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Nine New Stadtman Investigators Take on the Scientific World

BY LAURA STEPHENSON CARTER

Eagerly tackling challenging questions, using powerful scientific techniques, and already making significant discoveries, NIH's Stadtman Investigators are taking the biomedical-research world by storm.

You've already met several Earl Stadtman Investigators in past issues of *The NIH Catalyst*. Get ready to meet nine more: Cancer epidemiologist **Constanza Camargo** (NCI-DCEG); NIAID scientists **Heather Hickman**, **Tae-Wook Chun**, and **Susan Moir**; NIDDK investigators **Nicholas Guydosh** and **Jinwei Zhang**; **Ariel Levine** (NINDS); **Alexander Sodt** (NICHD); and **Mia Sung** (NIA).

The Earl Stadtman Tenure-Track Investigator Program, launched in 2009 and named for the legendary biochemist who worked at NIH for 50 years, aims to recruit a diverse group of scientists pursuing interests across the biomedical-research spectrum.

Following are lightly edited responses to some of the questions that *The NIH Catalyst* posed to these new Stadtmans.

Read the full interviews online at https://irp.nih.gov/catalyst/v25i5/nine-new-stadtman-investigators-take-on-the-scientific-world.

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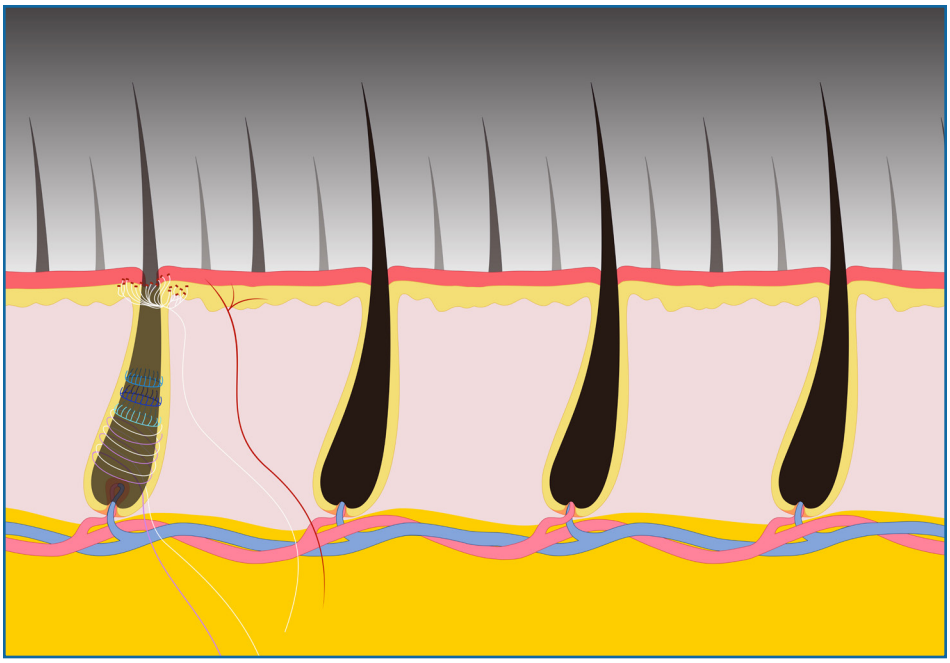
Specialized Neurons Play Unique Role in Pain

A Step Toward Designing New Approaches to Pain Therapy



JEREMY SWAN AND NICOLE SWAN, NICHD

Researchers in an NCCIH-led study have identified a class of sensory neurons that can be activated by stimuli as precise as the pulling of a single hair. Understanding basic mechanisms underlying these different types of responses will be an important step toward the rational design of new approaches to pain therapy.

Scientists know more about neurons that detect temperature and touch than they do about those that underlie mechanical pain (anatomical pain related to specific postures or activities). But a recent study, led by investigators at the National Center for Complementary and Integrative Health (NCCIH), combined functional imaging, recordings of electrical activity in the brain, and genetics to see how neurons respond to various stimuli. The researchers identified a class of sensory neurons that can be activated by stimuli as precise as the pulling of a single hair.

READ MORE ABOUT THIS AND OTHER NIH ADVANCES ON PAGE 8

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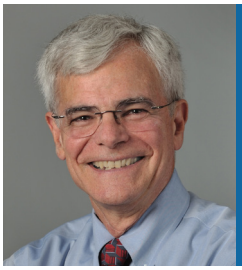


The DDIR Innovation Award Program

Supporting Collaborative Research Projects and Centers

BY MICHAEL GOTTESMAN, DDIR , AND CHARLES DEAROLF, ASSISTANT DIRECTOR FOR IR

Researchers have natural interactions with other members of their institutes and centers (ICs) and with their laboratory neighbors down the hall, but the demands and pace of research life can make it difficult at times to widen that circle of colleagues. One of our goals in the Office of Intramural Research is to promote scientific activities and events that reach across IC boundaries. Hence, OIR has traditionally supported a range of activities such as the scientific interest groups and the Wednesday Afternoon Lecture Series to bridge these gaps.

With the goal of sparking new partnerships, we are pleased that this year we could provide financial support to promote collaborative research projects and centers through the DDIR Innovation Award Program. The program was made possible by the generous contributions of the intramural scientific directors, who provided almost $6.9 million to support worthwhile projects. The Innovation Award Program was a major recommendation of the NIH Advisory Committee to the Director's report on Long-Term Planning for the NIH Intramural Research Program.

The Innovation Award Program provides seed money for innovative and high-impact research while stimulating interactions among investigators. We particularly welcomed proposals in the scientific fields that were identified as priorities as part of the intramural long-term planning process (inflammatory diseases, cell-based therapies, microbiome, drug resistance, neuroscience, RNA biology and therapeutics, vaccines, natural products, and animal modeling), but other topics were also considered.

The program offered three types of award to principal investigators. One type, to build scientific communities, was for program project awards to enhance collaborations among researchers working in the same or a similar scientific field. A team of three to five principal investigators (PIs) could propose a set of distinct but scientifically related individual projects.

A second type, to build research capacity, was to facilitate the creation or expansion of centers and facilities. Some research approaches, such as those requiring high-throughput technologies, expensive instrumentation, or a particular expertise, may be most effective when organized within a center or facility that interacts with investigators from multiple ICs. For this category, PIs from two or more ICs could submit a proposal to develop new scientific approaches, or a large-scale implementation of a current biomedical approach, centered on equipment and infrastructure.

The third type, to build bridges, was for smaller-scale collaborations with extramural investigators or industry. Priority was given to projects that would have a predictable, positive impact on human health or that involved patented or patent-pending inventions.

We distributed a call for proposals in March, and the response from the intramural community was overwhelming. We received 158 letters of intent (LOIs). Approximately half of these were invited to submit a full proposal, and 69 full proposals were submitted. The proposals were each reviewed by two or more intramural investigators. We had to recruit almost 100 reviewers to obtain the appropriate expertise for the different applications. In all, more than 450 investigators participated, either as reviewers or as project heads or collaborators on an LOI or a full proposal.

The Intramural Research Program (IRP) currently employs a little over 1,000 PIs, so almost half participated in some manner in the award program!

The program granted 25 awards, ranging from $48,000 to $750,000. A full list and description of the successful projects are available at https://oir.nih.gov/about/ddir-innovation-awards. It was incredible to read about so many innovative ideas percolating in the IRP, though we are not surprised at the wide-ranging creativity of our investigators. We wish we could have funded additional projects, as there were more worthwhile ideas than available funds.

We are encouraged that the DDIR Innovation Award program has stimulated investigators to initiate conversations with their intramural colleagues. As for the future, the program's fate is contingent on the budget situation for the IRP. We are guardedly optimistic that we'll be able to offer the program again next year. We envision that the program could provide a second year of funding for a subset of the ongoing projects as well as start-up funding for new projects. Regardless of the outcome, this year's program was a success, and we will be looking forward in the next few years to hearing about the results from the supported research. ●

Better Practices for Communicating Science

How to Avoid Hyping Your Research Findings

BY BARBARA VANN, NIGMS

CHRISTA REYNOLDS, NIGMS

From left: NIGMS Director Jon Lorsch moderates a panel discussion during the communicating science workshop with Angela DePace (Harvard Medical School); Lee Ligon (associate professor of biological sciences, Rensselaer Polytechnic Institute, Troy, New York); and Sara Reardon (reporter, *Nature*) on better practices for communicating scientific results.

From tweets and blog posts to press releases and news articles, reports of scientific advances can oversell the findings and misrepresent the discovery process. In fact, when **Jon Lorsch** joined the National Institute of General Medical Sciences (NIGMS) as its director in 2013, he was struck by the volume of press releases from grantee institutions that hyped incremental findings and gave too much credence to the conclusions from single studies.

These observations—and growing concerns about the negative consequences of hyped research—helped to spark a roundtable discussion organized by the Federation of American Societies for Experimental Biology (FASEB) and hosted by NIGMS. The workshop, held on June 22, 2017, brought together a diverse group of science communicators: researchers, including those who study communications; academic and corporate communications officers; policy advisors; and journalists.

Hype is "exaggerating the outcomes of research, for whatever motives people have, leading to potential negative effects due to inaccurate portrayal of research," according to keynote speaker Erika Check Hayden, a veteran science journalist and director of the Science Communication Program at the University of California, Santa Cruz.

To help bridge the gap between scientists and the public, systems biologist Angela DePace (Harvard Medical School) urged her colleagues at the workshop to think of everyone as a scientist, but at different scales of resolution—curious about the world, but approaching it from different points of knowledge and experience. She and other panelists also stressed the need for more communications training programs geared toward scientists.

