Stowers Institute

Stowers Report

FOUNDATIONAL SCIENCE. PROFOUND IMPLICATIONS.

2022

Stowers Report

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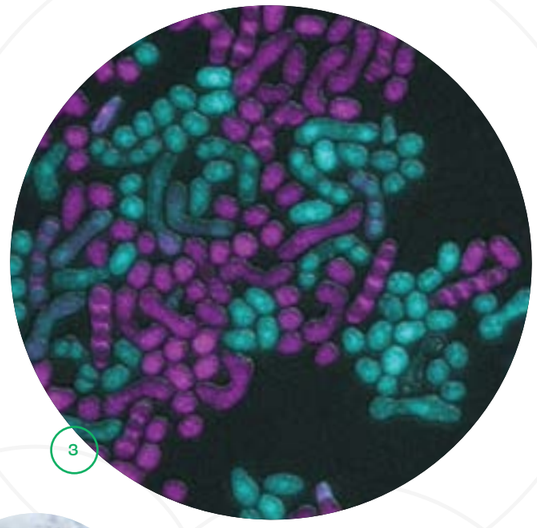
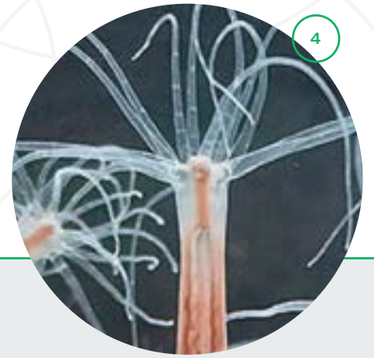
IN THIS ISSUE





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In Perspective

Alejandro Sánchez Alvarado, Ph.D.

Executive Director and Chief Scientific Officer

The physicist and Nobel Laureate Richard Feynman was fond of telling his students that there are two kinds of impossible. The first kind is in fact impossible, for example, 1+1 will never equal three. The second kind of impossible is that which contradicts what we would normally expect to be true. One hundred and nineteen years ago, the Wright brothers disproved the notion that humans cannot fly, and in 1969, humans walked on the moon. What did the universe look like 13.5 billion years ago? Humans can now peer to the edge of the cosmos, a gift of modern technology and the James Webb Space Telescope. Returning to Earth, what other impossibilities remain to be challenged? A cancer-free future, a neurodegenerative disease-free world, turning back the biological clock on aging?

The Stowers Institute for Medical Research focuses on solving the second kind of impossible. Yet, it is impossible to continue to discuss our Institute without reflecting on our history and the generosity and spirit of our founders, Jim and Virginia Stowers. They gave us a mission and as we enter 2023, I'd like to touch on some of the incredible contributions our scientists, students, and staff have achieved this past year.

In addition to publishing open access, groundbreaking research for the benefit of all, including our efforts to help complete the entire human genome sequence, we have kept true to our mission of collaboration. I am delighted to share with you that at the beginning of the year, the Stowers Institute established a satellite laboratory at the acclaimed Marine Biological Laboratory in Woods Hole, Massachusetts. We look forward to new collaborations, remarkable science, and innovation in the coming years.

I invite you to look back over 2022 in this report that highlights our many endeavors and achievements. This year we also suffered the tragic loss of our two predoctoral researchers, Camila Behrensen and Pablo Guzmán Palma. We extend our deepest condolences to their families, and we honor the accomplishments and ambitions of these two brilliant young minds as we rededicate ourselves to the scientific mission entrusted to us by our founders.

Your continued support for the Stowers Institute is both humbling and appreciated. Together, we will continue to promote creative thinking, curiosity-driven foundational research, and collaboration for the betterment of humankind. And so, let us take a moment to reflect on the positive and to embrace the vision of our founders— "The best is yet to be."

Research + Discovery

HIGHLIGHTS

Morphological differences between cavefish (top) compared with surface-dwelling river fish (bottom).

Looking to cavefish for insight into metabolism

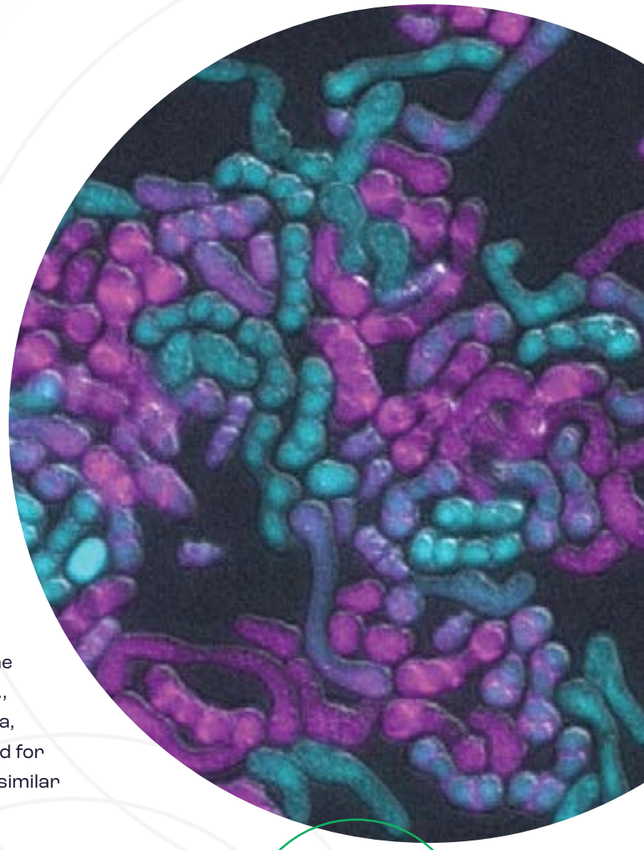
PUBLISHED ONLINE IN *NATURE GENETICS*, JUNE 17, 2022.

Cavefish, a surface-dwelling river fish that flooded into underground cave systems over 100,000 years ago, developed unique starvation-resistant "feast or famine" metabolic adaptations to survive and thrive underground in nutrient-scarce environments.

Jaya Krishnan, Ph.D., former Senior Research Associate in the lab of Nicolas Rohner, Ph.D., led a study that examined how two cavefish colonies of the tetra river fish, *Astyanax mexicanus*, independently evolved in a very similar manner. Krishnan and coauthors described genomic differences between cavefish and river fish. They created epigenomic maps of liver tissue and compared these between the Pachón and Tinaja cavefish and with their river fish cousins.

Upon close examination, they were able to identify many non-coding DNA sequences located throughout the genome that regulate the activity of nearby genes. Human genome studies have revealed that more than 90% of the mutations associated with complex metabolic disorders are in non-coding regions. Knowledge about cavefish genetic mutations and the role they play in metabolism can potentially help determine targets for drugs treating metabolic conditions in humans.

Krishnan's study is the first epigenomic map of cavefish liver cells, making the data an exciting new resource for their lab as well as the wider scientific community. ●



Shown here in blue and purple are spores, the reproductive cells of fission yeast.

