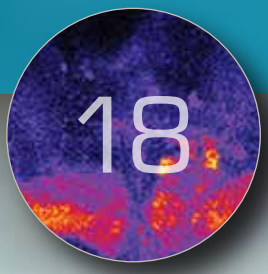
CREATING A SCIENTIFIC LEGACY THAT LASTS

PREPARING SCIENTIFIC THINKERS AND LEADERS FOR THE RESEARCH OF TOMORROW.

STOWERS REPORT

NEWS AND INSIGHT FROM THE STOWERS INSTITUTE FOR MEDICAL RESEARCH SPRING/SUMMER 2017



STOWERS REPORT

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In perspective

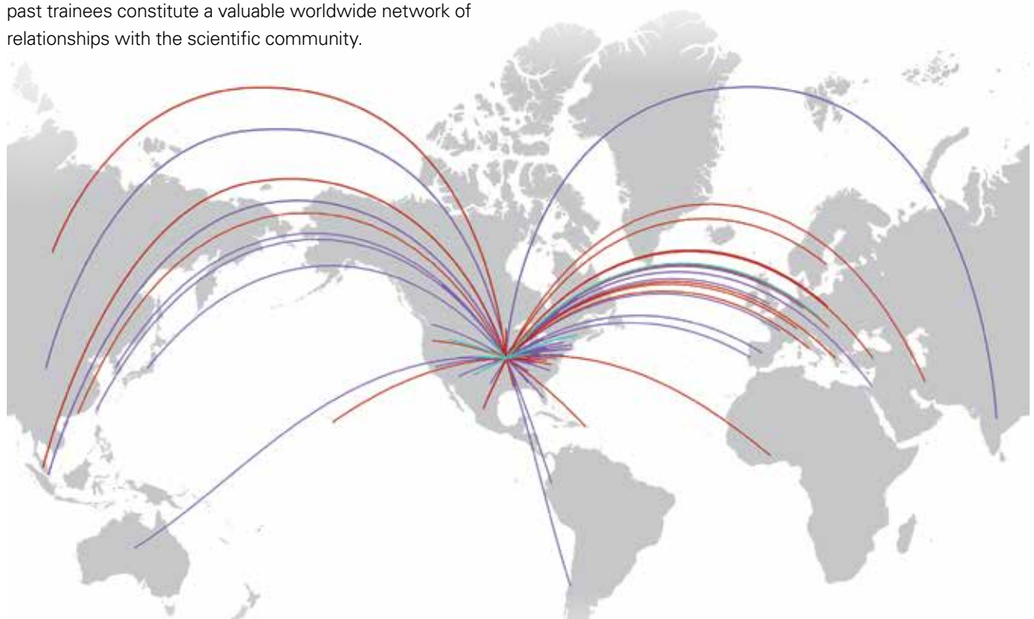
BY DAVID CHAO, PHD
PRESIDENT AND CEO

The Stowers Institute provides an exceptional environment for scientists to pursue answers to some of the world's most challenging and compelling research problems. As the Institute's trainees seek answers today, they are also developing the skills needed to serve as the scientific leaders of tomorrow.

As exciting and enjoyable as it is to see scientific discoveries emerge from the Institute's laboratories, it is equally inspiring and gratifying to watch predocs, postdocs, and other trainees grow in their scientific thinking, skills, and capabilities. The Institute maintains a strong commitment to research training and offers formal and informal opportunities for researchers at all levels. The cover story in this issue of the *Stowers Report* describes how these programs and initiatives work and how new trainees often jump-start research by seeing old challenges from new angles.

For many Stowers trainees, their time at the Institute is one stopover in a much longer career path. From Aberdeen, South Dakota, to Aberdeen, Scotland, our trainees come and go from many different places across the world. As a complement to the Institute's collaborations with colleagues around the globe, our connections with past trainees constitute a valuable worldwide network of relationships with the scientific community.

The Institute is a place where researchers can expect to develop scientific skills with the support and guidance of top-notch mentors and colleagues. What else might researchers gain from their time here? As echoed by several Stowers alumni sharing their subsequent career experiences on a recent return visit, researchers at the Institute also acquire an appreciation for the Institute's culture—its emphasis on collaboration, collegiality and teamwork and its embrace of unconventional thinking and approaches. Scientists trained at the Stowers Institute carry a piece of our culture with them wherever their scientific paths may take them. Our hope is that the Institute's training will have an immediate and direct impact on their future scientific productivity as well as a longer term, and perhaps ultimately more profound, impact in shaping the cultural norms of scientific research around the world.



A route map representing connections of the Stowers Institute to US states and countries through predoctoral and postdoctoral trainees. Lines represent trainee paths: red, incoming; blue, outgoing; purple, bidirectional.

By Marla Vacek Broadfoot

CREATING A SCIENTIFIC LEGACY THAT LASTS

The Stowers Institute's commitment to research includes training the scientific thinkers and leaders of tomorrow

Scott Hawley, PhD, was stumped. He had grappled with plenty of scientific problems over the course of his forty-year career, but this one was different. Hawley was hunting for a mutation that impairs a specific part of the biological machinery responsible for meiosis, the process that gives us eggs and sperm. His tried-and-true methods wouldn't work. He scoured the literature, queried his colleagues, and even held impromptu meetings with his lab, to no avail.

Then one day Hawley embarked on the first in a series of lectures on the nature of mutation. As he stood in front of a classroom, bespectacled and likely donning one of his favorite argyle sweaters, he described how a single mistake in the three billion A's, G's, C's, and T's that make up the tendrils of our DNA can generate disease. Most diseases are recessive, he explained, meaning that they are caused by two copies of a particular mutation. But some diseases, he went on to say, are dominant, triggered by just one copy of a mutation. The moment the words left his mouth, Hawley realized what he needed to do. He had to stop looking for recessive mutations and start looking for dominant ones.

"It was one of the best genetic screens I had ever done," says Hawley, Stowers investigator and founding dean of the Graduate School of the Stowers Institute. "We discovered a new mutation, and that spawned a number of high-profile papers and took my lab in a new direction. Some of the very best moments that I've ever experienced in my research career have come from lectures I've given, which force me to reexamine the basics of my craft."

> "Some of my students are coming up with things that I never thought about. I don't want them to be restricted by the confines of my own understanding."
>
> – Ron Yu, PhD

Other Stowers investigators can share similar stories of inspirational moments gained from teaching, but such moments could be thought of as just positive side effects of a training program well done. The main goal is to cultivate a lineage of expert minds who will answer their own questions and solve their own problems, in laboratories across the country and the world, for decades to come. That way, their impact won't end with any single project or laboratory, but will grow larger over time. Like the ripples on a pond.

Inspiration

When Stowers Investigator Ron Yu, PhD, went to graduate school at Columbia University Medical Center over twenty-six years ago, he was surprised to learn that research was not the clocklike, precise endeavor portrayed in textbooks, but a sometimes messy, unpredictable process.

"I grew up in China, where it was common for educators to teach what was in the textbook as fixed knowledge. They didn't teach students to question," says Yu. "As soon as I started doing research, I realized I needed to question everything, whether it was my own data or a paper in a prestigious journal. Research can be chaotic and not as logical as one might imagine, but it is beautiful and fun because it tickles your mind. It demands as much creativity as solid reasoning."

Today, Yu believes it is important to expose students to the reality of research early on, so they can decide for themselves if a career in science is right for them. He has hosted about fifty undergraduates in his laboratory, including many participants of the Stowers Summer Scholars Program, where students spend eight weeks conducting their own projects and attending scientific seminars. From their first day, Yu puts his students in the driver's seat. He tells them to watch people work, ask questions, and figure out what interests them. They normally end up shadowing one of the senior researchers in the lab, assist with experiments over time, and eventually develop more independence.

"That's my philosophy," says Yu. "I think I carried it from my own mentors, who let me do almost anything of my own choosing. I found it rewarding, and it gave me the freedom to explore. I think that's part of scientific discovery. Some of my students are coming up with things that I never thought about. I don't want them to be restricted by the confines of my own understanding."

Not everyone thrives under such conditions, but for those who do, it can solidify their path to an independent career. Yu has had many students return year after year, and many of his current graduate and predoctoral researchers are former Summer Scholars. In addition to researchers at different stages of training, Yu likes to keep a diverse mix of national and international lab members. "When people from different backgrounds interact, they complement and play off each other, and science in the lab is stronger for it."

Training

Since the Stowers Institute for Medical Research opened its doors in 2000, about 400 undergraduate students, 230 graduate and predoctoral researchers, and 350 postdoctoral researchers have received research training in its labs.