Recommendations:

- Use a scientific approach by developing and following a logic model to outline long-term and short-term communication goals.
- When discussing research advances, describe the complexity and uncertainty of science to help convey that science moves forward through the combined efforts of many groups publishing results over long periods of time—and that scientific understanding can change as more findings become available.
- Know when to release news to public audiences. Not every finding should be publicized; waiting until they are replicated also can prevent premature announcements.
- Rather than focusing on a single paper, delight in details about the research process.
- Tell a good story; emphasize the personal story and the enthusiasm behind the science.
- Be accessible. Accessibility includes swapping technical language for metaphors, analogies, and illustrations as well as taking the time to discuss research with colleagues, communications officers, reporters, and members of the community.
- Talk to family, friends, and others in social networks about studies; informal discussion can have a powerful influence on informing and exciting the public about science.
- Use resources (listed in the online *NIH Catalyst*) to hone skills for disseminating science to a broad audience. These skills apply to other biomedical careers, too. ●

Read more online at https://irp.nih.gov/catalyst/v25i5/news-you-can-use.

From the Fellows Committee

Using Science to Teach Science

BY CRAIG MYRUM, NIA

Imagine yourself back in the classroom of your first college science course. How was the content delivered? Did you learn through activities? Discussions? Demonstrations? Videos? Games? Group work? Chances are, probably not. You more likely listened to your professor attempt to pass along as much information as he could (probably via PowerPoint) within the allotted time.

But there are decades of pedagogy studies that clearly show that humans cannot retain large amounts of information delivered in a short amount of time. As scientists, we should be the ideal group to take scientifically proven methods and apply them in practice. Fortunately, higher education institutions are beginning to systematically improve teaching methods collectively in a method known as "active learning."

NIH is playing a role, too, in providing fellows with in-depth training in how to teach science: The Office of Intramural Training and Education (OITE) offers a nine-week *Scientists Teaching Scientists* course (https://www.training.nih.gov/sts_main_page).

"A lot of effort has been put into professional development for active faculty," said Barbara Houtz, a science educator who has taught the popular course for nine years. "But now more than ever, the focus has been placed on training scientists at the graduate and postdoc levels, who are more amenable to change."

In active learning, teachers strive to more directly involve students in the learning process through a diverse range of methods—reading, writing, discussing, and problem solving—all of which are aimed at having students think about the work as well as the purpose behind it. The approach enhances their higher-order thinking capabilities substantially more than passively listening to a lecture does. In a 2014 meta-analysis of 225 studies comparing traditional lecturing to active learning, researchers found that students receiving traditional lectures were 1.5 times as likely to fail as students in classes with active learning. The same study also showed that active learning boosted scores on exams, too. So if the data supporting the effectiveness of active learning are so compelling, why aren't more professors changing the way they teach?

> As scientists, we should approach teaching the same way we approach our research.

Given that traditional lecturing has been the go-to teaching method for centuries, the most obvious explanation is, "That's how I was taught." But tradition and habits do not mean it's the best way. Active-learning methods often require more preparation and classroom time, which can cut back on time professors' need to fulfill their research responsibilities. While more reluctance to adopt active-learning practices comes from the "I have too much content to cover" reason, it can be argued that it's worth the tradeoff. Attempts to "cover the content" limits students to simply memorizing facts and figures without learning the more important ability to apply their knowledge. As an added incentive, proponents of active learning also claim that it boosts attendance and course satisfaction.

Countless studies from behavioral psychology and neuroscience have taught us ways to confer a deeper understanding and more long-term retention of the material, including repetition, the use of all our senses, student engagement, and making meaningful connections to prior knowledge. As scientists, we should approach teaching the same way we approach our research—taking previous findings (such as those mentioned above) and then using them to guide our future work. A major hurdle, though, is that many professors are simply unaware that so many resources are available to them that would so greatly enhance their teaching effectiveness.

The *Scientists Teaching Science* course provides an introduction to the basics of learning styles, teaching philosophies (for example, inquiry-based science and active learning), and curriculum development. The course is approached from a cognitive-science perspective, and as the title of the course suggests, is tailored specifically for those with a scientific mindset. Check on future offerings in the upcoming events on the OITE website (https://www.training.nih.gov/). ●

REFERENCE: S. Freeman, S.L. Eddy, M. McDonough, et al., "Active learning increases student performance in science, engineering, and mathematics," *Proc Natl Acad Sci USA* 111:8410–8415, 2014; DOI:10.1073/pnas.1319030111; http://dx.doi.org/10.1073/pnas.1319030111.

DANIEL SONE, NCI

John T. Schiller (left) and Douglas R. Lowy, both of the National Cancer Institute, received the 2017 Lasker-DeBakey Clinical Medical Research Award for their significant research leading to the development of human papillomavirus vaccines.

NCI's Douglas R. Lowy and John T. Schiller Received 2017 Lasker Award

Two scientists at the National Cancer Institute (NCI) received the 2017 Lasker~DeBakey Clinical Medical Research Award for "technological advances that enabled development of HPV vaccines for prevention of cervical cancer and other tumors caused by human papillomaviruses." The award is the country's most prestigious biomedical research prize and was presented to **John T. Schiller** of NCI's Center for Cancer Research (CCR), and **Douglas R. Lowy**, also in CCR and acting director of NCI.

Lowy's and Schiller's collaborative work to understand and prevent HPV infection has led to the approval of three preventive HPV vaccines by the U.S. Food and Drug Administration.

Efforts to develop these vaccines were spurred by an urgent public health need. Infection with certain types of HPV causes almost all cases of cervical cancer, the fourth most common cancer in women worldwide. More than 500,000 women around the world are diagnosed with cervical cancer each year, many of them at relatively young ages. More than 275,000 women die from the disease annually, and most of these deaths occur in developing regions of the world. HPV infection also causes anal, vulvar, vaginal, penile, and oropharyngeal cancers.

While working to address the need to prevent HPV-caused cancers in the 1990s, a team led by Schiller and Lowy discovered that the proteins that form the outer shell of HPV could form virus-like particles (VLPs) that closely resemble the original virus but are not infectious. They found that these VLPs could trigger the immune system to produce high levels of protective antibodies that can neutralize the virus in a subsequent infection. The VLPs ultimately became the basis of the three current HPV vaccines: Gardasil, Gardasil 9, and Cervarix.

Three Postdocs Funded for Health-Disparities Research

BY REBECCA NEWTON, NIMHD

Although progress has been made in recent years in addressing existing inequities in health care and research among minorities, health disparities persist. One of the ways the National Institute on Minority Health and Health Disparities (NIMHD) is accelerating its efforts to improve the health of minorities and other health-disparity populations is by funding postdocs in the intramural research program (IRP) who want to do health-disparities research.

Three postdoctoral fellows were selected to receive the first **William G. Coleman Jr.**, Ph.D., Minority Health and Health Disparities Research Innovation Award. Recipients received $15,000 each. Coleman, who died in 2014, was the first permanent African-American scientific director in the history of the NIH IRP. He was dedicated to training future scientists, particularly in areas related to disparities research.

The 2017 Awardees

Tracy M. Layne (National Cancer Institute) is dong a project on "Prospective Metabolomic Profiling and Prostate Cancer Risk in African American Men." African-American men have the highest incidence rate of prostate cancer, experience more-aggressive forms of the disease and at younger ages, and are more likely to die from it than any other racial or ethnic group.

Candace Middlebrooks (National Human Genome Research Institute) is doing an "Investigation of Genetic Risk Modifiers of Leg Ulcer Development in Sickle-Cell Patients Using Whole Exome Sequencing and Microbiome Characterization." Leg ulcers are a common and disabling complication of sickle-cell disease (SCD), which affects approximately 100,000 Americans. One in 13 African-American babies is born with the sickle-cell trait, meaning they carry a single gene for SCD and can pass it along to their children.

Melanie Sabado (NIMHD) is doing an "Assessment of Mental Health Behaviors and Stigma among Young Adult Pacific Islanders." Over 2.2 million of Asian-American Pacific Islanders had a diagnosable mental illness in 2014. Mental-health disparities are understudied in these communities, where a better understanding about cultural stigma as well as other barriers to seeking treatment and access to care can provide insights toward better outcomes. ●

Read more online at https://irp.nih.gov/catalyst/v25i5/news-briefs.

Daniel Reich, M.D., Ph.D.

Imagining Brain Imaging

BY ANNE DAVIDSON, NICHD

Humming along in the corner of **Daniel Reich's** lab is a small scientific instrument that you'd expect to see at a tech company or in a design studio. It's a 3-D printer busily making a customized cutting box that can hold a brain extracted at an autopsy. The indentation at the bottom of the box cradles the brain while the comb-like projections along the sides are used as guides for slicing the brain into thin sections that can be compared with magnetic resonance imaging (MRI) scans.

Reich, a neuroradiologist and senior investigator in the National Institute of Neurological Disorders and Stroke (NINDS), and his group developed the 3-D-printed cutting boxes as part of their research on multiple sclerosis (MS), a chronic neuroinflammatory autoimmune disorder of the central nervous system. MS affects some 400,000 Americans and about 2.5 million people worldwide and appears most often when people are between 20 and 40 years old and more commonly among women.

In MS, the immune system damages or destroys the myelin (which envelopes and insulates the nerves) and causes plaques, or lesions, to form. The lesions show up as white spots on MRI scans of the brain. But the severity of the disease cannot be determined by scans alone. Even when symptoms—such as muscle weakness in the hands and legs, impaired vision, clumsiness, and other problems—worsen, MRI scans may not reflect an increase in the size or number of lesions. Conversely, new lesions that are visible on an MRI scan may not be accompanied by new symptoms.

