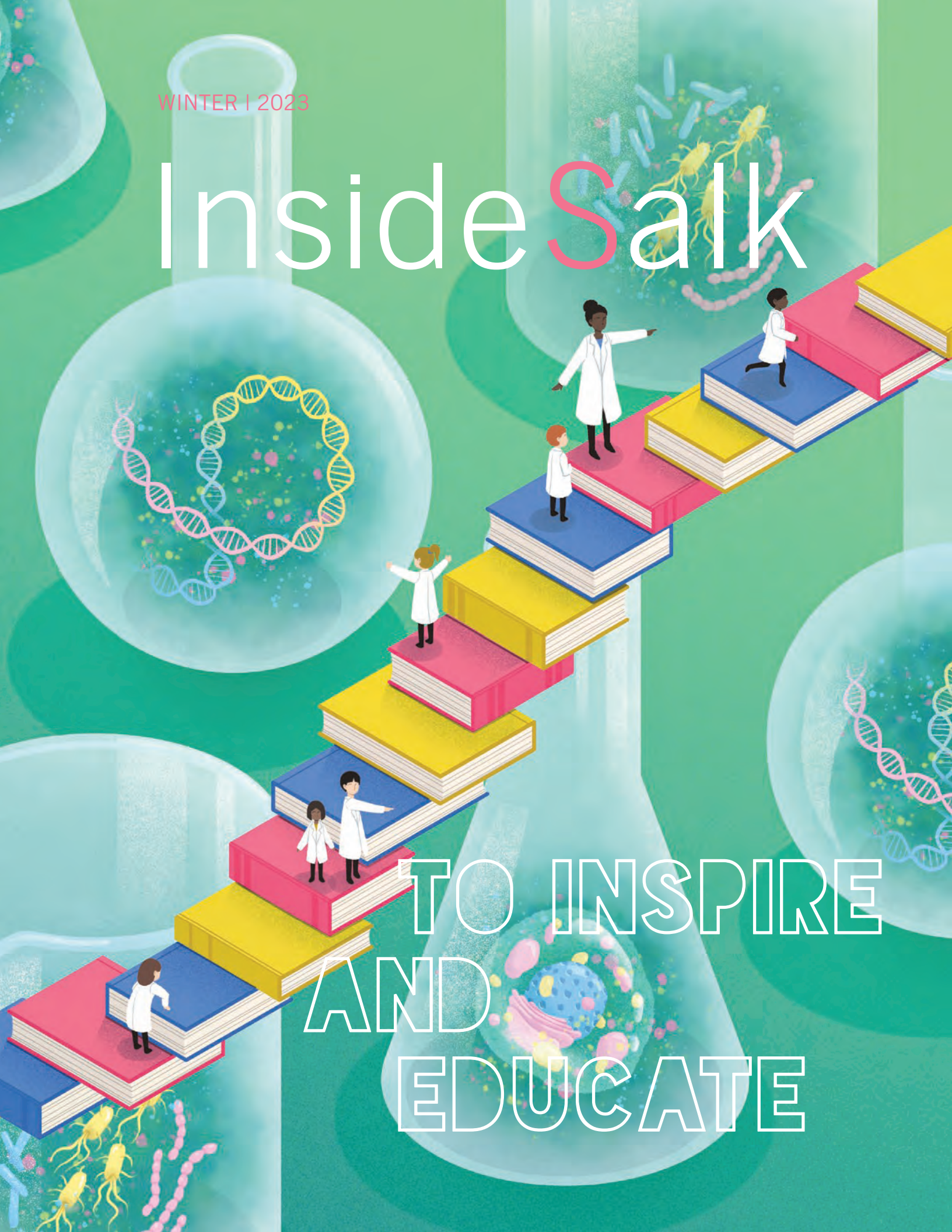
WINTER | 2023

InsideSalk



TO INSPIRE AND EDUCATE

CONTENTS

ON THE COVER:

At each stage on the path to becoming a scientist, Salk's Education Outreach team and Office of Diversity, Equity & Inclusion provide opportunities for thousands of students, a majority of whom come from underrepresented and underserved communities, to take part in innovative learning experiences and explore careers in science.

Dear Friends,

Since the creation of the Institute, people have been the driving force of Salk's scientific achievements. Jonas Salk sought out the brightest scientific minds—a cadre of Nobel Prize winners and other luminaries—to become the Institute's first faculty. Through the years, it's been people who have pushed Salk science to new heights, positioning this relatively small, basic science research institute to world-renowned status.

Every day, people in our labs make scientific breakthroughs, collaborating with each other across fields of research. People in our administrative and service departments keep the Salk engine running. And it's our early-career researchers, graduate students, and postdoctoral researchers who continually bring optimism, curiosity, and a fresh perspective to the bench.

In this spirit, and in keeping with the Institute's long history of teamwork, collaboration, and revolutionary breakthroughs, we recently launched the Office of People & Culture.

The objective of this new department is to align personnel with goals and metrics, while underscoring that ongoing scientific achievements are a result of close partnerships and inclusivity within a culture of belonging, trust, and respect. The Office of People & Culture at Salk supports collaboration of the key functions of Human Resources, the Pre & Postdoctoral Office, and the Office of Diversity, Equity & Inclusion.

As you will see in this issue of *Inside Salk*, it's the people who make our scientific success possible, and this certainly includes you, a loyal supporter of the Institute.

In our cover story, you'll discover how the people who make up Salk's Education Outreach team are on a mission to introduce as many San Diego County students as possible to the groundbreaking scientific research at Salk, with the goal of inspiring the next generation of scientists.

Additionally, Assistant Professor Deepshika Ramanan discusses her childhood in India and what motivates her to discover how mothers and babies influence each other's immune systems. Postdoctoral Researcher Melissa Hernandez shares her departure from and return to San Diego, as she revisits her childhood roots while conducting electrophysiology research at Salk after many years away in Oregon. And we hear how Trinka Adamson's lifelong love of animals drew her into the lab and ultimately to her current role as senior director of Salk's Animal Resources Department.

Finally, I would like to extend my heartfelt appreciation to you for your partnership this year. As 2023 comes to an end, I will always hold the year in special regard thanks to the overwhelmingly support I have received in my new role as the Institute's president. I am excited by the promise of a bright future for Salk science, which is due in significant part to the generosity of supporters like you. May you and your loved ones have a wonderful holiday season and a healthy and happy new year.

Warmest regards,

Gerald Joyce
Salk Institute President

"Through the years, it's been people who have pushed Salk science to new heights, positioning this relatively small, basic science research institute to world-renowned status."

DISCOVERIES

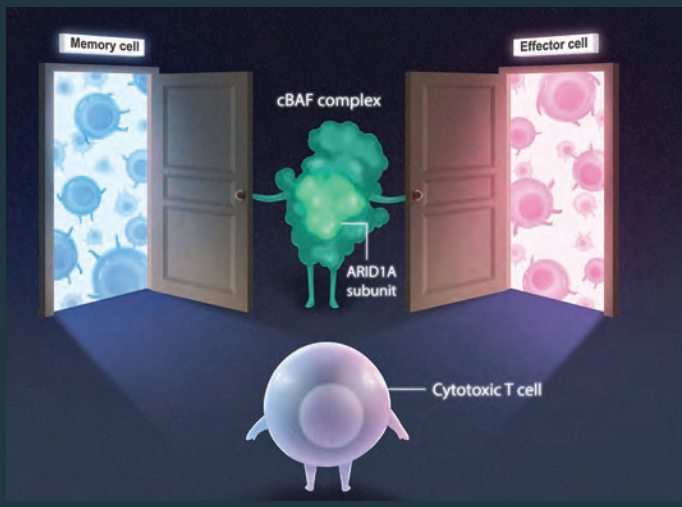
Unraveling our immune system's T cells

Just as the patches of a quilt complement each other, so too do the proteins, cells, and organs that make up our immune system. Our immune system wraps our body with protection, with its interacting components each uniquely contributing to our health. And while this protective patchwork is beautiful altogether, understanding the intricacies and effort required to design each patch alone can inspire greater appreciation of the whole. Such is the case for the T cell—one powerful immune system component able to target and attack diseased and cancerous cells. T cells can be divided into two broad groups: killer T cells, which can attack and destroy sick cells, and helper T cells, which coordinate killer T cells and other specialized immune cells. As Salk scientists pick apart the threads that connect these T cells, they uncover how they differentiate into subtypes, the approaches each type uses to fight disease and shrink cancerous tumors, and whether the cells' functions can be optimized by therapeutic intervention.

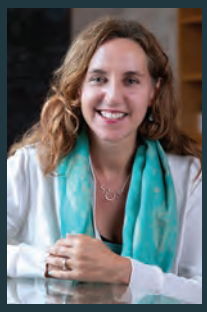
MAPPING THE DEVELOPMENT OF INFECTION-FIGHTING IMMUNE CELLS

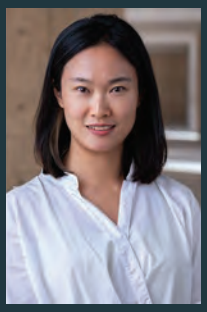
IMMUNITY 06/2023

Killer T cells, though a subtype themselves, can transform into even more specialized subtypes. Little was known about what influences this further differentiation until Professor Susan Kaech, Associate Professor Diana Hargreaves, co-first authors Bryan McDonald and Brent Chick, and colleagues endeavored to unravel this T cell differentiation mystery. What they discovered was that a protein complex called cBAF can open or close genetic "doors" to control T cell fate. Their findings illuminate how T cells fight and remember infections, and inspire the development of more effective vaccines and cancer therapeutics.



Cytotoxic T cell (purple) deciding whether to become a memory cell (blue) or effector cell (pink) subtype. The cBAF complex (green) and ARID1A subunit open the doors for both cell fate options.


SUSAN KAECH


DAN CHEN


SIVA KARTHIK VARANASI

USING THE BODY'S "INVISIBLE SCALPEL" TO REMOVE BRAIN CANCER

IMMUNITY 08/2023

Professor Susan Kaech, co-first authors Dan Chen and Siva Karthik Varanasi, and colleagues found that helper T cells play a crucial role in the success of the immunotherapy treatment anti-CTLA-4 in mice with glioblastoma, the most common and deadly form of brain cancer. The immunotherapy's success depended on helper T cells pairing up with brain-resident immune cells called microglia—demonstrating the value of the immune system's quilted connections. The findings show the benefit of harnessing the body's own immune cells to fight brain cancer and could lead to more effective immunotherapies for treating brain cancer in humans.

"We are already excited about so many new biological questions and therapeutic solutions that could radically change treatment for deadly cancers like glioblastoma."