There are a variety programs and opportunities for pursuing an advanced degree at the Institute. Stowers investigators serve as mentors for the thesis projects of predoctoral researchers from three different graduate training programs, including those through the Institute's affiliation with the University of Kansas Medical Center and the Open University, a public distance learning and research university based in the United Kingdom.*

In the fall of 2011, the Institute launched its own graduate school with the vision of having an internal program for developing an elite cadre of young scientists. By design, the program is fast-paced and immersive. The first semester is a series of intensive two-week modules of lectures and lab work focused on specific topics like transcription or proteomics. Every module is run by a set of instructors who are experts in that topic. By the end, the predocs are not only up-to-date on the topics and techniques of the trade, but they have also gotten to know the Stowers faculty members and experts in cutting-edge technologies.

After predocs complete the course modules, they spend six months playing musical chairs, rotating through three different labs before finally deciding where they will spend the next three or four years conducting their thesis project. The Stowers Graduate School has attracted trainees from a dozen countries, and last December, predoc Kobe Yuen became the first to complete all requirements for the PhD degree. Yuen has moved on to a postdoctoral position at the biotech company Genentech in San Francisco.**

Such postdoctoral positions can provide a valuable stepping stone for trainees as they move toward greater independence in their scientific pursuits, often with the goal of being ready to start a lab of their own or take a senior scientist position in private industry or government. Postdoctoral work typically lasts three to five years and gives trainees the opportunity to apply the scientific knowledge and skills they've learned to new areas of research. Over the years, the Stowers Institute has introduced numerous initiatives to support the postdocs among its ranks. Jerry Workman, PhD, a Stowers investigator and head of the Stowers postdoctoral affairs program, has led many of these efforts including a new faculty search group for postdocs who plan to apply for faculty positions, periodic workshops on applying for competitive grant funding, and expanded mentoring opportunities.

*See related story on page 20.
**See related story on page 19.

All of the Institute's predocs and postdocs have the chance to benefit from the outstanding scientific support of Stowers core facilities and technology centers, which allows them to learn and apply different types of experimental approaches to advance their research ideas. In addition to training in research, with input from a group of predocs and postdocs the Institute runs Crossroads, a program focused on providing career advice, ideas, and new skill sets for all levels of trainees. There are also exceptional opportunities for scientific interaction, such as the annual Young Investigator Science Retreat sponsored by Crossroads.

Empowerment

Predoctoral Researcher Devika Salim joined the Institute two years ago after a short time in a graduate program at an Ivy League school. Investigator Jennifer Gerton, PhD, initially brought Salim on as a technician, but she suspected that Salim had a different path ahead of her. At their weekly meetings, Salim would surprise Gerton with bits of knowledge gleaned from the literature. Within a short time, Salim had developed a new droplet digital PCR assay that the lab could use to measure the amount of ribosomal DNA, a notoriously unstable form of genetic material. Shortly thereafter, Salim was generating mountains of data, starting her own thesis project, and working toward a PhD through the Institute's affiliation with the Open University.

Salim credits the Molecular Biology Facility at the Institute with enabling her to accomplish so much so quickly. "It was nothing short of miraculous," she says. More recently, she worked with the Cytometry Facility to develop a single-cell assay for quantifying the instability of ribosomal DNA in yeast.

At the Stowers Institute, researchers have access to the most cutting-edge, advanced technologies available, which Hawley says "teaches them to always work beyond their reach." The Institute houses thirteen core facilities and technology centers run by a support staff of seventy trained scientists, covering practically every aspect of biomedical research from highly technical endeavors like mathematical modeling and electron microscopy to more routine tasks like media preparation and glass washing.

Impact

The scientific research culture at the Stowers Institute encourages not only those in formal training programs but also individuals at any stage of the career continuum to push themselves to the forefront of their field. Undergraduates have embarked upon graduate studies, predoctoral researchers have gone on to earn medical degrees or pursue postdoctoral work, and technicians have returned to school to become managers or leaders of core facilities.

Researchers of all stripes have the opportunity to present their work and get feedback from colleagues inside and outside the Institute through lab meetings, journal clubs, seminars, the Institute's Friday Science Club, and scientific conferences. They can also attend career development events and other activities on campus. For example, the Crossroads group organizes professional and academic development days, which give trainees and others a chance to network with individuals from a variety of sectors such as academia, biotechnology and pharmaceuticals, venture capital, and scientific consulting.*

*See related story on page 25.

Sue Jaspersen, PhD, a Stowers investigator who has trained more researchers than she can count, believes that a successful training program teaches young scientists that it isn't all about them—that their job requires them to support the wider scientific community, to promote science and better society. "The only way to improve our chances of understanding a particular disease or improving health care or solving whatever problem we want to solve is through an intelligently trained workforce. I want to train people to think critically and work independently and look at data skeptically, and then be persuaded, as opposed to believing what they hear. Truth and data and facts matter, regardless of where you end up."

A member of the first entering class of the Stowers Graduate School, Cori Cahoon, is beginning to think about what she will do once she finishes her PhD. The native Californian is leaning toward a postdoc in an academic lab on the West Coast, where she can keep doing basic research and carry on her mentor Scott Hawley's legacy of teaching. Cahoon says one of her most rewarding experiences at Stowers has been training technicians and undergrads in the lab, particularly Nicole Nuckolls, who came to the lab as an undergraduate researcher. Cahoon taught her molecular biology and fruit fly genetics. Nuckolls then applied to and joined the Stowers Graduate School and is currently in Sarah Zanders' lab, where she just submitted her first academic paper for publication.

At the Institute, the role of researchers is not only to generate knowledge but also to train the next generation how to tackle the scientific questions of tomorrow. That effort of preparing others for a lifetime of scientific pursuits can also reinvigorate one's own research, generating fresh perspective when a different way of looking at things is needed.

"Science for me is like a puzzle, and it can be the most frustrating puzzle ever because you don't have all the pieces out yet," says Cahoon. "But when you are surrounded by younger scientists, it can energize you. There are moments when things just click—a real motivation to keep moving and keep reaching for the next level of understanding."

At the Institute, the role of researchers is not only to generate knowledge but also to train the next generation how to tackle the scientific questions of tomorrow.

IN IT TO WIN IT

On Selfish Genes, Meiotic Drive, and Infertility

By Anissa Orr

They put themselves first, don't help others, and will do anything to get ahead. They're "selfish genes," and they have no apparent redeeming qualities, save one—these genetic parasites may offer new insight into infertility, disease, and even evolution.

"They have the power to explain some of the mysteries of biology," says Stowers Assistant Investigator Sarah Zanders, PhD, who is studying how selfish genes wreak havoc on the genomes and organisms they inhabit.

To be fair, selfish genes aren't the only ones looking out for number one. All genes are selfish in a sense. "If you're a gene, your goal is to make it into the next generation. That's how you survive," Zanders says.

But it's the way selfish genes game the system that sets them apart, and makes them so captivating to study. Selfish genes are like parasites, because they do nothing to promote the overall fitness of an organism. Instead, their sole purpose is to survive and spread.

How do they get away with it?

That's what Zanders wants to know. She's exploring the crafty and creative ways meiotic drive genes, a type of selfish gene, hijack sexual reproduction.

LINKS TO INFERTILITY

The trouble starts in meiosis—the form of cell division that creates sex cells, called gametes, like eggs and sperm. During meiosis, a male normally produces sperm having the X chromosome and sperm carrying the Y chromosome in equal numbers, and he fathers sons and daughters at an equal frequency.

But when selfish genes are at work, they can override this process. For example, if the male has a gamete-killing meiotic drive gene on his X chromosome, the sperm carrying that chromosome can destroy the sperm that carry the Y chromosome—killing up to half the sperm.

When the sperm compete to fertilize an egg cell, those with the X chromosome outnumber the ones with the Y chromosome and have greater odds of success. So, the male fathers only daughters. Or he doesn't have enough healthy sperm to have a shot at fertilizing the egg, rendering him infertile. Therein lies a potential paradox: an infertile individual can't pass a selfish gene on to the next generation.

But selfish genes aren't exactly big-picture thinkers, and they continue their self-serving ways. This behavior, called meiotic drive, has been observed across the spectrum of organisms used for research, and in human females. The gamete-killing type of meiotic drive remains elusive because it is so difficult to test. However, that will likely change with more innovations in technology and DNA sequencing, Zanders says.

FASCINATED BY MEIOSIS

Meiosis has fascinated Zanders since she was a graduate student at Cornell University studying meiotic recombination, a critical step in the formation of gametes. She remembers hearing Harmit S. Malik, PhD, a Howard Hughes Medical Institute investigator at the Fred Hutchinson Cancer Research Center (FHCRC), speak about how selfish genes could drive the evolution of genomes. Intrigued, Zanders joined FHCRC after graduation as a postdoctoral fellow to learn more.

While there, she discovered three independently acting meiotic drive genes, called *wtf* genes, in the hybrids of two fission yeasts, *S. pombe* and *S. kambucha*. The two species can mate to produce hybrids, but their hybrids have low fertility, also called hybrid sterility.