One of the ways that Reich is getting a better understanding of the pathological basis of MS is to do MRI-guided histopathology in which slices of postmortem brain tissue are compared with an MRI scan of the whole brain. That's where the customized 3-D-printed cutting boxes come in. In the past, it was difficult to obtain a correlation between MRI images and standard pathological sections of a postmortem brain. Tiny lesions that were visible on an MRI scan could be hard to find in actual brain tissue because the sections tended to be relatively thick and the slice faces weren't always parallel.

NINDS Senior Investigator Daniel Reich uses advanced MRI techniques to advance scientific knowledge about multiple sclerosis.

But the 3-D printer can be programmed to create a mold to fit each brain and have guides that ensure precision slicing. The use of the 3-D-printed cutting boxes can improve the speed, quality, and accuracy of finding—in brain tissue—MRI-identified small lesions that occur in MS and other brain diseases. Now this technique routinely helps Reich's lab study the use of MRI as a biomarker for the progression of MS.

Reich also uses MRI imaging to study the progression of MS in live patients. Most MRIs in ordinary medical settings operate at either 1.5 or 3 tesla in strength, but some research MRIs are much more powerful. The higher the strength, the stronger the MRI signal, and the better the image quality. Reich uses a 7-tesla MRI machine to get very detailed, high-resolution images that have provided new insights into the pathological changes of newly forming lesions. He's found that lesions evolve through different stages: centrifugal, where inflammation derives from a small blood vessel in the center of the lesion; and centripetal, where blood-derived inflammatory cells and molecules start from the rim and flow inward. He has also learned to identify a group of lesions that are chronically inflamed and a possible target for new drugs.

Reich's research is built on decades of MRI data collected at NIH. In the 1980s, NINDS scientist **Henry McFarland** pioneered the use of MRI to study MS. He was responsible for hiring Reich in 2009 and then mentoring him. In the 1990s and early 2000s, McFarland and **Joseph Frank** (Clinical Center) used marmosets as a primate model for MS research. Reich and NINDS senior investigators **Steven Jacobson** and **Afonso Silva** re-established the model at NIH in 2010. Using marmosets, the Reich lab has been able to noninvasively monitor pre-lesional changes in MS and has shown that blood-brain barrier permeability increases about four weeks before demyelination.

The lab is now working to develop the model further to study chronic MS-type lesions and how they can be repaired. ●

Read more online at at https://irp.nih.gov/catalyst/v25i5/daniel-reich-md-phd-imagining-brain-imaging.

Fibroid Link to Miscarriage Now in Doubt

BY KELLY LENOX, NIEHS

The largest study of its kind revealed that women with fibroid tumors are not at increased risk of miscarriage, contradicting common beliefs of women and health-care providers. The findings, reported in the *American Journal of Epidemiology*, may reduce unnecessary surgery for women with fibroids who plan to become pregnant. (*Am J Epidemiol* DOI:10.1093/aje/kwx062)

NIH reproductive epidemiologist **Donna Baird** and collaborators at Vanderbilt University Medical Center (Nashville) found that the results did not support earlier studies that indicated that fibroids' alteration of uterine shape or size as a risk factor for miscarriage.

"The paper convincingly counters accepted dogma because it is based on such a well-designed and well-conducted study—the Right from the Start study," said Baird, who is a senior investigator in the National Institute of Environmental Health Sciences (NIEHS) and head of the NIEHS Women's Health Group. The Right from the Start: A Study of Early Pregnancy was funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

Fibroid tumors in the uterus are benign growths that occur more frequently as women get older. The authors explained that until now, scientists thought that the location or size of a fibroid could interfere with attachment of the embryo, contraction of the uterus, or function of the placenta. As a result, surgery may be recommended for women with fibroids before they attempt to get pregnant, especially if a previous pregnancy ended in miscarriage.

Yet when the more than 5,500 women enrolled were divided into two groups, based on whether or not fibroids were detected in ultrasounds, the team observed the same rate of miscarriage in both groups—11 percent. The authors advised that surgical removal of fibroids to reduce risk of miscarriage should receive careful scrutiny.

"Women with fibroids had identical risk of miscarriage as women without fibroids, when taking into account other risks for pregnancy loss," reported Vanderbilt scientist Katherine Hartmann, who led the study, in a Vanderbilt press release. "We were stunned."

Her reaction hints at how deeply the conventional wisdom about fibroids and pregnancy is held among health professionals. Yet, according to the authors, the study confirmed several meta-analyses of clinical trials, one as recent as 2012, which found that removing fibroids had no effect on rates of miscarriage.

The authors suggested several reasons for the surprising findings.

• Unlike researchers in earlier studies, the team used research ultrasound to systematically document the fibroid status of all participants.

• The research team enrolled a large, racially diverse group of women, living in and near eight cities across three states.

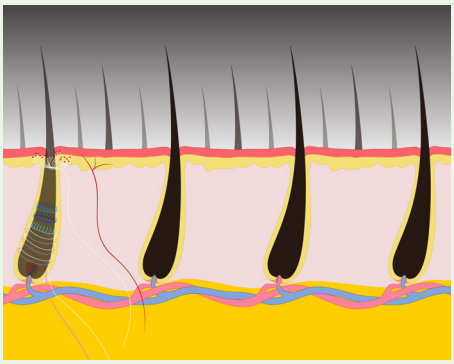
• Their statistical analyses accounted for age and race, because fibroids increase with age, and African-American women experience a higher prevalence of fibroids.

"This study addressed an important question with state-of-the-art methods," said **Dale Sandler**, chief of the NIEHS Epidemiology Branch. "The authors carefully considered all potential challenges to the validity of their findings, concluding rightly that their work calls into question a long-held belief in clinical practice." ●

ABBREVIATIONS

CC: NIH Clinical Center
CCR: Center for Cancer Research, NCI
CIT: Center for Information Technology
DCEG: Division of Cancer Epidemiology and Genetics, NCI
DIPHR: Division of Intramural Population Health Research, NICHD
FAES: Foundation for Advanced Education in the Sciences
FARE: Fellows Award for Research Excellence
FelCom: Fellows Committee
FDA: Food and Drug Administration
FNL: Frederick National Laboratory
IRP: Intramural Research Program
HHS: U.S. Department of Health and Human Services
NCATS: National Center for Advancing Translational Sciences
NCBI: National Center for Biotechnology Information
NCCIH: National Center for Complementary and Integrative Health
NCI: National Cancer Institute
NEI: National Eye Institute
NHGRI: National Human Genome Research Institute
NHLBI: National Heart, Lung, and Blood Institute
NIA: National Institute on Aging
NIAAA: National Institute on Alcohol Abuse and Alcoholism
NIAID: National Institute of Allergy and Infectious Diseases
NIAMS: National Institute of Arthritis and Musculoskeletal and Skin Diseases
NIBIB: National Institute of Biomedical Imaging and Bioengineering
NICHD: Eunice Kennedy Shriver National Institute of Child Health and Human Development
NIDA: National Institute on Drug Abuse
NIDCD: National Institute on Deafness and Other Communication Disorders
NIDCR: National Institute of Dental and Craniofacial Research
NIDDK: National Institute of Diabetes and Digestive and Kidney Diseases
NIEHS: National Institute of Environmental Health Sciences
NIGMS: National Institute of General Medical Sciences
NIMH: National Institute of Mental Health
NIMHD: National Institute on Minority Health and Health Disparities
NINDS: National Institute of Neurological Disorders and Stroke
NINR: National Institute of Nursing Research
NLM: National Library of Medicine
OITE: Office of Intramural Training and Education
OIR: Office of Intramural Research
ORS: Office of Research Services
ORWH: Office of Research on Women's Health
OTT: Office of Technology Transfer

Intramural Research Briefs



JEREMY AND NICOLE SWAN, NICHD

NCCIH, NIDDK, NICHD: SPECIALIZED NEURONS PLAY A UNIQUE ROLE IN PAIN

Researchers in an NCCIH-led study have identified a class of sensory neurons that can be activated by stimuli as precise as the pulling of a single hair. Understanding basic mechanisms underlying these different types of responses will be an important step toward the rational design of new approaches to pain therapy. In this study, the researchers used a novel strategy that combined functional imaging, recordings of electrical activity in the brain, and genetics to see how neurons respond to various stimuli. The scientists focused on a class of sensory neurons that express a gene called *CALCA* because these neurons have a long history in pain research.

The scientists applied various stimuli to the hairy skin of mice cheeks, including gentle mechanical stimuli (air puff, stroking, and brushing), "high-threshold" mechanical stimuli (hair pulling and skin pinching), and temperature stimulation. They found that the target neurons belong to two broad categories, both of which were insensitive to gentle stimulation. The first was a well-known type of pain fiber—a polymodal nociceptor—that responds to a host of high-intensity stimuli such as heat and pinching. The second was a unique and previously unknown type of neuron that responded robustly to hair pulling. They called this previously undescribed class of high-threshold mechanoreceptors (HTMRs) "circ-HTMRs," due to the unusual nerve terminals these neurons made in skin. The researchers observed that the endings of the fibers made lasso-like structures around the base of each hair follicle.