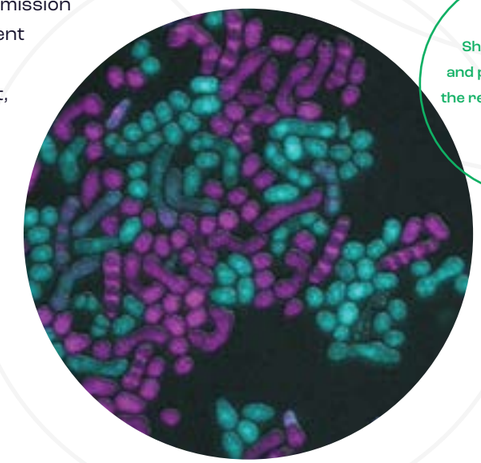
Cheating to win

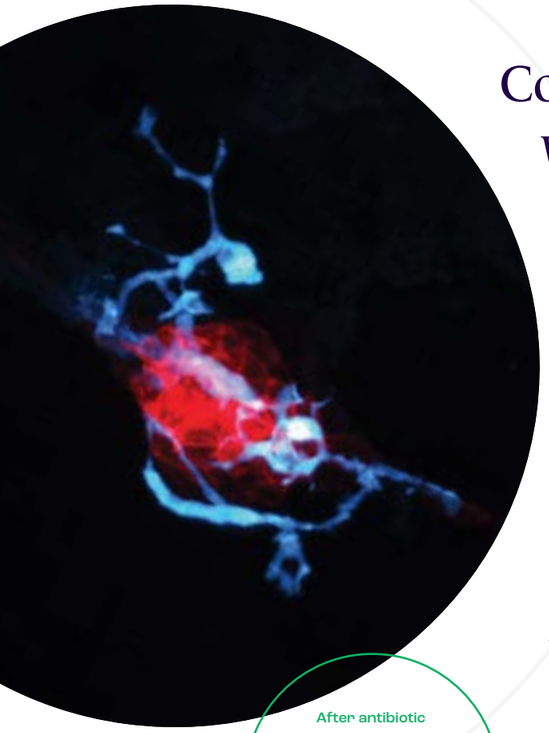
PUBLISHED IN *ELIFE* ON OCTOBER 13, 2022

Most genes follow the rules discovered by 19th century monk Gregor Mendel. However, a collaborative study led by Predoctoral Researchers Mickael De Carvalho, Ph.D., from the Zanders Lab, and Guo-Song Jia from the lab of Li-Lin Du, Ph.D., of the National Institute for Biological Sciences in Beijing, China, revealed that a rule-breaking selfish gene family has persisted for over 100 million years, transforming how we may search for similar genes in other species.

Selfish genes cheat to gain an unfair transmission advantage in violation of Mendel's 50 percent rule. The team discovered that the killer meiotic gene family, *wtf*, in the fission yeast, *Schizosaccharomyces pombe*, and in three other yeast species, has evaded natural selection at least 10 times longer than believed possible.

It is not widely understood or appreciated that not all pieces of a genome are beneficial. The notion that natural selection will always eliminate genes that are detrimental may in fact be a very narrow understanding of how evolution works. ●





After antibiotic treatment, macrophages (blue) invade the zebrafish sensory organ (red), engulfing and digesting dead hair cells and debris.

Connecting regeneration with the immune system

PUBLISHED ON SEPTEMBER 20, 2022, IN *NATURE COMMUNICATIONS*.

In some species, including humans, damage to organs like the brain or heart is irreversible, leading to scarring and loss of function.

Postdoctoral Researcher Nicolas Denans, Ph.D., from the lab of Tatjana Piotrowski, Ph.D., uncovered a three-step, sequential activation that macrophages, a type of white blood cell, undergo when repairing and regenerating zebrafish sensory hair cells.

Following cell death, the researchers studied individual macrophage cells using high spatial and temporal resolution to demonstrate that a single population of macrophages sequentially and independently transitions between three anti-inflammatory phases.

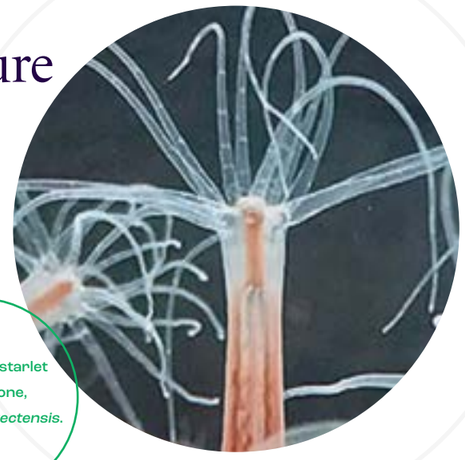
During the first phase, the macrophages clean up dead cells almost immediately after they die. Next, the macrophages change state to activate anti-inflammatory factors to begin hair cell repair and to reestablish neuronal connections for proper cell function. This identification is an important step for understanding how the immune system enables regeneration.

"Identifying the molecular recipe of macrophage activation in zebrafish may one day enable us to design regenerative immunotherapies in humans," said Denans. ●

Exploring the micro-architecture of a cellular weapon

PUBLISHED ONLINE IN *NATURE COMMUNICATIONS*, JUNE 17, 2022.

Research led by Ahmet Karabulut, Ph.D., in the lab of Matt Gibson, Ph.D., unveiled a precise operational model for the stinging organelle of the starlet sea anemone, *Nematostella vectensis*.



The stinging starlet sea anemone, *Nematostella vectensis*.

The study involved the application of cutting-edge microscopy imaging technologies along with the development of a biophysical model to enable a comprehensive understanding of a mechanism that has remained elusive for over a century.

The new model for stinging cell function provides crucial insights into the extraordinarily complex architecture and firing mechanism of nematocysts, the technical name for the stinging organelles. It reveals that the energy required for piercing and poisoning a target involves energy stored within multiple nematocyst substructures.

The researchers characterized the explosive discharge and biomechanical transformation of *Nematostella vectensis* nematocysts during firing. Insights from the work could lead to beneficial applications in medicine, including the development of microscopic therapeutic delivery devices for humans. ●

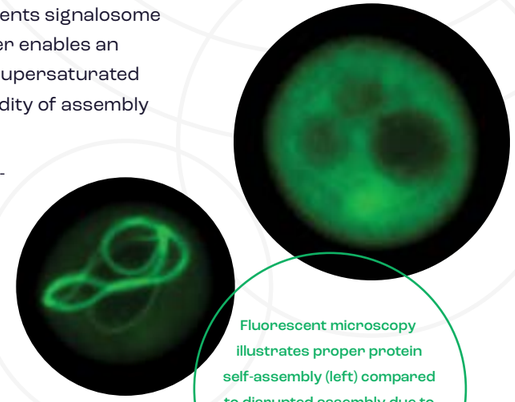
The switch-like nature of the immune system

PUBLISHED IN *ELIFE* ON JUNE 21, 2022.

Research led by Predoctoral Researcher Alejandro Rodríguez Gama from the lab of Randal Halfmann, Ph.D., shows that for an infinitesimally small stimulus to produce a very large, irreversible response requires a prepaid energy storage scheme within each immune cell.