Zanders discovered that the low fertility was the result of meiotic drive genes killing the yeast gametes that had not inherited these genes. When all the meiotic drivers acted together, they kept the two yeast species from reproducing.

Her findings, published in 2014 in the journal *eLife*, suggest that selfish genes play a role in speciation, the evolutionary process that keeps species distinct from one another.

We can look to the mule for a four-legged example of this phenomenon. While horses and donkeys can mate to produce mules, hybrid mules can't produce offspring of their own, because they are infertile.

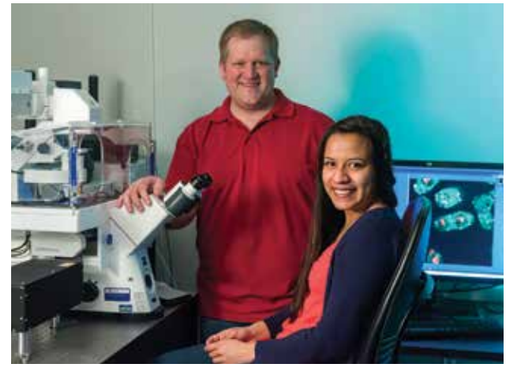
GROWING A RESEARCH PROGRAM

Zanders' research dovetails nicely with the Institute's research on the biology of chromosomes, says Stowers Scientific Director Robb Krumlauf, PhD.

"One major focus of our chromosome research is the process of meiosis," he says. "Sarah's work on meiotic drive is exploring and uncovering new mechanisms that explain how some genes can bias the outcomes in unexpected ways. This has important implications for genetic diversity in a population."

Zanders is eager to see what her research uncovers.

"Given its likely impact, meiotic drive is widely understudied. Many scientists have not even heard about it," she says. "When we have visiting scientists, I love to be the first to tell them about meiotic drive. It is very exciting."



Since joining the Stowers Institute last summer, she's immersed herself in the collaborative environment, aided by two predoctoral researchers, María Angélica Bravo Núñez and Nicole Nuckolls. The pair investigated meiotic drive in the lab of Sue Jaspersen, PhD, a Stowers associate investigator who studies the structure and geography of the cell's nucleus, until Zanders arrived and set up her own lab. The temporary situation built bridges between the two labs. Zanders and Jaspersen recently submitted a paper for publication identifying and characterizing a new meiotic drive gene.

Zanders has also enlisted the help of the Stowers Microscopy Center's Jeffrey Lange, PhD, for an up-close, live look at products of gamete-killing meiotic drive genes and their behavior.

A Snapshot of Gene Society

Genes live together in societies, much like humans do. Here's how they're organized:

GENE–A piece of DNA that contains instructions for a function. These are the individuals in gene society.

GENOMES–Genes living together in a more or less ordered community.

SELFISH GENES – Parasitic genes whose sole purpose is transmission into the next generation.

Gamete-killing meiotic drive genes make two different proteins: one is poison and one is an antidote. It can be challenging to differentiate them under a microscope, because autofluorescence (the light that cells naturally emit) interferes. To solve this problem, the researchers modified the proteins to glow green (for the poison) and red (for the antidote). Then they observed the sample through a sophisticated fluorescence microscope with a spectral detector, an attached device that can break up different wavelengths of light. The process is called linear unmixing.

"The idea is to use linear unmixing to separate the two components and get a true picture of what is going on and not the autofluorescence signal that just convolutes the image," Lange says.

He also worked with Bravo Núñez and Nuckolls to develop an innovative surface coating that sticks yeast to the slide, while keeping them "happy and alive." And he is using a method called single-particle tracking to follow tiny dots of the poison, called puncta, as they travel throughout the cell. These tools are helping Zanders' team visualize how gamete-killing meiotic drive genes accomplish their task.

Zanders has also partnered with mathematician Boris Rubinstein, a Stowers research advisor, to predict the long-term effects of selfish genes on a species. Consider, for example, a male who has a gamete-killing meiotic drive gene on his X chromosome. "Over time, what would happen is that more and more men would father only daughters. Then there would not be enough men to go around. This process can drive a species extinct," Zanders says. Rubinstein's mathematical models determine the influence of various factors on the extinction rate and help Zanders and her team determine whether their predictions are on the right track. "If our results in the lab match his model's predictions, we must have the biology right. If our data don't match the model, it tells us there is something about the biology we have missed."

Zanders credits these kinds of collaborations for propelling her research forward. "Here at the Stowers Institute, you have people at the top of their field, and yet their interest is to collaborate. In the future, we hope to work with the proteomics team as well. Our collaborations have been very fruitful so far."

WHAT'S NEXT?

Zanders plans to delve even deeper into the mechanisms driving selfish genes and identify more selfish genes. She believes they have the potential to answer fundamental questions that have long puzzled scientists.

"If we can find out more about these selfish genes, then we can better understand how they affect human health, and infertility and evolution," she says.

> "Here at the Stowers Institute, you have people at the top of their field, and yet their interest is to collaborate."
>
> – Sarah Zanders, PhD

A DISCUSSION WITH

MATT GIBSON, PhD

By Cathy Yarbrough

Growing up in Vermont, Stowers Investigator Matt Gibson, PhD, was fascinated with the behavior and biology of insects, amphibians, and other small creatures. In his bedroom, he kept a collection of critters including snakes, fish, salamanders, and even a slime mold. It wasn't until his high school biology class, however, that Gibson began considering science as a possible career as well as a passion.

"I had a really good biology teacher who conducted actual experiments with us," he recalled. "I did an independent project on how planaria (flatworms) regenerate missing body parts, and that experience really turned me on to experimental science," says Gibson, who has a secondary appointment as an associate professor in the Department of Anatomy and Cell Biology at the University of Kansas School of Medicine.

After high school, Gibson graduated from Yale University with a BS degree in biology in 1994. Following short stints working on a fishing boat in Alaska, driving a delivery truck in Vermont, and using his biology background at a patent law firm in New York City, Gibson moved across the country to Seattle for his graduate studies at the University of Washington. There, his research efforts investigating development and regeneration in the fruit fly *Drosophila* resulted in several publications and were recognized with the Harold M. Weintraub Award for Innovative Graduate Research and the Larry Sandler Award for the most outstanding thesis on *Drosophila* biology.

Upon completing his PhD in 2001, Gibson was awarded a Jane Coffin Childs postdoctoral fellowship at Harvard Medical School in the lab of the renowned geneticist and developmental biologist Norbert Perrimon, PhD. In 2005, he and Perrimon authored a paper on cell-to-cell communication that attracted abundant scientific attention and made the cover of *Science* magazine. In 2006, the duo published a *Nature* paper exploring how cell division influences the geometry of complex cell layers known as epithelia.

That same year, Gibson joined the Stowers Institute where he continues to study small creatures, including fruit flies and sea anemones (*Nematostella vectensis)*, as model systems for determining how the body's layers of epithelial cells are constructed during development and how they are maintained during growth and proliferation.

"Epithelial sheets that line the surfaces of organs and body cavities are not simply inert layers of cellophane," explains Gibson. "They are incredibly dynamic living biological systems." Epithelia perform a variety of functions in the body. For example, the epithelial cells in the outermost layer of the skin serve as a protective barrier. The sheet of epithelial cells lining the intestines absorbs and transports nutrients from food. Research on epithelial cell biology can provide a valuable window into both normal development and the origins of cancers, a majority of which originate in epithelial cells. "A better understanding of epithelial cell biology in simple animals," says Gibson, "will not only expand our knowledge of life, but also provide new avenues for the treatment and detection of disease."

WHY DID YOU JOIN THE STOWERS INSTITUTE?

The Stowers Institute offered a combination of great colleagues, great scientific support facilities, and great leadership. This place is truly unique because scientists have the freedom to take risks by pursuing novel ideas. If you are asking questions at the edge of what we understand, there are certain to be missteps and failures along the way. A willingness to take risks and the ability to tolerate failure is a major attribute of the most successful scientists, and the Institute has taken that spirit to an institutional level.

WHAT IS THE MOST IMPORTANT CHANGE THAT HAS OCCURRED DURING YOUR 11 YEARS AT THE INSTITUTE?

The creation of the Graduate School in 2011 dramatically changed the Institute's social and intellectual dynamic, particularly by increasing connectivity between labs. Each year the school brings in eight to ten talented young people who bond with each other and become friends through the hardship of their coursework. After they disperse to different labs to conduct their thesis research, the students continue to hang out together and exchange ideas even when they work in totally different areas. They informally exchange information about the studies in their respective labs, which in turn drives research forward at the ground level. This horizontal transfer of information really sparks new ideas and has given the Institute a new kind of vitality.

HOW DO YOU EXPLAIN THE RELEVANCE OF BASIC RESEARCH?

