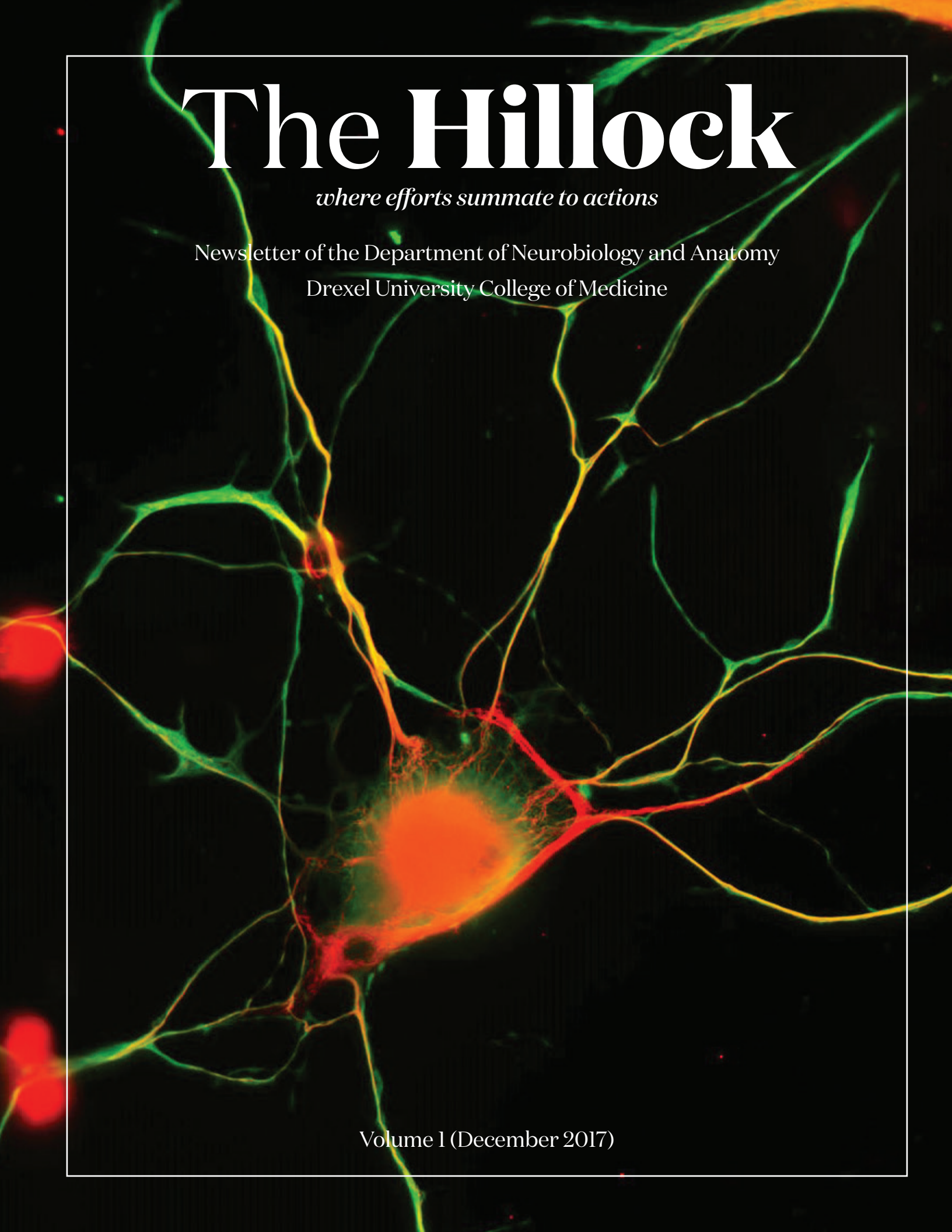


The Hillock

where efforts summate to actions

Newsletter of the Department of Neurobiology and Anatomy
Drexel University College of Medicine

Volume 1 (December 2017)

Editorial **Team:**

We thank our Chair, Dr. Itzhak Fischer,
for his support and guidance during this endeavor.

Cover image by Andrew Matamoros, PhD Candidate in the Baas lab.

A neuron from the rat dorsal root ganglion is immunostained for microtubules. Neuron-specific beta-III tubulin is stained in green, while acetylated alpha-tubulin is stained in red. Andrew's project explores the potential of a novel microtubule-severing protein, fidgetin, in axonal regeneration after injury.

A view from the Chair

As we approach our 20th anniversary at Queen Lane, I think about our legacy institutes (the Woman's Medical College and Hahnemann University), our rich history as a department, our present scientific and academic excellence and our promising future with a group of young faculty and bright students who are led and mentored by a team of experienced investigators. The coming 20th anniversary has a personal parallel in my tenure as Chair, a journey that began after the catastrophic bankruptcy of our medical school as it was configured at the time, which decimated the department. Like the "rise of the Phoenix," we not only persevered, but prospered into an outstanding and collaborative group of scientists and educators. In times of uncertainty, conflicts, and financial pressure, we learned to become self-reliant and creative, set long-term plans, and worked as a diverse but inclusive team. We are now part of Drexel's College of Medicine, but our history goes back long before that.

In 2017 our junior faculty continued their remarkable progress with respect to mentoring of graduate students, funding, and publications (see appendix). Drs. Marie Cote, Kazuhito Toyo-oka, Shaoping Hou, and Megan Detloff have recently been awarded their first R01. Drs. Michael Lane, Rodrigo Espana, and Kim Dougherty have submitted a renewal or second R01. Dr. Jessica Barson is making a transition from her R00 to R01, and our most recent recruit, Dr. Dong Wang, is getting ready to submit his first grant. Our senior faculty led by Drs. Peter Baas, John Houle, and Wenjun Gao have not only provided leadership to our research groups (Cell biology, Spinal Cord, and Systems, respectively), but also engaged in a mentoring program to review every R01 application in designated committees and "chalk talks." At the same time, our students have been awarded individual NIH fellowships, Dean's awards, and other internal and external distinctions. Finally, several of our MS students have moved to a PhD track as a result of their outstanding performance.

What is remarkable when you look at the department in 2017, relative to just a few years ago, is that we now have eight assistant professors (Dr. Veronica Tom has since been promoted and is in the process of getting her tenure), that our grant portfolio reached a level of >$8.5 million with a ranking of #21 among all (140) medical schools with respect to NIH grants, that our Systems Neuroscience faculty have organized into a cohesive group with shared facilities and a collaborative spirit, and that our Spinal Cord group has maintained national prominence by moving into areas of clinical relevance such as respiration, autonomic function, rehabilitation, pain, spinal circuitry, robotics, and modeling. Last, but not least, our educators have successfully transitioned into a new medical curriculum and continue their innovative online remediation course, creative Artistic Anatomy course, and summer courses for high school students.

As a symbol of our shared goals and the joy of the Holidays, we get together for our annual party with family and friends. We celebrate our achievements with good food, acknowledge the excellence of individuals with awards, and poke fun at each other. This year, we include in this celebration a newsletter created by the students. The theme of this inaugural newsletter is the history of the department, beginning with the "Amazing Adventures of Marion and Michael," or as Marion likes to call them—"the odd couple." I hope this new tradition of the newsletter will continue and become an archive of personal and professional stories from our extraordinary students, staff, and faculty.

Finally, as we get close to the end of 2017 and look into a new year that by all accounts will be challenging for the University, for the NIH, and for the US in general, I remain optimistic because (and I repeat) "we learned to become self-reliant and creative, to set long-term plans, and to work as a diverse but inclusive team." For the last 18 years, since we moved to Queen Lane, I have been a bit nervous during the preparation of our annual budget. However, to my relief and delight, each year we exceeded our budget goals, increased our funding portfolio, recruited outstanding students, and improved our mentoring and collaborative efforts. I am confident that in 2018 we will stay this course.

Itzhak Fischer, PhD
Professor and Chair

Letter from the Editor

A whole year has gone by as we jumped between lab work, lectures, seminars, and quick bites. What remain with us are sets of experimental data to analyze, and to ponder how they may extend the frontiers of our knowledge.

We cherish our stories of success; we buckle up to rectify our setbacks; and we celebrate, and sometimes commiserate, with friends, mentors, and colleagues. To capture and archive the spirit of collegiality which pervades the fabric of our department, and defines our collective success, we are delighted to present our first departmental newsletter—the Hillock.

This inaugural issue carries the theme of "Legacy" to honor the founders of our department, the late Dr. Michael Goldberger and Dr. Marion Murray, presented as Chapter 1 of a project to record the history of our department. Dr. Murray's story of our department's formative years is a testament to the power of shared passions and formidable friendships.

We have included interviews with other faculty and staff, who have been with the department for many years. We are humbled and inspired as we learn that their personal and scientific journeys are those of perseverance, and often defy the conventional road. We also included sections highlighting the achievements and imagination of our students. Finally, we showcase facets of perspectives and creativity of our family that inherently shape the culture of our department.

We ventured on this journey with the goal of bringing our community together by recording stories that do not always appear on the surface. We hope you enjoy reading these stories as much as we did finding and crafting them.

"The Hillock," in neuronal terms, implies a juncture where individual forces culminate into a meaningful output. We believe this first newsletter is a vehicle for celebrating our collective adventures over the year. It is our hope that this new tradition will continue in nurturing the unique harmony that our department embodies.

The Editorial team

Our student editors - (L-R) Linda Chamberlin, Ankita Patil, Surya Pandey, and Nicholas Stachowski.

The History of the Department of Neurobiology and Anatomy

Chapter 1: The Odd Couple

by Marion Murray, PhD

Image: Bottom row - (L-R) Marion Murray, Michael Goldberger, Liang Fang Wu | Top row - (L-R) Wendy Battsiti, Theresa Connors, Ted Wang

I was recruited to the University of Chicago from Rockefeller University, where I had been a postdoc with Bernice Grafstein. I thought I had died and gone to heaven. I was an assistant professor, invited to join an intellectually vigorous, strongly liberal, but not elitist campus with an innovative history of brain science. Michael Goldberger was one of my new colleagues. He had joined the department of anatomy a year or two earlier, recruited from Penn and the Chambers/Liu lab. He had thought University of Chicago was like what we now call a community college, and therefore served the underserved students of Chicago. We were both mistaken, but that's a different story.

We became close friends as well as colleagues–both interested in neural plasticity (oddly, a novel idea at the time) and on the right side politically (or maybe I mean left). Michael was focused on plasticity in the motor systems and the spinal cord. I was studying anatomical plasticity and regeneration. Using a novel technique (at the time), autoradiography, we were studying the molecular effects of activity in the hypothalamus and regeneration of goldfish optic nerves. We were also investigating the recovery of function, using behavioral methods. We sought ways of working together in research (Goldberger and Murray, 1974; Murray and Goldberger, 1974) and developed a highly regarded graduate course in neurobiology in which the students would choose the animal model of their choice (brains and spinal cords of rat, cat, monkey, sheep, snake,

or turtle, all prepared for histology). We also determined that Chicago pizza really was better than NY pizza, and we discovered we both loved going to the opera.

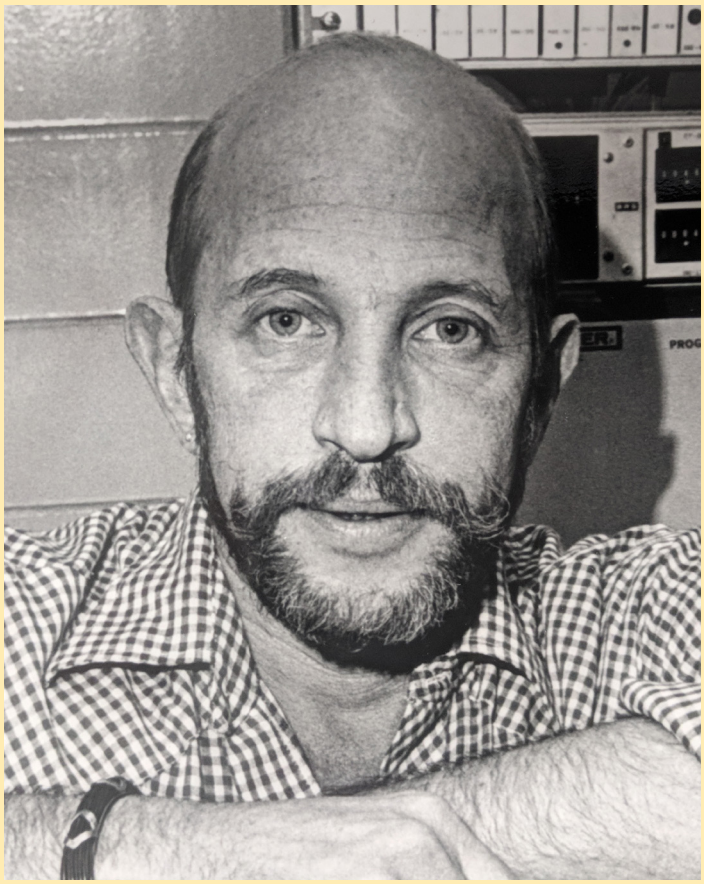
For somewhat different reasons we both became disaffected with the University of Chicago. It was a heady time in late 60's and early 70's. We were involved with gay liberation (Michael) and pro-choice feminism (Marion) and with anti-Vietnam war and anti- racist groups and many of us were optimistic about the future. It was also a toxic environment both politically and racially. Our Chairman was an unreconstructed South African and that was one of his more pleasant characteristics.

