careers, and positions of leadership in physiology and biomedical sciences. We have continued to increase the proportion of underrepresented undergraduate students participating in our summer programs. A new summer program (the Cancer Research Summer Fellowship program), recently established and directed by Dr. Yatrik Shah, is supported with the funds from multiple UM sources including our department, Translational Oncology Program, Comprehensive Cancer Center and PIBS. The goal of this new program is to recruit undergraduate students from underserved background to conduct research in gastrointestinal cancers. Feedback on these programs from our undergraduate researchers has been extremely positive, and we are all looking forward to next summer's programs.

DO YOU HAVE WHAT IT TAKES?

BY DANIEL MICHELE

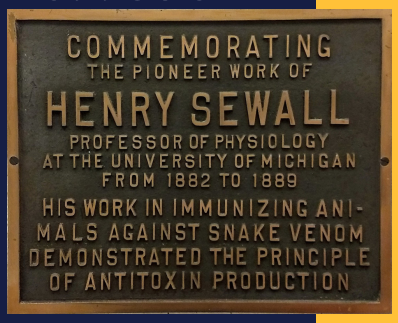
After a full year in the saddle as the Graduate Program Director, I am continually amazed by the scholarship of our graduate students. This past year we again welcomed six new Program in Biomedical Sciences (PIBS) PhD students to the University of Michigan with a primary interest in Molecular & Integrative Physiology (MIP). With the change to the medical school curriculum, we are still awaiting the entry of the next group of Medical Scientist Training Program students who will join the program in the spring. Twelve of our PhD students defended their dissertations and have moved on to postdoctoral opportunities or are completing medical training. Running the de facto new Twitter account for the graduate program and the department gives me a lot a joy to tweet and brag about our students' papers, presentations, fellowships, awards, and accomplishments. Follow us at @MicheleLabUM or @UMPhysiology to hear the latest news about our graduate program and department.

Having just completed our admissions season for students entering in 2019 and sifting through over 100 applications, I was asked to comment briefly on how a developing scientist interested in pursuing a PhD can best position themselves for entry into graduate school. By far the most important factor in PhD admissions is the applicant's research experience (our former grad chairs and admissions committee members concur). This can be quantified to some extent by the data in the applicant's CV in terms of time spent in research, publications, presentations, and fellowships. As a consequence, it has become more and more common in recent years to see applicants who have multiple full-time summer fellowship experiences, and in many cases up to several years of full-time research experience as a technician and/or post baccalaureate or MS degree student. The most important determinant of the quality of those research experiences is the student's own academic statement and the letters of recommendation from their research mentors. Through the applicant's writing, we can gain a window into how they think about a hypothesis or scientific problem, if they have experience in troubleshooting and creating stepwise solutions, and if they had outcomes that were meaningful enough to propose next steps or

alternative approaches. If the mentor's assessment supports the applicant's role in the research, their independent thinking, effort, grit, and creativity, then the applicant is clearly both ready and able to pursue PhD research. The rest of the recruiting process is just to determine if the research and training opportunities in our program can fit the applicant's research and career goals.

One of major changes in recent years is the removal of standardized test scores (the GRE) as admissions criteria. While still somewhat controversial amongst academics, "GRExit" has been officially adopted by many biomedical PhD programs including PIBS. This change is in part based on published data suggesting that the GRE is a poor predictor of graduate school outcomes. While this change hasn't dramatically changed the way MIP has evaluated students, it has reinforced the importance of the research experience, and the ability to communicate that experience, as the primary drivers of graduate student admissions decisions. Research experience is also the best way to find out if you love and enjoy science enough to commit to PhD training and the types of professional careers that follow.

Commemorating the Principle of Antitoxin Production



In April of 1882 Henry Sewall arrived to Ann Arbor to become the University of Michigan Professor of Physiology. Sewal was the first person in the United States to earn a doctor of philosophy in physiology, and he had worked under Carl Ludwig in Leipzig, Willy Kühne in Heidelberg, and J. N. Langley in Cambridge.

Henry Sewall had done a large range of physiological experiments during his European trip in 1879-80, and he continued the practice at John Hopkins before he was recruited for Michigan. In Ann Arbor he was able to determine the natural stimulus for the depressor reflex, detect the uneven flow of air in the lungs during normal breathing, and study color vision.