The fundamental mechanisms underlying life are very similar and are shared among all animal species. So what we learn from studying fruit flies, flatworms, and sea anemones can actually illuminate the principles of human biology. Scientists can understand biological processes at far higher resolution in model organisms than would be possible if they only studied human cell lines, making basic research the foundation of biomedical science and the testing ground for new ideas to address human disease.

UNTIL RECENTLY, THE FRUIT FLY WAS THE ONLY MODEL SYSTEM IN YOUR LAB. WHY HAVE YOU ALSO BEGUN TO STUDY THE SEA ANEMONE, WHICH IS SO PRIMITIVE THAT YOU ONCE DESCRIBED IT AS A "BAG OF EPITHELIUM"?

That overall morphological simplicity makes *Nematostella* a great animal for determining how developmental processes are controlled at both the mechanistic and evolutionary levels. But in this case "simplicity" might also be an illusion. An amazing thing about these sea anemones is their relatively large and complex genome, which has more in common with humans and other vertebrates than do the genomes of fruit flies, worms, and other traditional model organisms. Many human disease genes, for example, have been found in *Nematostella*, but are absent in fruit flies. The genomic similarities are shocking because it was assumed that the anemone, a simple organism, would have a simple genome.

WITH FOUR CHILDREN, AGES 2½ TO 11 YEARS OLD, AND THE DEMANDS OF YOUR LAB AT THE INSTITUTE, HOW DO YOU MANAGE YOUR TIME SO THAT YOUR FAMILY AND YOUR RESEARCH RECEIVE THE ATTENTION THEY NEED?

There is no one correct answer for this question because every person and every family differ. I found that once I had children, I just instinctively became more efficient, particularly at work. I also set some hard boundaries. On weekends, I prioritize my family time and rarely come to the lab. I can do much of my work, such as reading scientific papers and writing, from home. Some of the best quality time for thinking actually comes while mowing the lawn, walking the dog, or doing dishes. Most importantly, I also have an incredibly supportive spouse, and seriously doubt I could maintain sanity or achieve balance without her.

WHAT ACTIVITIES DO YOU ENJOY OUTSIDE THE LAB?

Many—playing music, gardening, beekeeping, and coaching soccer, to name a few. My favorite activities are probably fly fishing and hiking. This past summer we had a great time camping and fly fishing in northwest Arkansas. This winter my two oldest sons and I went hiking and skiing in the Adirondacks in upstate New York. I think it's essential for kids and adults alike to regularly unplug from the devices that deliver a constant supply of overstimulation. For clear thinking to occur, it's extremely important to have long periods of time away from the information stream. Unplugged time is probably more important than plugged time.

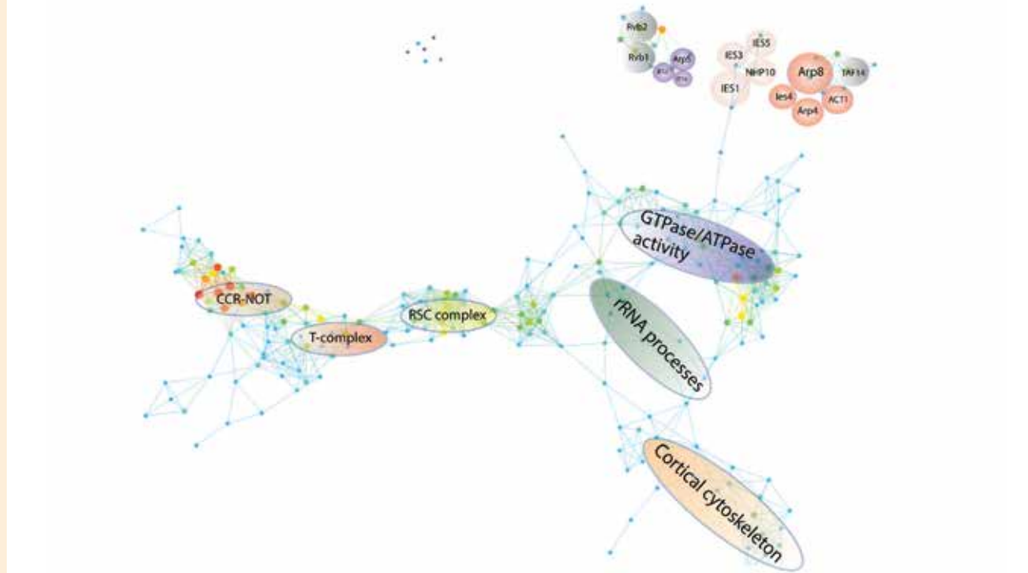
BEYOND SCIENCE AND FAMILY, ARE THERE ANY OTHER PASSIONATE PURSUITS YOU HAVE?

Until about a year ago, I was playing in a band that did some shows around Kansas City and made a recording of original songs—basically it was very loud, unrefined rock 'n' roll. It was fun but required a lot of time and energy, most of which fell between 10:00 p.m. and 1:00 a.m. Maybe when the kids are older, I'll do it again …

WHAT DO YOU WANT TO ACCOMPLISH IN THE NEXT FIVE YEARS?

Personally, I hope to survive my wild kids at home (*Gibson laughed*) and also spend as much time as I can outside with the family, whether it's hiking, fly fishing, or gardening in the backyard. Scientifically, I especially want to see through the vision of our work with *Nematostella* and expand our efforts into genome-wide chemical and genetic screening. We think these sea anemones could provide a window into whole new areas of biology and want to use the most modern tools to access those areas. I also want to build on our integrated research approach in which we take advantage of the best parts of fruit fly biology and anemone biology to understand the control of cell division at the epithelial level. This is really an amazing time to be a scientist, and there is still a huge amount to be learned.

UNCOVERING NEW RELATIONSHIPS AND ORGANIZATIONAL PRINCIPLES IN PROTEIN INTERACTION NETWORKS



Proteins play important roles in cells and tissues. Some proteins provide structural integrity, others drive biochemical reactions, and yet others regulate gene expression. Proteomics is the study of the structure, function, and interaction of all the proteins in a cell or organism, which can number in the hundreds of thousands or millions of variations.

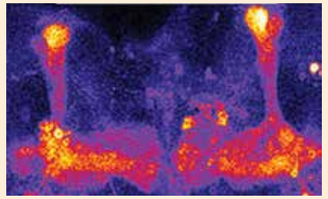
To better understand proteins in their dynamic world, researchers in the Washburn Lab and their collaborators used an advanced mathematical approach called topological data analysis (TDA) to study two different kinds of proteins and their interaction networks. The researchers changed, or perturbed, parts of these two protein networks and then determined how the networks were affected. Using TDA, groups of proteins exhibiting similar effects and sharing similar properties were identified as topological network modules. Additionally, the researchers were able to obtain an expanded view of cascading interactions across the larger network and identify new areas of biological networks to explore.

"TDA is a fast and efficient way to interpret complicated data sets," says Michael Washburn, PhD, director of proteomics. "There's very little data out there on disrupted or perturbed protein interaction networks. Most of the focus has been on static networks. By perturbing a system, you can learn how it works as a dynamic network. This approach can provide an accessible route to visualize relationships between proteins."

This work was published in the March 8, 2017, issue of the Nature Publishing Group's Scientific Reports.

RESEARCH POINTS TO ORB2 AS A PHYSICAL SUBSTRATE FOR MEMORY STRENGTH AND RETENTION

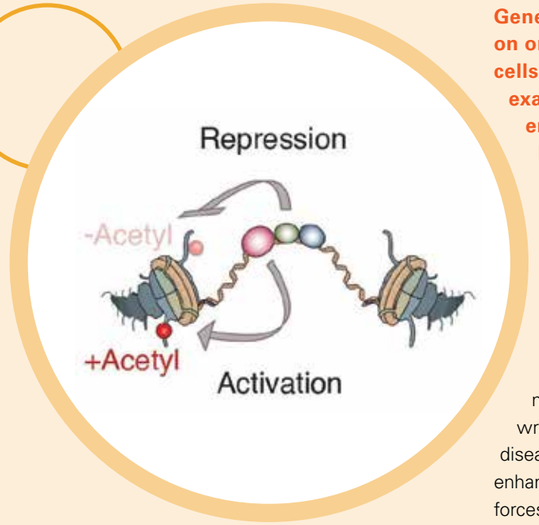
What underlies the making of a memory? Using molecular tools to manipulate a prion-like protein in fruit flies, researchers in the Si Lab have discovered evidence for specific molecular changes necessary for the formation, storage, and retrieval of memories.



The group reports that the protein Orb2 appears to be part of a memory stamp in the brain produced by a particular experience. The researchers also discovered that another protein, JJJ2, assists Orb2 in the formation of long-term memory. This work provides insight on how memories are made and retained in the fruit fly brain. Humans have a protein counterpart to Orb2 called CPEB, which suggests similar mechanisms may be involved in human memory.