The Dean tried to get us to stay but eventually pointed out that no one else in the department wanted to leave and that two young assistant professors were not going to make a change (although most of the neuroscientists did leave Chicago in the next few years). I was also tired of annual muggings in Hyde Park (why I now live in the leafy suburbs of Philadelphia, among the privileged and elite (I can sell out too)).

Enter Len Ross, late of Cornell University Medical School, who had just accepted a position as Chair of the Anatomy Department at Medical College of Pennsylvania. Len had learned that Michael and I were interested in leaving Chicago and we began thinking about Philadelphia. MCP's major distinction at the time was its history as the first women's medical school in the country (Women's Medical College). It became coeducational in 1967. Its other distinction was that the department was virtually empty except for a few teachers and a muscle cell biologist (Rhea Levine). On a visit we noticed that our interviewers all had neat desks, the men wore coats and ties and the women dresses.

Len promised that Michael and I could build a department primarily focused on plasticity and its relation to function (another novel idea) and that it would promote collaboration (another novel idea at the time). Because MCP was not a research-intensive institution, we had a lot of challenges. Our first move upon arrival was to visit the animal quarters and operating rooms. They were blood spattered and filthy. We asked the vet how they could have met the AALAC standards, to which he said, 'why should we?' We stormed over to the research administration to lodge our complaints and demanded that the vet be fired and replaced, with the goal of meeting the standards of AALAC.

Our target administrator was Sue McLeer—later to be the Chair of Psychiatry at MCP—who recounted her response to this later (shock and awe). Another challenge was to staff our department with individuals who were strong scientists and whose expertise would complement one another (physiologists, biochemists, behaviorists, and, once we knew what it meant, molecular biologists, bioengineers, and computational neuroscientists), who would form strong collaborations with one another, and who could teach one of the three medical school courses (gross, neuro, or histology) taught by the Department of Anatomy. Throughout this period Len was fully supportive of us and fulfilled these promises. Our research on plasticity, particularly on sprouting, had become quite controversial, with seemingly much of the scientific world



opposed to it (although now they seemed to have come around). One of our colleagues at Chicago, Hazel Murphy, had established a program in plasticity of the visual system in rabbits and was experienced in electrophysiology. At the time, she was the acting Chair of the department. She surprised us by wanting to join us in Philadelphia. We then interviewed a young man, Tim Cunningham, also interested in visual system plasticity. He was offered a job at University of Chicago (to replace either me or Michael or perhaps both) but shocked our former Chair when he told them that he had decided to accept our offer at MCP. We giggled at that.

Recruiting went well and everyone got grants (it was also hard then, although not so much as it is now). We had a thriving graduate program and good postdocs. A year or so later I was invited to give a talk at Georgetown University. The Chair, whom I had known at McGill, hadn't heard of MCP; so, he looked it up in the Anatomy society. That year, we were in the top five anatomy departments in funding (the others being the usual suspects, Harvard, Yale, Penn, Columbia). So, we were launched. Alan Tessler, our caring physician, joined us to provide clinical neurology to our armamentarium. Not too long after that we recruited Pat Levitt, who contributed to what one of our students has called our 'rock-star' image, and Tim Cunningham led the department softball team to the MCP championship.

By the time frame of the next chapter we had recruited Itzhak, had a PPG, and two training grants, and assorted other good things. We had moved from the MCP building into the top floor of the insane asylum known as the Eastern Pennsylvania Psychiatric Institute (EPPI) and were by and large happy within the department. One person on one of the lower floors (not a patient) observed that these new people in the 8-9th floors smiled and laughed as they came to work each day. Our experiment seemed to have worked well—most of our new colleagues stayed with us, although some moved on. Marty Pinter was a choice colleague because not only was he a spinal neurophysiologist, but he also could teach gross anatomy (before Dennis DePace joined us after the Hahnemann merger). But Marty was being recruited by other universities, and when he left he said he didn't want to be known primarily as the guy who turned down both Stanford and Emory to stay at MCP. We are still friends.

In 1991, on the same day, I was diagnosed with breast cancer and Michael with AIDS—both debilitating, one survivable and the other not. During my treatment Michael walked with me over to MCP for each of my chemo infusions, and when I could, we went out to lunch afterwards. Given his prognosis Michael wanted to work as long as he could and be as independent as he could. But by the next year, he asked me to tell his friends at the Neuroscience meeting of his condition. He hadn't disclosed his disease because he thought he would be seen as a dying man rather than a strong man. This was difficult and emotionally charged task for me, but he felt it important that they learn of it

from me. He died some months later at Hazel's house, surrounded by his friends. These were dark days.

Nevertheless, we persisted.

Our friends both in and out of science provided me with needed support. One of my greatest supporters was my next-door neighbor who would meet me at home after each chemo treatment with a couple of joints. We would read from the newest Peterman catalogue which at that time provided short vignettes of lives we would have liked to live. One thing led to another and we ran off to Scotland to get married on a beach on the remote Isle of Lewis where my father grew up. The wedding vows were spoken in Gaelic, which we couldn't understand, which was the point. My uncle said he would be sure that they included the part about obeying. Whose side was he on?

We returned of course, and the next phase was dominated by a megalomaniac sociopath (which resulted in the bankruptcy of the whole system).

(Medical College of Philadelphia (MCP), aka Allegheny University of the Health Sciences, MCP-Hahnemann, Philadelphia Health Education Consortium, Drexel University College of Medicine)

Look for another installment on the History of our Department in our next issue.

FACULTY REFLECTIONS

A journey down the microtubule: reflections on my research

By Peter Baas, PhD

My interest in microtubules began when I was an undergraduate (for reasons I can't remember) and persisted from there. I became a neuroscientist because nerve cells rely on sophisticated microtubule arrays for almost everything they do. By the time I started my own lab in 1990, I had become completely dedicated to elucidating the cellular mechanisms by which microtubules become organized in axons and dendrites of neurons, as well as during plastic changes in their morphology during development.

While I was fortunate to be hired by a university prominent in biomedical research, I hadn't trained in the kind of big powerful laboratories that produce most faculty hires at major universities. This may have put me at a political disadvantage in some circles, but it also gave me at least one notable advantage: I was fearless in my pursuit of my scientific interests, mainly because I had no idea that I shouldn't be. There was nobody to tell me to be afraid of bigwigs ruining me if I challenged their ideas, or that I had to be careful not to step on the toes of senior people who felt ownership over the issues that interested me. There was nobody to tell me that I needed to follow the latest trends and methods, although I do remember being amused at the formula by which most assistant professors were hired at the time. Regardless of the topic, the question was always whether a young investigator had a "mouse" yet. My mentors taught me to ask a very different question—what's your hypothesis?

One of the more interesting chapters in my early career revolved around a raging controversy of whether microtubules move down axons. Given my research interests, there was no way I could dodge the issue or keep both sides happy by straddling the line. I remember a friend telling me around the time I started my lab, "the microtubule transport model is dead." It seemed to most people that the popular opinions against the model were too strong to overcome, but to me, the more I thought about it, the more it was inescapable that microtubules had to move down axons. I figured that logical arguments and well-designed experiments could win the day, together with a mind open to learning new things beyond the dogma on either side of the controversy. There were some perilous moments along the way, but it was an adventure that helped forge my scientific identity. Today, young people are surprised that anybody ever doubted that microtubules are mobile in axons.

Science is all about coming up with ideas, taking risks, putting those new ideas on the table, and designing the best experiments to test your ideas. For me, the thrill was always in the creativity. For example, I came up with the idea that the mechanisms that organize microtubules in neurons are a re-purposing of the same mechanisms that organize microtubules in mitosis. Crazy idea to some people, perhaps, but once we started looking for mitotic motors in neurons, we found each one we looked for, as well as profound phenotypes when we started knocking them down. Nature doesn't throw away what works, I'd often say, but retools what works in new ways to suit new challenges. I remember saying to my first graduate student who worked on mitotic motors in neurons, "if this isn't the way it works, it should be," because we were so excited about the idea.

Since my arrival at Drexel 17 years ago, my research has gone beyond those basic questions. We are now delving into the roles microtubules play in neurodegeneration, with the goal of using knowledge of those mechanisms to develop microtubule-based treatments for disease and injury of the nervous system. When I first started in science, it was hard to explain the relevance of what I was doing to family members or other lay people. Today, it's not so hard, because I'm studying Spinal Cord Injury, Hereditary Spastic Paraplegia, Gulf War Illness, and Alzheimer's disease, all of which affect people in very real ways. I view this transition in my career as fulfillment of the promise I made to NIH, namely that putting in the hard work on the basic science would one day enable me to address very real health care problems. That day has come, and it's an exciting component of my career that my students especially like. I'm humbled by the opportunity to communicate with patients suffering from these maladies, all of whom display remarkable dignity that inspires me.

I recall wondering when I was younger whether my research would someday prove to be pivotal for the advance of my field or whether my contributions would mainly serve as a bridge to more consequential future work. Today, I don't really care one way or the other, because they're equally important, especially when the research is also a vehicle for training the future generation of scientists in my own laboratory. In my opinion, research is never a private ride, whether taken with your mentor, your collaborators, or your students, and the best reward isn't the destination but the journey itself.

FACULTY REFLECTIONS

My scientific travels (travails?) getting to Philadelphia: 25 years in the making

By John Houlé, PhD

My undergraduate major at the University of Kentucky was microbiology and I wanted to pursue graduate work in immunology with a focus on immune surveillance of cancer cells. I started on this path at Purdue University. I realized that cancer biology was not the field for me in part because I had just completed a Microscopic Anatomy class and seeing the beauty of the different cells, tissues, and organs in the body made me re-think my interests in science. It didn't hurt that the course instructor was working on spinal cord development and offered me a position as a technician.

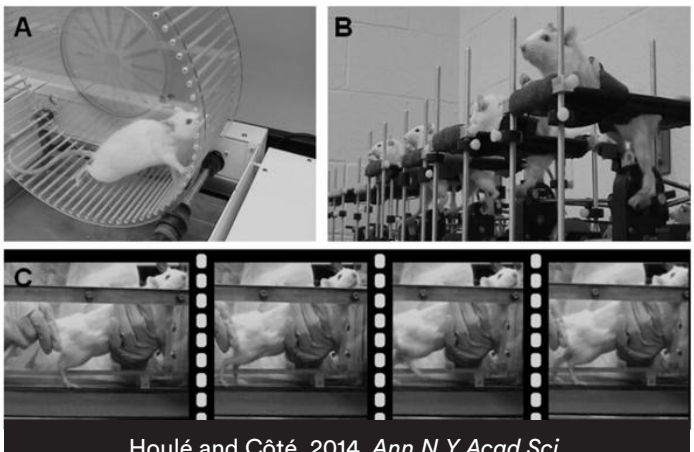
Over the next year I learned a lot about the intricacies of axon growth and guidance. In 1977, I joined the lab of Dr. Gopal Das at Purdue University, where I earned my PhD in 1981. Dr. Das was interested in neurogenesis, cell fate, and environmental influences on the development of immature neurons. He was the first to succeed in transplanting embryonic tissue into the rat brain and we asked if neuronal precursors were programmed to mature into a specific type of neuron or whether their location influenced that decision.

For instance, would embryonic cortical tissue transplanted into the cerebellum still form pyramidal neurons and make connections with local but aberrant targets? We also began work on transplantation in the injured spinal cord but that ended quickly with Das' pronouncement that embryonic spinal cord tissue would not survive the transplantation procedure. Interestingly, the 30+ years of success at the MCP/Hahnemann/Allegheny/Drexel Spinal Cord Research group has proved him wrong.