Beginning on 6 November 1886, Sewall injected several pigeons with different doses of rattlesnake venom diluted in glycerin. Those injected with small doses survived; those injected with large doses did not. Late in November he found that two pigeons who had survived injection of small doses remained alive after being injected with doses of venom previously determined to be fatal. Sewall's paper describing these results was published in the British *Journal of Physiology* in 1887 (Vol. 8, pp 203-210). His work is recalled by a bronze plaque affixed to the wall of the seventh-level corridor in the Medical Science Building II across the Department of Molecular & Integrative Physiology office.

Extracted from: Horace W. Davenport (1999) *Not Just Any Medical School: The Science, Practice, and Teaching of Medicine at the University of Michigan, 1850-1941*. The University of Michigan Press, Ann Arbor.

WHY DO A POSTDOC IN PHYSIOLOGY ANYWAY?

BY WYLIE STROBERG

As ever-tightening competition for faculty positions pushes the number and lengths of postdoctoral fellowships upwards nationally, getting the most out of a postdoctoral experience is essential. The environment for postdoctoral fellows within Molecular & Integrative Physiology (MIP) offers a unique blend of research excellence and career building that supports what can be a challenging academic career path.

Coming from a background in mechanical engineering, I have found this to be particularly true. Upon arriving to MIP, I had relatively little shared background with others in the department (I had to look up the definition of “physiology” in a dictionary before my first day). However, I have come to realize that I am not alone in this regard.

In fact, the diversity of scientific backgrounds is fundamental to physiology, whose central concern is understanding how many components merge together to form a functioning, or misfunctioning, whole. Much like the finely-tuned organisms we study, the MIP department must balance breadth and specificity to achieve peak performance.

This balance relies on the personal connections between members of the department across career stages, established through events like the barbecues, seminar series, and the (surprisingly competitive) annual faculty-student softball game.

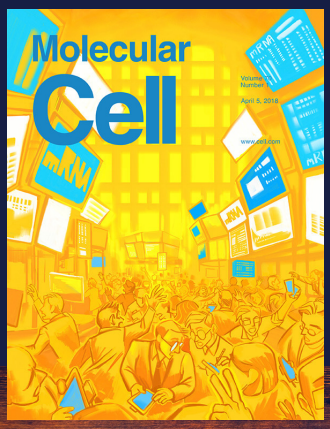
In addition to the collegial environment, the MIP department has many specific programs that facilitate postdoctoral advancement, several of which I have been a participant. For one, the Michigan Institutional Research and Academic Career Development Award (IRACDA) program, which is co-directed by MIP faculty member and former department chair Bishr Omary, M.D.,Ph.D., is an NIH-funded postdoctoral training program that combines biomedical research with pedagogical training. As a fellow in this program, I not only have had protected time to establish a research portfolio, but also received hands-on training and experience in undergraduate education. This training combined coaching from the UM Center for Research in Teaching and Learning with classroom apprenticeships at Henry Ford College. While classroom instruction is generally undervalued in the

scientific career path, particularly at the postdoctoral level, the benefits of teaching cannot be overstated. Undergraduate teaching has greatly improved my ability to succinctly convey complex topics in a way that will stick – a skill that is essential to disseminating research as well.

The MIP department works hard to facilitate and foster new collaborative projects. One example of this is the Michigan-Israel Partnership for Research and Education. This program funds new collaborations between UM scientists and researchers at either the Israel Institute of Technology or the Weizmann Institute of Science and is co-directed by MIP faculty member David Pinsky, M.D. Seed funding from this partnership, and others similar to it, is essential for developing the initial results and collaborations needed to transition into an independent academic position. My own involvement with this program has provided first-hand experience organizing and maintaining an international collaboration. In particular, despite the numerous technological advances that ease long-distance communication, the importance of face-to-face meetings has become readily apparent. With travel supported by the program, we have been able spend two intense one-week stints collaborating in person, which resulted in a published manuscript and several seed ideas for new projects.

While I have highlighted a few of the unique benefits I have received as an MIP postdoctoral fellow, another fellow in the department would likely have a completely different set of programs through which they have gained essential experience. This may be the defining feature of a postdoctoral fellowship in the MIP department: surprisingly individualized support in service of a broad range of scientific expertise.