In additional experiments, the researchers found that using optogenetics to directly activate circ-HTMRs was sufficient to drive protective behaviors such as avoiding a chamber paired with blue-light stimulation. These findings add insight into how the somatosensory system encodes pain. To see videos describing the research, go to https://www.nih.gov/news-events/news-releases/nih-study-uncovers-specialized-mouse-neurons-play-unique-role-pain and http://www.cell.com/neuron/video. (NIH authors: N. Ghitani, A. Barik, M. Szczot, J.H. Thompson, C. Li, C.E. Le Pichon, M.J. Krashes, and A.T. Chesler, *Neuron* **95**:944–954. e4, 2017; DOI:http://dx.doi.org/10.1016/j.neuron.2017.07.024)

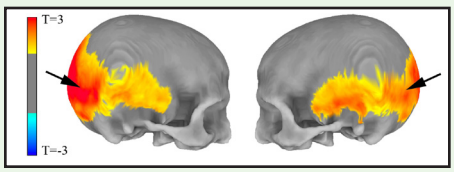
NIAID: NIAID RESEARCHERS PIONEER ROBUST NEW 3-D TISSUE-IMAGING TECHNIQUE

NIAID researchers have developed a new method for visualizing in great detail the distribution of cell types in tumors and other complex tissues. The method, called clearing-enhanced 3-D microscopy, or Ce3D, may help researchers evaluate how well immunotherapies target hard-to-treat cancers. Currently available tissue-clearing methods have substantial limits to how many cell types can be characterized and are often very difficult to use, hampering researchers' ability to obtain a comprehensive understanding of how a patient's immune system is affecting a tumor. Other current methods permit users to count many different cell types but involve slicing or grinding up the tissue, losing critical information about the 3-D organization of tumor and immune cells in the cancer. By contrast, Ce3D allows researchers to keep the biopsied tissue intact, mark a large number of different cell types with various tracking techniques, and view the results in 3-D. Ce3D is a sophisticated way to obtain a lot of information about a particular tumor, which is critical for researchers trying to evaluate therapies in animal models and physicians evaluating their patients. To see images and videos, go to https://www.niaid.nih.gov/news-events/3d-tissue-imaging. (NIH authors: W. Li, R.N. Germain, and M.Y. Gerner, *PNAS* DOI:10.1073/pnas.1708981114, 2017)

NIMH: ANCIENT ANCESTRAL GENES INFLUENCE MODERN HUMAN BRAINS

In the distant past, ancestors of modern humans are thought to have mated with their Neanderthal contemporaries, who went extinct 40,000 years ago. A new magnetic-resonance-imaging (MRI) study by NIMH investigators has provided the first direct evidence that this long-ago interbreeding continues to influence our brain structure to this day and potentially our cognitive abilities as well.

Researchers have long studied skulls of Neanderthals to infer their cognitive abilities. Those studies suggest that Neanderthals had more-developed visual systems than modern humans, but at the cost of less-complex brain structures devoted to social interaction. By analyzing the DNA of a large group of participants and scanning their brains with MRI, the NIMH researchers found that subjects whose genes were more similar to those of Neanderthals had skull shapes and brain structures more like members of that ancient human subspecies.



M. GREGORY, NIMH

NIMH: MRI data show (left) areas of the skull preferentially affected by the amount of Neanderthal-derived DNA and (right) areas of the brain's visual system in which Neanderthal gene variants influenced cortex folding (red) and gray-matter volume (yellow).

The subjects' Neanderthal-related genes specifically affected the visual cortex and the intraparietal sulcus in the brain. Because the former is involved in visuospatial abilities and the latter is thought to affect social cognition, the new study suggests that the same tradeoffs the Neanderthal brain made between visual and social capabilities may be made in the brains of modern humans with more Neanderthal-like DNA. Because certain mental disorders, such as the autism-related disorder Williams syndrome, appear to affect both social and visual abilities, the findings could shed light on the genesis of such conditions. (NIH authors: M.D. Gregory, J.S. Kippenhan, D.P. Eisenberg, P.D. Kohn, D. Dickinson, V.S. Mattay, Q. Chen, D.R. Weinberger, Z.S. Saad, and K.F. Berman, *Sci Rep* 7, 2017; DOI:10.1038/s41598-017-06587-0)

[BY BRANDON LEVY, NINDS]

NIA: HOW GLUCOCORTICOIDS TAME INFLAMMATION

Although glucocorticoids are widely used to treat inflammatory conditions, patients often suffer side effects that limit the therapeutic use. Strategies to overcome this problem have been hampered because the cellular actions of glucocorticoid receptor (GR), the molecular target of glucocorticoids, are still debated. NIA researchers used the latest genomic tools and examined the biochemical alterations of the genome in inflammatory cells. The study yielded many surprises, among which was the importance of GR's ability to turn *on* genes that counter inflammatory proteins. Conventional wisdom held that GR works by turning *down* inflammatory genes.

This study cautions that the pharmaceutical industry and researchers should re-assess the historical focus on developing synthetic drugs that selectively promote the gene-repressing activity of GR. The gene-inducing activity in GR is crucial for boosting the natural inhibitors of inflammatory factors. According to the researchers, next-generation steroids should keep or enhance this activity of GR for robust anti-inflammatory action while minimizing side effects. (NIH authors: K. Oh, H. Patel, R.A. Gottschalk, W.S. Lee, S. Baek, I.D.C. Fraser, G.L. Hager, and M. Sung, *Immunity* **47**:298–309.e5, 2017, DOI:10.1016/j.immuni.2017.07.012)

NCI: RESEARCHERS IDENTIFY ESSENTIAL GENES FOR CANCER IMMUNOTHERAPY

A new study, led by NCI and including investigators from several other institutions, identified genes that are necessary in cancer cells for immunotherapy to work. NCI researchers previously showed that the infusion of a large number of T cells can trigger a complete regression of cancer or directly recognize and kill tumor cells. But some tumor cells are resistant to such destruction. In the current study, the researchers used CRISPR-Cas9 gene-editing technology to knock out every known protein-encoding gene in the human genome and then tested the ability of gene-modified melanoma cells to respond to T cells. They found more than 100 genes that may play a role in facilitating tumor destruction by T cells.

J. BAILEY, NHGRI

NCI researchers have identified genes that are essential for cancer cells to be killed by T cells.

This gene list could serve as a blueprint to study the emergence of tumor resistance to T-cell-based cancer therapies. (NIH authors: S.J. Patel, R.J. Kishton, A. Eidizadeh, S.K. Vodnala, M. Cam, J.J. Gartner, L. Jia, S.M. Steinberg, T.N. Yamamoto, A.S. Merchant, G.U. Mehta, A. Chichura, E. Tran, R. Eil, M. Sukumar, E.Perez Guijarro, C.Day, P. Robbins, S. Feldman, G. Merlino, and N.P. Restifo, *Nature* DOI:10.1038/nature23477, 2017)

NIAAA: ALDOSTERONE LINKED TO ALCOHOL-USE DISORDER

A new study, led by NIAAA scientists, demonstrates that the hormone aldosterone may contribute to alcohol-use disorder (AUD). Aldosterone helps regulate electrolyte and fluid balance by binding to mineralocorticoid receptors (MRs) located throughout the body. The new report describes three studies conducted with nonhuman primates, rats, and humans that investigated the potential contribution of the aldosterone-MR pathway to AUD. Future studies are needed to determine whether the pathway might be targeted for the development of new pharmacotherapies for AUD. (NIH authors: C.L. Haass-Koffler, R. Lee, L. Leggio, *Mol Psychiatry*, DOI:10.1038/mp.2017.97) ●

Read more online at https://irp.nih.gov/catalyst/v25i5/research-briefs, including:

- **NIAID:** NEW B-CELL PROTECTIVE ROLE IN VIRUS INFECTION
- **NIEHS:** FEMALE MOUSE EMBRYOS REMOVE MALE REPRODUCTIVE SYSTEMS
- **NHGRI AND OTHERS:** GENE UNDERLYING RARE MUSCLE DISORDER
- **NIAID:** DISCOVERY OF POTENTIAL BROAD-SPECTRUM ANTIVIRAL
- **NCI-DCEG, CC:** FEASIBILITY OF CANCER-SCREENING PROTOCOL FOR RARE DISORDER
- **NHGRI:** SOCIAL INTERACTION AFFECTS CANCER PATIENTS' RESPONSE TO TREATMENT
- **NIAID:** TWO ZIKA VIRUS STUDIES
- **NICHD, NEI:** HIV HIJACKS SURFACE MOLECULE TO INVADE CELL
- **NEI, NIAID:** EYE MICROBIOME TRAINS IMMUNE CELLS TO FEND OFF PATHOGENS
- **NCATS, NICHD, AND OTHERS:** TWO STUDIES ON NIEMANN-PICK DISEASE

Stadtman Investigators

CONTINUED FROM PAGE 1

M. CONSTANZA CAMARGO, PH.D., NCI-DCEG

Earl Stadtman Investigator, Metabolic Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute

EDUCATION: Pontificia Universidad Javeriana, Bogotá, Colombia (M.H.A.); Escuela de Salud Pública de México, Instituto Nacional de Salud Pública, Cuernavaca, México (M.S. in epidemiology); University of Illinois at Chicago, Chicago (Ph.D. in public health and epidemiology)
TRAINING: Predoctoral fellow, postdoctoral fellow, and research fellow, NCI
CAME TO NIH: In 2008 as a summer fellow during her doctoral program and did part of her dissertation at NCI; became a postdoctoral fellow in 2010 and a research fellow in 2012, and a Stadtman Investigator in 2016
WEBSITE: https://irp.nih.gov/pi/maria-constanza-camargo

Research focus: I am a cancer epidemiologist. My research focuses on *Helicobacter pylori* infection, premalignant gastric lesions, and gastric cancer. I also conduct studies of esophageal squamous-cell carcinoma with an emphasis on the potential etiologic role of infections. In both lines of research, my program combines population-based studies on cancer causation with projects that may have translational applications for cancer screening, prevention, and treatment.