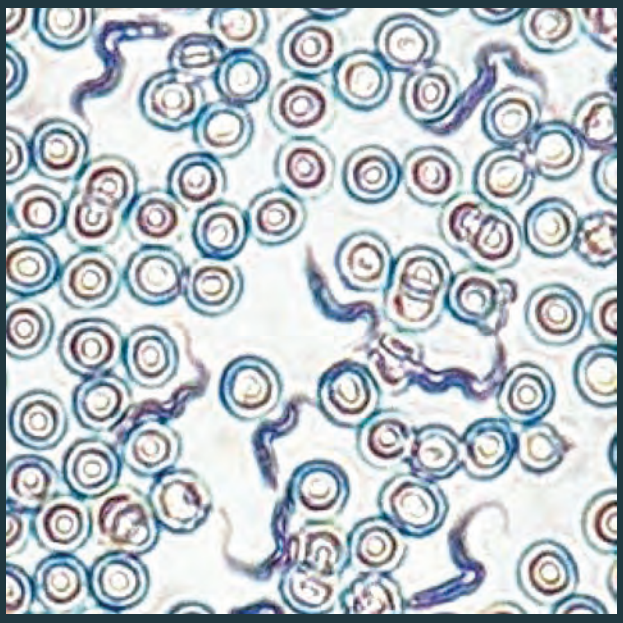
POSTDOCTORAL RESEARCHER SIVA KARTHIK VARANASI

WHY WE LOSE FAT AND MUSCLE DURING INFECTION

CELL REPORTS 07/2023

Since helper T cells lead the fight against infection and can promote the activity of killer T cells, when researchers were looking to explain wasting—the loss of fat and muscle that can occur during infection—they hypothesized the two T cell types may be cooperating. Professor Janelle Ayres, first author Samuel Redford, and colleagues discovered the wasting response to infection with the bacteria *T. brucei* in mice occurs in two phases, each regulated by different T cell subtypes. While fat loss did not benefit the fight against infection, muscle loss did—a surprising clue that some wasting may help manage illness. The findings can inform the development of more effective therapeutics that spare people from wasting and increase our understanding of how wasting influences survival and morbidity across infections, cancers, chronic illnesses, and more.

Parasitic *Trypanosoma brucei* parasites (dark blue) among mouse blood cells (light blue and white).



NEUROSCIENCE

Preying on hungry, anxious worms

eLIFE 07/2023

The life of the tiny worm called *C. elegans* consists mostly of looking for food, eating food, and laying eggs. So, when any of these behaviors are disrupted, there's cause for concern. In a new study, Professor Sreekanth Chalasani, co-first authors Amy Pribadi and Michael Rieger, and colleagues discovered that the "feel good" brain chemical dopamine regulates anxious worm behavior in the presence of nipping predators. The findings illuminate how this dopamine-regulated brain pathway may be related to anxiety and could provide insight into human conditions, such as post-traumatic stress disorder (PTSD).

Top: Worm (*Caenorhabditis elegans*) approaching two predators (*Pristionchus pacificus*) guarding a patch of food; Bottom (from left): Michael Rieger, Kirthi Reddy, Sreekanth Chalasani, and Amy Pribadi.

PLANT BIOLOGY

JOSEPH ECKER

TATSUYA NOBORI

Scan here for videos of the team's technology in action.

Seeing the inside of plants in 3D

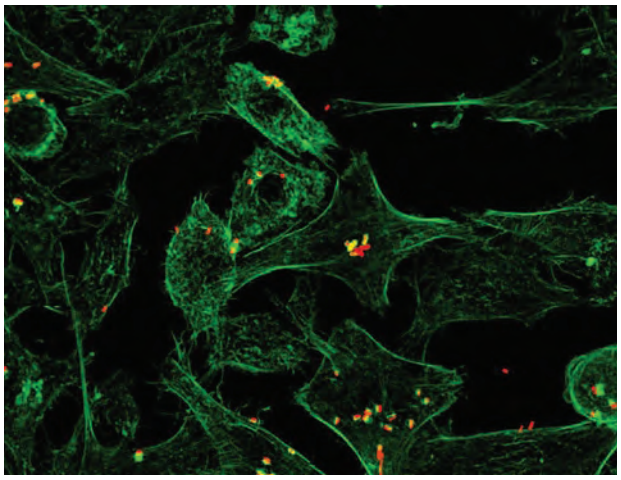
NATURE PLANTS 06/2023

The cellular life inside a plant is as vibrant as the blossom. In each plant tissue—from root tip to leaf tip—there are hundreds of cell types that relay information about functional needs and environmental changes. Now, a new technology developed by Professor Joseph Ecker, first author Tatsuya Nobori, and colleagues captures this internal plant world at an unprecedented resolution, opening the door for understanding how plants respond to a changing climate and how researchers might develop more resilient crops.

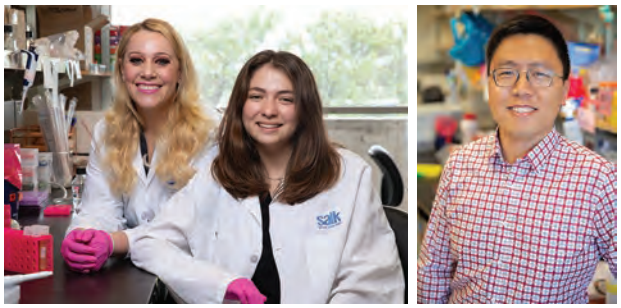
All the immunity, none of the symptoms

SCIENCE ADVANCES 06/2023

Worldwide, more than a million deaths occur each year due to diarrheal diseases that lead to dehydration and malnutrition. Yet no vaccine exists to fight or prevent these diseases, which are caused by bacteria like certain strains of *E. coli*. Professor Janelle Ayres, first author Grischa Chen, and colleagues found that pairing specific diets with disease-causing bacteria can create lasting immunity against diarrheal illness in mice without the cost of developing sickness. Their discovery paves the way for the development of new vaccines that could promote immunity for those with diarrheal diseases and possibly other infections.



Cells (green) becoming infected with bacteria (red).



From left: Janelle Ayres, Natalia Thorup, and Grischa Chen.

"With HIV, one must think two steps ahead of the virus. We've now determined how the virus could continue evolving against drugs like Dolutegravir, which is important to consider for the development of future therapeutics."

ASSOCIATE PROFESSOR DMITRY LYUMKIS

From left: Tim Strutzenberg, Zelin Shan, Dmitry Lyumkis, Dario Passos, and Avik Biswas.

Revealing HIV drug-resistance mechanisms through protein structures

SCIENCE ADVANCES 07/2023

Associate Professor Dmitry Lyumkis and colleagues, in collaboration with the National Institutes of Health, discovered the molecular mechanisms by which human immunodeficiency virus (HIV) becomes resistant to Dolutegravir, one of the most effective, clinically used antiviral drugs for treating the infection. The new study reveals how changes to the 3D structures of integrase, an HIV protein, can lead to Dolutegravir resistance and how other compounds may be able to overcome this resistance.

From left: Gabriela Estepa, Ronald Evans, Ruth Yu, Corina Antal, Annette Atkins, and Michael Downes.

"Super-enhancer" super-charges pancreatic tumor growth

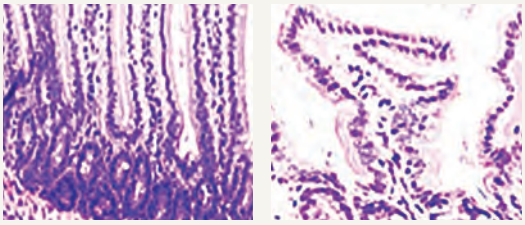
NATURE COMMUNICATIONS 09/2023

Pancreatic cancers are among the most aggressive, deadly tumor types, and for years researchers have struggled to develop effective drugs against the tumors. Now, Professor Ronald Evans, first author Corina Antal, and colleagues have identified a new set of molecules that fuel the growth of tumors in pancreatic ductal adenocarcinoma (PDAC), the most common type of pancreatic cancer. The new research explains how certain gene mutations trigger out-of-control growth in pancreatic cancer by activating a "super-enhancer" that turns on other genes. They also show the effectiveness of a new drug that puts the brakes on pancreatic cancer growth by blocking the effects of that super-enhancer.

High-fat diets alter gut bacteria, boosting colorectal cancer risk in mice

CELL REPORTS 08/2023

The prevalence of colorectal cancer in people under the age of 50 has risen in recent decades. One suspected reason: the increasing rate of obesity and high-fat diets. Now, Professor Ronald Evans, co-first author Ting Fu, and colleagues, in collaboration with UC San Diego, discovered exactly how high-fat diets can change gut bacteria and alter digestive molecules called bile acids, predisposing mice to colorectal cancer. The findings help scientists better understand colorectal cancer and how to potentially prevent it.



The inner folds of the intestines (purple) are different in healthy mice (left) compared to mice fed a high-fat diet (right). Salk researchers identified changes in bacteria and bile acids that drive these changes.

"The balance of microbes in the gut is shaped by diet, and we are discovering how alterations in the gut microbial population can create problems that lead to cancer. This paves the way toward interventions that decrease cancer risk."

PROFESSOR RONALD EVANS

TO INSPIRE AND EDUCATE

SALK'S EDUCATION OUTREACH IS ON A MISSION

Jonas Salk with students during High School Science Day, 1994.

A half-dozen high school students shuffle through an archway to a small microscopy room in the Salk Stem Cell Core facility.

"It's sticky!" exclaims a tall student as they step off the clean-room mat that removed loose particles from the soles of their Converse sneakers.

Once inside the 5-by-8-foot space, the students crowd around a monitor connected to a microscope. On the screen is a black-and-white video image of … what, exactly?

A white-coated laboratory technician tells the students that they're looking at induced pluripotent stem cells. He explains that cells taken from a person's skin biopsy have been reprogrammed, using a custom cocktail of proteins, into these cardiomyocytes—heart-muscle cells.

Suddenly, a student in rectangular glasses blurts out, "I can see them beating!" Everyone leans in eagerly. It's clear the cells are pulsating rhythmically. Murmurs of "Wow!" and "That's so cool!" ripple through the group.

This is precisely the kind of wonder and excitement the Salk Institute's March of Dimes High School Science Day was meant to inspire. The annual half-day event, which began in 1990, is one of Salk's oldest outreach programs, with more than 5,000 students and teachers participating to date. It is named in honor of the March of Dimes, an organization that provided early research funding to Jonas Salk, long before he founded the Salk Institute. The Anne and Neal Blue High School Science Fund is a major supporter of the program.

Every year, High School Science Day introduces approximately 250 high school students from around 25 schools in San Diego County to scientists and scientific research. Of the schools, 85 percent are Title 1, which means they receive federal funds to close achievement gaps among disadvantaged students, and this year, 87 percent of attendees identified as biracial or people of color. In addition to going on lab tours like the one in the Stem Cell Core, students participate in actual laboratory activities, including DNA extraction, cell culture, pipetting, and loading electrophoresis gels, which are typically used for separating DNA in genetic studies.

High School Science Day was important to Institute founder Jonas Salk, who thought it was essential that young people be introduced to the kind of groundbreaking scientific research that led him, in the early 1950s, to develop the first safe and effective vaccine for polio, a terrifying infectious disease that can result in death or lifelong disability. Thanks to vaccination, polio has almost been eradicated globally.