Physiology on the Cover



Jun Hee Lee Lab
Sim Namkoong, Allison Ho, Yu Mi Woo, Hojoong Kwak and Jun Hee Lee (2018). Systematic Characterization of Stress-Induced RNA Granulation.
Molecular Cell **70**, P175-187.E8

Santiago Schnell Lab
Wylie Stroberg, Hadar Aktin, Yonatan Savir, and Santiago Schnell (2018). How to design an optimal sensor network for the unfolded protein response.
Molecular Biology of the Cell **29**, 2969-3062

PERSONALIZED MENTORING AND ADVISING IN THE MASTER PROGRAM

After serving more than thirteen years as a pre-health professions academic advisor in LS&A at the University of Michigan, **Peggy Zitek, Ph.D.** joined our department three years ago as the Coordinator of Advising, Professional Development, and Student Affairs for the MS Program in Physiology. Peggy's main role has been to identify and implement approaches to enhance the MS program's services to former, current, and prospective students. Peggy's prior connection with the MS program, meeting with MS students in various capacities at her office located on central campus when her schedule permitted and presenting on various topics in the professional development seminar course (Physiology 605), made us realize how vital her input was to trainees and led to the establishing of her current full-time role.

With her background in advising pre-health undergraduate students and helping them develop plans for after graduation, she has focused her conversations with our MS students on the importance of taking ownership of their goals, not simply checking off items on a list. For example, students intending to pursue a profession in healthcare need to have had meaningful exposure to the field before submitting an application to their chosen profession, both for a successful application and to ensure that the experiences offered by that profession meet their career expectations. Challenging students to determine what could constitute a meaningful experience for them is not a simple task. Peggy takes the time to get to know the students on a personal level so she can best assist them at this stage of their journey. After listening to a student share their narrative and experiences, Peggy helps them explore steps they might take to achieve their goals. She helps them recognize their existing strength, as well as areas to improve. When applicable, she discusses strategies for becoming more efficient and effective in general study skills, taking multiple-choice standardized tests, intentionally developing their written professional school common applications with a perspective that complements and supplements the personal essays, and resumé content. She also provides valuable insight to help students identify which

specific health professions schools to include on their application, how to develop responses for secondary/ supplemental application essays, and possible content to incorporate into letters of update, continuing interest, and/or intent. When a student has received an interview offer, she prepares for and conducts individualized mock interviews both for traditional and Multiple Mini Interview (MMI) formats, either in-person or via FaceTime for program alumni no longer in the area.

In addition to assisting alums and current MS students with the aforementioned goals, she helps Dr. Oakley, the Associate Director for the MS Program, with shaping several of the weekly topics for Physiology 605. Peggy presents interactive sessions on Ethics and Professionalism and Personal Statements, Activities, and Interviews. The purpose of these presentations is to both demonstrate how students might successfully step outside the box when writing personal essays and provide them with an overview of applicable health career application processes. Throughout, a primary focus is the importance of exhibiting professional behavior - both during and after the MS program. By creating and grading an open-ended essay assignment for the seminar course, she encourages the students to augment their reflections and non-science writing skills as a prelude to developing the personal written content of their professional school applications.

Over the past sixteen-plus years, Peggy has attended numerous information sessions for pre-health advisors given by admissions teams at medical and dental schools, over 30 admissions executive committee meetings at the U-M Medical School, as well as several at medical schools both in Michigan and beyond. These experiences have aided her in defining which attributes are consistently desired by admissions committees. She has co-presented and presented sessions on various topics at state, regional, and national conferences for pre-health advisors, and met with admissions representatives to learn about changes in their school's missions and desired attributes in their matriculants. On occasion, Peggy has been able to procure interviews for MS students at various schools and even successfully advocate to have students be admitted from a school's alternate list. Altogether, the professional development training and mentoring provided by Peggy are an incredibly important aspect of the success of our MS program.

The MS in Physiology Fund is designed for students who plan to pursue employment in a research laboratory, or to continue their education as PhD, medical, dental or other health professional schools. Please consider making a gift to the program. All contributions will go towards providing financial assistant to master students.
Donate online at
http://victors.us/mipmaster

CONNECTING "PIECES OF REALITY" TO REVEAL THE WHOLE

BY CAROL ELIAS

The understanding of how biological systems work, of how we become who we are, and what happens when things go wrong and diseases develop are contained in one word: Physiology. These questions drive the ongoing studies in my laboratory in the Molecular & Integrative Physiology (MIP) Department. We aim to unravel the neural networks that link metabolism and reproductive function. Our ultimate goal is to find out what goes wrong when metabolic dysregulation, as in obesity and diabetes, disrupts reproductive function. The consequences for human health are many. They may vary from difficulties for successful pregnancy to aggravation of polycystic ovary syndrome and ovulatory dysfunctions, decreased sperm quality and infertility. If able to conceive, obese women have higher chances of early and recurrent miscarriages, and double the risk of preterm birth, stillbirth and neonatal death.