Have you made significant discoveries?
My colleagues and I provided key evidence supporting that Epstein-Barr virus–positive gastric cancer is a different clinical entity than other subtypes of gastric cancer and requires new diagnostic tools and treatment regimens (*Gut* **63:**236-243, 2014; DOI: 10.1136/gutjnl-2013-304531; *Int J Cancer* **134:**948-953, 2014; doi: 10.1002/ijc.28402; 5; and *Br J Cancer* **105:**38-43, 2011; DOI: 10.1038/bjc.2011.215; 7). Recently, we reported on gastric-cancer incidence trends showing that this neoplasia is re-emerging in the United States, particularly among young non-Hispanic whites. (*JAMA* **303:**1723-1728, 2010; DOI: 10.1001/jama.2010.496)

What is most exciting about your work?
That innovations evolve out of an open exchange of creative ideas with my colleagues, in which we discuss and debate concepts that result in high-quality research.

What do you like to do outside of work?
Salsa dancing; watching movies; traveling to new places; trying new restaurants; and spending time with family and friends.

What about you is surprising?
In 2005 Hurricane Katrina advanced my research career. Her winds pushed me from New Orleans (Louisiana State University Health Sciences Center) to Nashville (Vanderbilt University Medical Center), then to Chicago (University of Illinois at Chicago), and later to Bethesda.

Would you like to tell us anything else?
I love what I do. Research is not easy, but it is fun. So, for those considering this exciting career, I have some advice: 1) have passion for it; 2) know the knowledge gaps in your field; 3) do not be afraid of null results; 4) expose yourself to topics and people outside of your field so you can think outside of the box (a conversation can change everything); and 5) enjoy the long-term journey!

TAE-WOOK CHUN, PH.D., NIAID

Earl Stadtman Investigator and Chief, HIV Immunovirology Unit, Laboratory of Immunoregulation, National Institute of Allergy and Infectious Diseases

EDUCATION: Johns Hopkins University School of Medicine, Baltimore (Ph.D. in biochemistry, cellular, and molecular biology)
TRAINING: Research fellow, Laboratory of Immunoregulation, NIAID
CAME TO NIH: In 1997 for training; staff scientist (2001–2009); associate scientist (2009–2016); became a Stadtman Investigator in 2016
WEBSITE: https://www.niaid.nih.gov/research/tae-wook-chun-phd

Research Focus: My research focuses on 1) delineating the role of viral reservoirs in the pathogenesis of human immunodeficiency virus (HIV) disease; 2) examining host and viral factors that contribute to the maintenance of HIV reservoirs; and 3) developing therapeutic strategies aimed at achieving durable virologic control in infected individuals in the absence of antiretroviral therapy.

How did you become interested in science?
My father was a physician, which may have prompted my curiosity toward medicine and research at a young age. During my junior year in college, I was preparing for a school assignment and read several journal articles on HIV, one of which was published by NIAID's Laboratory of Immunoregulation.

I was intrigued by how the interactions between virus and host ultimately lead to the destruction of the immune system. This was the moment I decided to pursue a career in HIV research.

Have you made any significant discoveries?
My Ph.D. thesis included a project that led to the discovery and characterization of a minute fraction of resting CD4+ T cells carrying the integrated form of HIV DNA (now commonly referred to as the latent viral reservoir) in HIV-infected individuals (*Nature* **387:**183–188, 1997; DOI:10.1038/387183a0).

Shortly after I arrived at the NIH, Dr. **Anthony Fauci** and I demonstrated for the first time that a reservoir of latent cells harboring HIV persisted in virtually all infected individuals who were receiving clinically effective antiretroviral therapy. This finding has been the basis of research programs that focus on eliminating such cells in attempts to cure HIV in infected individuals who are receiving antiretroviral therapy. (*Proc Natl Acad Sci U S A* **94:**13193–13197, 1997)

What is most exciting about your work?
Seeing our ex vivo research projects progress and evolve into phase 1 clinical trials. Not only do I get to design and execute clinical trials, but I also get to meet and interact with the patients as well as the clinical staff.

What do you like to do outside of work?
Visit the National Zoo and observe my favorite animals, the pandas.

If I had more time I would …
...investigate the impact of other viruses, such as hepatitis C virus, cytomegalovirus, and herpes viruses.

What about you is surprising?
I always wanted to become an airline pilot and would watch airplanes landing and taking off for hours.

NICHOLAS GUYDOSH, PH.D., NIDDK
Earl Stadtman Investigator, Section on mRNA Regulation and Translation, Laboratory of Biochemistry and Genetics, National Institute of Diabetes and Digestive and Kidney Diseases

EDUCATION: University of Cambridge, Cambridge, UK (M.Phil. in chemistry); Stanford University, Stanford, Calif. (Ph.D. in biophysics)
TRAINING: Postdoctoral fellow, molecular biology and genetics, Johns Hopkins University (Baltimore)
CAME TO NIH: As a Stadtman Investigator in 2016
WEBSITE: https://irp.nih.gov/pi/nicholas-guydosh

Research Focus: The basic mechanism of protein synthesis and how this translation of the genetic code is regulated. As a postdoc, I discovered that the failure of ribosome recycling after protein synthesis leads to the production of short peptides. My lab is investigating how this process helps cells respond to stress, such as nutrient starvation, and defend against viral infection. We employ a number of high-throughput and computational tools and single-molecule fluorescence microscopy.

How did you become interested in science?
I've been fascinated by science for as long as I can remember. Raising caterpillars, keeping aquariums of fish, and building computers are all wonderful early memories. I got interested in RNA and translation when I began my postdoc and came to appreciate how the process is central to all life.

Have you made significant discoveries?
My most important work showed that the termination of translation isn't perfect: Its failure leads to ribosomes using an unconventional mechanism to translate the three-prime untranslated regions (3'-UTRs) of messenger RNAs (mRNAs). The 3'-UTR is one of several regions in mRNA that is not translated into protein and often contains regulatory regions that post-transcriptionally influence gene expression. It's exciting to figure out what regulates this process and how it affects cells and is involved in disease. (*Cell* **156:**950–962, 2014; DOI:10.1016/j.cell.2014.02.006; and *Cell* **162:**872–884, 2015, DOI:10.1016/j.cell.2015.07.041)

What is most exciting about your work?
The best moments are those when you first see a piece of data or finish a rudimentary analysis and you're not sure what it means but you know it's going to be exciting.

What's hot in your field right now?
There's a growing awareness that gene expression isn't limited to canonical coding sequences and that translation of "noncoding" regions is important for understanding cellular adaptation to stress and immunity.

What do you like to do outside of work?
Bike riding; gardening; and having adventures around Montgomery County with my young daughter.

What's the hardest lesson you've learned?
The reality of science is that it moves slowly and scientists spend much of their time debugging instruments and protocols that don't work. It makes it all the more exciting when breakthroughs do occur.

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Stadtman Investigators

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HEATHER HICKMAN, PH.D., NIAID

Earl Stadtman Investigator and Chief, Viral Immunity and Pathogenesis Unit, Laboratory of Clinical Immunology and Microbiology, National Institute of Allergy and Infectious Diseases

EDUCATION: University of Oklahoma Health Sciences Center, Oklahoma City (Ph.D. in microbiology and immunology)
TRAINING: Postdoctoral fellow, Cell Biology Section, Laboratory of Viral Diseases, NIAID
CAME TO NIH: In 2004 for postdoctoral training; became a staff scientist in 2007, a senior associate scientist in 2015, and a Stadtman Investigator in 2017
WEBSITE: https://www.niaid.nih.gov/research/heather-hickman-phd

Research Focus: Understanding antiviral immunity with an emphasis on the anatomy of immune responses, including the lymph node and infected peripheral tissues. My lab studies the immune response to a number of different viruses, from large DNA viruses such as Vaccinia virus to positive- and negative-stranded RNA viruses including Zika and influenza viruses. To complement many molecular and cellular approaches, we employ a number of microscopic techniques (including two-photon microscopy) to visualize virus-infected cells and antiviral immune effectors in animals.

How did you become interested in science?
Both my parents instilled a sense of discovery in me from a young age. From makeshift microscopes to geode-collecting mountain hikes, they taught me to explore and question my surroundings.

Have you made significant discoveries?
My colleagues and I defined a mechanism used by cytotoxic T cells to locate virus-infected cells in tissue (*Immunity* **42:**524–537, DOI:10.1016/j.immuni.2015.02.009). My independent research program will extend these concepts to better understand how antiviral effectors prevent infection and eliminate infected cells.

Is there anything you can look back on now and realize it was significant?
During my undergraduate training, I spent hours in a botany lab microscopically imaging green fluorescent protein–labeled viroid-movement proteins trafficking through the plasmodesmata of tobacco leaves in real time. Although at the time I didn't realize it, these studies taught me the value of patience during experimentation, important practical and computational skills I continue to use, and also that I truly love microscopy.

What do you like to do outside of work?
I enjoy outdoor activities, including running and gardening.

If I had more time I would …
...spend more focused time with my husband and son.

What's the hardest lesson you've learned?
Not every experiment can be perfect, but it can still be informative.

What about you is surprising?
I'm a big-time college football fan—go Sooners!

ARIEL LEVINE, M.D., PH.D., NINDS

Earl Stadtman Investigator, Chief of Spinal Circuits and Plasticity Unit, National Institute of Neurological Disorders and Stroke

EDUCATION: The Rockefeller University, New York (Ph.D. in developmental biology); Weill Cornell Medical, Cornell University, New York (M.D.)
TRAINING: Postdoctoral fellow in neuroscience, Salk Institute (La Jolla, Calif.)
CAME TO NIH: As a Stadtman Investigator in 2015
WEBSITE: https://neuroscience.nih.gov/ninds/Faculty/Profile/ariel-levine.aspx

Research Focus: How the molecules, neurons, and circuits of the spinal cord mediate normal behavior and how they change and adapt to allow learning. Using a mouse model system, my group applies novel genetic tools, molecular biology, and behavioral analysis to understand mechanisms of plasticity — from the control of gene expression to the wiring of spinal cord circuits. We hope to leverage our findings to improve the recovery of patients who've suffered a stroke or spinal-cord injury.