Jonas Salk did not live to see additional outreach programs developed that would cement the Institute's reputation in San Diego County as a provider of high-caliber science-education opportunities. But those who knew him—such as neurobiologist Ellen Potter, who began her Salk career in the lab of Professor Suzanne Bourgeois—are certain he would have been delighted.

"When Jonas talked to children, he looked directly at them and made them feel that there was no one more important," Potter says. "He was really receptive to being asked questions and answering them."

Left: Ellen Potter, March of Dimes High School Science Day, 2016.

EDUCATION OUTREACH

The Salk Institute's Education Outreach program was built from the ground up by Potter, who traded her pipettes for pencils in the mid-1990s, when DNA and its applications to medicine, law, and other fields were still relatively new to the public.

Potter remembers that there were discussions among the Salk faculty about how this was an opportunity to better educate people on what DNA was all about.

Potter and a few graduate students from Salk reached out to several local school districts and were pleased when a pair of middle school teachers in the Grossmont School District expressed interest in having the scientists run a workshop on DNA technology and genetics in their respective classrooms. So, Potter and her team loaded up her van with vials of fruit flies and other supplies and headed to East County. Salk's Mobile Science Lab was born.

Eventually, High School Science Day and the Mobile Science Lab came together under one administrative roof and became known as Education Outreach.

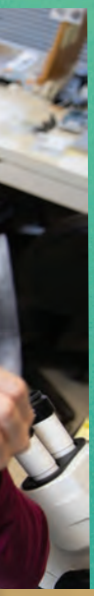
"Working side by side with teachers and science educators has been the strength of all the Salk educational programs," Potter says.

Potter retired in 2016 after 38 years at the Institute, leaving as her legacy a rich tradition of inspiring and educating the next generation of students and future scientists. She was followed in the director role first by Dona Mapston and then by Monika Wert-Parkinson. Wert-Parkinson skillfully saw the staff—which includes Shoshauna Borowitz, Joshua Von Trapp, Sara Sandoval, Kate Di Carlo, and Cecilia Hill—through the pandemic, taking some programs fully online and adapting others to a hybrid model with online and in-person components.

Bryan Robinson, Salk's vice president for External Relations, oversees Education Outreach. He says Jonas Salk's admonition to "be good ancestors" is the motivating force of the program. "Jonas founded the Institute with the philosophy that it should both drive scientific breakthroughs and inspire the next generation of elite scientists."

"Working side by side with teachers and science educators has been the strength of all the Salk educational programs."

ELLEN POTTER



The program's mission is threefold:

- To teach students, teachers, and the community about scientific literacy in addition to the role of basic biological research in our world.
- To inspire enthusiasm and interest in advanced levels of science instruction, and particularly in science as a career.
- To promote public awareness of Salk and the value of basic research as it relates to career readiness, critical thinking skills, and the development of an informed citizenry.

Education Outreach currently runs four programs: the Mobile Science Lab, which takes science experiments into middle schools; March of Dimes High School Science Day, a half-day of tours and activities in Salk labs; the Heithoff-Brody High School Summer Scholars Program, which offers eight-week paid internships in Salk labs; and the Edwards-Yeckel SciChats program gives elementary school students the opportunity to ask Salk scientists questions via video chat. A fifth program, which funded by the Stavros Niarchos Foundation, is being developed for high school and community college students and will launch in 2024.

Salk scientists of all levels—graduate students, postdoctoral researchers, and faculty—volunteer to work alongside Education Outreach staff. The staff also offers free training and equipment to teachers, to perform biotechnology activities in their own classrooms, and holds the Ellen Potter Research Connections for Teachers Symposium annually.

According to Robinson, "Salk's Education Outreach programs are offered for free to students, teachers, and schools, which reduces the economic barriers to a high-quality STEM education."

MOBILE SCIENCE LAB

The Mobile Science Lab visits up to 20 middle schools per year, many in underserved neighborhoods. The lab conducts three days of hands-on genetics experiments with the middle schoolers. The curriculum is the product of a collaboration between Salk scientists and San Diego educators. Day 1 focuses on phenotypes (physical characteristics) in fruit flies, the winged workhorses of genetics research. The students learn about genetic mutations and how certain mutations create observable differences in the flies.

For example, one mutation in a gene for wing shape causes normally straight wings to be curly. A mutation in a gene for eye color causes the flies' normally red eyes to be white. (In genetics parlance, the more common, nonmutated version of the gene is called the wildtype—the type most often seen in the wild).

Salk Associate Professor Kenta Asahina works with fruit flies to understand the simple genetic and neural circuits that cause responses like aggression and escape. It's not just about a single "aggression gene," however—genes and neurons are just the beginning. By tracing how the molecular underpinnings of behaviors give rise to more-complicated brain activity, he aims to eventually understand social interactions in humans. Asahina is currently helping to revamp the Day 1 curriculum.

On Day 2, the students explore the question, "What color is DNA?" They learn about the differences between animal and plant cells, extract DNA from a plant cell (wheat germ), and in the process discover that DNA is clear.

On Day 3, the middle schoolers "run gels"—shorthand for performing gel electrophoresis—an important laboratory technique for sorting molecules based on their size and electrical charge. The students learn that molecules like DNA have a negative charge and will be attracted by a positive charge. They also learn that small molecules move through a gelatinous substance called agar farther and faster than large molecules. In the activity, the students drop molecules of food dye into wells at one end of a rectangle of gel, apply electric current, and watch as the dyes migrate through the gel toward the opposite end. They learn firsthand that the distance the dye molecules travel is based on their size.

More than 40,000 middle school students have now participated in Salk's Mobile Science Lab. By doing science, students begin to see themselves as future scientists.

Well over a decade ago, one of these middle schoolers was Consuelo Sauceda. Now a graduate student working toward her PhD in biomedical sciences (BMS) at UC San Diego, Sauceda recently tweeted about the impact of the experience: "Just had the @UCSDBMS Diversity Committee session with BMS recruits and when speaking on Educational Outreach opportunities, I couldn't help but reflect on how the Salk Mobile Science Lab helped fuel my excitement for science back when I was in middle school!"

Sauceda was born in San Diego but lived in Mexico for part of elementary school so her parents could settle her grandparents' estates after they died. The family moved back to San Carlos shortly before Sauceda started middle school.

"None of my family is involved in science or higher education. They didn't know what science was, or research specifically. So I was the first generation in my family to go to college, and San Marcos Middle School is where it all started for me."

Sauceda explains that her middle school teacher, Debra Brice, "had close connections to people at Salk from previously doing research herself, so the van came out to our middle school."

She continues, "I had people come and teach me gel electrophoresis and DNA extraction, which I thought was super cool. At the time, I think we did strawberry or kiwi DNA extractions, using the standard lab techniques that are still used today."

The Mobile Science Lab was Sauceda's first exposure to Salk science, but it wouldn't be her last.

> **"No one in my family has a career in biology. My parents were first-generation college students, so for me to possibly be a scientist in the future is pretty awesome."**
>
> ISELA ORDONEZ

MARCH OF DIMES HIGH SCHOOL SCIENCE DAY

Isela Ordonez, now a junior at Orange Glen High School in Escondido, participated in High School Science Day last spring.

"It was truly amazing," says Ordonez, for whom the timing of the event during her sophomore year was perfect.

"I always loved science classes in elementary and middle school, but it wasn't until my freshman year biology class that I really grew an interest in it," she explains. "Salk was my first experience [outside of school] getting exposure to what a lab looks like. I didn't even know there were institutes specific for research."

Ordonez's science teacher at Orange Glen High School, Robert Shull, says that, when he had the opportunity to select two students for High School Science Day, "Isela's name immediately came to mind. She's the type of student who always wants to talk about science, so right away it was a no-brainer to take her."

He remembers that Ordonez's enthusiasm started high and remained there for the duration of the event and beyond.

"We sat down for that little intro they do in the auditorium, and one of the first things they mentioned was a summer internship opportunity. Right away, Isela turned to me and asked, 'Do you think I could do that?'" A few hours later, when the duo met for lunch, she told him all about the lab that she had gotten to tour that morning, the research they were doing, and how she "definitely wanted to apply for the internship."

Isela Ordonez with her parents.

Clockwise: Isela Ordonez (pictured far right) with the rest of the Salk High School Summer Scholars; Ordonez presenting at the Salk High School Summer Scholars program; Dona Mapston and Ellen Potter with the Mobile Science Lab.

HEITHOFF–BRODY SUMMER SCHOLARS PROGRAM

The High School Summer Scholars program is an eight-week, paid internship during which students conduct full-time research projects in a Salk lab. They formulate and test hypotheses, prepare experiments, participate in group meetings, and tour neighboring research facilities. After a rigorous application process, only 12 students out of 400 applicants are accepted each year; the unusual chance to do actual research alongside world-class scientists makes it a coveted opportunity. The students' summer salaries are funded in part by the San Diego Foundation.

"We've had a wide range of students," Potter says. "Some were very well qualified and had parents that encouraged them, and then there have been others that didn't have anyone who was even remotely aware of what biomedical research was. The strength of the program is that we've been very, very attuned to making sure the student and mentor are well matched. And we've had funding for the summer salaries, which allows students that need to work during the summer to still participate."

Potter credits longtime colleague Dona Mapston for ensuring that the Summer Scholars program reached its full potential, and for the expansion of the Mobile Lab to serve all of San Diego County. Mapston was a high school AP science teacher before joining Education Outreach and was Potter's professional partner for 15 years.

"It was Dona's commitment to excellence that led to the high educational standards for all of the Education Outreach programs," Potter says.

Last spring, when the summer internship application opened a few weeks after High School Science Day, Shull helped Ordonez prepare her application, wrote her a letter of recommendation, and conducted mock interviews with her for practice. She applied, then they waited anxiously to hear back.

"I'll never forget it—it was during my sixth period class, and she ran into my classroom almost screaming, 'I got the internship!' It's one of the highlights of my career," says Shull.

When Ordonez talks about her eight weeks as a Summer Scholar this past summer, you can hear her justified pride in her accomplishments. "I had my own research project, which is super empowering to me. I, myself, contributed to research and got experience in a lab with real scientists. I had a huge

support system, with four mentors, as well as [the Education Outreach team] and the other interns I was with. Not only did I do research, but I presented my research, too. I also had the opportunity to visit different biotech companies and talk to people with different careers within science."

Ordonez's family came to see her presentation about her research on the maize genome. "They're super proud of me," she says. "No one in my family has a career in biology. My parents were first-generation college students, so for me to possibly be a scientist in the future is pretty awesome."

Shull echoes how transformative Ordonez's Salk experiences have been. "One of my favorite things is just seeing Isela's confidence since this internship. She's been coming in during my prep period to read scientific articles together. The coolest part is she's spreading [her enthusiasm] to other kids. She's inviting other kids to come read articles with us. It's the ultimate moment as a teacher."

BEYOND HIGH SCHOOL

Consuelo Sauceda, who experienced Salk's Mobile Science lab during middle school, also participated in High School Science Day.