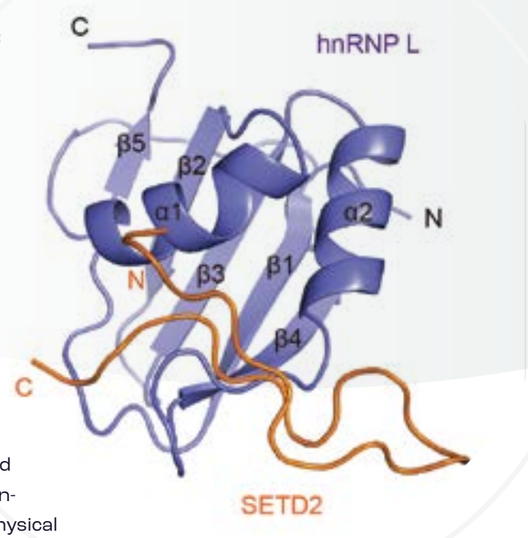
In response to recognition of an invading molecule, a large protein complex called a signalosome is assembled which stimulates a signaling pathway that activates the immune system in an "all-or-nothing" fashion. They also found that a large energy barrier prevents signalosome assembly from easily occurring but that this same barrier enables an adapter protein that encodes the switch to naturally be supersaturated within a cell. This in turn increases the certainty and rapidity of assembly at some point in the cell's future.

While these results indicate that inflammation in progressive and age-related illness is inevitable, the findings have broad implications for uncovering the causes and progression of inflammatory illness and other age-related diseases like Alzheimer's. ●



Fluorescent microscopy illustrates proper protein self-assembly (left) compared to disrupted assembly due to a mutated protein (right) in yeast cells.

Innovation



A structural model depicts a direct interaction between proteins involved in generating proteome complexity.

Partners in complexity

PUBLISHED IN *NATURE COMMUNICATIONS*, NOVEMBER 8, 2021 AND MARCH 4, 2022.

Two studies published by Saikat Bhattacharya, Ph.D., a Senior Research Associate in the lab of Jerry Workman, Ph.D., revealed a key link between two biological processes involved in creating proteome complexity out of information stored in the human genome.

These two fundamental processes are transcription, which creates protein-producing instructions from a gene, and alternative splicing, which generates different versions of the RNA instructions giving rise to related but distinct proteins. The creation or loss of a splice site in RNA can result in a non-functional or malfunctioning protein which can lead to disease. While these processes are usually studied independently, Bhattacharya and coauthors demonstrate a direct physical interaction between them.

The team reported that an alternative splicing regulator called hnRNP L not only binds RNA, but also binds a protein known to be associated with cell transcription machinery and is mutated in many cancers. Next, they teamed up with protein crystallization researchers from the University of Science and Technology of China to determine the structural basis of the interaction. These findings provide new information that can now be studied for its relevance in cancers. ●

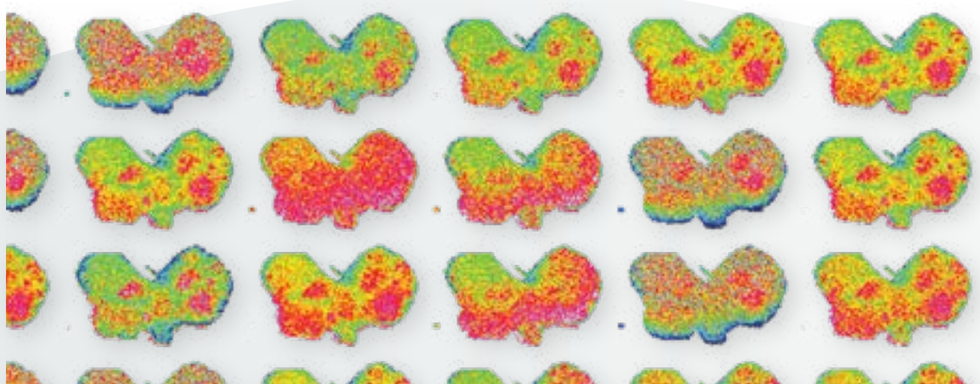
New instruments keep Technology Centers at the forefront

Several new additions to the scientific instrument lineup in the Systems Mass Spectrometry and Microscopy groups allow unprecedented resolution of tissues, cells, and molecules, and the integration of multiple collections of data to allow researchers to discern new intricacies of biology.

The Systems Mass Spectometry team installed a new mass spectrometer, the Bruker timsTOF Flex MALDI-2, which is considered the most advanced tool for performing “spatial multi-omics,” the study of multiple collections of biomolecules and how they are positioned within a tissue section, without having to add labels like antibodies.

The Microscopy Center added three new instruments. The Zeiss Elyra 7 super-resolution live-imaging light microscope uses a special 3D lattice illumination pattern to generate images far beyond the limit of conventional microscopy, allowing detailed visualization of cells, organelles, and suborganelle components. The Leica FALCON Lifetime imaging upgrade can measure light arrival at the sub-nanosecond scale, allowing the study of a protein’s microenvironment. The Thermo Scientific Talos F200C electron microscope stands out as having the Institute’s highest ever resolution capability and is used for both 2D and 3D imaging of subcellular structures and large biomolecule complexes in samples at cryogenic or room temperature. ●

Monitors showing samples analyzed by the new Talos microscope.



Sequential slices of a tissue sample show biomolecule localization patterns in timsTOF analysis.

Field research drives bench research

Jasmin Camacho, Ph.D. (second from right) with her field research team.

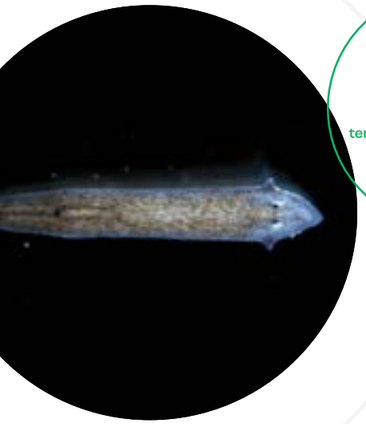
This year, Alejandro Sánchez Alvarado, Ph.D., published a report on a newly discovered flatworm isolate located in Guanajuato, Mexico.

While leading a group of undergraduate students in a developmental biology workshop on a search for native planarian flatworms, he discovered a population of fresh-water flatworms, living in a shallow pool. Back in the lab his team compared them to the widely studied planarian species, *Schmidtea mediterranea* and *Dugesia japonica*.