This study was published in the December 5, 2016, issue of Current Biology.

NEW FINDING REVEALS BATTLE BEHIND GENE EXPRESSION

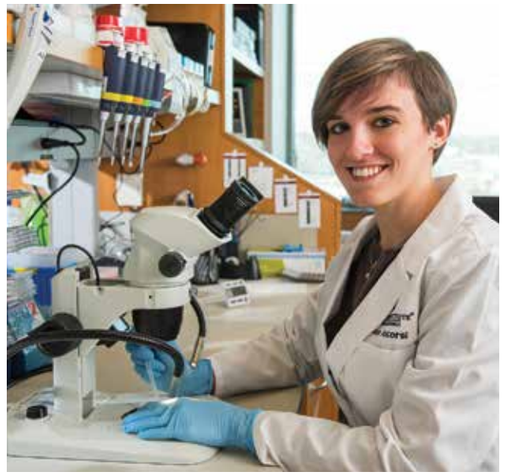


Gene expression is the process of turning genes on or off, and it's essential for creating specific cells in the body. Zeitlinger Lab researchers examined regions of fruit fly DNA called enhancers. These enhancers increase the likelihood of gene expression.

It turns out DNA enhancers are locked in an ongoing battle between activation and repression. Activation sparks DNA enhancers into action—switching them on. Repression prevents the switch from ever being flipped. Their research found that a crucial balance between the two actions is maintained at the level of histone modifications, around which DNA enhancers are wrapped. Such insight could provide understanding into diseases and developmental disorders caused by DNA enhancer mutations and give us a glimpse into the genetic forces that have contributed to human evolution.

The report appeared online in January 2017 at Genome Research.

Postdoc receives fellowship funding

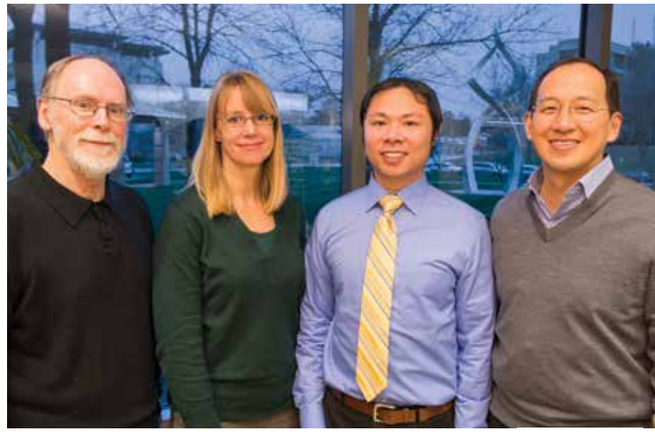


Alice Accorsi, PhD, a Howard Hughes Medical Institute postdoctoral research associate in the Sánchez Alvarado Lab, recently received $20,000 in fellowship funding from the American Association of Anatomists (AAA). The award is designed to encourage scientific exploration and cutting-edge approaches to research.

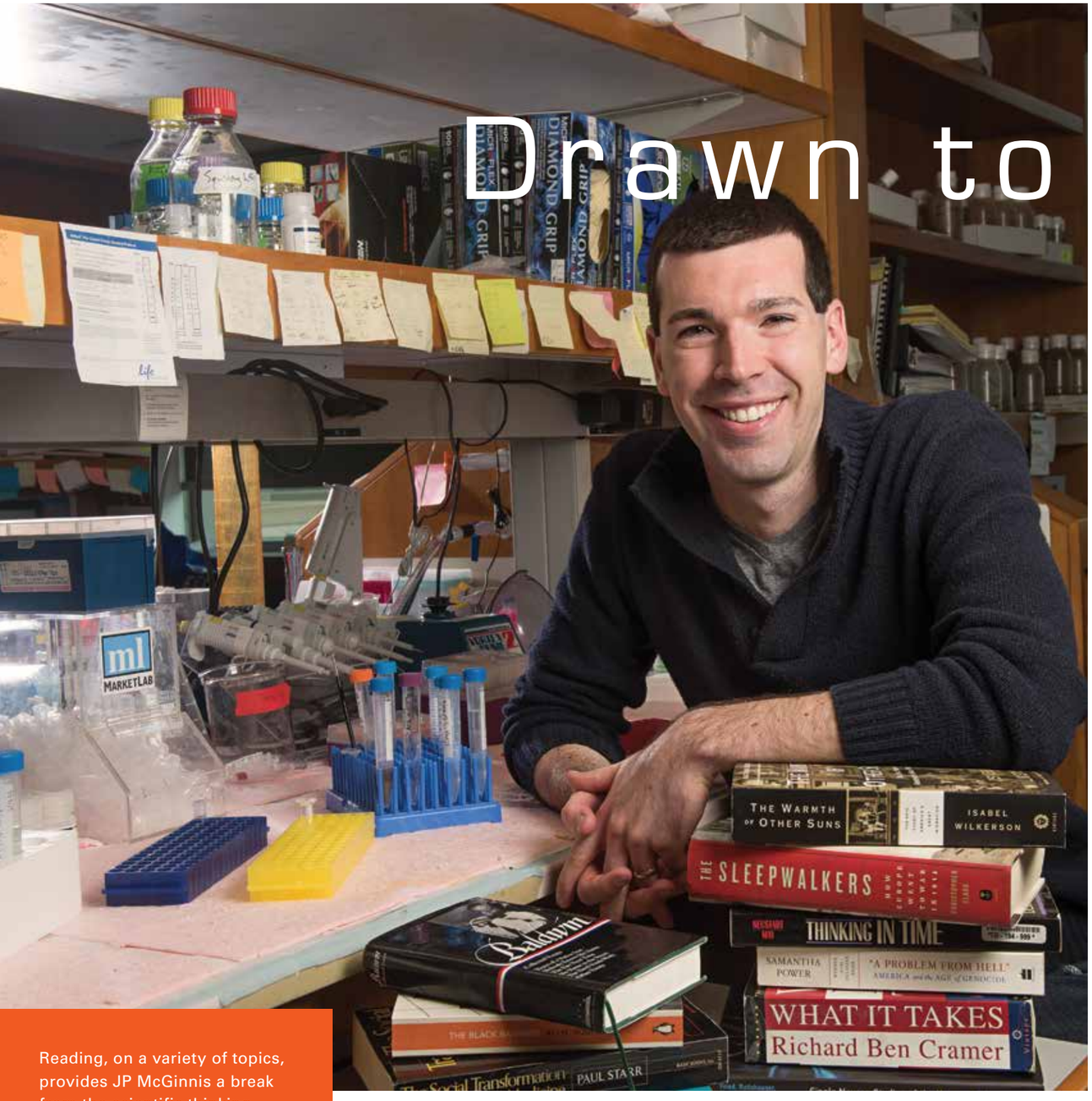
Accorsi's research utilizes *Pomacea canaliculata,* which is a large freshwater snail. This snail has the fascinating ability to regenerate a damaged or entirely lost eye. The camera eye of the snail, which is a single-chambered eye comprising cornea, iris, lens, retina, and optic nerve, is similar to a vertebrate eye. Accorsi is probing the molecular and cellular processes underlying *P. canaliculata* eye development to better understand what orchestrates the adult eye regeneration. Her results could prove helpful for efforts aimed at replacing damaged or diseased human eyes.

First PhD awarded by Stowers Graduate School

After successfully defending his thesis on December 12, 2016, Kobe Yuen became the first graduate of the Graduate School of the Stowers Institute for Medical Research. Yuen joined the graduate program from the Chinese University of Hong Kong. In January, Kobe began a postdoctoral fellowship at Genentech in their immunology-oncology group.



Yuen performed his thesis work in the Gerton Lab, where he characterized proteins involved in maintaining the three-dimensional organization of chromosomes. Investigator and mentor Jennifer Gerton, PhD, shares, "I'm so proud of Kobe and the quality of his work. He is a terrific scientist and has set a high bar for Stowers predoctoral researchers. His motivation and creativity will make him an asset in his postdoc position in cancer biology research at Genentech."



Reading, on a variety of topics, provides JP McGinnis a break from the scientific thinking required in the lab.

Drawn to Neuroscience

By Cathy Yarbrough

John P. (JP) McGinnis, a medical student, neuroscience researcher, and new father, relaxes by reading about politics and music as well as science and medicine. He's also surprisingly active on Twitter, sharing information about books, articles, and blog posts that he's read. "Reading is pretty much how I spend all my free time," says McGinnis.