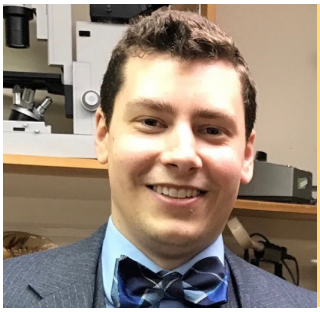
As my PhD work was nearing completion I contacted the dynamic duo of Marion Murray and Michael Goldberger at MCP who were doing cutting edge work on spinal cord plasticity and recovery of function. Unfortunately, the timing was not right for them to take on a new postdoc, something about 'no money.' So, in 1981, I began my postdoctoral training in the lab of Dr. Sergey Fedoroff in Saskatoon, Saskatchewan, Canada because of his interest in glial cell lineages and the role of astrocytes in neuron development. The short story there is that the research environment was very stimulating, I learned a lot about glia and I learned that life is very difficult when it is -40oC and there are only 4-5 hours of daylight during the winter.

In 1984, I got the chance to return to spinal cord injury research when I was recruited to the University of Florida to run the lab of Dr. Paul Reier. Dr. Reier had recently demonstrated that embryonic spinal cord tissue survived, differentiated and integrated with the host adult spinal cord. We moved from the frozen tundra to sunny Florida. I spent three years developing basic surgical and transplantation procedures for the injured spinal cord, performed some of the first non-human primate transplants, and established a chronic injury-delayed transplant approach that continues to be a staple of my research. During this time, I renewed personal and professional relationships with the MCP group and began some studies with Alan Tessler and Itzhak Fischer, but unfortunately, there still was no money for me at MCP. As I needed to establish my own lab and identity, in 1987, I became Assistant Professor at the University of Arkansas and stayed there for 17 years. I was fortunate to have a very supportive department Chair and two colleagues who were interested in locomotion physiology. It was during this time we established the motorized bicycle as an exercise/training paradigm for spinal cord injured rats, and I have used it ever since.

In 2004, when Itzhak invited me to give a department seminar, I did not know at the time that this also would be the beginning of a job interview. Would I finally get my chance to work with Marion, Itzhak, and Alan every day? The department had a reputation for being collegial, interactive and nurturing and I learned firsthand what a great mentor Itzhak was and how dedicated he was to his faculty and staff. All the visiting scientists quickly appreciated that there was a very special environment here and I eagerly accepted the challenge. It took me a long time to get to Philadelphia and I am grateful for every minute that I spend at Queen Lane.



Houlé and Côté, 2014. *Ann N Y Acad Sci.*



RESEARCH HIGHLIGHTS

14-3-3epsilon in neuronal design

by Brett Cornell

One day, during my first week in the lab, Dr. Toyooka excitedly called me into our microscope room and asked me to look at a couple of dishes of neuronal cells. I noticed that the cells in one dish looked quite odd and appeared to have very short dendrites and axons. Dr. Toyooka quickly agreed with my observation and told me that he had increased the expression of the protein 14-3-3epsilon in these cells. I asked him why the protein stunted the growth of the dendrites and axons, to which he responded, "I have no idea." Thus, began my dissertation research.

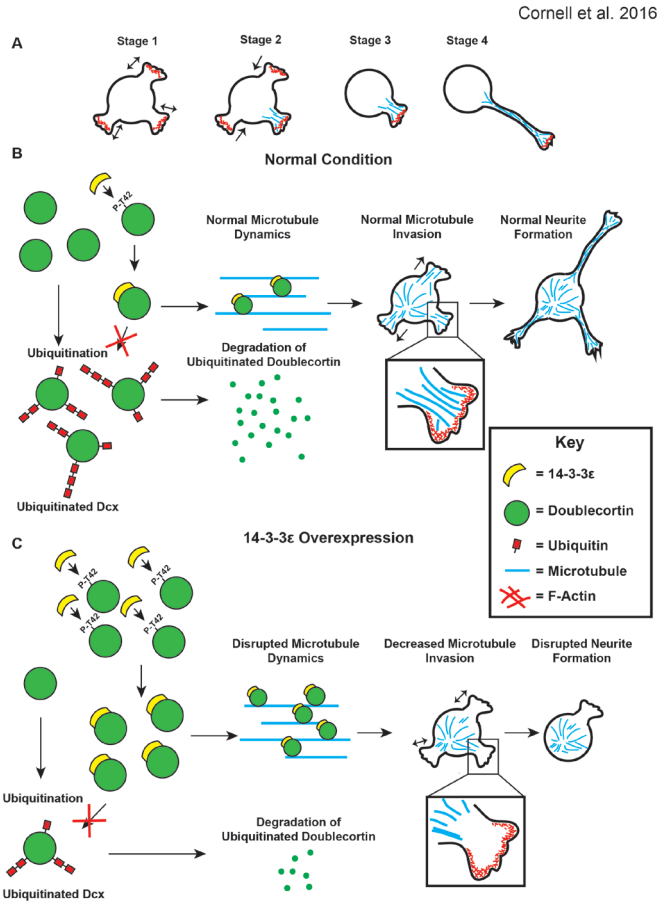
The 14-3-3 protein family consists of seven proteins that mediate various molecular interactions to modulate cellular functions including, but not limited to, signal transduction, cell cycle control, and apoptosis. These proteins are highly expressed in the brain, particularly during brain development. 14-3-3 proteins have also been associated with many neurological disorders such as Parkinson's disease, Alzheimer's disease, schizophrenia, epilepsy, and Miller-Dieker syndrome. However, much is still unknown about how these proteins function in a normally developing brain and how they are involved in a number of neurodevelopmental disorders. Dr. Toyooka's lab focuses on studying the functions of the 14-3-3 proteins during brain development and their involvement in these neurodevelopmental disorders.

In my dissertation work in Dr. Toyooka's lab, we elucidated the functions of 14-3-3epsilon in neuromorphogenesis, the process by which neurons form their architecture. This led to the first evidence of this protein's involvement in the cellular pathology of a neurodevelopmental disorder called 17p13.3 microduplication syndrome. This newly identified genetic disorder is characterized by gene duplications, including the duplication of the 14-3-3epsilon gene, which results in a number of neurological disorders including autism spectrum disorder. Using mice as our research platform, we sought to identify the molecular mechanisms by which the overexpression of the 14-3-3epsilon protein affects neuronal morphology.

We discovered that 14-3-3epsilon binds to the microtubule binding protein, doublecortin (Dcx), in a phosphorylation dependent manner, and that this binding increases the Dcx protein levels in the cell by interrupting ubiquitin based degradation. Given the role of Dcx in stabilizing and arresting microtubule dynamics, we found that the increased levels of Dcx disrupted microtubule invasion into the lamellipodia of newly forming neurites, thus disrupting an initial stage of neurite formation.

This disruption, in turn, could be rescued by the knockdown of Dcx in 14-3-3epsilon overexpressing cells. In addition, with the use of 14-3-3e flox mice, we found that spatiotemporal 14-3-3e deficiency results in an increase in neurite formation. This suggests that 14-3-3epsilon functions as a negative regulator of neurite formation. Overall, our findings elucidated novel functions of 14-3-3epsilon and Dcx in neuronal morphogenesis and implicate their role in 17p13.3 microduplication syndrome.

Our hope is that our work to understand the functions of the 14-3-3 proteins in brain development will eventually pave a way for the development of treatments for neurodevelopmental disorders.



RESEARCH HIGHLIGHTS

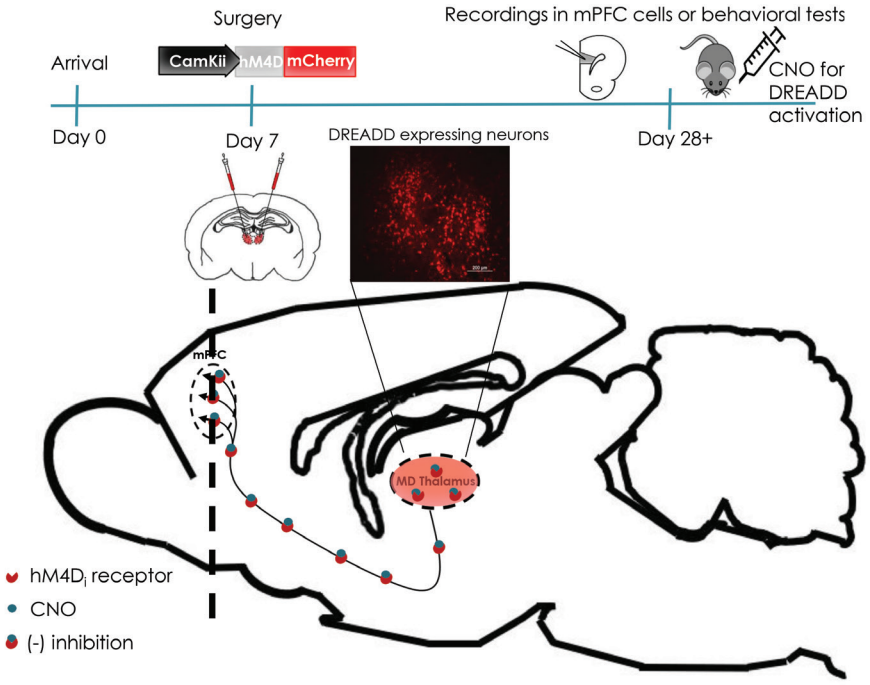
Thalamic and prefrontal interactions guide cognitive and social behavior

by Brielle Ferguson

My work at Drexel involved trying to understand how two areas in the brain—the mediodorsal thalamus (MD) and the prefrontal cortex (mPFC), communicate. These regions have both been linked to numerous cognitive functions, including working memory and cognitive flexibility, that are disrupted in psychiatric diseases. However, how these two structures cooperate to generate successful cognitive function had remained unclear.

A principle important for organizing cortical activity is maintaining a proper balance between excitatory and inhibitory signaling (E/I balance). We hypothesized that the MD may help the PFC maintain this balance to optimize behavior.

To explore this, we took advantage of a recently developed pharmacogenetic tool for modulating neuronal activity—DREADDs (Designer Receptors Exclusively Activated by Designer Drugs)—to decrease MD activity and measure the resultant changes in activity in the PFC neurons as well as the behavioral correlates.



Manipulating MD activity with DREADDS

We found that dampening MD activity caused significant reductions in GABAergic signaling, increased E/I balance in the mPFC, and was concomitant with abnormalities in working memory and cognitive flexibility. Further, by selectively activating parvalbumin (PV) interneurons in the PFC with a novel pharmacogenetic approach, we restored GABAergic signaling and E/I balance, as well as ameliorated all behavioral impairments.

We also observed that our circuit was implicated in other PFC-dependent behaviors outside the realm of cognition, and found that dampening MD activity disrupted social interaction and caused abnormal anxiety-related behaviors. Promisingly, our targeted intervention for upregulating GABAergic activity normalized these behaviors as well.

These findings suggest that the proper manifestation of a range of PFC-dependent behaviors hinges upon appropriate balance between excitatory and inhibitory signaling in the PFC. Given that cognitive dysfunction is a strong predictor of functional outcome in both schizophrenia and autism, diseases which harbor comorbid deficits in social interactions and anxiety, our work may highlight a pathway for therapeutic development.

During this research, I gleaned that my preferred method of investigation was trying to understand basic mechanisms that support behavior and how they may go awry in pathology. I also became fascinated with the thalamus for its importance in supporting so many fundamental cognitive processes, and curious how activity in the intra-thalamic circuit could get hijacked resulting in other pathological conditions such as epilepsy.

This led me to pursue a postdoctoral fellowship in the laboratory of John Huguenard, an expert in the field of epilepsy research, along with normal and pathological mechanisms of thalamocortical function. Currently, I am working on trying to understand how circuit alterations which result in absence seizures can also mediate attentional impairments observed in epileptic patients.

Chasing peptides

An interview with Dr. Timothy Cunningham by Surya Pandey

Dr. Timothy Cunningham has been with the Department of Neurobiology and Anatomy since its beginning. From cab driving in Honolulu to discovering a CHEC-9 peptide moiety, Dr. Cunningham's life speaks of passion and perseverance. Here is a snippet of his extraordinary journey.