How did you become interested in science?
I became interested in science as a young child through my father (who was a physician-scientist) sharing his love of science with me. Often in the evenings, I would ask him a question about nature, and his answer would serve as my bedtime story.

I became interested in my specific field of spinal-cord biology through my postdoctoral research with Dr. Sam Pfaff at The Salk Institute. I chose to work with him because his research linked my prior training in developmental biology with the field of neuroscience, which I wanted to learn, and because his lab was a lively and exciting place to do research.

Have you made significant discoveries?

We found a group of neurons in the spinal cord that seem to be a core component of the neural circuits that govern movement. The spinal neurons we identified are a major source of input to the motor neurons that directly control muscles. When we activated these spinal neurons, we found that they can drive coordinated activity in multiple motor groups. (*Nat Neurosci* **17:**586–593, 2014; DOI:10.1038/nn.3675)

Is there anything you can look back on now and realize it was significant?

When I started my graduate research in Dr. Ali Brivanlou's lab at Rockefeller University, I had assumed that he would assign me a project. But the first thing he told me was to leave and come back when I could describe what was the most important question in our field of developmental biology. He said that this question would define my Ph.D. project. I first picked a question that was too big to answer, so I settled into another project. That experience transformed how I thought about myself as a scientist. I continue to ask that important question of myself.

What do you like to do outside of work?

My husband, my son, my daughter, and my parents are a huge part of my downtime and relaxation. I enjoy being outdoors, either walking in the beautiful forests around here or watching one of my kids' many sports games. I also love reading and getting together with our friends.

SUSAN MOIR, PH.D., NIAID

Earl Stadtman Investigator, B-Cell Immunology Unit, Laboratory of Immunoregulation, National Institute of Allergy and Infectious Diseases

EDUCATION: Université du Québec, Institut Armand-Frappier, Laval, Québec (M.Sc. in virology and immunology); Université Laval, Québec (Ph.D. in microbiology and immunology)
TRAINING: Postdoctoral training, NIAID's Laboratory of Immunoregulation (LIR)
CAME TO NIH: In 1996 for training in NIAID's LIR; research fellow positions, LIR (2001–2006); staff scientist, LIR (2006–2010); associate scientist, LIR (2010–2015); became a Stadtman Investigator in 2015
WEBSITE: https://irp.nih.gov/pi/susan-moir

Research Focus: The roles of B lymphocytes in human immunodeficiency virus (HIV) infection and pathogenesis. My group assesses transcriptional, phenotypic, and functional attributes of B cells that circulate in the peripheral blood and those that reside in tissues, particularly lymph nodes and the bone marrow. We are also interested in expanding our knowledge of human B-cell immunology as it relates to health and disease and in identifying common pathways of dysregulation that could serve as the basis for therapeutic interventions.

Have you made significant discoveries?

Under the leadership of my longtime mentor, Dr. **Anthony Fauci**, the LIR has been leading the field in B-cell pathogenesis in HIV disease for more than three decades, with my involvement being close to 20 years. In 2008, we described HIV-associated B-cell exhaustion, a dysregulation of immunologic memory of B cells that occurs due to the persistence of HIV, especially in individuals whose viremia is not kept in check either with antiretroviral therapy or without in rare cases of long-term nonprogression (*J Exp Med* **205:**1797–1805, 2008; DOI:10.1084/jem.20072683).

What is most exciting about your work?

The opportunity and privilege of conducting human-based studies that may, in the future, help alleviate suffering of people afflicted by the diseases we study.

Is there anything you can look back on now and realize it was significant?

After the departure of one of our staff clinicians, I was asked to take over some of his clinical protocols, even though I do not have a medical degree. It has been very challenging but also very fulfilling to take on these responsibilities and interact directly with our study participants and clinical staff.

What do you like to do outside of work?

Spend time with family and friends; cooking; swimming; and exploring Washington, D.C., on foot and bicycle.

If I had more time I would …

…do more volunteer work in my community, serving underprivileged youth and our veterans.

What's the hardest lesson you've learned?

Patience.

What about you is surprising?

In my youth, I was heading for trouble. But sports and a deep-seated fear of academic failure kept me on the straight and narrow.

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Stadtman Investigators

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ALEXANDER SODT, PH.D., NICHD

Earl Stadtman Investigator, Section on Integrative Biophysics, Eunice Kennedy Shriver *National Institute of Child Health and Human Development*

EDUCATION: University of California, Berkeley, Berkeley, Calif. (Ph.D. in chemistry)
TRAINING: Postdoctoral fellow in biophysics, University of California, Berkeley; postdoctoral fellow in biophysics, National Heart, Lung, and Blood Institute
CAME TO NIH: In December 2009 for training; became a Stadtman Investigator in 2016
WEBSITE: https://science.nichd.nih.gov/confluence/display/sodt/Home

Research Focus: My lab uses molecular simulations to compute how membrane composition and the modular chemistry of lipids determine the material and physical properties of membranes. We use physics-based all-atom simulation with new statistical mechanical methods, mathematical analysis, and creative model building to determine the role of lipids in disease. The physics are important because they directly influence processes related to disease, such as dysfunctional signaling at the membrane in cancer and the ability of viruses to penetrate into and bud from the cell.

How did you become interested in science?
I grew up near Seattle in the booming dot-com era. My friends were all interested in computer programming; some of them skipped college to take jobs. I loved programming but couldn't resist the course titles for physics and chemistry, which seemed to promise to reveal so much about the world. I realized very gradually that a scientist could use a computer to do an experiment. It has been so much fun to show NIH summer interns the same thing, but they are learning much earlier than I did!

Have you made significant discoveries?
During my postdoctoral work I discovered a few dramatic cases in which our assumptions about the behavior of lipids were incorrect. I am now trying to use modifications of the theory to improve our understanding of complex cellular membranes.

What do you like about the NIH IRP?
The problems being solved here and the expertise of the research labs. I relish the challenge of demonstrating to the NIH that quantitative physics–based modeling can help elucidate mechanisms in disease.

What is most exciting about your work?
When a model makes a counterintuitive prediction that is verified. If I smell even a whiff of this type of prediction, it's hard to work on anything else.

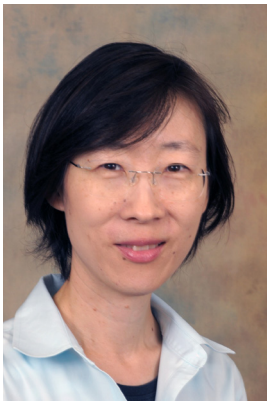
What do you like to do outside of work?
My life outside of work is family and lawn maintenance (mostly family).

What's the hardest lesson you've learned?
When to quit a bad idea. I am still learning.

What about you is surprising?
When I met my wife (she has style), I had been cutting my own hair. She was willing to ignore my terrible hair. Nowadays I have it professionally cut.

MYONG-HEE (MIA) SUNG, PH.D., NIA

Earl Stadtman Investigator and Chief, Transcription Systems Dynamics and Biology Unit, Laboratory of Molecular Biology and Immunology, National Institute on Aging



EDUCATION: State University of New York at Stony Brook, N.Y. (Ph.D. in mathematics)
TRAINING: Research associate, Institute for Physical Science and Technology, University of Maryland (College Park, Md.)
BEFORE COMING TO NIH: Assistant professor, Department of Mathematics and Statistics, American University (Washington, D.C.)
CAME TO NIH: In 2000–2002 as a guest researcher (on sabbatical from American University); staff scientist (2002–2005) in the Biometric Research Branch, National Cancer Institute (NCI); staff scientist, Laboratory of Receptor Biology and Gene Expression, NCI (2005–2015); became a Stadtman Investigator in 2015
WEBSITE: https://irp.nih.gov/pi/myong-hee-sung

Research Focus: Applying quantitative-imaging, mathematical, epigenomic, and biochemical methods toward understanding the mechanisms of transcription-factor signaling and genome regulation in the immune system. We use these diverse systems-biology approaches to study how cell-signaling dynamics influence gene expression in immunity and how such control mechanisms are altered in aging.

Have you made significant discoveries?

Although NF-kappaB is considered a master regulator of immunity and cell survival, little was known about its dynamics before David Baltimore's lab (California Institute of Technology) published a study in 2002. A few years later, Michael White's lab (University of Liverpool, Liverpool, England) published a single-cell study containing results different from the Baltimore study. But each study had its own limitations, and the puzzle remained for several years.

I used long-term live microscopy to quantitatively image the natural NF-kappaB protein and showed that it has multiple cycles of action (oscillations) in individual cells after exposure to a pro-inflammatory stimulus. This finding resolved the debate and led to the possibility that signaling dynamics of transcription factors may encode important functional information that cells receive from their environment such as infection or other danger signals. (*PLoS One* **4**(9):e7163, 2009)

Subsequently, at the Keystone NF-kappaB meeting, our *PLoS One* work served as a proof that oscillations happen in wild-type cells, and the community came to a consensus. (*Immunol Rev* **246:**221–238, 2012. DOI:10.1111/j.1600-065X.2011.01092.x)

What is most exciting about your work?

How a project often takes an unexpected turn and heads in a more interesting direction. It is also gratifying to see more young scientists who are trained in both quantitative and biomedical sciences.

What do you like to do outside of work?

Listen to classical music; hang out with my two daughters.

What about you is surprising?

I played drums in a high school rock band. I thought it was the coolest thing then.