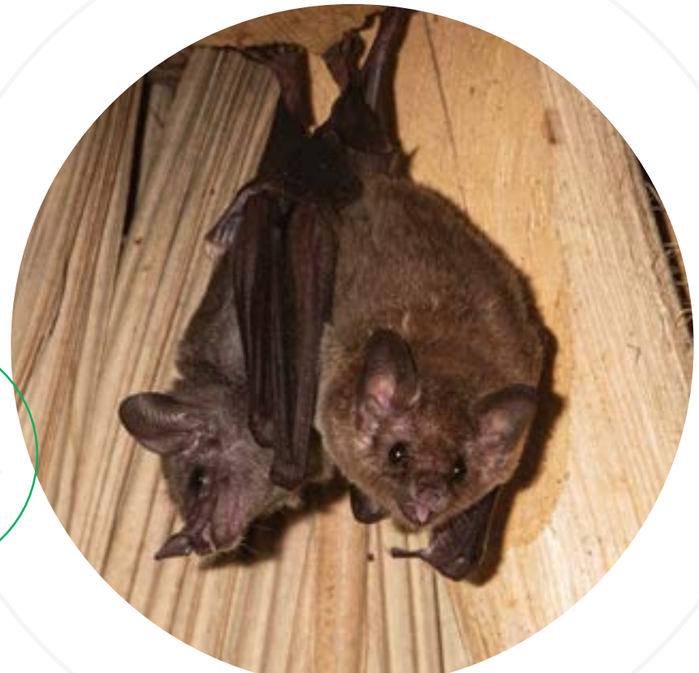
While they found obvious and striking differences in these worms, one was particularly interesting. Planarian regeneration is in part dependent on the quantity and quality of adult stem cells present, and when dosed with a lethal level of radiation, *Girardia* sp. (Guanajuato) managed to maintain a subset of their stem cell population four times longer than *S. mediterranea*. This finding may be attributed to a specialized stem cell adaptation, which may be applicable to human cancer patients undergoing radiation therapy, particularly for those whose cancer is radiation resistant.

Also this year, Rohner Lab Postdoctoral Researcher Jasmin Camacho, Ph.D., travelled to the jungles of Belize and other Central American and Caribbean countries observing and documenting bat behavior and phenotypes and collecting genetic samples from nectar bats.

Nectar bats have evolved to consume their weight in sugar to sustain their high metabolism. How their metabolism adapted to accommodate that much sugar while remaining healthy is the focus of Camacho's bench research. Understanding these bats' cellular mechanisms and genomes and may ultimately provide insight into human metabolic conditions. •



A possibly never-before-seen strain of a planarian flatworm, tentatively named *Girardia* sp. (Guanajuato).



Possible discovery of a new bat species from the genus *Gardnerycteris*, collectively known as hairy-nosed bats.

A new tool for studying cells of uncommon research organisms

Classifying cells in less-studied research organisms is now easier, thanks to a new tool developed at the Stowers Institute.

Understanding an organism's "cellular catalog"—the classification of the various types and numbers of cells it possesses—reveals much about how it thrives, dies, or otherwise responds to environmental changes.

To aid researchers studying organisms yet to be fully characterized, a collaborative team of researchers from the laboratories of Nicolas Rohner, Ph.D., and Alejandro Sánchez Alvarado, Ph.D., and the Cytometry and Microscopy Technology Centers developed a new image-based cell classification tool called Image-Cytometry Cell Classification, or Image3C. It allows researchers to characterize the cellular make-up of tissues at single-cell resolution in research organisms when pre-existing knowledge about their cell types is not available.

Image3C uses intrinsic cellular features and broadly acting dyes to perform cell composition analysis. After individual cells are imaged by a cell sorting instrument and clustered by size, the tool applies artificial intelligence to further cluster the cells based on detailed appearance to reveal groups that represent different parts of tissues and organs, providing clues as to how these develop and function.

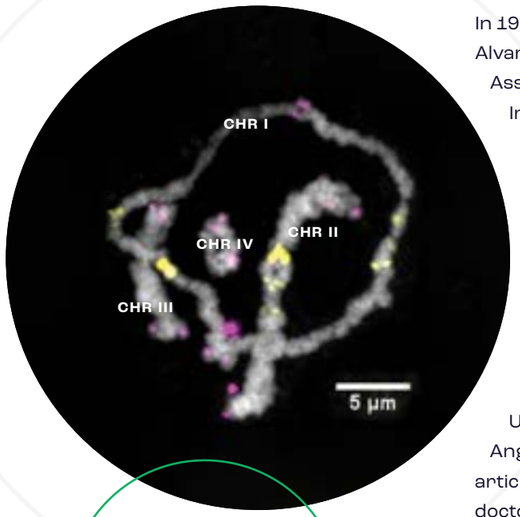
Stowers researchers have used Image3C to study the immune system of cavefish and the hemolymph of apple snails. This research could potentially help us understand more about autoimmune diseases and regeneration in humans.

"There are many opportunities and situations that bring people from the research labs and the Technology Centers together," said Alice Accorsi, Ph.D., a postdoc in the Sánchez Alvarado Lab. "These conversations often lead to common ground where we can work together." For the Image3C team, coming together not only helped answer their own research questions but strengthened capabilities for broader use at the Institute and beyond. •

Collaboration + Convening

The foundational research road

COLLABORATION LEADS TO NOVEL FINDINGS ON SEX CHROMOSOME EVOLUTION



Chromosomes duplicate and pair during cell division, revealing an unusual ring structure formed by Chromosome 1 (CHR I) which suppresses recombination.

In 1999, Alejandro Sánchez Alvarado, Ph.D., then a Staff Associate at the Carnegie Institution Department of Embryology, received a package from Sardinia -- 50 semi-frozen flatworms, the hermaphroditic strain of the planarian, *Schmidtea mediterranea*.

Twenty-three years later, a collaboration between the Stowers Institute and the University of California, Los Angeles, resulted in a *Nature* article led by former Stowers predoctoral researcher, former UCLA postdoctoral researcher, and now faculty member at the University of Michigan, Longhua Guo, Ph.D.

Novel insights into planarian genetics, the assembly of linkage maps for every gene in the planarian genome, and new evidence supporting the theory of sex chromosome evolution are just some of results of this fruitful partnership.

The sexual strain of *S. mediterranea* is indigenous to several Mediterranean islands including Sardinia and Corsica. In these isolated environments, these worms are found to stubbornly maintain heterozygosity — having two variations of a particular gene in a pair of chromosomes — despite prolonged inbreeding. After over 10 generations of inbreeding, in the lab and in the wild, the planarians maintain distinct haplotypes, or groups of genes inherited together, due to the improbability of recombination on Chromosome 1 – providing new insights into sex chromosome evolution and potential new insights into regeneration and aging. •