SP: What brought you to Drexel (then MCP)?
TC: After my post-doc at Vanderbilt, I had been offered a position at University of Chicago in addition to other places. Interestingly, those were the very positions vacated by Michael Goldberger and Marion Murray who had left UC to start a program here. I decided to follow them instead. At the time, neuroplasticity was just getting off the ground and during my graduate and post-doc years, we were studying anatomical and physiological changes that accompany early lesions, and that was a relatively new area. So, I decided to come here because some of the original people interested in plasticity were here.

SP: Do you remember your first day at MCP?
TC: I remember my seminar during the interview. There was a skeleton in the conference room and I asked them if that was the last applicant. I don't remember my first day. I must admit I was a little bit of a partier. So, I don't remember much.

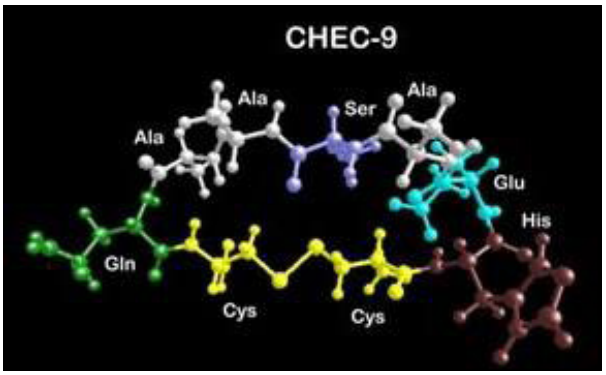
SP: How were the early years?
TC: Shortly after the group got together, they applied for the first Program Project grant. Two were granted that year, one to Harvard and one to us. We were a concentrated group of plasticity people who were excited to advance the field. The Program Project went on for a while and then we all got individual grants. I went on for about 20 years trying different things. Then I discovered something and that's when my life got terrible.

SP: Please take me on your journey with DSEP peptide.
TC: We were doing plasticity—lesioning brain areas and observing how the pathways reorganized. Then, it became clear that in order to affect the CNS it was important to investigate at the molecular level and that's when I got into protein chemistry. We were interested in molecular factors that neurons produced as a protective mechanism to thwart inflammatory cells during tissue damage. So, we stressed a human neural cell line in tissue culture with hydrogen peroxide, assuming such self-protective agents would be produced by the cells. After repeated trials, we finally isolated and identified the amino acid sequence of a novel human polypeptide called DSEP (for diffusible survival evasion peptide) from the culture medium of these cells. It turns out, the C-terminus of this polypeptide has some antimicrobial property, which a group in German synthesized and called Dermcidin. That was C-terminus, I purified the N-terminus and that's how we got the full-length protein. Now, although the C-terminus has antimicrobial property, every time a full peptide was transfected, it resulted in activation of the survival protein making family, and the N-terminus tended to dominate this activity. So, I wiggled away N-terminus, shorter and shorter until I found the smallest active molecule possible, which we called CHEC-9. This was important to make it more drug-like for efficient manipulation and better chance of absorption by the system. We tested this molecule systemically, injecting into the bloodstream, as well as orally, and we observed biological activity. In my most recent work with this molecule, I have shown its activity in human blood. The manuscript is in review. I think it is a jump-up from animal models in vivo to human plasma, to show that it works in human circulation.

SP: What does CHEC-9 do?
TC: We demonstrated that CHEC-9 inhibits secreted phospholipases A2 (sPLA2), enzymes traditionally thought to be part of the acute or early response to inflammation. Most recently, we have demonstrated its role in breaking down neuronal aggregates. Molecules that operate on inflammation often operate on aggregates. It appears that this molecule acts through heat-shock protein 70 (HS-70) to inhibit aggregate formation. In fact, when we inhibit HS-70 using antibody or inhibitor, the inhibition disappears. So, we have discovered a novel role for this molecule that may be important for reversing some of the pathology like amyloid-beta accumulation seen in Alzheimer's disease.

SP: I work with molecules that have already been discovered. So, the idea of discovering a new molecule fascinates me. What goes into this process?
TC: A lot of luck. You have to make decisions at every step. First you start with a biologically active soup, fractionate it based on size, charge, hydrophobicity, to isolate biologically active ingredients. Then you test these various fractions for biological activity until you get one that consistently gives you results. Finally, you sequence the molecules. When the sequencing comes back, it's usually albumen or immunoglobulin, proteins that are present in abundance. You could have a trace molecule in there, but you are going to get the most abundant ones that stick

to everything. That was the case for us for two years. Then, I got it down to a point where the soup was pure enough that we could get a dominant sequence out of it. I wasn't sure if that was the only thing there, but that soup tended to work. I didn't have the money at the time, but with Itzhak's support I was able to synthesize the molecule and that was it. So, in addition to luck, you need someone to believe you too. It was really Itzhak who kept it going.



SP: Do you remember any experiments where you had unexpected or opposite finding?
TC: That was the case all the time, at least once a week. You may see activity with a soup, you add this to pyramidal cells and they look beautiful, and then when you try it in vivo, suddenly it stops working; you see nothing, or sometimes it works in completely unexpected way, killing off cells. And you don't know whether it's concentration, or contamination, or something else. That happens all the time. But you go back and start again with the same or another soup.

SP: What would you say is your most important contribution to neuroscience?
TC: Early on I wrote a review article for International Journal of Cytology where I discuss the various processes by which neurons die. I introduced the idea that nervous cells also die by apoptosis, a mechanism by which cells outside the nervous system die. I believe that generated a lot of discussion in the field and contributed to the future discoveries surrounding neuronal survival and death. I'd say that was my most scholarly contribution. On the other hand, my discovery of the peptide moiety was a more practical contribution to the field. We have yet to see if this will prove meaningful clinically.

SP: What have you changed your mind about and why?
TC: I used to trust that people were generally of good will. I took it that everybody was trying to be supportive and kind. But, perhaps because of how the current socio-political scenario is playing out, it has hit me that that is not the case, that the world is made of a bunch of self-centered and mercenary people who are in it because of money. I suppose I have transitioned to realizing that there are real inequities in society. A lot of people you thought had pure motives are just out for themselves. I believe the basic driving force of humans is to increase life expectancy of the species. I hope we will eventually factor in genuine compassion to that idea.

SP: What is your favorite explanation?
TC: I'd have to say Darwin's Origin of Species. It was the most impressive thing I ever read. The other one would be Freud's Interpretations of Dreams. They are observational, not experimental, but they certainly tell fascinating stories.

SP: Do you have a favorite scientist?
TC: Michael Goldberger; he certainly influenced my work and career.

SP: Why do you do what you do?
TC: Basically, because if I didn't I'd be on the streets. But seriously, I do it simply to be useful. I got into neuroscience sort of by accident. During my undergraduate we had a talk from an electrophysiologist from University of Washington working on hypothalamus, and that was the coolest thing I had ever seen or heard and one that interested me the most. So, after college, I had applied to a program called Biological Structure at University of Washington. In the meantime, I was a cab-driver in Honolulu essentially driving people in shopping malls to their homes, if they knew how to get there (there was no GPS). Then, when that wasn't making me much money, I took a job at a pineapple factory as a chemist. Then one day, I got a telegram saying my application was accepted. I couldn't even remember I had applied. So, when that telegram came about I decided to move to Seattle and started my graduate school.

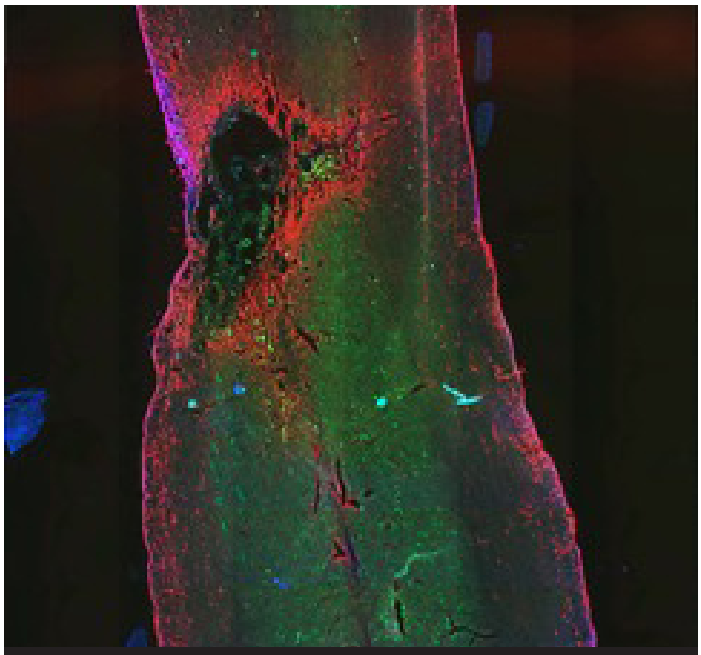
SP: How has the department changed over the years?
TC: It has increased in size and diversity, and both of those aspects have been orchestrated very well by Itzhak. We were a small and focused group of researchers. Now we have labs with a wide range of interests. Despite the growth, there still seems to be enough cohesiveness and harmony within the group.

SP: Has your role changed in the department?
TC: Certainly! I have taken more administrative roles as the years progressed. The most valuable thing I do now is the Journal Club with graduate students. I keep current and that's a place where I can bring a whole lifetime of experience to the analysis. Science is based on skeptical analysis which is necessary for the rigor and I have been trying to impart that upon students.

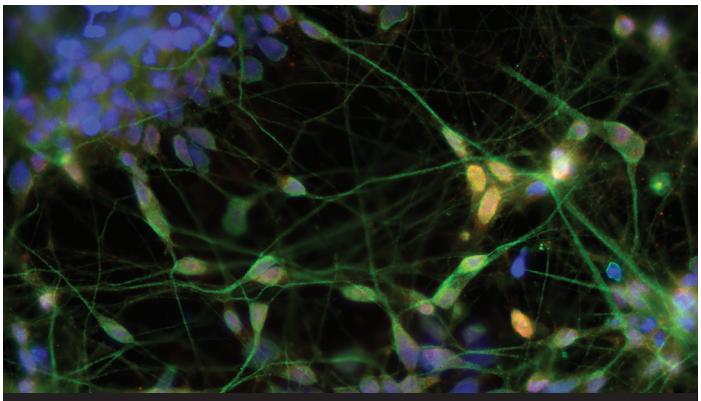
SP: What do you do when you're not doing science?
TC: I like to write. More recently, I have discovered the audio-books, which I enjoy. Lately, I have been interested in basic matters of reality. So, I find myself educating and ruminating on those topics.

SP: What is your advice for young scientists like myself?
TC: Do something extraordinary! Be bold! Try something that's high risk. If you have an idea, try to pursue it until you realize you were either right or wrong. And don't be afraid to ask something that you may think will make you look stupid. If you do that, you'll know that you can survive the embarrassment, and you will know to be more precise in your curiosity.