"I went on to tour the Salk Institute officially for the first time with my high school chemistry teacher," Sauceda explains. "And we got to see pictures and learn about glow-in-the-dark mice. That was my first ever true exposure to real science. I remember getting to talk to scientists—like actually be in the lab, be exposed to all the things that they do. I thought it was so amazing and I just knew that was something I wanted to do someday. I felt research was an avenue I could explore in hopes of having an impact on human health, especially after learning of the origin story behind the Salk and its founder, Jonas Salk."

"We've been very impactful in San Diego County and we're very proud of that. But our goals for the future are really to be able to figure out ways to partner with national organizations and scale up to a national level and broaden our impact."

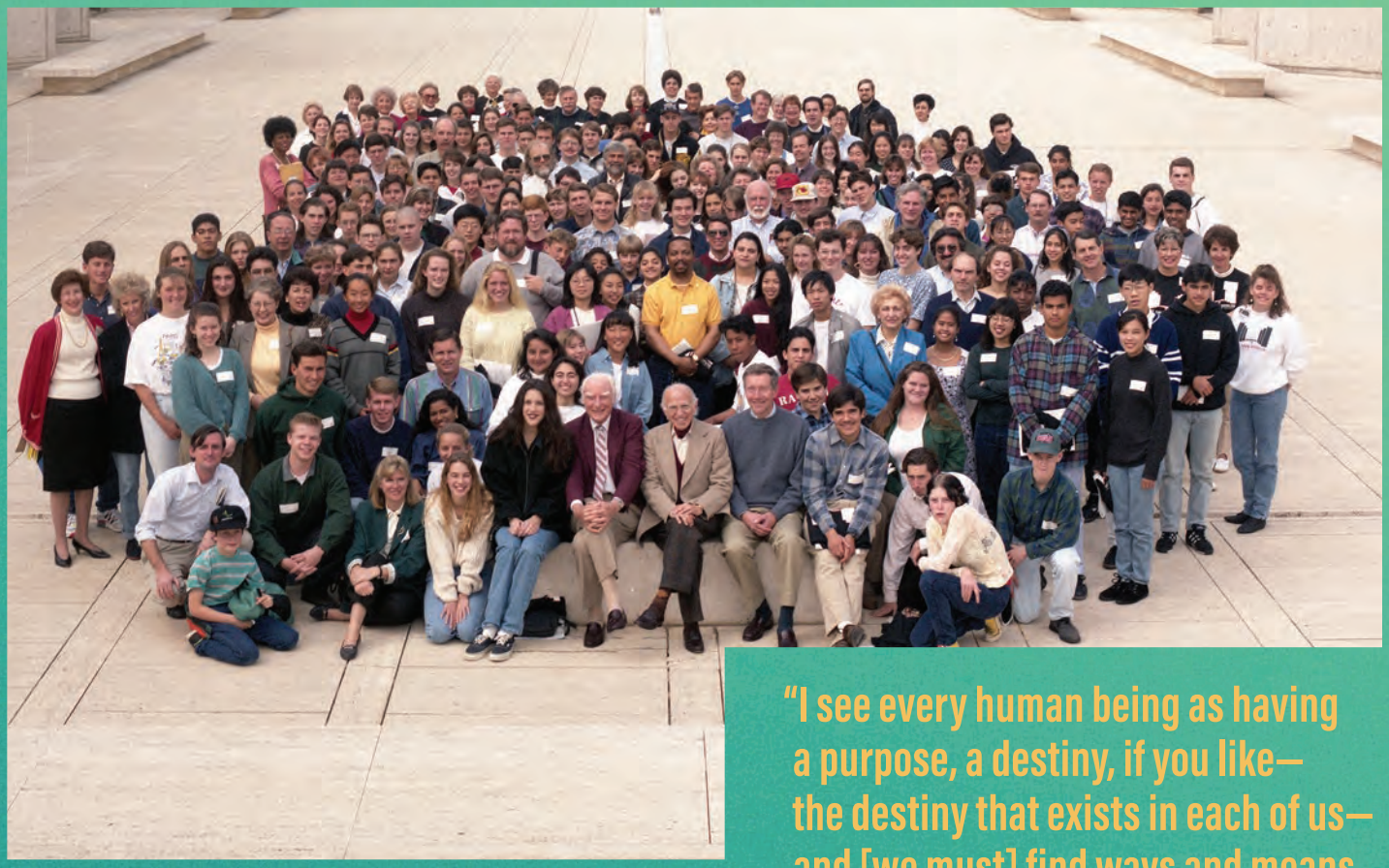
BRYAN ROBINSON, SALK VP FOR EXTERNAL RELATIONS

Sauceda went on to college at CSU San Marcos, where she majored in biochemistry, conducting research with a marine bacterium called *Mycobacterium marinum* and trying to find new antibiotics to treat tuberculosis.

After college, Sauceda worked as a lab technician at UC San Diego. She then applied to graduate school there and is now working toward her doctorate in David J. Gonzalez's lab, studying host-microbiome interactions. Specifically, she is trying to identify and quantify microbial proteins to understand how different diets may change the composition of the gut microbiome in conditions such as inflammatory bowel disease.

Now in her fourth year of graduate school, Sauceda tears up when talking about how proud her parents have been of what she's accomplished. "I've been fortunate enough to go down this path without really having much guidance. But the people I've met, the mentors that I've had along the way, and the educational outreach like this is so integral for people like me, because we otherwise wouldn't have had the opportunity or exposure. My mom knew this would be something that was good for me. She didn't understand it herself, but she tried her hardest to help me get to the point where I am today."

Sauceda's mother passed away two years ago, but Sauceda is looking forward to having her father and friends watch her defend her thesis in the near future.



Francis Crick and Jonas Salk with students attending High School Science Day at Salk, 1994.

> "I see every human being as having a purpose, a destiny, if you like—the destiny that exists in each of us—and [we must] find ways and means to provide such opportunities for everyone."
>
> JONAS SALK

EXPANDING OUTREACH

Ellen Potter is confident that Jonas Salk would also have been proud of Sauceda, Ordonez, and the thousands of other students who have been inspired either to pursue careers in science or to support science, thanks to Salk's Education Outreach programs.

"I know that Jonas would be very thrilled with what Education Outreach has achieved because he felt that science couldn't be an ivory tower," Potter says. "We have to be—you know his phrase—good ancestors. And part of being a good ancestor is inspiring young people."

Robinson adds, "We've been very impactful in San Diego County and we're very proud of that. But our goals for the future are really to be able to figure out ways to partner with national organizations and scale up to a national level and broaden our impact."

The Education Outreach staff have lots of plans for 2024. The team will pilot a four-day workshop focused on Salk's Harnessing Plants Initiative to store excess carbon from the atmosphere deep within the roots of crop plants, they'll welcome a small cohort of community college interns to campus in the summer, and they'll continue to expand outreach to high school and community college students.

"The Institute is very committed to Education Outreach, but it does rely upon philanthropic support to grow," says Robinson. "Corporations, foundations, and individuals who care about scientific literacy all have an important role to play in helping create a diverse workforce for the future."

As Jonas Salk said, "I see every human being as having a purpose, a destiny, if you like—the destiny that exists in each of us—and [we must] find ways and means to provide such opportunities for everyone."

To learn more: **www.salk.edu/education-outreach**
To support Salk: **www.salk.edu/donate**

DEMYSTIFYING AND DIVERSIFYING THE PATH TO BECOMING AN ACADEMIC SCIENTIST

COLLEGE STUDENT

The Salk Summer Undergraduate Research Fellowship (SURF) is a 10-week, paid internship that provides college students with research experience, access to world-class research facilities, and a network of mentors. This program is open to students with limited or no research experience.

Salk's community college summer research internship program will launch in the summer of 2024. Modeled after the successful high school internship program, the program will include training and seminars designed to help students interested in pursuing STEM careers.

MIDDLE SCHOOL STUDENT

The Salk Mobile Science Lab team travels to middle schools throughout San Diego County, bringing a free, three-day program that includes studying fruit flies under a microscope, isolating plant DNA, and learning about DNA analysis techniques.

The Teacher Activity Kit program provides free training and supplies for middle and high school teachers interested in bringing hands-on activities into their classrooms. Kits include all necessary supplies and lesson plans.

HIGH SCHOOL STUDENT

Each year, Salk hosts March of Dimes High School Science Day, opening our doors to hundreds of students and their teachers for a day that features Salk scientists sharing stories of their work life, lab tours, and the opportunity to participate in scientific experiments.

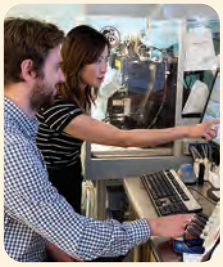
During the annual eight-week, paid Heithoff-Brody Scholars Program, high school student interns work in Salk labs, as well as spend time in seminars, workshops, data analysis projects, and other enrichment activities. At the end of the program, students present their research projects to their mentors, lab peers, and families.

Launching in January 2024, Salk's Harnessing Plants Initiative four-day workshops will be piloted in five high school classrooms across San Diego County. These workshops teach critical laboratory skills, experiment design, data analysis, and scientific communication.

At the Ellen Potter Research Connections for Teachers Symposium, middle and high school teachers hear from Salk scientists in a seminar environment, then collaborate with colleagues to apply what they have learned to create lesson plans applicable to their classrooms.

SciChats@Salk is a free virtual interactive experience that pairs a classroom with a volunteer researcher for an interactive conversation about what it's like to be a scientist.

V POSTDOCTORAL TRAINEE



At the annual Salk Rising Stars Symposium, select postdoctoral trainees—scientists who have completed their PhDs but do not yet run their own research programs—present their research at Salk, are provided with networking opportunities, and are paired with a Salk faculty member for mentorship. Rising Stars postdoctoral trainees are also kept informed about upcoming faculty recruitment opportunities.

IV GRADUATE STUDENT WORKING TOWARD A PHD

The Salk EDGE Summer Program is a two-week summer program that aims to Elevate Diversity in Graduate Education by equipping graduate students for competitive careers in academic science. Students are trained on cutting-edge techniques, and the program also supports the use of these new techniques in their home labs through a $2,000 pilot grant to be used in their PhD labs.

VI JUNIOR FACULTY MEMBER (PRINCIPAL INVESTIGATOR)

Faculty members—from assistant to associate to full professor—are scientists who lead their own research teams made up of approximately five to 30 staff scientists, postdoctoral trainees, and graduate and undergraduate students. They set the research directions for their labs, develop new research questions to pursue, guide experiments, and hire and mentor their lab members. They apply for grant funding, publish papers, file patents, present their lab's work at conferences, collaborate with other labs, and sometimes found spin-out companies. To encourage their success, junior faculty members at Salk are provided with networking and funding opportunities, grant writing assistance, and mentorship from senior faculty. At Salk, faculty members also have internal funding opportunities and are nominated for awards.

This graphic defines the educational path to becoming an academic scientist—a faculty member at a place like the Salk Institute. At each stage, the Salk Institute's Education Outreach team and Office of Diversity, Equity & Inclusion provide opportunities for thousands of students, a majority of whom come from underrepresented and underserved communities, to take part in innovative learning experiences and explore careers in science. These programs are offered at no cost, thereby reducing economic barriers to high-quality science education—and ultimately helping to diversify the scientific career pipeline.