The hypothalamus, a very small area in the brain, is the main regulator and guardian of the internal environment. It orchestrates the autonomic, endocrine and behavioral responses necessary to maintain life and species survival. These responses and their regulation are very consistent among mammals. To test our scientific hypotheses, we use genetically-engineered mouse models that allow the manipulation of genes in cell- and time-specific manners, as well as visualization of physiological changes using dyes and reporter genes.

Because of the integrative aspects and complexity of these systems (metabolism and reproduction), our studies are multidisciplinary in nature and increasingly dependent on sophisticated instrumentation. We employ multiple cellular and molecular biology techniques, but the interpretation of the findings requires objective analysis of the physiological changes at the cellular or subcellular levels in addition to the whole animal. Identification of posttranslational modifications, cell trafficking, nuclear translocation and the presence of nucleic acids within a tissue or cell are few examples of physiological read-outs with key functional meanings. Microscopy is thus a fundamental tool in our laboratory, as it is in many areas of physiology. In studies of the brain, the lens of a powerful

microscope is the necessary tool to analyze and grasp what the famous neuroscientist Ramon y Cajal once called "pieces of reality". More than a century after Cajal's drawings and interpretation of the brain, our needs have evolved to much higher levels where static, fixed and dead tissues in histological preparations no longer provide novel information. In modern physiology, microscopy gives us the opportunity to "watch" in real time the dynamic changes in protein localization and trafficking, the cellular responses in three dimensions of space over time. This allows us to detect precisely new cellular components and physiological changes, providing mechanistic understanding of physiological processes. We are living through a true revolution of technological advances in novel imaging systems, and in a very exciting time for scientific discovery. Our laboratory, in collaboration with University of Michigan colleagues from the MIP and other departments, is working to establish scientific program focused on the use and development of novel technology for "in vivo" assessment of complex biological system. Recognition of the potential of being part of this process is what made me move to Ann Arbor and to the MIP Department, a place that assembles the expertise necessary to open doors to the "reality"Ramon y Cajal never envisioned it would be possible to draw in his life time and that has not been possible to visualize until very recently.

The First Microscopes at the University of Michigan

The microscope was introduced in the University as early as October 1854, for in an addendum to the Annual Report of President Tappan, it is stated that "several fine microscopes are also in used of the Medical Department". [Unfortunately,] nothing is known of these instruments.

Extracted from: Wilfred B. Shaw (editor, 1951) *The University of Michigan: An Encyclopedic Survey in Nice Parts. Part V. The Medical School, the University Hospital and the Law School (1850-1940).* University of Michigan Press, Ann Arbor, page 800.

COLLEGIATE PROFESSORSHIP WILL ADVANCE MUSCULAR AGING RESEARCH

On September 26, 2018, the Department of Molecular and Integrative Physiology celebrated the inauguration of the Christin Carter-Su Collegiate Professorship in Physiology and the installation of **Susan Brooks, Ph.D.** as the first Carter-Su Chair. Dr. Brooks joined the U-M faculty in 1995 and has risen through the academic ranks in the Department of Molecular and Integrative Physiology, while also maintaining strong interactions with and appointments in the Department of Biomedical Engineering and the Institute of Gerontology. Dr. Brooks has a long history of commitment to muscle physiology research. Her laboratory is dedicated to determining the mechanisms underlying age-associated muscle wasting and weakness. She explains that she is 'particularly interested in the factors that initiate age-associated muscle loss as well as the circumstances throughout life that might modulate, either positively or negatively, the rate of the progression and the magnitude of the loss.'

Physical frailty, with its associated immobility and disability, is a major factor limiting independence and quality of life in old age. Impaired mobility,disability, and a high incidence of falls typify the frail elderly, and falls contribute significantly to morbidity and mortality. A key contributor to frailty is age-related loss of muscle mass and strength, referred to as sarcopenia. By 60 to 70 years of age, muscle mass of human beings decreases 25 to 30%. The decline in strength is even greater due to impairments in the function of the remaining muscle.