Creations



Celestial tissue of star dust (Spinal Cord tissue section) - Silvia Fernandes



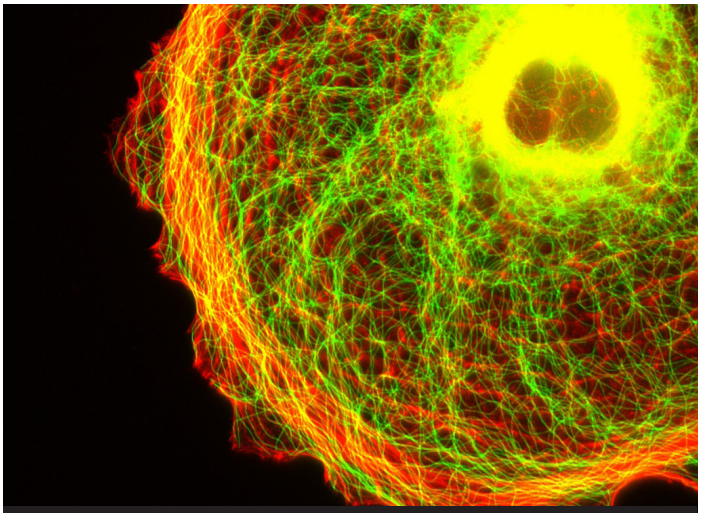
Human induced Pluripotent Stem Cells differentiated into neurons. These neurons will model Gulf War Illness and study related microtubule behaviors in the culture dish. - Philip Yates

A HISTOLOGY HAIKU:

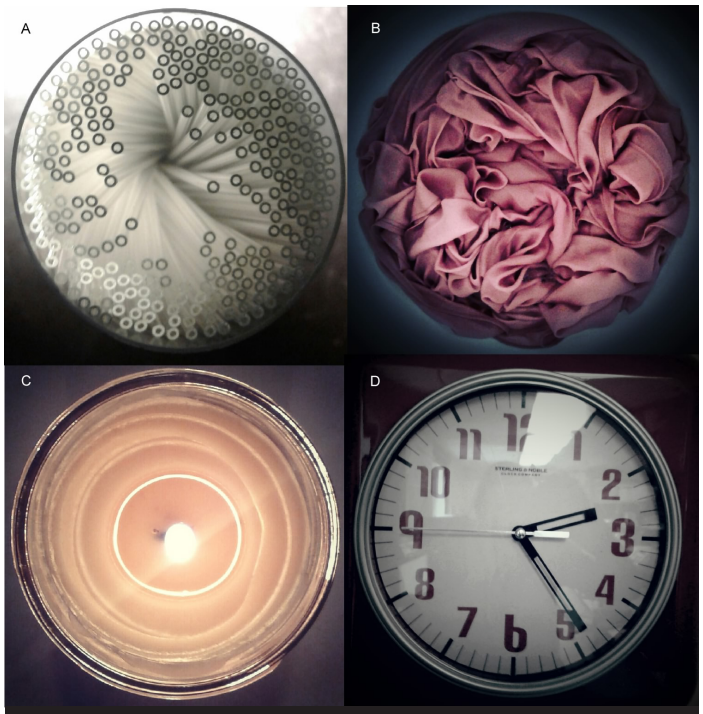
Mounting minds of mice
Ghosts of baby butterflies
Fixed, we seek their flight

Linda Chamberlin

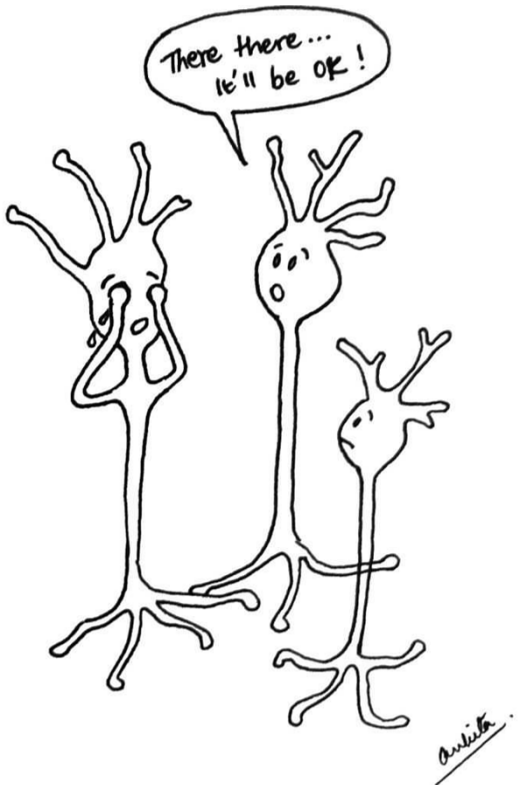
"Road to Mt. Hood" (watercolor on paper) - Megan Detloff, PhD



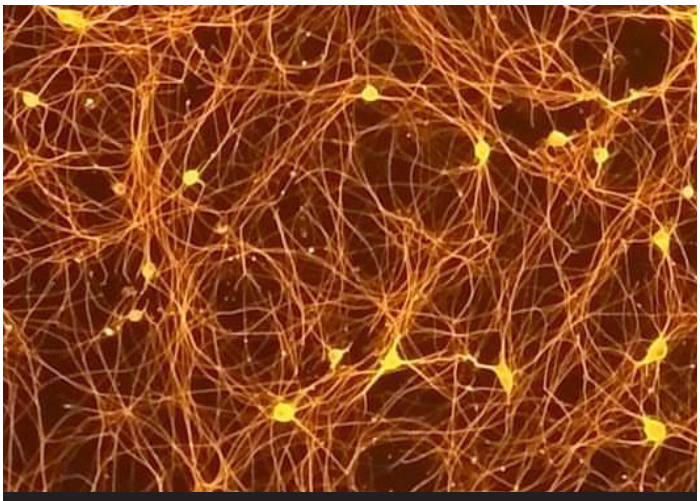
"What's that cell?" - Hemalatha Muralidharan



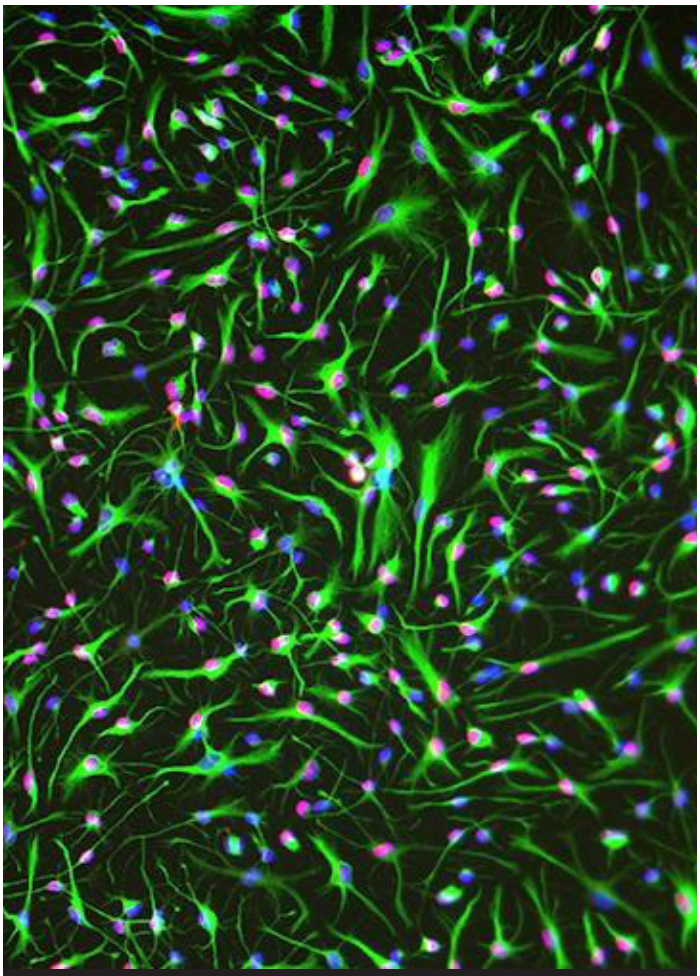
Array of Circles. A) Peering into my future. Micropipettes that will be heated to a point and snapped in half, filled with a mimic of liquid life, and used to peek inside a cell, electric and alive on a sheet of glass. B) Laundry. A swirling and tissue-like orb of skirt, spun by hand at home. C) Concentric. A candle lit for fewer hours than the time before leaves a nested waxen memory canyon in which the flame will flicker. D) Pointing hands. Three arrows sweep their endless arcs, dessous and dessus, chassent en tournant to pass the time. - Linda Chamberlin



Sympathetic neurons - Ankita Patil



A dense network of sympathetic neurons from the rat superior cervical ganglion. Long and relatively straight, the processes of these neurons serve as a useful medium in which to observe microtubule-related phenomena. - Ankita Patil



Proliferating nerve cells
green: Nestin (intermediate filament protein)
blue: DAPI staining nucleus
pink: double staining of DAPI and Ki67
(marker of proliferating cells)
- Surya Pandey

A life with cells

An interview with Maryla Obrocka by Surya Pandey

Maryla has spent over 20 years in the Department of Neurobiology and Anatomy as a research assistant. Her passion for contributing to science through research set her on a journey from Poland to the United States. We asked her about her time with our department.

SP: What brought you to Drexel (then MCP)?
MO: I first came to the states because I got a position at Wistar Institute. I wanted to improve my English and make better money. Of course, neither worked very well. I realize that when you come to a different country, one year is not enough. I thought I'd make enough money in a year to go back to Poland and buy an apartment; I didn't want to be here. But life started to feel better here and one year became two and three and here I am. I am glad about my decision though; now I love it here. After three years at Wistar I moved to University of Pennsylvania to work with John Trojanowsky and Virginia Lee who were working on Alzhiemer's disease at the time. I was their first technician. After four years at Penn I went to a private company where I worked to produce antibodies in mice. When the company went bankrupt, I was looking for jobs and I came across Dr. Fischer's ad.

SP: Do you remember your first day at MCP?
MO: Yes! I had two big surprises on my first day. I came to MCP from these fancy places like Wistar and Penn. So, the decrepit building of MCP was a bit of a shock. We had a long corridor with labs on each side. The space was small. The elevator was slow and often smelly, likely because of the events happening at the asylum in the floors below us (later, I remember, I often tried to walk to the 9th floor. I was out of breath at the 6th). Anyway, I didn't mind; I was thankful I had a job. I find it funny now that we were in those conditions. Second surprise came when I found out that a friend from Poland who I knew was in the states somewhere, not only was in that same building that day but also worked in this same lab. So, I was quite amazed my first day.

SP: What motivates you to come to work every day?
MO: I like it. It's the idea that when I am part of somebody's experiment I am part of a bigger machinery and I am contributing to its workings. It's meaningful to me that I am doing something useful.

SP: What meaning do the cells under the microscope hold for you?
MO: I think there are two different things about them. Sometimes they are wonderful pieces of art. I remember a few years ago, when I was looking at a dish of cells, they had shapes of flowers and animals. It's quite artistic. The next thing is you realize that they are living things and they are factories where a lot is happening. They have their own life and when you inject them in animals they become a part of the bigger machinery. Then, when you force them in a different environment, manipulating whatever growth factor, they can become something else. It's fantastic how they can take different identities.

SP: You have worked in both industry and academia. What has been your experience?
MO: When I was at the company, I made good money, but I had to earn every penny. The company was much closer to my house and I could work long hours, but I didn't have time to spend the money I was making. Weekends went by recuperating for the following week. I am much happier here making less money but living a more fulfilling life with less stress and more time to enjoy other things in life. So, remain where your passion is and where you really love to be. Research in companies are largely motivated by money whereas in the academia it's usually about real passion for science and discovery, which involves years and years of hard work, without the equivalent monetary reward.

SP: In your view, how has our department changed?
MO: We have grown but not too big that we are isolated. We are a friendly and helpful group.

SP: What do you do when you are not at work?
MO: I like to read, mostly history of things and events. Recently I picked up A History of World in 6 Glasses by Tom Standage. It's interesting; I learned it was the rum, before tea, that led to the big revolution in the US. I also enjoy gardening, going to movies, and theatre.

SP: What's your plan for the next 5 years?
MO: My first plan is to stay alive. I would like to work as long as I am able to. I'd like to be useful.

SP: With your years of experience in the field of research, what is your advice for young researchers?
MO: First, be true to yourself. Because if you don't like what you do, it will not help you. When you love what you do, then you will do well.

ALUMNI REPORT

A mighty mentor

by Maureen Helgren PhD, PT (Class of 1991)
Associate Professor and Chair, Physical Therapy Department, Quinnipiac University

When I was in graduate school in the late 80s, we had a three-phrase mantra: 1) see one, 2) do one, 3) teach one; steps one and two optional. I was so intimidated by this mantra when I realized it was not a joke. Michael Goldberger (MG) was my mentor and he came back from some international meeting and reported that he invited colleagues to the lab for us to teach them the surgical approach to remove the habenula nuclei. Thanks to TC in Marion Murray's lab, the visitors learned the surgery. Michael's confidence in this crazy mantra (minus steps one and two) was rooted in his brilliance and his capacity to advance the abilities of those who worked with him. In retrospect, his expectations were inspiring. If I were to give advice to my younger self entering graduate school I would propose three things: 1) be prepared to say "yes" even if it appears to be outside your plans, 2) understand how your leisure time molds you as a person, 3) secure a good mentor. I still think 1 and 2 are important, but the path of my life would be categorically different if I had not had the wonderful opportunity to be mentored by MG.

I came to Drexel (actually the Medical College of Pennsylvania on Henry Ave) after working for a few years as a physical therapist. My plan was to attend graduate school to enhance my education, return to clinical work, and be a better physical therapist. I said yes to Dr. Goldberger when he offered me to study under his guidance. I said yes and received much more than a PhD in Anatomy and Neurobiology. I find Michael's influence in all my career decisions. I may never be as smart as him (his intellectual capacity for deciphering the nervous system was staggering), but I carry his passion with me every day.

I did not return to clinical practice after defending my thesis. I had more knowledge, and in theory, I would have been a more competent therapist, but the significance of contributing at the level of the individual was no longer my aspiration. My yearning was to elucidate the mechanism of recovery of function, or perhaps developing the methodology to prove what Michael understood. I was waiting for technology to catch up in order to provide the evidence. Michael's focused lifework on the recovery of function exposed many students to the value of perseverance, and motivated many to commit their lifework to improve the lives of others.