To learn more: **www.salk.edu/education-outreach** | To support Salk: **www.salk.edu/diversity-equity-inclusion**

Deepshika Ramanan

From iguana poop to breastmilk

When Assistant Professor Deepshika Ramanan was a child growing up near the forests of South India, she and her siblings would accompany their photographer father on nature shoots. The siblings were all thrilled whenever they were chased by wild elephants—something their homemaker mother also took in stride, since this was a common occurrence in the region.

Ramanan—with her parents' strong support—has always followed her insatiable curiosity, whether into the forest to enjoy nature at age 7 or to America to study biology at age 17.

At Salk, Ramanan is a member of the NOMIS Center for Immunobiology and Microbial Pathogenesis. She studies maternal-infant immunity: specifically, how the immune system develops in babies—influenced by factors in breastmilk—as well as how a pregnant person's immune system changes during pregnancy and breastfeeding.

Both of these areas are poorly understood, and Ramanan has many, many questions.

Inside Salk *sat down with the new assistant professor for some answers on what motivates her powerful drive to discover.*

You became interested in biology fairly early in life. Can you tell us more about that?

DR: I was always a curious child, and because of my dad's love for wildlife, we spent a lot of time in the forest. So I had always gravitated toward nature. Then, in sixth grade, I had a biology teacher who I really connected with. I already loved nature and wildlife, but she really strengthened my love for biology.

This was pretty important, because no one in my family had any experience in science or medicine. My father went to technical school and my mother didn't finish high school. None of us knew any scientists. Even my biology teacher didn't mention being a scientist as an option for me. A female scientist was just a very far-fetched idea where I'm from. Luckily, my parents supported me by helping me to leave home and make my own path.

How did your interest in the biology of disease come about?

DR: When I was in 7th grade, my grandmom passed away. She'd had diabetes and couldn't walk because of nerve damage. When I was young, I didn't quite understand her illness. People said, "This is how God wants it." But it just didn't make sense to me that God would want someone to suffer like that. I thought, "Well, that can't be the reason." So I started reading more and more about biology and health, and I got really into learning about diseases and the idea of doing research.

You did some unusual research as an undergraduate in Minnesota—can you describe that?

DR: I got my degree in cell and molecular Biology from Winona State University, but I was very interested in microbiology. We had iguanas in our biology labs there, and my microbiology professor introduced us to the concept of the microbiome and offered me a project to look at, well, their poop! I was looking to see how many different kinds of bacteria I could grow from the iguanas, so I could characterize their microbiomes. It involved collecting fecal samples and sequencing them. Interestingly, we grew a lot of the same kind of bacteria that we can grow from people.

How did you go from studying iguana poop as an undergraduate to studying the immune system in graduate school?

DR: When I was in college, I did an internship at the Mayo Clinic in Rochester, Minnesota. I trained in an immunology lab, which was my introduction to immunology. I was working with the thymus, the butterfly-shaped gland where your immune cells get "educated." I thought it was just fascinating. So when I applied to graduate schools, I was interested in both immunology and microbiology.

I ended up going to New York University, where I met my PhD mentor, Ken Cadwell, during a poster session. In his lab, the team was looking at immune cells in response to the microbiome, and I was instantly hooked. I loved immunology from my internship. I loved microbiology from my undergrad experience. I thought, "This is the lab that I want to be in, because it's bringing together two branches of science that I love." So I joined his lab as his first student, and worked on setting up a mouse model of intestinal inflammation in inflammatory bowel disease (IBD).

It's interesting—not a lot of people who have the gene mutation that makes you susceptible to developing IBD get the disease, which suggests that, in addition to genetics, a person's environment also influences risk for IBD.

So we used mice that have the same mutation that a lot of people with IBD have, and I found that the intestine of these mice had inflammatory microbiota that made them more likely to have the type of inflammation seen in IBD. Surprisingly, if we gave these mice parasites, they promoted a protective microbiota and got rid of the disease-causing microbes, and the mice no longer had the disease. We also translated our findings to humans, and we found that people who lived in regions where parasite infections were common also had a protective microbiota, and people with IBD had inflammatory microbiota similar to what we had found in mice. To me, as a graduate student, that was just amazing.

What did you study for your postdoctoral fellowship?

DR: For my PhD, I worked on the microbial aspect of intestinal disease, but I was also really fascinated by the intestine and wanted to focus more on the immune aspect of it in the next phase of my training. So I joined the lab of Diane Mathis and Christophe Benoist at Harvard Medical School. They are experts in a type of immune cell that suppresses inflammation, called a regulatory T cell, or Treg.

When you get infected with some type of bug, you're going to have a lot of inflammation as part of your body's immune response to clear the infection. But how does your body know when it's time to stop fighting? It turns out Tregs tell the infection-fighting immune cells to stop. They're sort of like immune police.

At Harvard, I began working on Tregs that were responding to the microbes in the intestine, trying to understand how they maintain tolerance to the microbes in the intestine so that you don't react to all the beneficial microbes that you have living in your guts. But while I was trying to figure out their function, I serendipitously ended up making a surprising discovery—that the intestinal Tregs in mice were determined by their mothers! Long story short, mothers transfer antibodies

in their milk that form a coating around microbes in mouse babies' intestines. And this coating determines the levels of Tregs the mice will have in their intestines, not just as babies, but also as adults!

So did that discovery kindle your interest in breastmilk?

DR: It did! I have so many questions! What my lab at Salk is working on now is trying to understand the mechanism of how and when this breastmilk immunity is happening. *How* do the antibodies that are in breast milk educate the immune system? Are they just educating immune cells in the intestine, or are they educating other cells in the intestine that then tell the immune cells what to do? How are these antibodies shaping the microbes? What is the antibody coating doing to the microbes?

It just blows my mind that milk is literally the first food we get as humans, and we know barely anything about it.

You sound quite impassioned about that.

DR: I am. A lot of what my lab studies was inspired by my own personal journey while pregnant and breastfeeding, and I was surprised we knew so little about the immune system during these critical times. I think that's one reason why we need diversity in science and why we need to have people of different backgrounds and different experiences, so entire groups of people don't get left out.

Our lab is also very interested in looking at what's happening to the mothers themselves during pregnancy and lactation. Because, while we don't know much about what's in the milk, we also don't know anything about what happens to the mammary gland during pregnancy and breastfeeding, in terms of immunity.

"It just blows my mind that milk is literally the first food we get as humans, and we know barely anything about it."

ASSISTANT PROFESSOR DEEPSHIKA RAMANAN

For example, pregnant people are somewhat immunosuppressed. Their blood and uteruses are immunosuppressed, yet during pregnancy and lactation, we see the opposite in the mammary gland—there is a lot of immune-cell activation. We're trying to find out why that's happening. It is known that people who breastfeed are less likely to develop breast, ovarian, and uterine cancers, but we don't know why. Our studies could offer an explanation for this, which can help us prevent or treat these cancers in the future.

I'm also excited that I'll be partnering with the Human Milk Institute at UC San Diego, which is the largest repository of breastmilk in the country. We're going to be looking at the composition of the antibodies in milk. Antibodies are just one part of milk, obviously; there are a ton of other factors in milk as well. So we're interested in also looking at what other factors could be shaping the immune system of offspring. Another benefit is that if scientists know what the components of breast milk are, then formula makers can find ways to design better formula, because not everyone can breastfeed.

You arrived at Salk in the spring of 2023. How has your experience been so far?

DR: It's been incredible. When I first came to interview, everybody was so friendly, excited to have me, and asked me such great questions. During my chalk talk, faculty who were not even in my field were asking me insightful questions and offering me ideas on ways to make my science better, which felt amazing. I thought, "What better environment is there than this? Everybody's so supportive. Everybody's genuinely interested in science. It doesn't matter what area of science, people are just genuinely curious, like me." I called my husband right afterward and told him that Salk was my top choice of institutions. My first impression could not have been truer.

I'm excited to be at Salk and to work with the entire scientific community here. I have also been fortunate to recruit an amazing team in the short amount of time I have been here, and together, I'm sure we are going to discover exciting things. I'm looking forward to it.

Scan here to watch a video in which Ramanan describes her upbringing, career journey, and motivations.

BELONGING

New strategic plan provides roadmap for enhancing diversity, equity, inclusion, and belonging at Salk

The Salk Institute is known for making fundamental discoveries in the fields of cancer, neuroscience, immunobiology, aging, plant biology, computational biology, and more.

These accomplishments depend on people—people drawing on their training, life experiences, and perspectives to ask creative questions, design and execute experiments, analyze data, and share the results.

Advancing diversity, equity, and inclusion (DEI) in the workplace is not only the right thing to do, studies show that diverse teams outperform homogenous ones in terms of problem-solving ability, complex decision-making, and introducing novel ideas—all critical for high-impact science. At Salk, improving DEI is a commitment to both scientific discovery and humanity.

To further diversify the Salk community and embed DEI into decision-making at all levels, the Institute's DEI team recently published the Strategic Plan for Further Diversifying Salk. The plan is based on listening sessions, discussions, individual and committee recommendations, a campus climate survey, working group feedback following the survey report, and comments on drafts of the plan.

The plan focuses on four strategic priorities developed by Luzilda (Lucy) Arciniega, director of DEI at Salk.

"These strategic priorities serve as a roadmap for how to advance diversity, equity, inclusion, and belonging across the Institute, and importantly, they enable us to measure the efficacy and impact of our efforts."

LUCY ARCINIEGA, DIRECTOR OF DEI AT SALK

The strategic plan is intended to empower grassroots work and initiatives led by individuals or groups across campus, with the DEI team acting as a resource, setting benchmarks, and reporting on progress.

"This is an important moment for the Institute," says Sue Bacino, Salk's vice president of People & Culture. "It's an opportunity for the entire Salk community to help move this plan forward and build upon it through their individual efforts and collective participation."

The four strategic priorities are:

01

ACHIEVING EDUCATION & UNDERSTANDING OF DEI

Efforts that advance knowledge of DEI help foster positive working environments. Salk is committed to building individual and collective understandings of DEI in a culture that is welcoming and productive.

02

INCREASING ACCESS & REPRESENTATION IN STEM

Salk is part of a broader national effort to diversify the STEM workforce as a commitment to scientific discovery and humanity. Equally, Salk aims to continue to increase representation with talented employees who support the STEM enterprise.

03

EXPANDING & STRENGTHENING THE SALK COMMUNITY

Salk maintains a unique and innovative culture. Through attention to diversity, equity, and inclusion, all community members can continue to strengthen internal relationships and expand external relationships through philanthropy, education, community outreach, and communication.

04

ENSURING RECOGNITION THROUGH ACCOUNTABILITY

To be a leader in DEI, it is critical to measure and hone efforts to ensure that the Institute is achieving its DEI goals and communicating its achievements and progress. We also recognize individuals and groups for the hard work they are doing to change culture and achieve DEI goals.

To learn more, visit
www.salk.edu/diversity-equity-inclusion

INSIGHTS

Supporting Salk science through animal care

On the shores of a lake in Arkansas, baby Trinka Adamson got a kiss on the cheek from a deer.