JINWEI ZHANG, PH.D., NIDDK

Earl Stadtman Investigator, Laboratory of Molecular Biology, National Institute of Diabetes and Digestive and Kidney Diseases

EDUCATION: University of Wisconsin-Madison, Madison, Wisc. (Ph.D. in biomolecular chemistry)
TRAINING: Postdoctoral training in molecular biophysics, Howard Hughes Medical Institute and Fred Hutchinson Cancer Research Center (Seattle); postdoctoral training in molecular biophysics, National Heart, Lung, and Blood Institute
CAME TO NIH: In 2011 for training; became a Stadtman Investigator in 2015
WEBSITE: https://www-mslmb.niddk.nih.gov/zhang/zhanglab.html

Research Focus: Visualizing and understanding ribonucleic acids (RNAs) that aren't used as templates to code for proteins, making them "noncoding" RNAs. They are frequently referred to as the "dark matter" of the genome. We are working to uncover the general motifs and principles that govern how noncoding RNA structures are built and organized, how RNA structures morph to change their shape, and how host and viral RNAs differentially modulate the activities of host proteins such as those involved in antiviral immunity. Such fundamental understanding of RNA will allow new therapeutics to be developed to modulate these biologically important molecules in human pathophysiology.

Have you made significant discoveries?

My Ph.D. work helped define how nucleotides are loaded and assembled into RNA by bacterial RNA polymerases and how the progeny RNA can influence the parent protein enzyme in a "tail-wags-dog" scenario. My postdoctoral work determined the first crystal structure of a T-box riboswitch RNA in a complex with its binding partner, a transfer RNA (*Nature* **500:**363–367, 2013; DOI:10.1038/nature12440).

This RNA-RNA interaction allows many pathogenic bacteria to detect and respond to nutrient limitation in an ever-changing environment. The work also provided a proof of principle that noncoding RNAs can recognize each other through their matching shapes. With the discovery of tens of thousands of noncoding RNAs in our and other genomes, we have barely scratched the surface.

What is most exciting about your work?

The ability to visualize and understand a molecule for the first time and the Eureka moment when we figure out how it works. With noncoding RNA as a young discipline, there are more unknowns than knowns, which is another source of excitement. Sometimes, our work is akin to trying to photograph an elephant before anyone knows what an elephant looks like or whether elephants are even real.

What do you like to do outside of work?

My family and I enjoy travel and nature. My favorite places are Canyonlands National Park (Utah) and Mount Saint Helens National Volcanic Monument (Washington).

If I had more time I would …

…learn new languages as well as more basic principles in math, physics, and chemistry. In college, one is taught vast amounts of material without being briefed on their utility or importance. Now I wish I had paid more attention. ●

Recently Tenured

LAUFEY AMUNDADOTTIR, NCI-DCEG

SONJA BERNDT, NCI-DCEG

JOSÉ FARALDO-GÓMEZ, NHLBI

SAMER HATTAR, NIMH

SANDRA LYNN WOLIN, NCI-CCR

LAUFEY THORA AMUNDADOTTIR, PH.D., NCI-DCEG

Senior Investigator, Laboratory of Translational Genomics, Division of Cancer Epidemiology and Genetics, National Cancer Institute

Education: University of Iceland, Reykjavik, Iceland (B.S. in biology; fourth-year degree in genetics); Georgetown University, Washington, D.C. (Ph.D. in cell biology)

Training: Postdoctoral fellow in the laboratory of Philip Leder, Department of Genetics, Harvard Medical School (Boston)

Before coming to NIH: Division head, Department of Cancer Genetics, deCODE Genetics (Reykjavik; 1998–2006)

Came to NIH: In 2007 as a senior scientist in NCI-DCEG's Cancer Genomics Research Laboratory; became tenure-track investigator in the Laboratory of Translational Genomics in 2008

Selected professional activities: Co-leader for PanScan and the Pancreatic Cancer Cohort Consortium; Co-chair, Pancreatic Cancer Interest Group (PCIG), NCI; Steering Committee member, Center of Excellence in Integrative Cancer Biology and Genomics, NCI

Outside interests: Traveling with her family; hiking; camping; reading

Website: https://irp.nih.gov/pi/laufey-amundadottir

Research interests: Pancreatic cancer is one of the leading causes of cancer mortality in the United States. It is often diagnosed at an advanced stage, contributing to a dismal survival rate. My research focuses on the interface between gene-mapping and the function of inherited pancreatic-cancer risk variants.

I co-lead gene-mapping approaches within the Pancreatic Cancer Cohort Consortium, which is in the framework of the NCI Cohort Consortium. One of the approaches I co-lead is PanScan, a genome-wide association study (GWAS) of pancreatic cancer. We collaborate with national and international consortiums to identify genetic factors that contribute to the risk of pancreatic cancer. Our GWAS includes close to 12,000 cases and 17,000 control subjects from more than 30 cohort and case-control studies from the United States, Europe, and Asia. Our GWAS has led to the discovery of 23 common susceptibility signals for pancreatic cancer. Further GWAS phases, as well as studies aimed at uncovering less common and rare pancreatic-cancer risk variants, are underway.

My laboratory is also working toward explaining the underlying biology of pancreatic-cancer susceptibility variants. Our research involves fine-mapping of risk loci identified in PanScan, collaborative gene-mapping efforts, and multiple genomic and wet-lab approaches. Some of those approaches are targeted at investigating specific risk loci whereas others are tailored to the analysis of multiple risk loci simultaneously. Our aim is to identify functional variants and their target genes at each locus and uncover the mechanisms by which they influence pancreatic-cancer risk.

SONJA BERNDT, PHARM.D., PH.D., NCI-DCEG

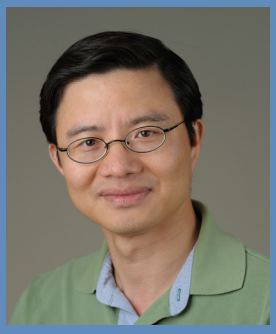
Senior Investigator, Occupational and Environmental Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute

Education: Dartmouth College, Hanover, N.H. (A.B. in English literature); University of Michigan, Ann Arbor, Mich. (Pharm.D.); Johns Hopkins University, Baltimore (Ph.D. in epidemiology)

Training: Cancer Research Training Award (CRTA) fellow, Occupational and Environmental Epidemiology Branch, NCI-DCEG; research fellow, Occupational and Environmental Epidemiology Branch, NCI-DCEG

Came to NIH: In 2003 as a CRTA fellow in NCI while still in Ph.D. program; became research fellow in 2007, tenure-track investigator in 2009, and senior investigator in 2017

Selected professional activities: Editorial boards of *Environmental and Molecular Mutagenesis* and of *Cancer, Epidemiology, Biomarkers, and Prevention*



JINFANG (JEFF) ZHU, NIAID

Outside interests: Spending time with her children; horseback riding; hiking; reading
Website: https://irp.nih.gov/pi/sonja-berndt

Research interests: As a genetic and molecular epidemiologist, I have primarily focused on using cutting-edge statistical methods to elucidate the genetic underpinnings of cancer and related conditions. I am also exploring other molecular biomarkers to further understand the complex etiology of cancer. My training in genetics and epidemiology, combined with my knowledge of statistics and pharmacology, has allowed me to integrate and merge knowledge from different disciplines to pursue a broad range of important scientific projects.

From my early days as a predoctoral fellow at NCI, I have been interested in discovering the genetic determinants of prostate-cancer risk. I began my research at NCI by conducting candidate-gene studies but quickly realized the need for a more general approach as well as large sample sizes. I have co-led and collaborated on multiple genome-wide association studies (GWAS) collaborations, which have identified more than 100 genetic loci associated with cancer risk. Together these genetic variants explain approximately 33 percent of the familial risk in populations of European ancestry. But many questions remain, such as how these genetic variants interact with environmental exposures and how they may be used to inform and predict cancer risk in the context of screening. I am exploring these and other questions in my research.

As part of the Genetic Investigation of Anthropometric Traits (GIANT) Consortium, which is an international consortium of investigators interested in anthropometric traits (such as body-mass index), I am studying genetic variants related to obesity and height. I co-led several large-scale meta-analysis GWAS identifying multiple loci for height and body-mass index and elucidating some of the underlying biological pathways behind these quantitative traits. There is still much that can be learned, however, from studying these traits. I am currently exploring the contribution of height, which may serve as a marker of increased exposure to growth hormones; other factors that stimulate cell growth and proliferation; and the role of adiposity in cancer risk.

In my non-Hodgkin lymphoma (NHL) research, I am trying to identify genetic loci associated with different NHL subtypes, such as follicular lymphoma and chronic lymphocytic leukemia (CLL). I co-lead a large GWAS for NHL, which currently includes more than 9,000 cases from 22 studies of people of European ancestry. This effort has led to the discovery of 27 new genetic variants associated with specific subtypes of NHL, more than doubling the number of identified loci for NHL, and the identification of a key role for apoptosis in CLL susceptibility.

Although some regions of the genome were shown to harbor variants associated with susceptibility to more than one NHL subtype, most discovered loci were subtype-specific, suggesting substantial etiologic heterogeneity among subtypes. I am currently expanding this study and hope to further elucidate the genetic architecture of NHL.