My plan for a post-doc was to find a good lab at an R1 institution, preferably on the US East Coast or in Sweden. I accepted a post-doc position at a pharmaceutical company. The biotech industry was an option I had not considered but Regeneron Pharmaceutical Co. in the 1990s was a blast. It continues to be an impressive company. The possibilities seemed endless. My desire was to learn molecular biology (hot technology at the time) and I remember MG telling me, "sure, learn some fancy techniques, but don't ignore the behavior, the real outcome." He gave great advice. When my post-doc was complete I was asked to stay on as a scientist in neurobiology and be a part of the team developing animal models for neurological diseases. I loved my time at Regeneron and I am glad that I did not compromise on pushing the value of behavioral outcome measures.

My decision to leave Regeneron was difficult. Through clinical trials of pharmacological agents, I had the opportunity to integrate my clinical skills as a physical therapist and my deeper understanding of the motor function and recovery following the nervous system insults. At the same time, I had an opportunity to teach in the physical therapy program at Quinnipiac University and to collaborate in a neurobiology lab at Yale. Michael was no longer around that I could seek advice, but his voice was (still is) ever present to me—see one, do one, teach one. I accepted the academic position and through the years I have had the honor to teach neurophysiology, neuropathophysiology, research, and human anatomy. I admit that I miss working full time in research, but I love teaching. Michael would not admit that he loved teaching his graduate students, but his actions conveyed a different message. He loved to challenge people (on all topics) and we took his bait. Challenging a new generation to be just and to use their educational privilege was a notion MG instilled in me and I carry that message with me every day.

Michael had a way of influencing people to confront their role in humanity. He encouraged leadership as a means to have impact on larger populations. He led with integrity and I have learned from his example. I may not have Michael's hutzpah, but I carry his passion to my work. In January 2018, I will assume the role of the Director of Anatomy at the Frank Netter School of Medicine at Quinnipiac University. The aim of this relatively new medical school is to train MDs in primary medicine, inter-professional practice, and global health. I think Michael would be pleased with this focus and I hope to represent his legacy well.

Graduates *of 2017*

Anand Rao

Adviser: Peter Baas, PhD

Thesis Title: A Dynein-Based Mechanism, Repurposed from Neuronal Migration, Establishes and Preserves Microtubule Organization in the Axon
Defense date: January 8th, 2017
Current position: Postdoctoral Scholar at Stanford University; Co-Founder of XSO, LLC.

Lauren Hanlon

Adviser: Ramesh Raghupathi, PhD

Thesis Title: Microglial Reactivity and Functional Deficits Following Traumatic Brain Injury in the Neonate Rat
Defense Date: February 23, 2017
Current Position: Postdoctoral Researcher in the Department of Bioengineering and the Department of Neurosurgery at the University of Pennsylvania

Brett Cornell

Adviser: Kazuhito Toyooka, PhD

Thesis Title: 14-3-3 Proteins in Neuronal Migration and Neuromorphogenesis during Cortical Development and Neurodevelopmental Disorders
Defense Date: March 24th, 2017
Current Position: Adjunct Assistant Professor, College of Saint Benedict and Saint John's University

Yelena Gulchina

Adviser: Wen-Jun Gao, PhD

Thesis Title: NMDA Receptor Dysfunction in the Developing Prefrontal Cortex in Two Animal Models for Schizophrenia: Expression profile, epigenetic mechanisms, and physiology
Defense Date: April 5, 2017
Current Position: Postdoctoral Associate in the Translational Neuroscience Program in the Department of Psychiatry at the University of Pittsburgh

Brielle Ferguson

Adviser: Wen-Jun Gao, PhD

Thesis Title: Elucidation of the mediodorsal thalamic regulation of PFC-dependent behavior
Defense Date: August 3rd, 2017
Current Position: Postdoctoral Fellow in the Huguenard Lab at Stanford University

David Bernstein

Adviser: Rodrigo Espana, PhD

Thesis Title: Hypocretin Receptor 1 Knockdown in the Ventral Tegmental Area Attenuates Mesolimbic Dopamine Signaling and Reduces Motivation for Cocaine
Defense Date: November 28th, 2017
Current Position: Postdoctoral Fellow in the Mosca Lab at Thomas Jefferson University

Victoria Spruance

Adviser: Michael Lane, PhD

Thesis Title: Neural progenitor transplantation to improve breathing function after cervical spinal cord injury
Defense Date: December 11th, 2017

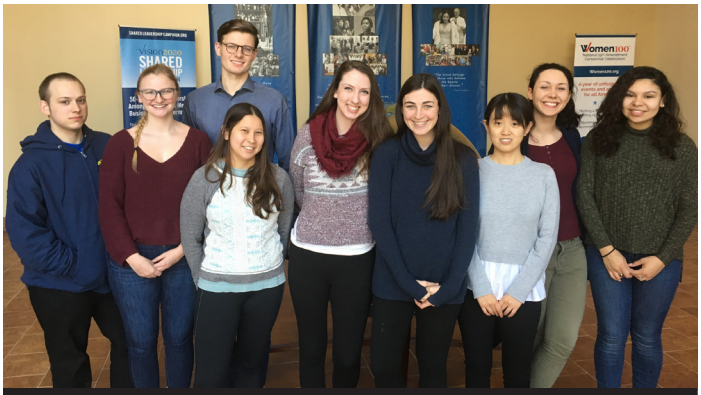
First Years *of 2017*

Master's Program:

Cassandra Alexandropoulos
Andrey Borisyuk
Tucker Collins
Jordan Eason
Abreah Little
Avery Runyan
Ioanna Yiantsos

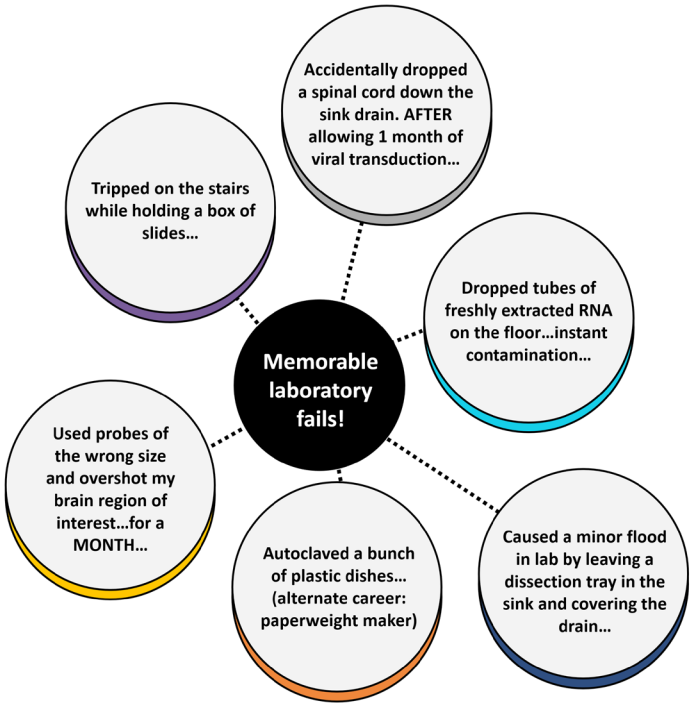
PhD Program:

Sarah Bennison
Phillip Clark
Moriah Harling
Nancy Mack
Dillon Malloy
Micaela O'Reilly
Shasha Yang

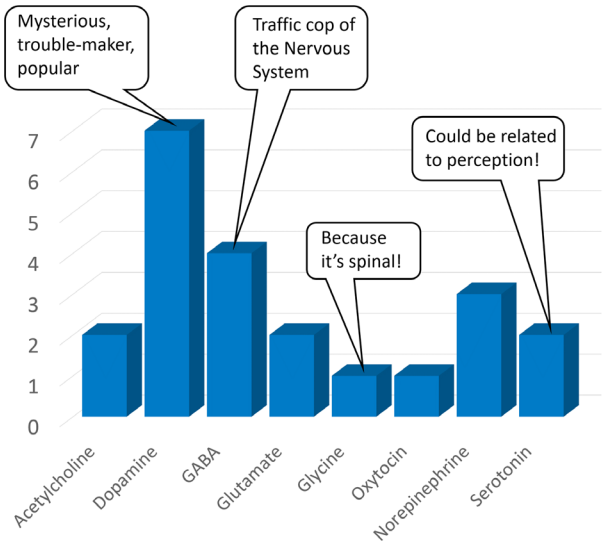


Some of our new students - (L-R) Tucker Collins, Sarah Bennison, Andrey Borisyuk, Avery Runyan, Micaela O'Reilly, Nancy Mack, Shasha Yang, Cassandra Alexandropoulos, and Abreah Little.

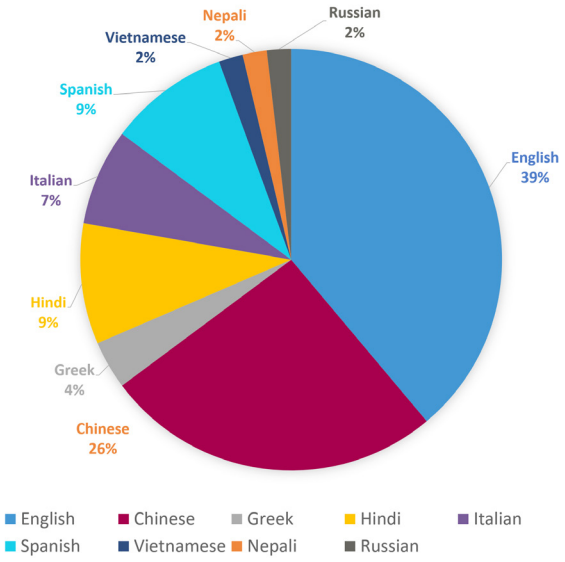
Culture



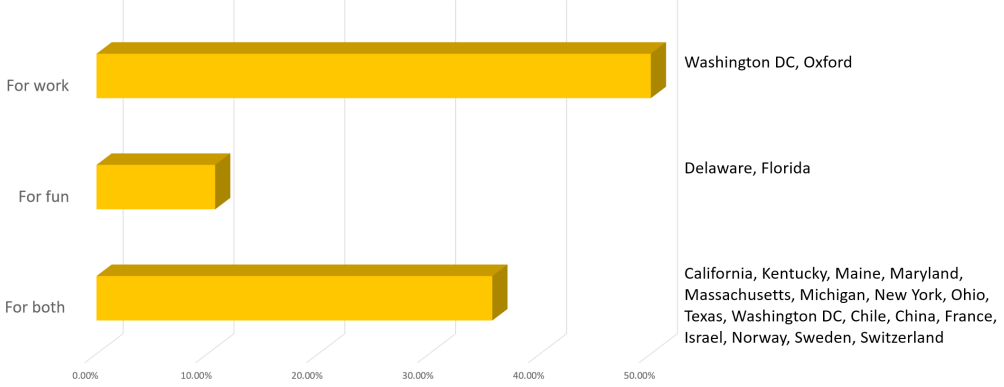
What is your favorite neurotransmitter and why?



How many languages are spoken in your lab?



Did you travel in 2017?



Outreach

Advanced Artistic Anatomy

The Department of Neurobiology & Anatomy hosts a course in human anatomy unlike anything else in the country. This course in Advanced Artistic Anatomy, sponsored by the Fleisher Art Memorial, brings art students into our gross anatomy lab to use the medical school cadaver dissections as models.

Michael Grimaldi, the instructor, has a gift for explaining how to visualize anatomy as it presents itself in life, and transfer that visualization to paper or other media. In his words, "this is an enormous opportunity for my students and me to learn and apply first-hand knowledge of anatomical concepts to our work."

He adds, "as we move towards our shared goals of being able to perceive and translate the forms and structures of the human body with increased intelligence, we also allow the important contemplation of the relationship between science and art and the humanities by opening a crucial but often neglected dialogue."

This unique collaboration has been featured on the Emmy nominated WHYY-TV's (PBS) FRIDAY ARTS program in a story called "THE GROSS LAB."
(see link - https://whyy.org/segments/the-gross-lab-4/)

Taste of Science

Taste of Science is an annual science festival held simultaneously in multiple cities across the country, where local researchers are invited to give short talks on their work and its implications for society.