"My mom likes to recount that memory and say she knew from that moment that I'd work with animals one day—but I think the deer was probably just licking off some leftover food from my face," laughs Adamson.

Adamson, now senior director of Salk's Animal Resources Department, takes immeasurable pride in her work at the Institute. Through college years of physiology courses, triathlon training, and a career detour into human medicine, Adamson kept finding her way back to animals. As a child, she wanted to be a veterinarian. When she got to college, her personal love for exercise physiology inspired a medical school track. But after shadowing in hospitals, she turned back to animal sciences and went on to veterinary school, where she discovered that a board specialty in laboratory animal medicine existed. She then knew she was meant to follow that path and be involved with animal research. Her greatest joy comes not only from caring for animals, but also from supporting the faculty and innovative science possible only at Salk.

Trinka Adamson

EARLY LIFE

Born and raised in Shreveport, Louisiana, Adamson dreamed of being a veterinarian from her earliest years. But at just 10 years old, she got a chance to sit in on a veterinary surgery and concluded she was too emotional to deal with animals in a clinical setting. So, given her self-identified sensitivity with animals and an extracurricular interest in sports, she pivoted to human physiology.

Adamson attended the University of Arizona, where she began volunteering in hospitals and joined an undergraduate teaching team that inspired a love for teaching that endures today. She narrowed her focus to exercise physiology and began a graduate program in physiology, but when she got there, her passion for animal science was rekindled.

"I was the annoying grad student," says Adamson. "I would question whether we were using the best animal model for the work, whether we should be using more modern anesthetic protocols, or if we should provide more animal enrichment. It was obvious in those years that animal science was my passion."

She realized that caring *about* the animals meant caring *for* the animals, and that her sensitivity ultimately was a strength. Her emotional vulnerability manifested as extreme diligence in her studies and premium quality of animal care as she transitioned into veterinary school after graduate school.

JOINING SALK

After her veterinary laboratory animal medicine residency at UC Davis, she worked at the City of Hope Beckman Research Institute in Duarte, California, as a clinical veterinarian and then associate director. After 10 years of employment at City of Hope, Adamson joined Salk as the attending veterinarian for the institution and the senior director of the Animal Resources Department. As the senior director, Adamson is responsible for overseeing the management of department staff and operations and coordinating the care of a variety of rodents, small mammals, and nonhuman primates.

"No two days are alike at Salk," says Adamson. "There are emails, protocols, papers, at times grants to read or write, faculty questions to answer, teaching and training to complete, and a whole lot of problems to solve. It's like Tetris every day—shifting things around so everyone and everything is aligned to best support the science."

Adamson and the Animal Resources Department team provide the highest-quality veterinary medical care, husbandry, enrichment, and professional technical support to enable the scientists to perform their animal research. Importantly, as Adamson mentioned, they accommodate the rapidly changing needs of the scientists, while maintaining a foundation of high-quality animal care and use.

Adamson boasts not only about the quality of the Animal Resources Department output at Salk, but also of the community that surrounds her. Her colleagues in her department and the faculty that rely on their work offer encouragement to start that game of Tetris fresh every day.

"I am very proud to support the animal research here at Salk," says Adamson. "Everyone is here for the right reasons, so I wake up every day feeling excited about what I do. And best of all, the research at Salk is just so above and beyond any other research I have ever supported in my career."

OFF-CAMPUS ADVENTURES

When she's off campus, Adamson enjoys traveling with her family and showing her two daughters the world. They travel within the country, like to Washington State or back home to Louisiana, and go on longer trips abroad, like a past trip to Germany and an upcoming vacation to Costa Rica.

"You learn so much from others when you travel," says Adamson. "I want to instill in my daughters that there are numerous cultures out there and many ways to live. There's just so much to see in the world, and the more you see, the more you get a sense for who you are and who you want to be."

FUN FACT

These days, Adamson is too busy to continue with her old triathlon hobby. Instead, she puts her energy into supporting her daughters' schools and interests, while finding some time on the side for book clubs, hiking, Pilates, musical theater, and exploring San Diego.

WHAT LIES AHEAD

Salk plans to break ground next year on the new, 100,000-square-foot Joan and Irwin Jacobs Science and Technology Center. The expansion of the campus creates the opportunity for the Animal Resources Department to grow as well. New buildings bring the promise of new animal facilities and potentially new animals, which encourages Adamson to set high expectations for the impact of her efforts. She hopes, too, that her work ethic and adventurous philosophy inspire her girls as they grow up. S

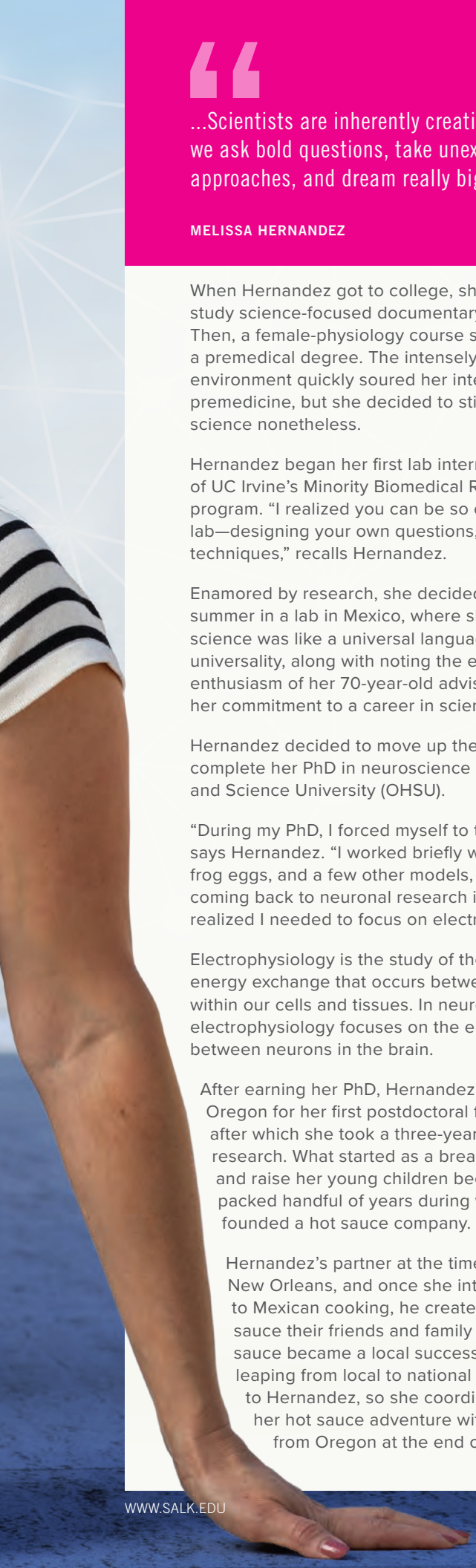
NEXT GEN

Melissa HERNANDEZ

Horses, hot sauce, and human brain research

Training at Salk brings Melissa Hernandez, a postdoctoral researcher in the lab of Professor Rusty Gage, full circle—she was born in San Diego but cites her early-childhood move north as fundamental to her growth and sense of self.

"When we lived on California's Central Coast, I loved riding horses and going for bike rides to find wild turkeys and salamanders," says Hernandez. "And when we came back to San Diego, I got really into dancing—Mexican folk dancing, specifically. I developed a strong love of nature, music, and expression that I brought with me to college."



> ...Scientists are inherently creative people—we ask bold questions, take unexpected approaches, and dream really big."
>
> **MELISSA HERNANDEZ**

When Hernandez got to college, she thought she'd study science-focused documentary filmmaking. Then, a female-physiology course steered her to a premedical degree. The intensely competitive environment quickly soured her interest in premedicine, but she decided to stick with science nonetheless.

Hernandez began her first lab internship as a part of UC Irvine's Minority Biomedical Research Support program. "I realized you can be so creative in the lab—designing your own questions, plans, and techniques," recalls Hernandez.

Enamored by research, she decided to spend a summer in a lab in Mexico, where she realized science was like a universal language. This universality, along with noting the enduring enthusiasm of her 70-year-old advisor, prompted her commitment to a career in scientific research.

Hernandez decided to move up the coast to complete her PhD in neuroscience at Oregon Health and Science University (OHSU).

"During my PhD, I forced myself to try everything," says Hernandez. "I worked briefly with fruit flies, frog eggs, and a few other models, but I kept coming back to neuronal research in mice, and I realized I needed to focus on electrophysiology."

Electrophysiology is the study of the biological energy exchange that occurs between and within our cells and tissues. In neuroscience, electrophysiology focuses on the electrical pulses between neurons in the brain.

After earning her PhD, Hernandez stayed in Oregon for her first postdoctoral fellowship, after which she took a three-year respite from research. What started as a break to stay home and raise her young children became an action-packed handful of years during which she even founded a hot sauce company.

Hernandez's partner at the time was from New Orleans, and once she introduced him to Mexican cooking, he created a fusion hot sauce their friends and family loved. The hot sauce became a local success in Portland, but leaping from local to national was unappealing to Hernandez, so she coordinated the end of her hot sauce adventure with her departure from Oregon at the end of 2020.

After Oregon, Hernandez returned to San Diego and found herself revisiting a familiar inspiration. "During my time doing research in Oregon, Rusty Gage was like a god to all of us," Hernandez laughs. "After stepping away from science for those few years, I started reading up on all this new work coming out of his lab at Salk. I was amazed that it was now possible to study the electrical properties of human brains with autism spectrum disorder, Alzheimer's disease, and beyond."

Now, Hernandez's electrophysiology perspective adds meaningful nuance to the Gage lab's mission to understand age-related cognitive decline. There are many rare diseases with ion channel mutations, which hinder neuronal ability to produce message-sending electrical pulses—Hernandez's specialty.

Additionally, the lab has been working on improving models of the brain.

"Studying aging in a mouse or rat is challenging because you can't really capture that fragility, and you can't see electrical activity either," says Hernandez. "Rusty has come up with a way to take skin cells from human patients and generate neurons that retain the genetic and epigenetic background of the donor and allow us to start to capture that fragility and electrical activity."

Genetic and epigenetic preservation means that not only are the genetic instructions for cell behavior intact, but so too are any protein or molecular modifications made to those instructions. This new model allows Hernandez to perform electrophysiological investigation in human tissues that was impossible before.

Beyond the lab, Hernandez is chair of Underrepresented Minorities Advancing Scientific Engagement (URMase), a Salk affinity group that provides support for Salk scientists from backgrounds historically underrepresented in STEM. "I like having a lot of other things going on; that way, when my experiments aren't going well, I can focus on something else for a bit."

As Hernandez replants her old San Diego roots, she has begun to find herself again. While she has some new identities, like mother and scientist, she has become reacquainted with old identities, too, like singer and naturalist.

"In some ways, music is just like science," says Hernandez. "In music, you must listen to a lot of other people's songs, then stop so you can generate your own. In science, that same process occurs with reading a lot of other people's research. When you draw that parallel, I think it becomes obvious that scientists are inherently creative people—we ask bold questions, take unexpected approaches, and dream really big."