Superficially, the decrease in muscle mass that is observed with aging appears to be analogous to the atrophy associated with disuse. With a decrease in activity, such as occurs following the casting of a limb, with bed rest, or during exposure to microgravity, the muscle atrophy that occurs results from a decrease in the size of individual muscles cells, called fibers, with no decrease in the total number of

fibers. This disuse atrophy results from a decrease in the size of individual muscles cells, called fibers, with no decrease in the total number of fibers. Disuse atrophy is fully reversible and muscle mass and fiber size are restored when normal activity levels resume. In contrast, the muscle atrophy that occurs in old age involves loss of muscle fibers, with little or no individual fiber atrophy and is therefore irreversible. While the decreases in muscle mass and strength during aging may be related to decreased activity levels throughout life, maintenance of physical activity does not protect skeletal muscles completely from these age-related decrements. Even superbly trained world class athletes, who at any given age display higher values for muscle mass and strength than untrained individuals, show similar trends and time courses of decline in structural and functional properties.

Despite the enormity of the personal as well as societal costs of sarcopenia, only modest progress has been made in understanding the mechanisms responsible. The lack of mechanistic understanding of the factors that initiate muscle loss and define the trajectory of its evolution presents a critical barrier to progress toward lessening the severity of sarcopenia and its devastating effects on quality of life among older persons. Dr. Brooks leads a multidisciplinary research program that is pursuing the overall hypothesis that functional changes in specific motor neurons trigger degeneration of neuromuscular synapses and ultimately denervation of the associated fibers. The extent to which the process of age-related denervation and muscle fiber loss may be aggravated by an increased susceptibility of muscles in old animals to contraction-induced injury and by the impaired capacity for regeneration is also of interest. Her work has continuously received robust support from the National Institutes of Health and the American Federation for Aging Research/Glenn Foundation for Medical Research. Thanks to her appointment as the Carter-Su Chair, Dr. Brooks will be able to expand her work into exciting and riskier areas especially in the area of testing therapeutics.

In addition to her research, Dr. Brooks has been strongly committed to facilitating career development opportunities for junior faculty through service as director of the research development core of the Nathan Shock Center for Basic Biology of Aging from 2005-2015 and her current role as associate director of the Michigan Integrative Musculoskeletal Health Core Center. On her naming as the first Christin Carter-Su Collegiate Professor, Dr. Brooks

says, 'Being named the inaugural Carter-Su Collegiate Professor was completely unexpected and overwhelming. I am truly honored and hope that I can live up to the exceptional example that Dr. Carter-Su continues to demonstrate for scientific discovery and professional citizenship.'

Dr. Carter-Su was a full professor when Dr. Brooks joined the faculty in the department and served as an inspirational role model for Dr. Brooks with her strong commitment to mentorship for which she has been officially recognized nationally with the Bodil Schmidt-Nielsen Distinguished Mentor and Scientist Award from the American Physiological Society and locally by her appointment as the Anita H. Payne Distinguished University Professor. Distinguished University Professorships are the University's most prestigious professorships to recognize senior faculty with both exceptional scholarly achievements and superior records of teaching, mentoring, and service. With respect to Dr. Carter-Su's exceptional example, Dr. Brooks states, 'Since my earliest days in the Department, Christy has been a powerful and positive presence. She has been a role model as both a creative and careful scientist and a committed and compassionate mentor.' Dr. Brooks similarly aims to be a devoted mentor to students and trainees at all levels, and she is absolutely delighted to have had the opportunity to celebrate Dr. Carter-Su's esteem while she is still a colleague.

The kind support of the family, friends and colleagues of Dr. Christin Carter-Su ensures that Dr. Carter-Su's legacy will be honored in perpetuity. Through a generous endowment, the Christin Carter-Su Collegiate Professorship in Physiology will ensure that the research programs of deserving scientists at the University of Michigan Medical School will be supported for years to come.