The Philadelphia team for the 2017 Taste of Science consisted of six students from our department—Andrew Matamoros, Brielle Ferguson, Sarah Monaco, Victoria Spruance, Eugene Mironets, Hemalatha Muralidharan, and Ankita Patil. Talks are hosted at local eateries to create a casual atmosphere where community members can interact with scientists, learn about the latest advancements, and ask questions.

By making contemporary science and scientists more accessible, we hope to build public awareness and support of scientific research. Our events took place over three days in April at different locations in Center City.

We had our biggest attendance yet this year, with about 85 attendees at each event! The speakers included experts of diverse research backgrounds and the topics ranged from universe expansion theories to conservation biology to renewable chemistry. We look forward to the next round of Philadelphia Taste of Science in April 2018.

Medical Student for a Day

In 2003, Theresa Connors started the Medical Student for a Day. Through this program, middle and high school students interested in the health professions visit the Queen Lane campus to interact with medical students, graduate students, post-docs, and faculty in actual and simulated class sessions. The program has grown over the years, and now includes students from over a dozen area schools. The visitors represent a cross section of students with a special focus on schools in economically depressed areas of Philadelphia and the suburbs to ensure that their students have access to this unique educational opportunity.

The visitors spend time in Gross Anatomy and Medical Neuroscience labs, and in sessions on Orthopedic Anatomy and holistic vs conventional medical practices. They also participate in discussions about study techniques, college pursuits, and career options with Drexel medical and graduate students and faculty. These visits have a significant impact on the students' views about education and on career choices, with some going on to attend Drexel University College of Medicine as medical students.

The program would not be possible without the student, post-doc and faculty volunteers from the Department of Neurobiology & Anatomy who do fantastic presentations for the visiting students throughout the academic year. Association with the Office of Community Experience, the SIM Center and other resources at Drexel University College of Medicine are in the works. If anyone is interested in participating in future visits, please contact Theresa Connors at tc42@drexel.edu or X8307.

Activities

Signs made by our students for the March for Science

Drexel students win awards at Asilomar

Pumpkin carving!

Students at the 2017 GSA Halloween Party

Dr. Megan Detloff celebrating her talk at the International Symposium on Neural Regeneration (ISNR) at Asilomar

Students participated in MLK Day of Service by re-painting the walls of a local school activity center

Publications

BAAS LAB

Leo, C. Weissmann, M. Burns, M. Kang, Y. Song, L. Qiang, S.T. Brady, P.W. Baas, and G. Morfini. 2017. Mutant spastin proteins promote deficits in axonal transport through an isoform-specific mechanism. Human Molecular Genetics 26: 2321-2334.

Rao, A.N., A. Patil, Z.D. Bronik, L. Qiang, R.A. Espana, K.A. Sullivan, M.M. Black, and P.W. Baas. Pharmacologically increasing microtubule acetylation corrects stress-exacerbated effects of organophosphates on neurons. Traffic 18: 433-441.

Solowska, J.M., A.N. Rao, and P.W. Baas. 2017. Truncating mutations of SPAST associated with hereditary spastic paraplegia indicate greater accumulation and toxicity of the M1 isoform of spastin. Molecular Biology of the Cell 28: 1728-1737.

Qiang, L., A.N. Rao, G. Mostoslavsky, M.F. Comfort, K. Sullivan, and P.W. Baas. 2017. Reprogramming cells from Gulf War veterans into neurons to study Gulf War Illness. Neurology 88: 1968-1975.

Rao, A.N., A. Patil, M.M. Black, E.M. Craig, K.A. Myers, H.T. Yeung, and P.W. Baas. 2017. Cytoplasmic dynein transports axonal microtubules in a polarity-sorting manner. Cell Reports 19: 2210-2219.

Austin, T.O, A.J. Matamoros, J.M. Friedman, A.J. Friedman, P. Nacharaju, W. Yu, D.J. Sharp, and P.W. Baas. 2017. Nanoparticle delivery of fidgetin siRNA as a microtubule-based therapy to augment nerve regeneration. Scientific Reports 7: 9675.

Craig, E.M., H.T. Yeung, A.N. Rao, and P.W. Baas. 2017 Polarity sorting of axonal microtubules: a computational study. Molecular Biology of the Cell. Epub ahead of print.

Rao, A.N., and P.W. Baas. Polarity sorting of microtubules in the axon. Trends in Neuroscience, in press.

BARSON LAB

Barson JR, Leibowitz SF. 2017. Orexin/Hypocretin system: Role in food and drug overconsumption. Int Rev Neurobiol. 136:199-237. doi: 10.1016/bs.irn.2017.06.006. Epub 2017 Aug 8.

Bernstein DL, Badve PS, Barson JR, Bass CE, España RA. 2017 Hypocretin receptor 1 knockdown in the ventral tegmental area attenuates mesolimbic dopamine signaling and reduces motivation for cocaine. Addict Biol. Oct 2. doi: 10.1111/adb.12553. [Epub ahead of print]

Pandey S, Badve PS, Curtis GR, Leibowitz SF, Barson JR. 2017. Neurotensin in the posterior thalamic paraventricular nucleus: inhibitor of pharmacologically relevant ethanol drinking. Addict

Biol. Sep 6. doi: 10.1111/adb.12546. [Epub ahead of print]

Poon K, Barson JR, Shi H, Chang GQ, Leibowitz SF. 2017. Involvement of the CXCL12 system in the stimulatory effects of prenatal exposure to high-fat diet on hypothalamic orexigenic peptides and behavior in offspring. Front Behav Neurosci. May 17;11:91. doi: 10.3389/fnbeh.2017.00091. eCollection 2017.

CÔTÉ LAB

Côté M.-P., Murray M.M. Lemay M.A. (2017) Rehabilitation strategies after spinal cord injury: Inquiry into the mechanisms of success and failure. J. Neurotrauma. 34:1841-1857. PMID: 27762657.

Wu D, Klaw MC, Connors T, Kholodilov N, Burke RE, Côté M-P, Tom VJ (2017) Combining constitutively-active Rheb expression and chondroitinase promotes functional axonal regeneration after cervical spinal cord injury. Molecular therapy, in Press.

Hormingo K.M., Zholudeva L.V., Spruance V.M., Marchenko V., Côté M.-P., Vinit S., Giszter S., Bezdudnaya T., Lane M.A. (2017) Enhancing neural activity to drive respiratory plasticity following cervical spinal cord injury. Exp. Neurol. 287(Pt 2):276-287. PMID: 27582085.

DOUGHERTY LAB

Gosgnach S., Bikoff J., Dougherty K.J., El Manira A., Lanuza G., and Zhang Y. Delineating the diversity of spinal interneurons in locomotor circuits. J Neurosci, In press for Nov 2017 issue.

Caldeira, V., Dougherty, K.J.#, Borgius, L., and Kiehn, O.# (2017) Spinal Hb9::Cre-derived excitatory interneurons contribute to rhythm generation in the mouse. Sci Rep. 7:41369. #Co-corresponding authors

Zholudeva L.V., Karliner J.S., Dougherty K.J., Lane M.A. (2017) Anatomical Recruitment of Spinal V2a Interneurons into Phrenic Motor Circuitry after High Cervical Spinal Cord Injury. J Neurotrauma. 2017 Jun 29. doi: 10.1089/neu.2017.5045. [Epub ahead of print]

ESPAÑA LAB

Gentile TA, Simmons SJ, Barker DJ, Shaw JK, España RA, Muschamp JW (2017). Suvorexant, an orexin/hypocretin receptor antagonist, attenuates motivational and hedonic properties of cocaine. Addic Biol, doi: 10.1111/adb.12507

Escobar AP, González MP, Meza RC, Noches V, Henny P, Gysling K, España RA, Fuentealba JA, Andrés ME (2017). Mechanisms of kappa opioid receptor potentiation of dopamine D2 receptor function in quinpirole-induced locomotor sensitization in rats. Int J Neuropsychopharmacol. doi: 10.1093/ijnp/pyx042PubMed [journal]PMID: 28531297

Rao AN, Patil A, Brodnik ZD, Qiang L, España RA, Sullivan KA, Black MM, Baas PW (2017). Pharmacologically increasing microtubule acetylation corrects stress-exacerbated effects of organophosphates on neurons. Traffic doi: 10.1111/tra.12489

Levy KA, Brodnik ZD, Shaw JK, Perrey DA, Zhang Y, España RA (2017). Hypocretin receptor 1 blockade produces bimodal modulation of cocaine-associated mesolimbic dopamine signaling. Psychopharmacology. Epub ahead of print

Brodnik ZD, Black EM, Clark MJ, Kornsey KN, Snyder NW, España RA (2017). Susceptibility to traumatic stress sensitizes the dopaminergic response to cocaine and increases motivation for cocaine. Neuropharmacology. Epub ahead of print

Bernstein DL, Badve P, Barson JR, Bass CE, España RA (2017). Hypocretin receptor 1 knockdown in the ventral tegmental area attenuates mesolimbic dopamine signaling and reduces motivation for cocaine. Addiction Biology. Epub ahead of print

Schelp SA, Brodnik ZD, Rakowski DR, Pultorak KJ, Sambells AT, España RA, Oleson EB (2017) Diazepam concurrently increases the frequency and decreases the amplitude of dopamine transient release events in the nucleus accumbens. J Pharmacol Exp Ther. Epub ahead of print

FISCHER LAB

Marianda TT, Jin Y. Kalinski AL, Fischer I, Twiss JL (2017) Neural progenitor cells promote growth and alter axonal mRNA localization in adult neurons. eNeuro. DOI: 10.1523/ENEURO.0171-16.201.

Lane MA, Lepore LC, Fischer I (2017) Improving the therapeutic efficacy of neural progenitor cell transplantation following spinal cord injury. Expert Rev Neurotherapeutics, (Dec 21:1-8. doi: 10.1080/14737175.2017.1270206. [Epub ahead of print] PMID 27927055).

Hou S, Fischer I (2017) Using neural stem cells to enhance repair and recovery of spinal circuits after injury. Oxford Research Encyclopedia of Neuroscience (in press). http://neuroscience.oxfordre.com

Submitted
Jin Y. and Fischer I (2017) Axonal regeneration of different tracts following transplants of human glial restricted progenitors into the injured spinal cord in rats. Submitted to Brain Research.

GAO LAB

Kimberly Urban, Yan-chun Li, Bo Xing, Wen-Jun Gao (2017) A Clinically-Relevant Dose of Methylphenidate Enhances Synaptic Inhibition in the Juvenile Rat Prefrontal Cortex.
Journal of Reward Deficiency Syndrome & Addiction Science. 2(3):69-77

Meng-Lin Li, Yelena Gulchina, Sarah Monaco, Bo Xing, Brielle R. Ferguson, Yan-Chin Li, Feng Li, Xi-Quan Hu, and Wen-Jun Gao (2017) Juvenile Treatment with a Novel mGluR2 Agonist/mGluR3 Antagonist Compound, LY395756, Reverses Learning Deficits and Cognitive Flexibility Impairments in Adults in A Neurodevelopmental Model of Schizophrenia. Neurobiology of Learning and Memory, 140:52-61

Yelena Gulchina, Songjun Xu, Melissa Snyder, Felice Elfant,

Wen-Jun Gao (2017) Epigenetic mechanisms underlying NMDA receptor hypofunction in the prefrontal cortex of juvenile animals in the MAM model for schizophrenia. J of Neurochemistry, 2017 Jun 19. doi: 10.1111/jnc.14101.

Kimberly R. Urban and Wen-Jun Gao (2017) Psychostimulants As Cognitive Enhancers in Adolescents: More Risk than Reward? Front Public Health, Sep 26;5:260. doi: 10.3389/fpubh.2017.00260. eCollection 2017.
Submitted

Austin A. Coley and Wen-Jun Gao: PSD95: a synaptic protein implicated in schizophrenia or autism? Progress in Neuropsychopharmacology & Biological Psychiatry. (Revision under review)

Brielle R. Ferguson and Wen-Jun Gao: : Thalamic control of cognition and social behavior via regulation of GABAergic signaling and E/I balance in the medial prefrontal cortex. Biological Psychiatry. (Revision under review)

Sha-Sha Yang, Yan-Chun Li, Austin A. Coley, Linda A. Chamberlin, Ping Yu, and Wen-Jun Gao: Cell-type specific and age-dependent development of the hyperpolarization-activated current, Ih, in prefrontal cortical neurons. Frontiers in Synaptic Neuroscience. (Under revision)

Sarah Monaco, Brielle R. Ferguson, and Wen-Jun Gao: Lithium selectively regulates NR2A receptor expression in prefrontal neurons via GSK3β-β-catenin pathway. Neuropharmacology, (rejected, ready for re-submission).