Salk adds three new faculty members

DANIEL BAYLESS

Daniel Bayless joined Salk's Molecular Neurobiology Laboratory on September 1 as an assistant professor. His research focuses on the neuronal basis of sex differences that lead to complex behaviors such as social approach, aggression, and mating in mice. He received his PhD from Tulane University and completed his postdoctoral research at Stanford University. At Salk, Bayless will focus on how life experiences and sex hormones affect social information processing that manifests differently across sexes.

LENA MUELLER

Lena Mueller will join Salk's plant biology faculty as an assistant professor in January 2024. She joins Salk from the University of Miami, where she is currently an assistant professor studying interactions between plants and fungi. These interactions are important for plant productivity in natural and agricultural settings and may help promote carbon sequestration in soil. Mueller received her PhD from the University of Zurich and completed her postdoctoral research at Cornell University. At Salk, she will continue to study peptide signaling mechanisms that govern development and maintenance of plant-fungus interactions.

AGA KENDRICK

Agnieszka (Aga) Kendrick joined Salk's biochemistry and biophysics faculty on November 1 as an assistant professor in the Molecular Neurobiology Laboratory. She is a structural biologist who studies how cells recognize and transport cargo within the cell. Kendrick received her PhD from the University of Colorado, Denver, and completed her postdoctoral research at UC San Diego. Her work has implications for many aspects of the biology studied at Salk, from neurons to plants.

Assistant Professor Christina Towers receives NIH New Innovator Award

Towers received a five-year, $2.85 million National Institutes of Health (NIH) Director's New Innovator Award from the NIH Common Fund's High-Risk, High-Reward Research program. Towers is one of 58 researchers to receive the award this year.

With the award, Towers and her team will employ new tools and models to better understand cancer cells' rapid and dynamic response to metabolic changes—all with the goal of preventing treatment resistance in cancer patients.

Investing in the future of innovation

Launched in 2006 from the forward-thinking minds of then-Board Chair Irwin Jacobs and his wife, Joan, Salk's Innovation Grants is a vital program for supporting emerging science. The grants are designed to fund out-of-the-box ideas that hold significant promise but do not yet have the track record to gain support from more traditional funding sources. Awarded semiannually by peer review, Innovation Grants are critical for catalyzing emerging science with the power to redefine the future. The 2023 Summer Innovation Grants were awarded to:

Professor **Edward Callaway** and Assistant Professor **Pallav Kosuri**, who will create a new screening platform based on cutting-edge MERFISH technology to identify pieces of DNA called enhancers, which regulate gene expression in different cell types. By bringing down the cost of these screening tests by a factor of a hundred compared to current methods, the MERFISH-based platform will make it possible to explore gene control in thousands of different kinds of cells at once.

EDWARD CALLAWAY

PALLAV KOSURI

KENTA ASAHINA

EIMAN AZIM

TALMO PEREIRA

Associate Professor **Kenta Asahina**, who will use a thorough understanding of fruit fly genetics as a springboard to establish sweat bees as a novel model organism for exploring the evolutionary origins and brain basis of social behaviors.

Associate Professor **Eiman Azim** and Salk Fellow **Talmo Pereira**, who will create a computational model of how the brain produces behavior that takes into account what we know about the nervous system and structure of the body—brains, bones, and muscles. They hope this new approach opens doors for neuroscientists to study the relationship between the brain, body, and movement with higher accuracy than ever before.

Physician-scientist Jesse Dixon named Rita Allen Foundation Award Scholar

Assistant Professor **Jesse Dixon** was one of nine scientists the Rita Allen Foundation named to its 2023 class of Rita Allen Foundation Scholars. The distinction is given to biomedical scientists whose research holds exceptional promise for revealing new pathways to advance human health.

The selected scholars will receive grants of up to $110,000 annually for a maximum of five years to conduct innovative research on critical topics in cancer, immunology, neuroscience, and pain. Dixon and the other scholars were chosen for their bold approaches to basic scientific questions that address problems of global concern, as well as their potential for learning, leadership, and collaboration.

Salk names St. Jude and Caltech researchers to Nonresident Fellows faculty

Douglas R. Green, co-leader of the Cancer Biology Program and Peter C. Doherty Endowed Chair of the Department of Immunology at St. Jude Children's Research Hospital, and **Stephen L. Mayo**, a Bren Professor of Biology and Chemistry and Merkin Institute Professor at Caltech, have joined Salk as Nonresident Fellows.

Green seeks to understand the complex world of how cells eat, live, and die. His lab investigates fundamental molecular processes involved in cell survival and death, and how these processes operate in cellular contexts and disease states. He earned both his undergraduate degree in biology and his PhD in immunology from Yale University. He is a member of the National Academy of Sciences and a fellow of the Royal Society of Canada and has received numerous awards and recognitions for his research, including a National Cancer Institute Outstanding Investigator Award and the Wilbur Lucius Cross Medal for Yale Alumni Achievement.

Mayo's research focuses on the development of computational approaches to protein engineering—a field that has broad applications ranging from advanced biofuels to human therapeutics. He earned an undergraduate degree in chemistry from Pennsylvania State University and a PhD in chemistry from Caltech. He is a member of the National Academy of Sciences, received a National Security Science and Engineering Faculty Fellowship, and was recognized with the Pennsylvania State University Distinguished Alumni Award.

Salk's Nonresident Fellows consist of eminent scientific advisors who assist in guiding the Institute's leadership.

"The number one objective at Salk is to produce high-impact science, and the addition of Drs. Green and Mayo will contribute greatly to our continued pursuit of this goal."

SALK PRESIDENT GERALD JOYCE

Two faculty members earn V Foundation awards for cancer research

Assistant Professors **Christina Towers** and **Deepshika Ramanan** were named V Scholars by the V Foundation for Cancer Research. They will each receive $600,000 over three years to fund their unique cancer research goals.

Towers was named to the first class of recipients of V Foundation's A Grant of Her Own: The Women Scientists Innovation Award for Cancer Research, which was created to help counteract long-standing gender disparities in research. She is a member of Salk's National Cancer Institute-designated Cancer Center, where she works to uncover the mechanisms that cancer cells use to recycle nutrients and power-generating mitochondria to grow in low-nutrient environments.

With her V Scholar Award, Towers will investigate these recycling mechanisms in pancreatic cancer. She will use mini pancreatic organs in the lab to study how treatment-resistant pancreatic cancer cell-recycling pathways can promote or block tumor growth.

Ramanan is a member of the Salk Cancer Center and the Institute's NOMIS Center for Immunobiology and Microbial Pathogenesis, where she works to uncover the mechanisms that underlie cancer and autoimmune diseases. She studies how the maternal immune system changes during pregnancy and breastfeeding and affects immunity and inflammation in babies across multiple generations. (See Observations on p. 18.)

CHRISTINA TOWERS

DEEPSHIKA RAMANAN

With her V Scholar Award, Ramanan will study the mechanisms by which breastmilk factors can shape intestinal microbes and immune cells and potentially protect generations from colorectal cancer. Her work will provide much-needed insight into immune cell-microbe-diet interactions and their role in cancer initiation and progression, in turn inspiring a future where breastmilk factors could be used to prevent or treat colorectal cancer.

Salk postdoctoral researcher awarded HHMI Hanna H. Gray Fellowship

Louis Parham, a member of Assistant Professor Christina Towers' lab, was among 25 early-career scientists who received fellowships from the Howard Hughes Medical Institute's Hanna H. Gray Fellows Program. The program provides each fellow with up to $1.5 million in support for up to eight years spanning postdoctoral training through transition to an early-career faculty position.

ANNA-MARIA GLOBIG

JAKE MINICH

YUAN SUI

New Salk Institute NOMIS Fellows

Postdoctoral researchers **Anna-Maria Globig**, **Jeremiah (Jake) Minich**, and **Yuan Sui** have been awarded NOMIS fellowships. NOMIS fellowships support emerging, early-career researchers who, like other NOMIS researchers, demonstrate the potential to lead groundbreaking, high-risk basic research.

Globig, a member of Professor Susan Kaech's lab, was recognized for her research on neuronal regulation of immune responses. Using murine models of viral infection and cancer, she will study how T cell-neuronal interactions instruct T cell exhaustion and memory differentiation.

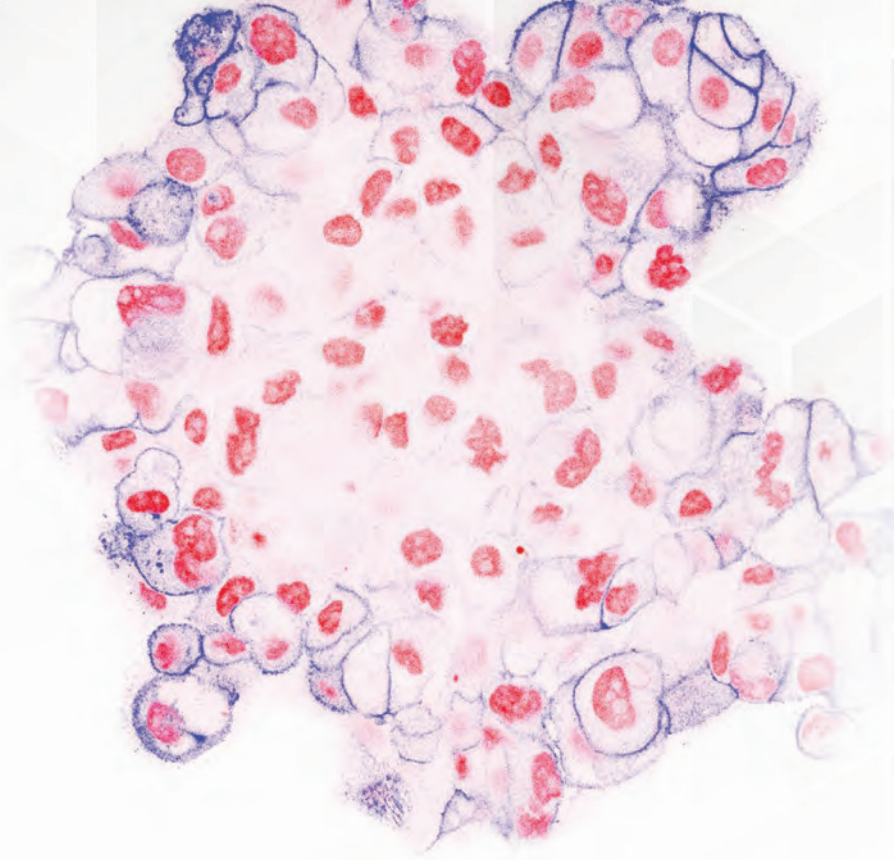
Minich, a member of Research Professor Todd Michael's lab, received the award for his research on the role of the gut microbiome in infant malnutrition.

Sui, a member of Professor Tony Hunter's lab, was awarded a fellowship for his research on pancreatic ductal adenocarcinoma.