Facilitating idea exchange and advancing science

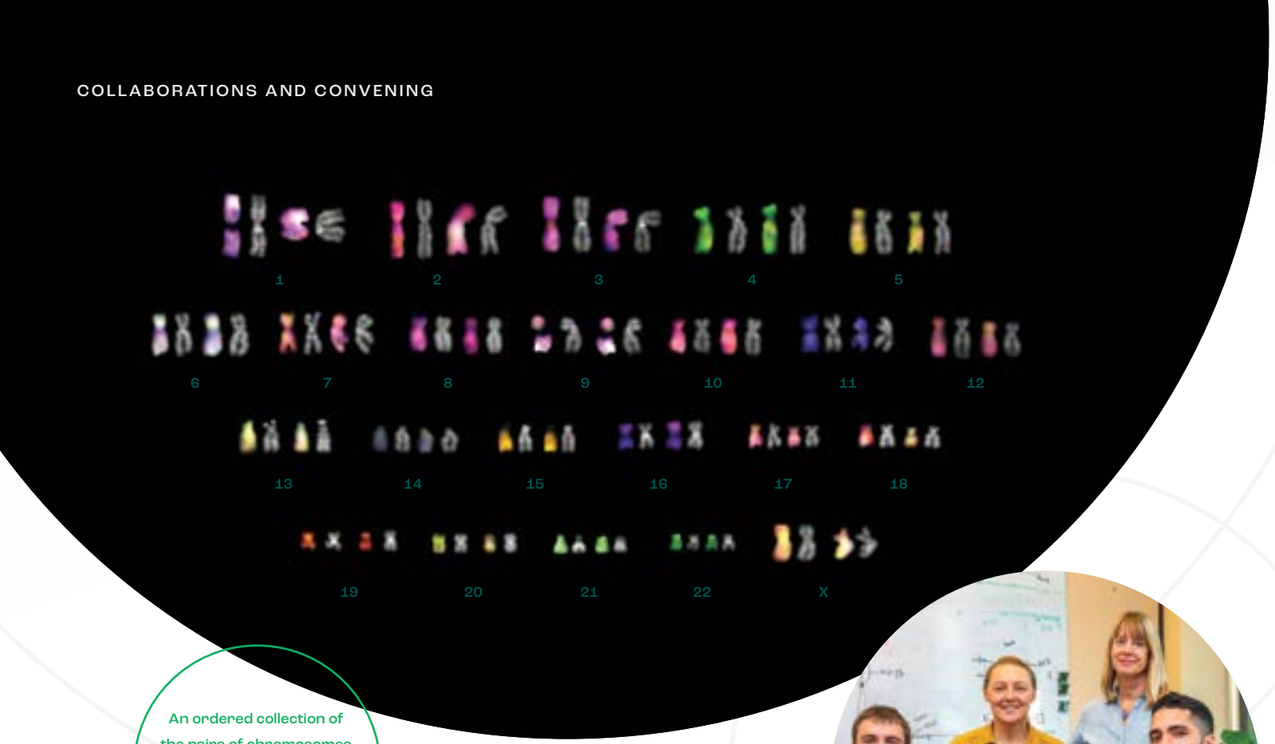
This year, the Stowers Institute harnessed the power of convening by hosting numerous seminars, workshops, and conferences.

The Stowers Research Conferences are a series of meetings exclusively organized and hosted by Stowers faculty. The series aims to inspire creativity, collaboration, and career development in the biological sciences, with each conference focused on a particular topic in a subfield of biology.

The October Genetics and Genomics – Stuck on Repeat conference focused on the dynamics of repeated sequences in genomes.

In July, the Institute hosted the American Society for Biochemistry and Molecular Biology: Evolution and core processes in gene expression meeting. Stowers Investigator Julia Zeitlinger, Ph.D., and Associate Investigator Nicolas Rohner, Ph.D., were among the organizers. The meeting highlighted recent insights into the cis-regulatory code contained within DNA that controls developmental gene expression processes. Participants also discussed new genomics technologies and computational methods that can aid in the study of gene expression regulation.

Also in July, Stowers hosted the European Molecular Biology Organization Lab Leadership Course. Building on the strengths that most scientists already have—critical thinking, the ability to make careful observations, the ability to plan strategically and capably communicate complex ideas—the four-day course introduced key concepts that can enable individuals to become effective and productive scientific leaders. •



An ordered collection of the pairs of chromosomes analyzed in the T2T complete human genome sequencing project.

Left-right: Matthew Borchers, Tamara Potopova, Jennifer Gerton, Leonardo Gomes de Lima

Sequence complete

Nearly two decades ago, the Human Genome Project reported the complete sequencing of the human genome. However, 8 percent of the sequence was, in fact, a "complete" mystery.

In a multi-institutional, international collaboration, the Telomere-to-Telomere (T2T) consortium finally filled in gaps in the sequence. Investigator Jennifer Gerton, Ph.D., and several fellow Stowers researchers participated in the project, a true milestone in modern biology.

The missing genetic sequences were particularly difficult to assemble due to their length, similarity, and repetition. Imagine trying to translate a book from one language to another and finding in the middle, "and and and and and and and and...." A natural inclination would be to ignore the extra copies as extraneous. As it turns out, these sequence repetitions are extraordinarily important components of our genetic makeup and diversity.

A big chunk of the mystery sequences were repetitive DNA encoding ribosomal RNA, a component of each cell's protein-producing machines called ribosomes. As every cell requires proteins to carry out a wide range of tasks, these locations are critical for cellular function. •

Organizational
HIGHLIGHTS

Marine Biological Laboratory

HOME TO NEW STOWERS SATELLITE LAB

This year, the Institute launched an initiative to facilitate new opportunities for research and collaboration.

In early 2022, the Stowers Institute established a satellite lab at the Marine Biological Laboratory (MBL) for year-round use by Stowers researchers. The MBL is dedicated to scientific discovery – exploring fundamental biology, understanding biodiversity and the environment, and informing the human condition through research and education. Founded in Woods Hole, Massachusetts, in 1888, the MBL is a private, nonprofit institution and an affiliate of the University of Chicago.

The MBL draws a unique mix of researchers ranging from early career scientists to Nobel Laureates, and students from high school to postdoctoral. This diversity has led to led to multiple, transformative breakthroughs in our understanding of biology. The MBL, located at the southern tip of Cape Cod, provides Stowers researchers with access to marine biology not available in the Midwest. With an already vast array of research organisms studied at the Institute, Stowers researchers are well poised for the study of new marine organisms. •

Stowers Institute + American Century Investments®

United by a vision for helping others

Jim Stowers Jr. believed that the success of American Century Investments, which he founded in 1958 as a mutual fund company, would come from making the company's clients successful. Providing innovative solutions to help clients reach their financial objectives has allowed American Century to become a leading global asset management firm while making a positive and enduring impact on humankind by funding innovative biomedical research at the Stowers Institute.

Jim and Virginia Stowers founded the Stowers Institute with their own personal wealth, including an equity stake in American Century. Since 2000, the Institute's more than 40 percent ownership of American Century has generated $1.87 billion in dividends directed to the Institute, helping to accelerate biological discoveries that provide insights for medical advances and improving human health.

Additionally, as the official national beneficiary of the annual American Century Championship celebrity golf tournament, the Institute received proceeds totaling $1.2 million in 2022.

At the American Century Championship held July 6-10, Kansas City Chiefs football players Patrick Mahomes and Travis Kelce joined more than 80 other sports and entertainment stars on the roster. Former Dallas Cowboys quarterback Tony Romo clinched victory for the third time in five years and donated his $125,000 first place prize money to the Stowers Institute and other tournament charities. •

"Joining the Stowers Institute was an outstanding opportunity for us to enhance our research programs by synergizing with the scientific expertise and technological capabilities at the Institute."

Stowers welcomes new investigator

Renowned developmental biologist, Tatjana Sauka-Spengler, Ph.D., joined the Stowers Institute this year from Oxford University. She also serves on the faculty of the Graduate School of the Stowers Institute.