Dr. Santiago Schnell (Interim Chair, Physiolgy),
Dr. Susan Brooks & Dr. Carol Bradford (Executive Vice Dean for Academic Affairs)

THANK YOU FOR YOUR SUPPORT

We hope our successes this past year make you proud of the University of Michigan Department of Molecular & Integrative Physiology. Our philanthropy funds play a key role in strengthening our department, faculty, and trainees. We hope you will play part and join many others in supporting Molecular & Integrative Physiology by making a gift to the funds listed in this issue or below:

Molecular & Integrative Physiology Annual Fund: Your gift will enable the Department of Molecular & Integrative Physiology to direct resources where they are most needed or where opportunities are greatest, from upgrading or replacing a critical piece of lab equipment to providing resources to our trainees, researchers and faculty. **Donate online at http://victors.us/mipfund**

John and Margaret Faulkner Lectureship: You will be supporting an annual lectureship by a prominent invited speaker selected by the students and faculty in honor of John and Margaret Faulkner. **Donate online at http://victors.us/faulknerfund**

Dr. Hobbs (UT Southwestern Medical Center) was the John & Margaret Faulkner 2018 Lecturer. Her lecture "Fatty liver disease: Ancient mutations for a common disease" was delivered on September 7 in the University of Michigan Kahn Auditorium.

Pictured (L to R) Peg Faulkner, Dr. John Faulkner, Dr. Helen Hobbs & Dr. Ormond MacDougald

If you would like to discuss making a donation to any of our funds, leaving a gift for us in your will, or offering a pledge or gift of appreciated stock, please contact Chrissy Barua, our development officer, at 734-763-4938, or cebarua@umich.edu.

SCIENCE EDUCATION & ENGAGEMENT FOR KIDS(SEEK)

Did you know that many elementary schools in the Ypsilanti Community School District do not have an established science curriculum? SEEK aims to help bridge this gap in access to science education by leveraging the time and knowledge of U of M graduate students and postdoctoral fellows. Through hands-on learning activities and close mentorship, we hope to ignite excitement and curiosity and inspire the next generation of scientists.

This year, more than $10,000 has been given by current students and faculty, alumni, and friends of the Physiology Department towards the Science Education and Engagement for Kids (SEEK) fund. These funds will enable SEEK to expand existing initiatives and develop new and exciting opportunities for young students to develop passion and interest in the sciences.

During Physiology Fun Days, Molecular & Integrative Physiology (MIP) trainees spend the day teaching elementary school students about the functions of the cardiovascular, respiratory, gastrointestinal, nervous, and immune systems through hands-on, interactive activities. Previous events have focused on fourth graders. This year, your support will allow SEEK to host Physiology Fun Days for both third and fourth grades at two local schools. These events will reach over 500 students.

Although many schools in Ypsilanti do not have the resources to provide teachers with an elementary-level science curriculum, students must still take the science component the state-mandated M-STEP exam after fifth grade. SEEK has developed a new initiative to teach lessons focused specifically on topics assessed by the M-STEP. We have developed 22 detailed lessons that are divided into three blocks: Physical Sciences, Earth-Space Sciences, and Life Sciences. Graduate students and postdoctoral trainees will teach biweekly lessons to fifth graders at Estabrook Elementary School, providing crucial exposure to a broad range of scientific concepts and topics. With your support, SEEK expects to implement the full curriculum beginning in Fall 2019.

… Graduate students and postdoctoral trainees will teach hands-on science lessons to fifth graders in schools lacking a science curriculum.

SEEK by the Numbers

Amount raised this year

>$10,000

Individual Donors to the SEEK Program in 2018

106

Elementary School Students reached (since founding-Fall 2016)

>800

Graduate students & postdoctoral trainees involved

88

Physiology Fun Day events hosted thus far

5

… Fifth graders will learn about the nervous system through interactive neuroscience lessons

SEEK recently received a Diversity, Equity and Inclusion Innovation Grant from the University of Michigan to purchase five Backyard Brains mobile neuroscience kits. Using these kits, graduate students and postdoctoral fellows are teaching fifth graders about the human brain and nervous system. Demonstrations include using electrophysiology to control a friend's arm and EKGs to learn about the connection between the brain and the heart. With your support, SEEK will be able to expand this new initiative.

… SEEK is developing new and exciting collaborations with other K12 outreach organizations at U of M

With your support, SEEK is now working with other organizations, including Michigan DNA Day and American Women in Science (AWIS) to develop subject-specific modules that can be taught to third, fourth, and fifth graders in local low-resource, high-need classrooms.

Since its inception in Fall 2016, SEEK has cultivated close relationships with the teachers and staff at Estabrook Elementary School in Ypsilanti. SEEK can provide a much-needed platform for other local K12 outreach organizations. By leveraging the collective time and passions of trainees across the univerisity SEEK aims to create a broader unified movement that will inspire young students to engage in exploration of the sciences. If you would like to support the development of this outreach educational program, please ***donate online at http://victors.us/mipseek.***

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