He has not had a lot of time to spare so far in 2017. On January 9, McGinnis successfully defended his PhD thesis based on his five years of neuroscience work in the lab of Stowers Investigator Kausik Si, PhD. Four days later, he and his wife Emily celebrated the birth of their first child. "I thanked Ella for kindly waiting to arrive until after I defended," he jokes. Since Ella's birth, McGinnis says that he and Emily have been in survival mode. They've enjoyed getting to know Ella and adjusting to parenthood—all while Emily finishes her doctoral dissertation in music education this spring.

For the past seven years, JP, whose hometown is Freeport, Illinois, has been in a different kind of survival mode as a member of the rigorous MD-PhD physician-scientist training program at the University of Kansas Medical Center (KUMC). He joined the program after graduating from Luther College in Decorah, Iowa, where he earned a BA degree in biology.

McGinnis majored in biology because he wanted to attend medical school after college. During his freshman year science classes, however, he became fascinated with experimental research. While a student at Luther, he worked in the labs of his biology and psychology professors. After his freshman year, he was a summer student in the physiology lab. "I was surprised by how much I liked research," says McGinnis.

To learn more about research, McGinnis applied to and joined the Stowers Summer Scholars Program for undergraduates the summer before his senior year. As a Summer Scholar, he conducted experiments in stem cell biology under the guidance of Stowers Investigator Linheng Li, PhD, and another KUMC MD-PhD student, David Scoville. The experience boosted McGinnis' interest in experimental research, but he still wanted to be a physician. He decided that after graduating from college he would enroll in a joint MD-PhD program, a graduate curriculum that combined the best of both worlds. McGinnis applied for KUMC's MD-PhD program, which would allow him to conduct his predoctoral studies at the Stowers Institute.

After his second year as a medical student in the KUMC program, McGinnis returned to the Institute for a research rotation in Si's lab. "I was becoming more interested in neuroscience, and what Kausik was trying to accomplish—understanding the molecular basis of long-term memory—was one of the most interesting problems I'd ever heard of," says McGinnis. Si agreed to serve as McGinnis' mentor for his predoctoral studies, and now, five years later, McGinnis has completed the requirements for a PhD degree in molecular and integrative physiology.

"I was becoming more interested in neuroscience, and what Kausik was trying to accomplish—understanding the molecular basis of long-term memory—was one of the most interesting problems I'd ever heard of."

– JP McGinnis

This spring, McGinnis is headed back to KUMC to finish the remaining two years of medical school. He anticipates that he'll graduate in 2019. Then, armed with both MD and PhD degrees, he'll begin what will likely be six to eight years of medical residency training. During his clinical rotations in the final two years of medical school, McGinnis will decide whether to apply for a residency program in neurosurgery, his current interest, or in another field of medicine. After his residency program, McGinnis hopes to work at a major academic medical center as a physician. "Even though I don't necessarily see myself running a lab, I do want to keep a hand in some kind of research," he says.

While a predoctoral researcher at Stowers, McGinnis received a lot of advice from Si. "Kausik always says to pay attention to results that don't make immediate sense, because those are the kind of results that can lead to something new and important," McGinnis recalls. Si also told him that great scientists are not necessarily the smartest ones but those who are "willing to put in the time thinking about their research."

McGinnis says that he also admires Kausik for demonstrating a balanced life. "At 5:45 p.m., every day, Kausik goes home to cook dinner for his family," McGinnis says. "He's often back in the lab after his kids are in bed, but he obviously makes a point of spending time with his family during the week as well as on weekends. Seeing someone so successful make this time for family is quite a useful lesson for us younger scientists."

During his five years in Si's lab, McGinnis says he likely accomplished much more than he would have if his predoctoral training had occurred at most other institutions. "Because the research support services are so great at Stowers, I'm sure I was able to get more done, and learn more, than I otherwise would have," he says.

According to Si, McGinnis' research "opened up a completely new area for the lab." In studies with fruit flies, McGinnis sought to identify the rewarding properties that result in some experiences being remembered for a long time while other experiences are not. Fruit flies were given a choice between two sweet and chemically similar sugars, D-arabinose and L-arabinose. While the fruit flies clearly preferred D-arabinose, subsequent tests showed that they were more likely to form long-term memories of L-arabinose. The results suggest that the immediate appeal of a reward, such as the taste of a sugar, does not always predict the reward's long-term reinforcement value and, therefore, the likelihood that it will be remembered. McGinnis and his collaborators reported these findings in a 2016 *eLife* article.

Si explains the results of the study according to the "liking" (in-the-moment need) and "wanting" (motivational need) concept of rewards proposed by the University of Michigan scientist Kent C. Berridge, PhD. In McGinnis' experiments with fruit flies, D-arabinose seemed to drive the "liking" component, while L-arabinose involved more of the "wanting" component.

Prior to McGinnis' research, Si did not consider fruit flies a laboratory model for investigating the logic of so-called higher cognitive functions such as "liking" and "wanting" rewards. Now he does. When McGinnis heads back to medical school, other members of the Si Lab will continue this work by searching for the neurons underlying these processes in fruit flies.

RESEARCH RELATED TO HEARING LOSS FUNDED BY NIH

Associate Investigator Tatjana Piotrowski, PhD, has been awarded a highly competitive grant totaling more than $1.7 million over five years. The National Institute on Deafness and Other Communication Disorders of the National Institutes of Health awarded the grant for Piotrowski's research on zebrafish sensory hair cell regeneration.

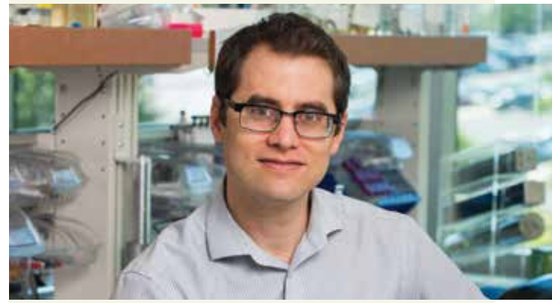
Hearing disorders due to sensory hair cell loss are the most common sensory disorders in humans. Unfortunately, mammalian inner ear hair cells do not regenerate and thus hearing loss is permanent. In contrast to mammals, fish regenerate hair cells throughout life.

Zebrafish possess hair cells in their ears and also in their sensory lateral line system, which detects water movement. Despite their location on the trunk, lateral line hair cells develop and differentiate by developmental mechanisms very similar to those used by ear hair cells.

Building upon previous work, the Piotrowski Lab will investigate the gene regulatory networks that underlie hair cell regeneration by utilizing a powerful assay that the group developed that allows the functional interrogation of gene interactions that regulate the balance of progenitor cell self-renewal and differentiation at the single cell level. The single-cell analysis is powerful because it allows detection of heterogeneity in support cells that is masked in bulk analyses of these cells.

Piotrowski says that intimate knowledge of these interactions is crucial for the development of strategies aimed at inducing proliferation and hair cell regeneration and restoring a functional sensory system in mammals.

HALFMANN LANDS TWO GRANTS: ONE NATIONAL AND ONE REGIONAL



Assistant Investigator Randal Halfmann, PhD, has been awarded the Basil O'Connor Starter Scholar Research Award from the March of Dimes Foundation. This highly prestigious and selective award is intended to support individuals in the early years of their research careers. The award will support Halfmann's efforts to probe proteins that form self-templating aggregates known as prions. Halfmann hypothesizes that prion-forming proteins may be responsible for oocyte aging and reduced developmental potential, which ultimately can lead to reduced human reproductive outcomes. Additionally, Halfmann believes this line of inquiry may provide a molecular basis for oocyte aging.

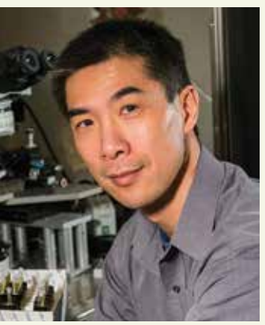
Halfmann has also received a grant through the University of Kansas Alzheimer's Disease Center and the Landon Center on Aging. The funds will support research that focuses on producing new biosensors for detecting prions. Prions have been previously implicated in neurodegenerative diseases including Alzheimer's Disease (AD). With this funding, Halfmann hopes to establish effective ways to detect known and suspected AD-associated prion proteins in biological specimens, which may accelerate the discovery of new interventions aimed at disrupting the disease progression.

ADVANCING SCIENCE TO SERVE SOCIETY

Associate Investigator Sue Jaspersen, PhD, was elected as an American Association for the Advancement of Science (AAAS) Fellow for her distinguished contributions to the field of cell biology, particularly for her research on the yeast spindle pole body and nuclear envelope using imaging and genetics.

Jaspersen is one of 391 members elected in 2016 as Fellows of the Association. The tradition of electing AAAS Fellows began in 1874 to recognize members' efforts to advance science or its applications.

NIH GRANT RENEWAL



Investigator Ron Yu, PhD, was awarded a five-year renewal of a grant from the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health. This grant supports research related to understanding the neural mechanisms that control innate social and sexual behaviors.