A leader in the areas of developmental genomics and gene regulation, Sauka-Spengler has pioneered key methodologies to investigate fundamental biological processes. She aims to understand how genetic programs, encoded at the genome level, are translated into networks of interacting biological components such as genes, proteins, and RNA to carry out developmental processes in vertebrates. This type of knowledge is essential to understanding not only the mechanisms of normal developmental processes but also human diseases that are triggered when biological circuits malfunction.

Sauka-Spengler said she is looking forward to collaborations with her colleagues at Stowers, "Joining the Stowers Institute was an outstanding opportunity for us to enhance our research programs by synergizing with the scientific expertise and technological capabilities at the Institute." •

Education + Training

BIOMED VALLEY DISCOVERIES

Focused on moving discoveries from lab bench to patient

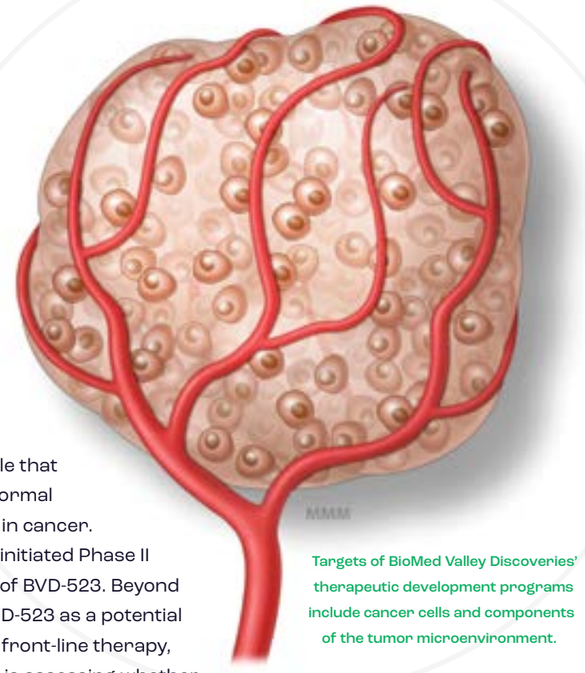
When Jim and Virginia Stowers founded the Stowers Institute, they also wanted to accelerate the path, when possible, from lab discovery to practical application. They created BioMed Valley Discoveries (BVD) to evaluate and move promising research findings from the Institute and other labs into clinical development.

The BVD team, led by President Brent Kreider, Ph.D., is developing drug candidates by leveraging partners at leading academic, contract research, and clinical institutions.

BVD's most clinically advanced drug candidate is ulixertinib (BVD-523), a small molecule that reduces abnormal cell signaling in cancer. In 2020, BVD initiated Phase II clinical trials of BVD-523. Beyond the use of BVD-523 as a potential single-agent, front-line therapy, the company is assessing whether it may be effective as part of novel combination therapy regimens, as well as in patients with specific genetic profiles that are resistant to other drugs.

BVD is also studying other ways to combat cancer, including a drug currently in Phase I clinical trials that exploits the unusual conditions inside tumors using an altered form of the bacteria, *Clostridium novyi* which can digest a tumor from the inside out.

Other programs at earlier stages of development involve antibody–drug conjugates that target cancer cells and associated blood vessels for cancer ablation using selective localization of a toxic payload. •



Targets of BioMed Valley Discoveries' therapeutic development programs include cancer cells and components of the tumor microenvironment.

The Graduate School marks 10 years and accreditation

With the start of the 2022-23 academic year, the Graduate School of the Stowers Institute for Medical Research welcomed the 11th class of predoctoral researchers. Over the past 10 years, the Graduate School has conferred M.S. and Ph.D. degrees to more than 30 researchers, with many transitioning to post-doctoral research positions at other academic institutions and others choosing careers in scientific industry, education, or hospital-based research programs.

In late 2021, after a multi-year process, the Graduate School received institutional accreditation from the Higher Learning Commission, an agency recognized by the U.S. Department of Education and the Council for Higher Education Accreditation. Accreditation is an important validation of the quality of the education provided by the Graduate School and a notable achievement for the Institute. •

FROM LEFT TO RIGHT

Julianna Haug
University of Arizona

Michay Diez
National University of San Martin, Argentina

Stefanie Williams
Heinrich Heine University, Dusseldorf, Germany

Thoa Truong
University of Science, Vietnam

Siddharth Shivanandan
Indian Institution of Science Education and Research, Thiruvananthapuram, India

Paxton Kostos
University of Missouri

Roberta Fiorino
University of Modena and Reggio Emilia, Italy

Introducing the new class

In August, seven new predoctoral researchers, hailing from six different countries, began their formal graduate education in the Stowers Graduate School's Ph.D. program. Over the next five to seven years, they will be mentored by principal investigators and senior researchers and gain hands-on training and experience with state-of-the-art technology and methodologies that will refine their skills, allow them to make a significant contribution to their field, and prepare them for independent research. •

IN MEMORY OF

Camila Behrensen

AND

Pablo Guzmán Palma

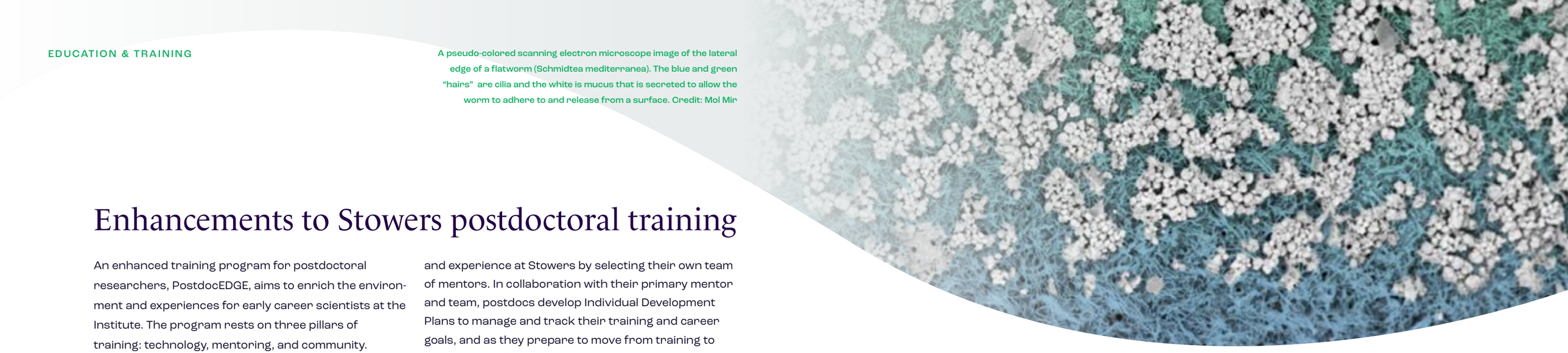
The Stowers Institute and The Graduate School of the Stowers Institute remember our predoctoral researchers whose tragic deaths in 2022 have left a void in our hearts and our community.

Camila and Pablo were extraordinary individuals and valued members of the Stowers community. They cared deeply for their science and their colleagues, and both were undoubtedly destined to make significant contributions to our understanding of biology. We grieve the loss of their unrealized personal and scientific contributions yet celebrate all they had accomplished in their lives.