MARGARET FAYE WILSON

Salk Institute mourns the loss of Margaret Faye Wilson

Former Salk Board Trustee and longtime supporter **Margaret Faye Wilson** died on July 10. She was a leader in the banking and retail industries, and served as a Trustee on the Institute's Board from 2010 to 2019. Wilson was a generous donor to Salk over the years, including supporting Symphony at Salk, the Institute's premier annual event.



Three trainees awarded Dan and Martina Lewis Biophotonics fellowships

Salk's Waitt Advanced Biophotonics Center provides funding to support graduate students and postdoctoral researchers through the Dan and Martina Lewis Biophotonics Fellowship Program. Congratulations to this year's awardees:

MK Duff is a graduate student in Associate Professor Axel Nimmerjahn's lab and was awarded $60,000 toward stipend and graduate program fees for her project interrogating astrocyte-neuron interactions in the spinal cord.

Atousa Mehrani is a postdoctoral researcher in Associate Professor Dmitry Lyumkis' lab. She was awarded $80,000 in salary and fringe support for her research on visualizing HIV protein-RNA packaging at the cellular plasma membrane using cryo-electron tomography.

Amanda Wacker is a graduate student in Assistant Professor Pallav Kosuri's lab. She was awarded $60,000 of stipend and fee support toward her research developing a method for long-term continuous tracking of single-molecule protein-DNA interactions through DNA origami nanostructures.

Postdoctoral Researcher Zhibin Liang named 2023 STAT News Wunderkind

Liang was honored by STAT News, a life science news publication produced by Boston Globe Media, as a STAT Wunderkind—an award that recognizes the work of early-career scientists and clinicians. As a member of Research Professor Pamela Maher's lab, Liang is uncovering the underlying mechanisms of the bioactive ingredients in plants to develop more effective therapeutics. He aims to use these natural products (plant chemicals) to treat incurable diseases, such as Alzheimer's. He is also looking at how these active molecules prevent mitochondrial dysfunction in neurodegeneration and aging.

ZHIBIN LIANG

EVENTS

27TH ANNUAL SYMPHONY AT SALK

On August 19, a full audience of sponsors and community members was entertained by the sensational sounds of the San Diego Symphony, led by conductor Sean O'Loughlin, together with special guest Jennifer Hudson, at the 27th annual Symphony at Salk.

The concert under the stars featured a mix of classical and Broadway numbers performed by the San Diego Symphony and other popular songs by Hudson, a two-time GRAMMY® Award-winning recording artist, Academy Award-winning actress, and Tony and Emmy Award-winning producer. The evening opened with a spectacular sunset over the Pacific Ocean and ended with the crowd on its feet, dancing and singing along with Hudson.

Throughout the night, attendees also helped celebrate the 50th anniversary of Salk's Cancer Center and the many life-changing discoveries its researchers have produced over these decades, and learned about Salk's Campaign for Discovery, a seven-year, $750 million effort to attract the people and acquire the technology and space necessary to expand and accelerate Salk's discoveries for decades to come.

The event was dedicated to the Institute's dear friend Françoise Gilot, who died earlier this year. Gilot was an icon in the art world, wife of the Institute's late founder Jonas Salk, and honorary chair of Symphony at Salk since its inception.

The night was a great success thanks to Salk's many generous sponsors, who help to continue the bold work Salk scientists pursue every day in their efforts to make the world a healthier place to live.

Martha Gilmer, CEO of the San Diego Symphony, and Gerald Joyce, president of the Salk Institute.

FULL OF PRIDE

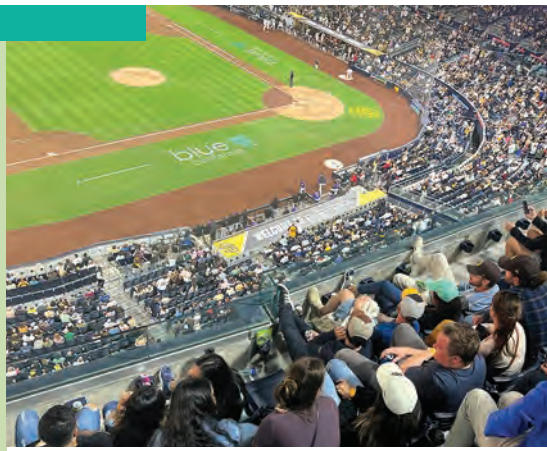
In honor of Pride Month in June, the Salk Pride Society hosted a celebration on campus with rainbow-colored drinks and food, games, and Pride trivia. Salk scientists and staff also joined the greater San Diego community on July 15 and 16, hosting a booth at the San Diego Pride Festival. Booth visitors had the opportunity to spin the wheel of prizes and learn more about the Institute.

ANNUAL SALK PICNIC DELIVERED ON FUN, FOOD, AND COMMUNITY

Salk's picnic featured a beautiful, sunny day full of games, good food, and even better community shared between scientists, staff, trainees, and their families on July 21. Held on the Institute's North Lawn, the festivities included volleyball, corn hole, and table tennis tournaments, with winners of each crowned by the end of the day. An annual event, the Salk picnic is always a great reminder of what makes the Institute so special: the people.

ALUMNI MIXER AND BASEBALL NIGHT

As part of National Postdoc Appreciation Week (September 18-22), the Society of Research Fellows held an engaging discussion with a panel of alumni who had completed their postdoctoral training at the Institute before following a variety of career paths. The panel featured Maya Capelson, associate professor at San Diego State University; Lawrence Fourgeaud, principal scientist at The Janssen Pharmaceutical Companies of Johnson & Johnson; Fangjian Gao, senior scientist at Odyssey Therapeutics; and Amir Zarrinpar, associate professor and gastroenterologist at UC San Diego. Later in the week, alumni attended a baseball game together at Petco Park. The group cheered for the San Diego Padres on September 19 as they took on the Colorado Rockies, watching the Friars ultimately win on a walk-off home run.



JUNETEENTH AT SALK

The Black Association at Salk hosted the Institute's third annual Juneteenth celebration in the Eucalyptus Grove. The gathering provided an opportunity for the Salk community to appreciate the significance and history of this holiday, foster community, and share delicious food from local Black-owned businesses.

The power of a scientific legacy.

Make a tax-free gift with an IRA

You can give any amount up to $100,000 per year from your IRA directly to the Salk Institute without paying income taxes on the revenue if you are 70½ years of age or older. You can also name Salk as a beneficiary of your retirement plan simply by filling out a form with your plan's administrator. When left to Salk, retirement plan assets pass tax-free, allowing us to put 100 percent of your gift toward new discoveries in healthy aging, neurodegenerative disease prevention, climate change mitigation, and other major global challenges.

People who make a planned gift to Salk in their estate plans become members of our legacy society, Partners in Research.

We look forward to welcoming you as the newest member of this visionary group that invests in the future of science.

salk®
Institute for
Biological Studies

To learn more, please contact
Dacia Samilo at (858) 453-4100 x2068
or dsamilo@salk.edu.

CAMPAIGN FOR DISCOVERY

THE POWER OF SCIENCE

The Campaign for Discovery is the Salk Institute's seven-year, $750 million comprehensive fundraising campaign. The goal is to attract the people and build the technology and space necessary for innovation in six critical areas: cancer, healthy aging, plant biology, immunobiology, neuroscience, and computational biology.

As part of the campaign, we plan to build the new 100,000-square-foot Joan and Irwin Jacobs Science and Technology Center on the east side of our iconic campus.

Science is a collaborative pursuit, and we invite you to join us in accelerating life-changing discoveries: **www.salk.edu/campaign**

salk®

InsideSalk
Read it online.

Engage with our award-winning magazine, *Inside Salk*, on any device.

inside.salk.edu

Stay up to date with Salk and follow us on social media.

@salkinstitute

salk®

SALK RECEIVES NUMEROUS COMMUNICATIONS AWARDS

Inside Salk *(both print and online) and other Institute collateral garnered numerous accolades across a variety of awards during 2023. The Trade Association Business Publications International awards are among the most prestigious in the publishing industry, and the San Diego Press Club awards showcase San Diego's best communicators in media.*

TRADE ASSOCIATION BUSINESS PUBLICATIONS INTERNATIONAL, 2023 TABBIES AWARDS

- Best Feature Article: Top 10 for "Human Connection," *Inside Salk* Winter 2022
- Best e-Newsletter, Silver – Salk e-Newsletter, August 2022
- Best Front Cover, Illustration, Silver – "Human Connection," *Inside Salk* Winter 2022

SAN DIEGO PRESS CLUB, 50TH ANNUAL EXCELLENCE IN JOURNALISM AWARDS

FIRST PLACE

- Magazine, Feature - Serious Subject, "Journey of a Lifetime – The Cancer Center at Salk celebrates 50 years of lifesaving discoveries." *Inside Salk* Spring 2023
- Magazine, Front Page Design, Human Connection, *Inside Salk* Winter 2022
- Magazine, Profile, Tony Hunter: "How an animal virus discovery led to a cancer drug." *Inside Salk* Winter 2022
- Magazine, Science/Technology/ Biotech, "Human Connection," *Inside Salk* Winter 2022
- PR, PIO, and Trade Publications, Special interest or one-time publications, *Mid-Century to Next Century*

SECOND PLACE

- Photography, Still, Feature - Light Subject, Salk Equinox

THIRD PLACE

- PR, PIO, and Trade Publications, PR Writing - Serious Subject, "AI chatbot ChatGPT mirrors its users to appear intelligent."

Gerald Joyce
President

Bryan Robinson
Vice President, External Relations

Heather Buschman
Senior Director, Communications

Liz Hincks
Senior Director, Graphic and Digital Communications

Amy Cao
Science Illustrator

Isabella Davis
Science Writer

Alex Endsley
Graphic Designer

Stephanie Harada
Digital & Web Designer

Aaron Howard
Manager, AV and Video Communications

Curtis Ippolito
Development Writer

Mike Jeffs
Multimedia Producer

Chanelle Jimenez
Manager, Communications

Victoria Johnson
Manager, Media Relations

Chris Keeney
Photographer

Elizabeth Noguera
Communications Project Administrator

Kent Schnoeker
Senior AV Technician

Kara Sjoblom-Bay
Communications Administrator

Oliver Yambao
Senior Graphic Designer

Visit the Salk Institute at **www.salk.edu.**

Inside Salk is published by the Salk Institute for Biological Studies. Please send comments to communications@salk.edu or contact the Communications Department at (858) 453-4100 x1371.

Inside Salk is printed on recycled paper.

Salk Institute for Biological Studies
10010 N Torrey Pines Rd
La Jolla, California 92037-1002
Telephone: (858) 453-4100
www.salk.edu

NONPROFIT ORG.
U.S. POSTAGE
PAID
PERMIT NO. 611
SAN DIEGO, CA

THERE ARE MANY WAYS TO SUPPORT SALK.

For detailed information on opportunities, please email giving@salk.edu, call (858) 453-4100 x2068, or visit www.salk.edu/support.

VISIT US ONLINE AT inside.salk.edu.

Salk Institute has received the highest rating 12 consecutive times from Charity Navigator, the nation's foremost charity evaluator.

Charity Navigator
FOUR-STAR

Follow us on:

@salkinstitute