Bo Xing and Wen-Jun Gao: Juvenile treatment with mGluR2/3 agonist LY379268 ameliorates learning deficits via enhancing NMDAR GluN2B function in a developmental model of schizophrenia. Submitted to Neuropsychopharamacology. Rejected. Under revision for resubmission.

GISZTER LAB

Hormigo KM, Zholudeva LV, Spruance VM, Marchenko V, Cote MP, Vinit S, Giszter S, Bezdudnaya T, Lane MA. Enhancing neural activity to drive respiratory plasticity following cervical spinal cord injury. Exp Neurol. 2017 Jan;287(Pt 2):276-287. doi: 10.1016/j.expneurol.2016.08.018. Epub 2016 Aug 28. Review. PMID: 27582085

Mehta R, Cannella M, Henry SM, Smith S, Giszter S, Silfies SP. Trunk postural muscle timing is not compromised in low back pain patients clinically disgnosed with movement coordination impairments. Motor Control. 2017 Apr;21(2):133-157. doi: 10.1123/mc.2015-0049. Epub 2016 Aug 19. PMID: 26623551

HOU LAB

Hou S. *, Saltos T.M., Iredia I.W., Tom V.J. (2017) Surgical techniques influence local environment of injured spinal cord and cause various grafted cell survival and integration. Journal of Neuroscience Methods. 293:144-150. PMID: 28947264

Sharif H, Hou S. (2017) Autonomic dysreflexia: a cardiovascular disorder following spinal cord injury. Neural Regeneration Research 12:1390-1400

Hou S, Fischer I (2017) Using neural stem cells to enhance repair and recovery of spinal circuits after injury. Oxford Research Encyclopedia of Neuroscience. http://neuroscience.oxfordre.com

HOULÉ LAB

Theisen CC, Sachdeva R, Austin S, Kulich D, Kranz V, Houle JD. Exercise and peripheral nerve grafts as a strategy to promote regeneration after acute or chronic spinal cord injury. J Neurotrauma. 2017 May 15;34(10):1909-1914

LANE LAB

Zholudeva LV, Karliner J, Dougherty K, Lane MA (2017). Interneuronal recruitment into phrenic motoneuron circuitry after high cervical spinal cord injury. J Neurotrauma – online

Bezdudnaya T, Marchenko V, Zholudeva LV, Spruance VM, Lane MA (2017). Supraspinal respiratory plasticity following acute cervical SCI. Experimental Neurology - online

Nair J, Bezdudnaya T, Zholudeva LV, Detloff M, Reier PJ, Lane MA*, Fuller DD (2017). Histological identification of phrenic afferent projections to the spinal cord. Respiratory Physiology & Neurobiology, 236:57-68 (*Co-Corresponding Author)

Reier PJ, Hoh DJ, Mitchell G, Behrman AL, Howland DR and Lane MA (2017). Spinal Cord: Repair and Rehabilitation. In: Encyclopedia of Life Sciences. John Wiley & Sons, UK.
DOI: 10.1002/9780470015902.a0021403.pub2,

Hormigo KM, Zholudeva LV, Spruance VM, Marchenko V, Pascale M-P, Vinit S, Giszter S, Bezdudnaya T, Lane MA (2017). Enhancing neural activity to drive respiratory plasticity following cervical spinal cord injury. Experimental Neurology, 287(Pt2):276-287

Lane MA, Lepore AJ, Fischer I (2017) Improving the therapeutic efficacy of neural progenitor cell transplantation following spinal cord injury. Expert Review of Neurotherapeutics, 21: 1-8

In Revision
Spruance VM, Zholudeva LV, Hormigo KM, Bezdudnaya T, Marchenko V, Lane MA (2017). The effects of neural progenitor transplantation on respiratory circuitry and functional recovery following cervical contusion injury. J Neurotrauma (in revision)

Submitted
Zholudeva LV, Iyer N, Spruance VM, Hormigo KM, Bezdudnaya TG, Sakiyama-Elbert S, Lane MA (2017). Transplantation of excitatory neural precursor cells to promote phrenic motor recovery after cervical spinal cord injury. Submitted to J Neurotrauma

Bezdudnaya T, Lane MA, Marchenko V (2017). Breathing and phrenic nerve activity evoked by epidural stimulation following complete cervical spinal cord injury Submitted to J Applied Physiology

Bezdudnaya T, Hormigo TM, Marchenko V, Lane MA, (2017). Spontaneous respiratory plasticity following unilateral high cervical spinal cord injury in behaving rats. Submitted to Experimental Neurology

MARCHENKO LAB

Bezdudnaya T, Marchenko V, Zholudeva LV, Spruance VM, Lane MA. Supraspinal respiratory plasticity following acute cervical spinal cord injury. Exp Neurol. 2017 Jul;293:181-189.

Hormigo KM, Zholudeva LV, Spruance VM, Marchenko V, Cote MP, Vinit S, Giszter S, Bezdudnaya T, Lane MA. Enhancing neural activity to drive respiratory plasticity following cervical spinal cord injury. Exp Neurol. 2017 Jan;287(Pt 2):276-287. doi: 10.1016/j.expneurol.2016.08.018. Epub 2016 Aug 28.

In Revision
Spruance VM, Zholudeva LV, Hormigo KM, Bezdudnaya T, Marchenko V, Lane MA (2017). The effects of neural progenitor transplantation on respiratory circuitry and functional recovery following cervical contusion injury. J Neurotrauma (in revision)

Submitted
Bezdudnaya T, Lane MA, Marchenko V (2017). Breathing and phrenic nerve activity evoked by epidural stimulation following complete cervical spinal cord injury Submitted to J Applied Physiology

Bezdudnaya T, Hormigo TM, Lane MA, Marchenko V (2017). Spontaneous respiratory plasticity following unilateral high cervical spinal cord injury in behaving rats. Submitted to Experimental Neurology

QIANG LAB

Leo, C. Weissmann, M. Burns, M. Kang, Y. Song, L. Qiang, S.T. Brady, P.W. Baas, and G. Morfini. 2017. Mutant spastin proteins promote deficits in axonal transport through an isoform-specific mechanism. Human Molecular Genetics 26: 2321-2334.

Rao, A.N., A. Patil, Z.D. Bronik, L. Qiang, R.A. Espana, K.A. Sullivan, M.M. Black, and P.W. Baas. Pharmacologically increasing microtubule acetylation corrects stress-exacerbated effects of organophosphates on neurons. Traffic 18: 433-441.

Qiang, L., A.N. Rao, G. Mostoslavsky, M.F. Comfort, K. Sullivan, and P.W. Baas. 2017. Reprogramming cells from Gulf War veterans into neurons to study Gulf War Illness. Neurology 88: 1968-1975.

Hu Z, Feng J, Bo W, Wu R, Dong Z, Liu Y, Qiang L*, Liu M*. 2017. Fidgetin regulates cultured astrocyte migration by severing tyrosinated microtubules at the leading edge. Mol Biol Cell. 28:545-553 (* co-corresponding authors).

RAGHUPATHI LAB

Hanlon L.A., Raghupathi R. and Huh J.W. Differential effects of minocycline on microglial activation and neurodegeneration following closed head injury in the neonate rat. Exp. Neurol. 290:1-14, 2017.

Lamprecht M.R., Elkin B.S., Kesavabhotla K., Crary J.F., Hammers J.L., Huh J.W., Raghupathi R. and Morrison B. 3rd Strong correlation of genome-wide expression after traumatic brain injury in vitro and in vivo implicates a role for SORLA. J Neurotrauma. 34:97-108, 2017.

Merkel S.F., Cannella L.A., Razmpour R., Lutton E., Raghupathi R., Rawls S.M. and Ramirez S.H. Factors affecting increased risk for substance use disorders following traumatic brain injury: What we can learn from animal models. Neurosci. Biobehav. Rev. 77:209–218, 2017.

Raghupathi R. and Huh J.W. Age-at-injury effects of microglial activation following traumatic brain injury: implications for treatment strategies. Neural Regen. Res. 12:741-42, 2017.

RYBAK LAB

Kim, T, Hamade, K. C., Todorov, D., Barnett, W. H., Capps, R. A., Latash, E. M., Markin, S. N., Rybak, I. A., and Molkov, Y. I. (2017) Reward based motor adaptation mediated by basal ganglia. Front. Comput. Neurosci. 11:19.
Teka, W. W., Hamade, K. C., Barnett, W. H., Kim, T., Markin S. N., Rybak, I. A., and Molkov, Y. I. (2017) From the motor cortex to the movement and back again. PLoS One. 12(6): e0179288. [PDF]
Molkov, Y. I., Rubin, J. E., Rybak, I. A., and Smith, J.C. (2017) Computational models of the neural control of breathing. WIREs Syst. Biolol. Med., 9 (2), e1371
Barnett, W. H., Abdala, A. P., Paton, J. F., Rybak, I. A., Zoccal, D. B., and Molkov, Y. I.(2017). Chemoreception and neuroplasticity in respiratory circuits. Exp. Neurol., 287: 153-154.
Ausborn, J., Snyder, A. C., Shevtsova, N. A., Rybak I. A., and Rubin, J. E. (2017) State-dependent rhythmogenesis and frequency control in a half-center locomotor CPG. J. Neurophysiol. (in Press). doi: 10.1152/jn.00550.2017.

Submitted:
Danner SM, Shevtsova NA, Frigon A, Rybak, IA. Long propriospinal neurons and gait
expression in quadrupeds: Insights from computational modeling. eLife (under 2nd review).

Ausborn J, Koizumi H, Barnett W, John, TT, Zhang R, Molkov Y I, Smith JC, Rybak I. A. Organization of the core respiratory network: Insights from optogenetic and modeling studies. PLoS Ciomp. Biology (under review).

TOM LAB

Wu D, Klaw MC, Connors T, Kholodilov N, Burke RE, Côté MP, Tom VJ. Combining constitutively active Rheb expression and chondroitinase promotes functional axonal regeneration after cervical spinal cord injury. Mol Ther. 2017 Aug 19. pii: S1525-0016(17)30370-2. doi: 10.1016/j.ymthe.2017.08.011. [Epub ahead of print]. PMID: 28967557

Hou S, Saltos TM, Iredia IW, Tom VJ. Surgical techniques influence local environment of injured spinal cord and cause various grafted cell survival and integration. J Neurosci Methods. 2017 Sep 22;293:144-150. doi: 10.1016/j.jneumeth.2017.09.014. [Epub ahead of print] PMID: 28947264

Wang Z, Nong J, Shultz RB, Zhang Z, Kim T, Tom VJ, Ponnappan RK, Zhong Y. Local delivery of minocycline from metal ion-assisted self-assembled complexes promotes neuroprotection and functional recovery after spinal cord injury. Biomaterials. 2017 Jan;112:62-71. doi: 10.1016/j.biomaterials.2016.10.002. Epub 2016 Oct 5. PMID: 27744221

Submitted
Eugene Mironets1, Patrick Osei-Owusu2, Valerie Bracchi-Ricard3, Roman Fischer3, Elizabeth A. Owens2, Jerome Ricard3, Di Wu1, Tatiana Saltos1, Eileen Collyer1, Shaoping Hou1, John R. Bethea3*, Veronica J. Tom1* Soluble TNFa signaling within the spinal cord contributes to the development of autonomic dysreflexia and ensuing vascular and immune dysfunction after spinal cord injury. Submitted J Neuroscience (revision to be sent out soon)

TOYO-OKA LAB

Wachi, T., Cornell, B. and Toyo-oka, K. Complete ablation of the 14-3-3epsilon protein results in multiple defects in neuropsychiatric behaviors. Behav Brain Res, 2017, 319 31-36.

Cornell, B and Toyo-oka, K. 14-3-3 Proteins in Brain Development: Neurogenesis, Neuronal Migration and Neuromorphogenesis. Front Mol Neurosci, 12 October 2017 | https://doi.org/10.3389/fnmol.2017.00318

Submitted
Blazejewski, S.M., Bennison, S.A., Smith, T.H. and Toyo-oka, K., Neurodevelopmental Genetic Diseases Associated with Microdeletions and Microduplications of Chromosome 17p13.3, Front Genet, submitted

Department of Neurobiology and Anatomy
Drexel University College of Medicine
2900 W Queen Lane, Philadelphia, PA 19129
Tel: 215-991-8400
neurobio.drexel.edu