Scholars programs provide early exposure to innovative science

The inaugural class of Stowers Research Scholars completed their year-long fellowships this summer. This ambitious postbaccalaureate program provides accomplished recent undergraduates from historically underrepresented communities with mentored research experience, access to Graduate School courses, and academic career mentoring focused on higher education research opportunities. Program Administrator and Assistant Dean for Academic Affairs Jinelle Wint Ph.D., said, "The Research Scholars Program provides an opportunity for biomedical research experience that makes our scholars more competitive for PhD or MD/PhD programs."

This year, the Stowers Summer Scholars Program, an immersive research internship, hosted 21 undergraduates in 14 different labs and technology centers across the Institute. The scholars explored various experimental techniques and technologies while conducting independent research projects. "This program provides valuable experience that contributes to many undergraduates attending graduate school and pursuing scientific careers," said SaraH Zanders Ph.D., Graduate School Vice Dean and Administrator of the program which is supported by a generous donation from the Stowers Foundation. •



A pseudo-colored scanning electron microscope image of the lateral edge of a flatworm (Schmidtea mediterranea). The blue and green "hairs" are cilia and the white is mucus that is secreted to allow the worm to adhere to and release from a surface. Credit: Mol Mir

Enhancements to Stowers postdoctoral training

An enhanced training program for postdoctoral researchers, PostdocEDGE, aims to enrich the environment and experiences for early career scientists at the Institute. The program rests on three pillars of training: technology, mentoring, and community.

Stowers postdocs are empowered with technologically advanced tools and access to technology experts to design and execute multidisciplinary research at unparalleled pace and scale.

Mentoring is designed as a distributive process, allowing postdocs to take advantage of the extensive talent and experience at Stowers by selecting their own team of mentors. In collaboration with their primary mentor and team, postdocs develop Individual Development Plans to manage and track their training and career goals, and as they prepare to move from training to their next professional role, they are provided access to resources that aid in career navigation.

The culture of scientific collaboration at Stowers promotes rapid research progress, while simultaneously providing postdocs with numerous interaction opportunities and resources, a reminder that each scientist is an integral part of the Institute. •

HOPE FOR LIFE FUND

Investing in tomorrow's cures

Today, Stowers scientists are at the forefront of unraveling the mechanisms behind health and disease and preparing the groundwork for novel treatments and cures.

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

We thank all who believe in our mission.

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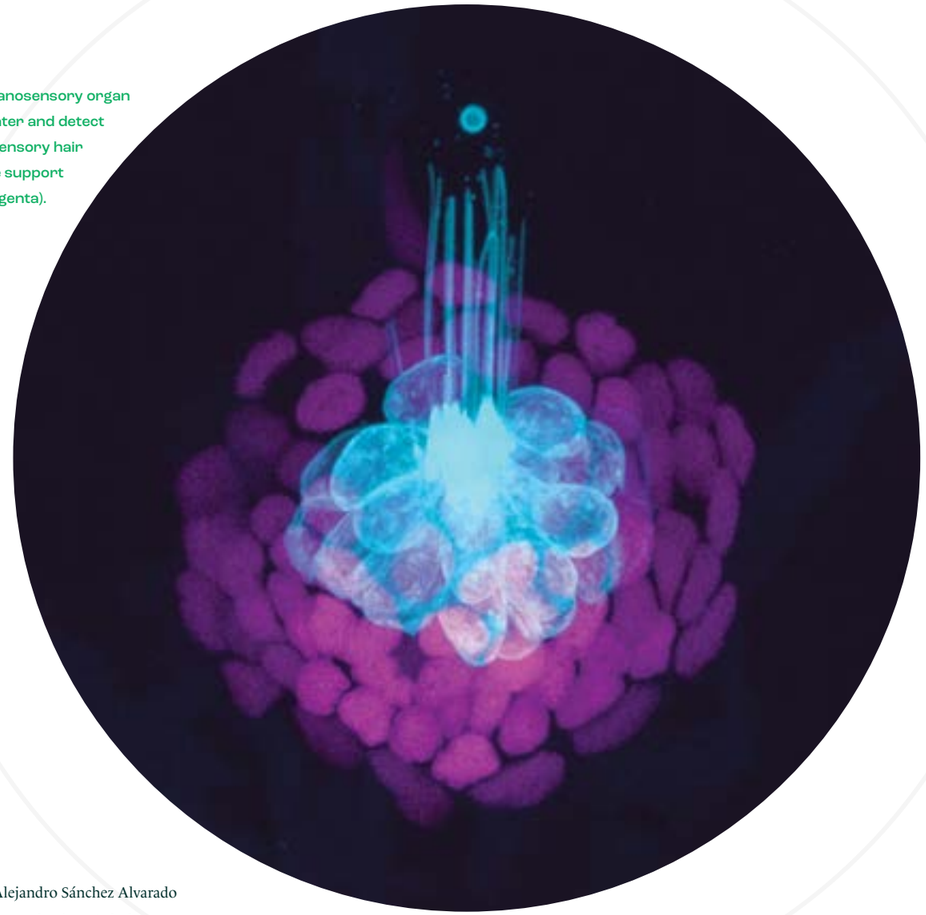
A zebrafish neuromast is a mechanosensory organ that helps the fish orientate in water and detect prey. It is comprised of lateral line sensory hair cells (shown in blue) and lateral line support cells (shown in magenta).