Identification of the specific neural circuits that process a set of defined social signals in mice will provide essential information in understanding brain mechanisms for sensory information processing, social communication, and endocrine control.

NIH GRANT FOCUSES ON EYE DEVELOPMENT

Investigator Ting Xie, PhD, was recently awarded a new grant by the National Eye Institute of the National Institutes of Health to study aspects of mammalian eye development and function. This highly competitive grant totals more than $1.2 million over three years.

The grant will support research on an eye structure called the ciliary body, which is important for lens function and for production of the aqueous humor, the fluid that maintains pressure in the eye. Prior studies by the Xie Lab identified a key signaling pathway involved in the formation of the ciliary body in mice. The long-term goal of this work is to gain a greater understanding of the molecular signals and mechanisms that control mammalian ciliary body development and secretion.

Xie says these research efforts may provide insight on conditions of the human eye such as anterior segment dysgenesis (ASD), a spectrum of disorders affecting eye structures including the ciliary body, iris, and cornea. About half of individuals with ASD develop glaucoma, an increase of pressure within the eye that can cause loss of vision. Understanding the signals and mechanisms underlying the pathogenesis of glaucoma and other eye ailments may help enable the development of better treatments for these conditions.

Stowers alumni return to provide insight and inspiration

Success of a research institute can be measured in a variety of ways. If measured by publications, the Stowers Institute has been successful in furthering fundamental knowledge of science with more than 1,200 scientific publications. Another measure of success is the quantity and quality of the scientists that work and train in its laboratories, and move on to careers outside of the Institute where they continue to advance science in a multitude of ways.

Stowers alumni have pursued a diverse array of careers, but one thing they have in common is a remarkable set of skills developed and refined under the mentorship of leaders and experts in their fields of science. A recent career development event hosted by Crossroads, a Stowers program focused on integrative internal events with participation from predocs, postdocs, and core and staff scientists, highlighted the experiences of a handful of Stowers alumni as they moved into careers outside of the Institute. Each speaker shared the value of their experiences while at the Institute and what tools helped them land their current positions.

Stowers Alumni Speakers Then & Now

RAY CAMAHORT, PhD
THEN Predoctoral Researcher, Gerton Lab
NOW Associate, Novo Ventures, Inc.

SAM MEIER
THEN Programmer Analyst, Computational Biology and Zeitlinger Lab
NOW Software Engineer, Broad Institute

ALEX GARRUSS
THEN Programmer Analyst, Computational Biology
NOW Research Scientist and PhD Candidate, Wyss Institute for Biologically Inspired Engineering at Harvard University

KENDRA WALTON
THEN Senior Research Technician, Molecular Biology Facility
NOW Senior Researcher, National Jewish Health Hospital

MATT GOERING, PhD
THEN Predoctoral Researcher, Gerton Lab
NOW Director of Clinical Embryology, Center for Advanced Reproductive Medicine and Assistant Professor, University of Kansas Medical Center

A culture of collaboration and access to unmatched tools and expertise were considered by all the alumni to be of unparalleled value during their time at the Institute. Kendra Walton, who was a senior research technician in the Stowers Molecular Biology Facility and is now a senior researcher in the genomics facility at a hospital in Denver, Colorado, said, "It was the skills I obtained at Stowers that put me in a position to take on a job like this." Walton's job has included rebuilding, from scratch, the genomics core facility that had no staff and little equipment when she took the position, but now has become a well-respected and flourishing facility.

Ray Camahort, PhD, a former predoctoral researcher in the lab of Jennifer Gerton, PhD, and currently an associate with a life sciences venture capital firm, appreciated the generous and widespread support he had at the Institute. He said that in his experiences in both bench science and technology development outside of the Stowers Institute, he had to get used to being a number in a queue and that expert advice was not nearly as free-flowing as it had been at the Institute.

The panel of alumni also shared what was most helpful for advancing their careers. Included among this advice was the importance of regularly attending conferences and seeking out people and scientific ideas that challenge traditional ideology. Matt Goering, PhD, lab director of the Center for Advanced Reproductive Medicine at the University of Kansas Medical Center, suggested that attendees take advantage of situations where they can speak up and share their knowledge. "Be the expert in the room. You never know who might be listening."

As diverse as career options are, so too were the tips, tools, and advice for landing the next job. But, common among the advice from these alumni was to take advantage of the amazing support and collaboration available at the Institute to build a broad skill set and a robust network.

2006-2016

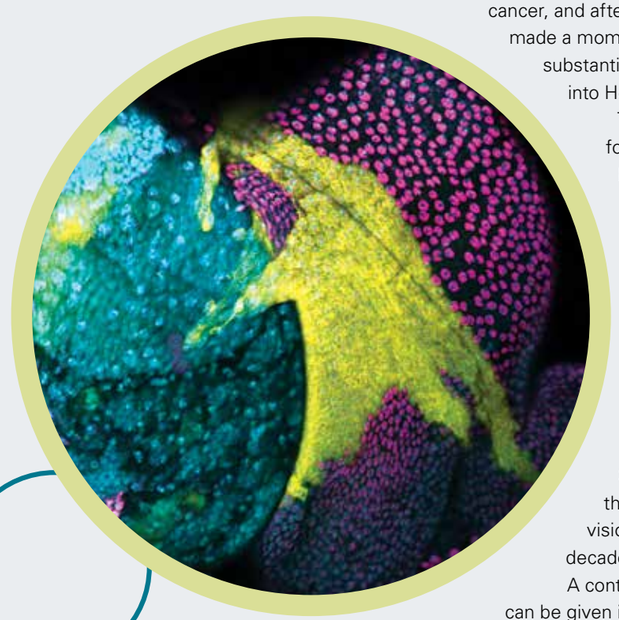
A decade of service celebrated

At the end of 2016, thirty members had achieved a milestone ten years of service and dedication to the Institute and its vision.

Front row, left to right: Julie Vandervoort, Christina Piraquive, Kristy Winter, Amanda Kroesen, Merry McLaird, Kristin Kessler. Second row: Qiang Qiu, Maryhelen Boyd, Ruby Dunn, Amanda Redetzke, Anita Saraf, Gaye Hattem, Stacie Hughes, Allison Peak. Third row: Howard Smith, Kelly Smith, Michelle Walker, John Bestor, Adam Petrie, Swami Venkatesh, Anoja Perera. Back row: Tim Wen, Doug Butts, Kathleen Zapien, Matt Gibson, Chris Wood, Mark Mattingly, Mechelle Harcar, Andrew Box. Not pictured: Hua Li.

INVESTING IN TOMORROW'S CURES:

The Hope Shares® Endowment



Cancer. Alzheimer's disease. Diabetes. Cardiovascular disease. Birth defects. Chances are, you or someone you know has been affected by at least one of these conditions, which are all too common in our society.

For Jim and Virginia Stowers, the challenge was cancer, and after successful treatment and recovery, they made a momentous decision: They would draw on their substantial fortune to transform their own adversity into Hope for Life® for millions.

Today, Stowers scientists are at the forefront of unraveling the mechanisms behind health and disease and preparing the ground for novel treatments and cures. Their work is made possible by the Hope Shares Endowment—the lifeblood of the Stowers Institute.

Unlike most research programs at universities, which immediately spend their donors' contributions, the Institute uses every gift, no matter how big or small, to add to its endowment. As the capital invested in the Hope Shares Endowment grows, it ensures that Jim and Virginia Stowers' extraordinary vision continues to gain momentum for decades to come.

A contribution to the Hope Shares Endowment can be given in the donor's name or in memory or honor of someone they love.

We are fortunate to have the support of many loyal donors who know their generous contributions to the Hope Shares Endowment help secure the Institute's future and accelerate our researchers' life-changing contributions to human health. It's an investment that will pay dividends in improved health and well-being for decades to come.

The following pages pay homage to all the visionary men and women who believe in our mission and are convinced that an investment in the Stowers Institute is the best way to advance knowledge and provide Hope for Life®.

Lifetime Contributions

As of December 2016

$10 Million+

Pamela Stowers

$1 Million+

American Century Investments Foundation

William Neaves for the "Priscilla Wood Neaves Endowed Chair in Biomedical Sciences"

Helen Nelson Medical Research Fund for the "Helen Nelson Distinguished Chair"

Pamela Stowers in Memory of Laura S Stowers

$500,000+

Dunn Family Foundation

Barnett and Shirley Helzberg, *including In Memory of James E Stowers Jr.*

Howard Hughes Medical Institute

Margaret Lichtenauer Estate

Frederick and Mary McCoy

$100,000+

American Century Investments Employees, *including In Memory of James E Stowers Jr. In Memory of Mary T and Andrew T Goodyear*

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Cerner Corporation (in kind)

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CIBC In Memory of James E Stowers Jr.