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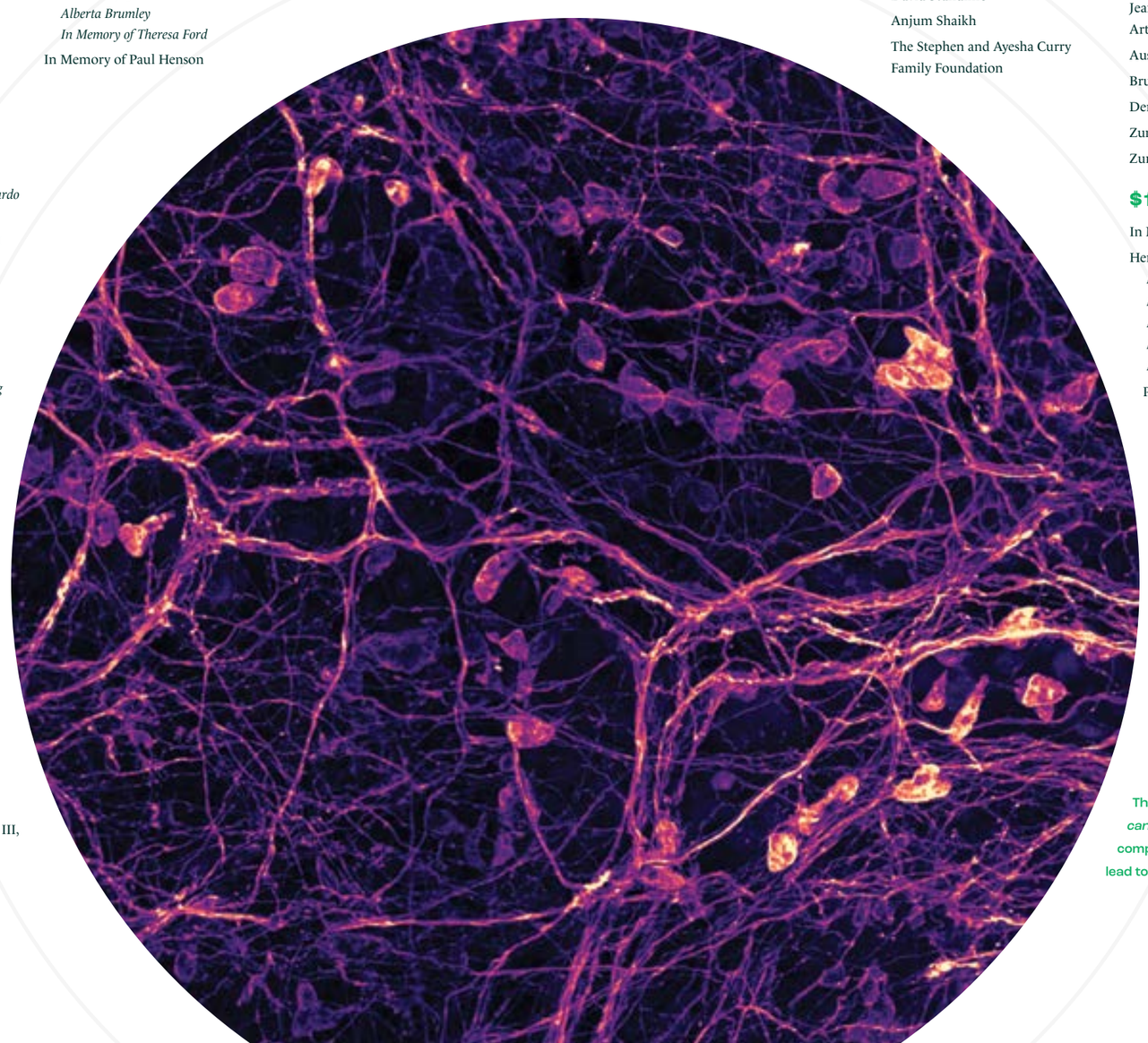

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The intricate mesh of neurons in the brain of an apple snail, *Pomacea canaliculata*. Understanding how apple snails can regenerate eye components, which are remarkably similar to vertebrate eyes, may lead to treatments for human eye disorders.

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Behind the Science

Cooling a facility the size of the Stowers Institute that runs thousands of large- and small-scale pieces of scientific equipment requires significant mechanical and financial investment and leaves a large environmental footprint. In 2022, after years of research and planning, the Institute replaced one of the five original units, and installed a new magnetic bearing centrifugal chiller unit that provides significant energy and financial savings. Only on the very hottest of days is back-up assistance required from the other chillers to keep the Institute at a comfortable temperature, thus reducing the Institute's environmental footprint.

>3,000,000 Gallons of chilled water produced and circulated each day

$200,000 Annual savings in electrical costs over the replaced oil-dependent chiller

19,000 Weight in pounds of the chiller

14,000 Rotations per minute of the compressors on friction free magnetic bearings

1600 Tons of cooling provided by new chiller
(A single ton of cooling is 12,000 BTU/hour).

15 Length in feet

1 Required number of maintenance engineers to operate the chiller

<.4 Kilowatts of electricity used per ton of cooling
compared to >.7 kw/ton for old chillers

Chiller by the Numbers

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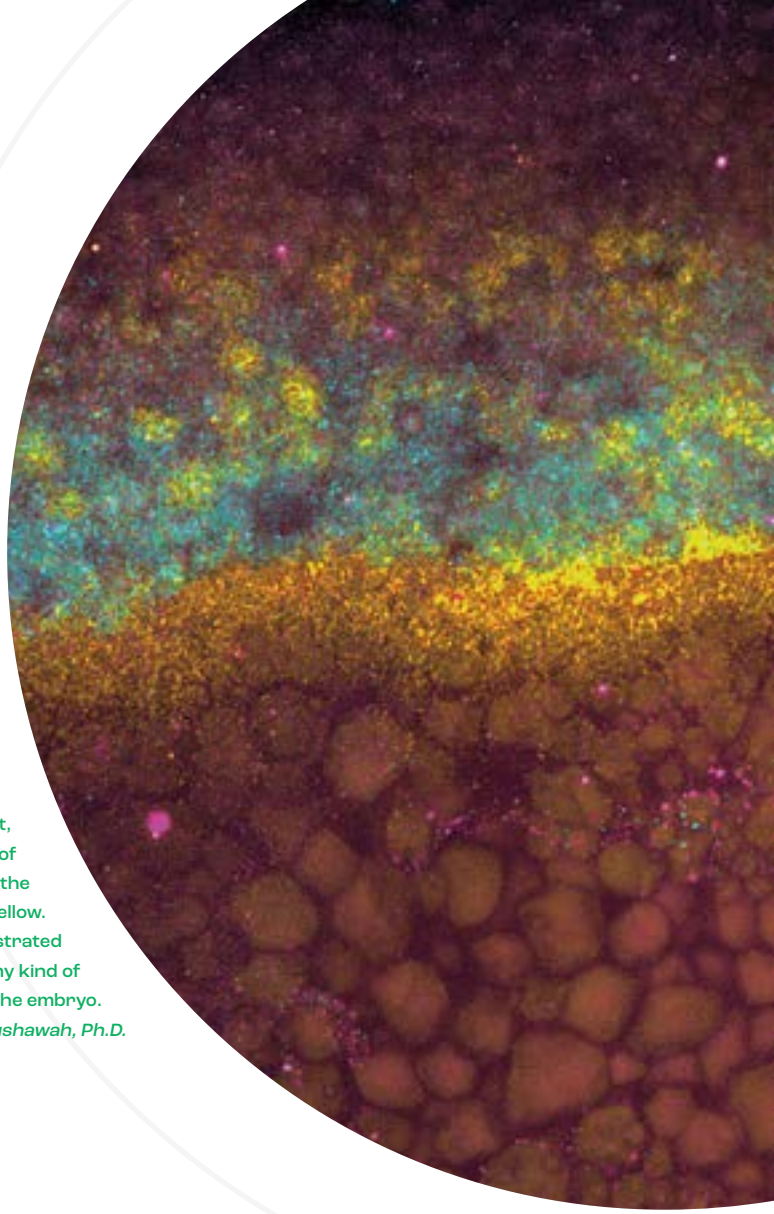

The Bazzini Lab studies how genes are regulated to impact development, physiology, and disease. This image depicts the different germ layers of a zebrafish embryo. The ectoderm (outer layer) is stained magenta, the mesoderm (middle layer) is blue, and the endoderm (inner layer) is yellow. The cells in these three layers are dynamic and move in an orchestrated manner to regulate the future embryo body plan in time and space. Any kind of failure in this process can lead to developmental abnormalities in the embryo.

Image author: Postdoctoral Research Associate Gopal Kushawah, Ph.D.

Our Mission

To make a significant contribution to humanity through medical research by expanding our understanding of the secrets of life and by improving life's quality through innovative approaches to the causes, treatment, and prevention of diseases.