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William and Priscilla Neaves, *including In Memory of Robert Dornhoffer In Memory of Betty Mae Patterson In Memory of James E Stowers Jr. In Memory of Pamela Stowers In Memory of Arveta Washington*

In Memory of James E Stowers Jr.

Jim and Michele Stowers, *including In Memory of Virginia C Wimberly*

Roderick and Linda Sturgeon, *including In Memory of James E Stowers Jr. For the "Priscilla Wood Neaves Endowed Chair in Biomedical Sciences" In Memory of Steve Sturgeon*

Jonathan and Cyndi Thomas, *including In Memory of James E Stowers Jr.*

David and Wendy Welte, *including In Memory of James E Stowers Jr.*

Hank Young (*Gameface* book proceeds)

$50,000+

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Marilyn N. Prewitt Trust, *including In Memory of Marilyn Prewitt*

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Peter Cieszko

Mildred E. Coats Trust

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Gilmore and Bell PC

Webb Gilmore

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In Memory of Virginia C Wimberly

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Bo Kreiling, *including In Memory of Helen Jayne Kreiling*

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Linheng Li

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Amy Noelker, *including In Memory of James E Stowers Jr.*

Jennifer Noland

Susan Blue Olness in Memory of James E Stowers Jr. and Howard Chandler Blue

Tom and Jeanne Olofson

James and Josephine Olson, *including In Memory of James E Stowers Jr.*

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Michael and Terese Raddie

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Byron Thompson, *including In Memory of James E Stowers Jr.*

David and Eden Thorne, *including In Memory of Mark Dover In Memory of Honorable Elwood Thomas*

Stephen Thune, *including In Memory of Theresa Ford*

In Memory of Vernon Voorhees II

John Whitten, *including In Memory of James E Stowers Jr.*

Victor Zhang

Michael and Louise Zolezzi

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In Memory of Frederick Jr. and Mary Coulson

Terrence and Peggy Dunn

Penny Elmquist

Envestnet Asset Management, Inc.

Barry and Deborah Fink

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In Memory of James E Stowers Jr.

Stephen Garcia

Mark and Rhonda Gilstrap, *including*
In Memory of James E Stowers Jr.

Stephen and Patricia Gound

Michael Green, *including*
In Memory of Mary Lee Pricco

James E Griffin III and Margo Denke, *including In Memory of James E Griffin Jr.*

In Memory of Gloria Hanaway

Roger Hanaway in Memory of Gloria Hanaway

Brett Hart, *including*
In Memory of Delmar and Alberta Brumley
In Memory of Theresa Ford

Irv and Ellen Hockaday

Kelly Kerr

Thomas Kmak Family

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Dawn Lind

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In Memory of Revie Neaves

Catherine Netherland

Frank Leo O'Gara

Eric Olson for the "James Stowers Memorial Lecture Fund"

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In Memory of James E Stowers Jr.

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Daniel Shiffman

Richard and Dorothy Stowers in Memory of Dr. James E Stowers, Laura Stowers, and James E Stowers Jr.

John and Karen Thiel

In Memory of Arthur Weitzmann

Austin and Laura Wilson

Zurich Financial Services Australia Ltd

$1,000+

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Herbert and Estelle Adler, *including*
In Memory of Arthur Dym
In Memory of Caryn Lisnek O'Connell
In Memory of Mr. and Mrs. Ronald Shlifka

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CONNECTIONS ACROSS A LIFETIME INSPIRE PHILANTHROPY

Having spent her career working in the biological sciences, Andrea Hall deeply appreciates the Stowers Institute and what its scientists do.

"I know how challenging basic research is—you're laying the foundation for a particular area of science," says Hall, who has a PhD in biology from Georgetown University in Washington, DC. Hall's dissertation research was in the production of medicinal compounds from plant cell tissue culture.

Hall says she felt a connection to the Institute from its founding.

"My husband Richard and I met Jim and Virginia Stowers before the construction started. They were so excited about their plans to build the Institute," recalls Hall. "They had a dream to establish a world-class facility in Kansas City. It was a major effort and they just *did it*."

After the Institute was built, a tour of the facility, with its beautiful surroundings, top-quality laboratories, and scientists from around the world, cemented her commitment.

Hall is also connected through her work as an independent director on the board of American Century Investments (ACI), the asset management firm that Jim Stowers founded. She has served on the ACI board for 18 years. Although she and Richard are now retired and living in Florida, they enjoy returning to Kansas City when she attends board meetings.

Another connection to the Institute for Hall comes from her experience as a cancer survivor and as a daughter caring for her parents when they had cancer. "What the Stowers Institute is doing is so profound for the future impact on cancer and other diseases," she says.

As a former senior vice president for research operations at MRI Global, an independent contract research organization with headquarters in Kansas City, Hall concentrates her philanthropy on the Stowers Institute. Her husband, a retired Air Force colonel and retired business professor at Rockhurst University in Kansas City, supports veterans causes. Together, they also give to children's hospitals and an American Indian School.

"My hope is that our friends and acquaintances in Kansas City will see our names listed as donors and want to learn more about the meaningful work being done at the Institute and decide to support it," says Hall.

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BACKSTAGE PASS

The world of research is a stage for this little starlet. The starlet sea anemone, known to researchers as *Nematostella vectensis,* is a model organism that is used to study a variety of biological questions related to evolution, genomics, reproductive biology, developmental biology, and ecology, but it is their appearance that can steal the show. Their nearly translucent body seems to glow pink when amply fed with brine shrimp, they sport a crown of tentacles that sway wildly with the gentlest movement of their salt water habitat, and they appear to float as if in an otherworldly state of suspension.

Nematostella vectensis is a superb organism for studying processes fundamental to human health and disease, in part because its genome is more like the human genome than some other model organisms used in research, including insects and roundworms. They are also relatively easy to cultivate and care for in the laboratory.

NEMATOSTELLA BY THE NUMBERS

40,000-405,000
Range of offspring produced each week by stocks at the Institute

4,000
Approximate number of sea anemones housed at the Institute

100-1,000
Range of eggs laid per clutch

22
Largest number of tentacles observed in animals at the Institute

18
Average number of tentacles

3
Average length in centimeters of adult anemone

1
Number of feedings per day

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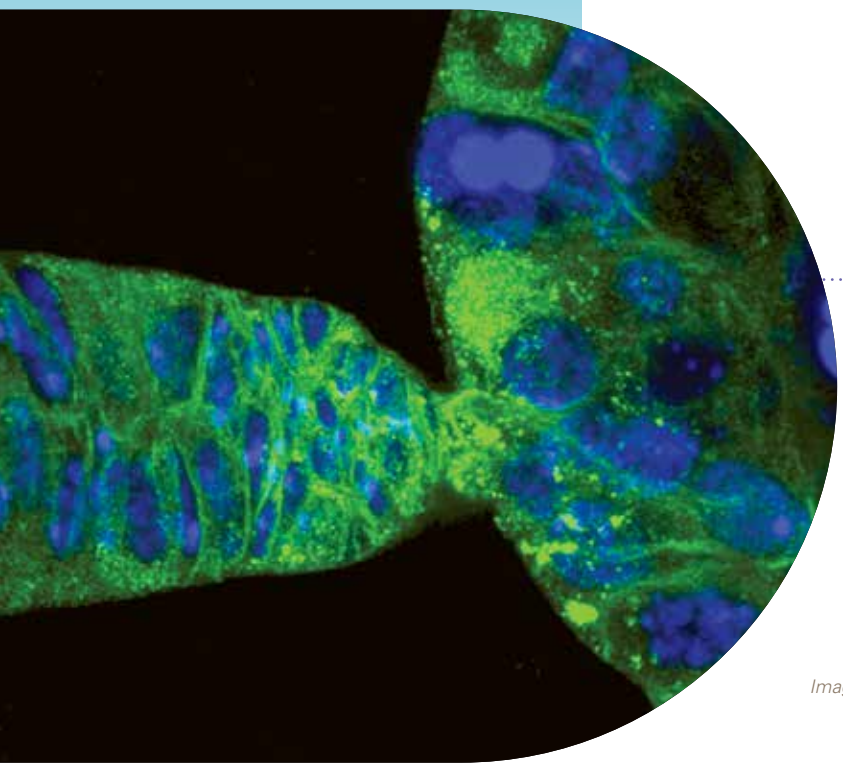

DNA DAMAGE EMPTIES GERMLINE STEM CELLS FROM THE NICHE

A stem cell niche is a specialized microenvironment within a tissue where stem cells are maintained. This image shows part of a fruit fly ovary in which all germline stem cells have been lost from the niche and have differentiated into egg chambers after DNA damage. The membrane cytoskeleton protein Hu-li tai shao is labeled in green and DNA in blue.

Image courtesy: Xing Ma, PhD, Xie Lab