JOSÉ FARALDO-GÓMEZ, PH.D., NHLBI

Senior Investigator, Theoretical Molecular Biophysics Section, Biochemistry and Biophysics Center, National Heart, Lung, and Blood Institute

Education: Universidad Autónoma de Madrid, Madrid, Spain (B.Sc. in physics); University of Oxford, Oxford, England (Ph.D. in computational molecular biophysics)
Training: Postdoctoral training in Department of Physiology and Biophysics at Weill Cornell Medical College (New York); postdoctoral training in Department of Biochemistry and Molecular Biology at University of Chicago (Chicago)
Before coming to NIH: Max-Planck Research Group Leader at the Max Planck Institute of Biophysics (Frankfurt, Germany)
Came to NIH: In 2013 as tenure-track principal investigator in NHLBI
Selected professional activities: Associate editor, *The Journal of General Physiology*; editorial board member, *Biophysical Journal*
Outside interests: Sailing; playing tennis
Website: https://irp.nih.gov/pi/jose-faraldo-gomez

Research interests: The aim of my research program is to help elucidate the structural mechanisms of biomedically important molecular systems associated with cellular membranes. We are particularly interested in systems that are involved in transmembrane transport, signaling, and energy conversion.

Membrane proteins mediate many essential processes in living cells, such as the import and metabolism of nutrients and the transmission of chemical signals between and within cells. A wide range of human health disorders, from heart disease to neurodegeneration, are associated with the malfunction of membrane-associated systems. Membrane-transport proteins are also crucial for the survival of

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multidrug-resistant pathogenic bacteria and cancer cells and are promising pharmaceutical targets. A detailed understanding of the molecular mechanisms of these fascinating systems will eventually facilitate the design of more effective pharmacological approaches.

Our investigations rely primarily on computationally intensive, physics-based molecular simulations and related theoretical methods. This approach enables us to formulate novel mechanistic hypotheses and interpretations of existing empirical data, which in turn guide the design of new experimental work. Our theoretical studies are often carried out in synergy with experimental collaborators, both at NIH and elsewhere, particularly in the areas of structural biology, biochemistry, and molecular biophysics.

On the methodological front, we are actively involved in the development and implementation of novel approaches to extract reliable thermodynamic and mechanistic information from molecular simulations.

SAMER HATTAR, PH.D., NIMH

Chief and Senior Investigator, Section on Light and Circadian Rhythms, National Institute of Mental Health

Education: Yarmouk University, Irbid, Jordan (B.S. in biology, minor in chemistry); American University of Beirut, Beirut, Lebanon (M.S. in biochemistry); University of Houston, Houston (Ph.D. in biochemistry)

Training: Postdoctoral fellow, Department of Neuroscience, The Johns Hopkins University (JHU)–School of Medicine (Baltimore)

Before coming to NIH: Associate professor, Department of Biology and joint appointment: Department of Neuroscience, JHU, and JHU–School of Medicine

Came to NIH: In 2017

Selected professional activities: Elected vice chair for the 2019 Gordon Conference on Chronobiology and chair for 2021; editorial board of the *Journal of Biological Rhythms*; elected secretary for the Society of Research on Biological Rhythms (2014–2016)

Outside interests: Watching and playing soccer; traveling to our treasured national parks; enjoying good food and company

Website: https://www.nimh.nih.gov/labs-at-nimh/principal-investigators/samer-hattar.shtml

Research interests: For many years, it was assumed that rods and cones were the only photoreceptors capable of detecting light in the mammalian retina. However, research from several laboratories uncovered a third type of photoreceptor cell, called intrinsically photosensitive retinal ganglion cells (ipRGCs). They express their own photopigment called melanopsin. My lab's main goals are to understand how ipRGCs detect light and send light information to the brain to regulate physiology and behavior.

We have shown that ipRGCs target many of the brain's visual centers, including the circadian pacemaker and the area responsible for pupil constriction, and are critical for the influence of light on circadian rhythms, sleep, mood, and pupil constriction. Recently we found that ipRGCs are more abundant than previously appreciated and that there are at least five different subtypes. Some of these subtypes target regions of the brain involved in image formation and allow mice that lack rod and cone function to have rudimentary pattern vision. In addition, we have found that ipRGCs also mediate the negative effects of light on mood and learning and enhance the ability to detect contrast in an image.

Many questions still remain about the function of these cells and the circuits that are critical for ipRGC-mediated behaviors. We are continuing our explorations using a variety of techniques including mouse genetics, anatomy, in vivo calcium imaging, viral-circuit tracing, and animal behavior.

SANDRA LYNN WOLIN, M.D., PH.D., NCI-CCR

Senior Investigator and Chief, RNA Biology Laboratory, Center for Cancer Research, National Cancer Institute

Education: Princeton University, Princeton, N.J. (A.B. in biochemical sciences); Yale School of Medicine, New Haven, Conn. (M.D.); Yale University, New Haven, Conn. (Ph.D. in molecular biophysics and biochemistry)

Training: Postdoctoral training at the University of California, San Francisco (San Francisco)

Before coming to NIH: Director, Yale Center for RNA Science and Medicine; Professor of Cell Biology and Molecular Biophysics and Biochemistry, Yale School of Medicine

Came to NIH: In 2017

Selected professional activities: Fellow of the American Association for the Advancement of Science and of the American Academy of Microbiology; editorial board of the *RNA Journal*; associate editor, *Molecular Biology of the Cell*

Outside interests: Hiking with her husband; gardening; enjoying her artist son's work

Website: https://irp.nih.gov/pi/sandra-wolin

Research interests: Most transcripts in cells do not encode proteins; instead, most RNAs are noncoding. My laboratory studies how noncoding RNAs function, how cells recognize and degrade defective RNAs, and how the failure to degrade these RNAs affects cell function and contributes to human disease.

One pathway that we study involves noncoding RNA–protein complexes known as Ro60 ribonucleoproteins (RNPs). These RNPs were discovered because they are

clinically important targets of the immune system in people with the disease systemic lupus erythematosus. RNP's major protein component, the ring-shaped Ro60 autoantigen, is present in most animal cells, some archaea, and about five percent of bacteria. In all studied organisms, Ro60 binds noncoding RNAs called Y RNAs. By studying Ro60 RNPs in bacteria, we discovered that the Ro60 protein and Y RNA are complexed with a ring-shaped nuclease, forming a double-ringed machine specialized for structured RNA degradation. Interestingly, Ro60 contributes to the survival of mammalian cells and some bacteria in the presence of stresses, such as ultraviolet light, that damage nucleic acids. We are defining this new RNA-degradation machine in mechanistic detail and uncovering additional roles for Ro60 and Y RNAs in both mammalian cells and bacteria.

We recently discovered a new RNA-surveillance pathway in mammalian cells. In this work, we collaborated with researchers at the University of Michigan (Ann Arbor, Mich.) to study how retroviruses such as the human immunodeficiency virus type 1 assemble in the cytoplasm of infected cells. It has long been known that retroviruses package their own genomes into virions as well as encapsidate specific cellular noncoding RNAs. We discovered that retroviruses package these host-cell RNAs from a previously unknown pathway in which defective and unneeded newly made RNAs are exported to the cytoplasm for degradation. We are characterizing this new RNA-surveillance pathway in molecular detail and are also determining how the packaged RNAs contribute to retrovirus replication.

If you have been recently tenured, *The NIH Catalyst* will be in touch with you soon to do an article about you on these pages.

JINFANG (JEFF) ZHU, PH.D., NIAID

Senior Investigator, Molecular and Cellular Immunoregulation Section, Laboratory of Immunology, National Institute of Allergy and Infectious Diseases

Education: Nankai University, Tianjin, China (B.S. in biochemistry); Shanghai Institute of Biochemistry (now Shanghai Institute of Biochemistry and Cell Biology), Chinese Academy of Sciences, Shanghai, China (Ph.D. in biochemistry and molecular biology)

Training: Visiting fellow, Laboratory of Immunology, NIAID

Came to NIH: In 1998 as visiting fellow in NIAID; in 2002 became staff scientist; in 2011, became a Stadtman Investigator in the Molecular and Cellular Immunoregulation Unit, Laboratory of Immunology, NIAID

Selected professional activities: Review editor, *Frontiers in Immunology*; editorial board, *Journal of Interferon and Cytokine Research*; editorial board, *Cellular and Molecular Immunology*

Outside interests: Listening to music; playing pingpong; swimming; hiking

Website: https://irp.nih.gov/pi/jinfang-zhu

Research interests: My lab is investigating the heterogeneity and plasticity of immune cells and their functions during normal and pathological immune responses at the cellular and molecular levels. In particular, we are focusing on transcriptional regulation in CD4 T-helper (Th) cells and innate lymphoid cells (ILCs) as well as the relationship between these adaptive and innate lymphocyte subsets.

CD4 T cells—including regulatory T cells (Tregs) and effector Th cells—and recently identified ILCs play important roles in host defense and inflammation. Both CD4 T cells and ILCs can be classified into distinct lineages based on their functions and the expression of lineage-specific genes, including those that encode effector cytokines, cell-surface markers, and key transcription factors. Appropriate differentiation and activation of these lymphocytes are essential for mounting different types of immune responses to various microorganisms. Inappropriate responses to pathogens may lead to chronic infection and/or tissue damage to the host.

Similarly, unnecessary activation of ILCs and Th cells by harmless environmental or host-derived factors can cause autoimmune diseases or allergic inflammatory diseases.

The differentiation and development of Th cell and ILC subsets are regulated by specific transcription-factor networks. Some of the master regulators of Th and ILC lineages have been identified, but emerging data suggest that there are many more critical transcription factors in the regulatory network that are critical for T-cell and ILC fate determination and function.

In our research, we are identifying lineage-specific genes in Th and ILC subsets, some of which may serve as biomarkers and/or targets for treating specific human diseases. To understand the mechanisms of transcriptional regulation of lineage-specific genes, we also use chromatin immunoprecipitation followed by high-throughput sequencing to assess genome-wide epigenetic modifications in different cell types, including cells from genetically modified mice, and to map DNA-binding sites for key transcription factors.

A complete understanding of how transcription-factor complexes are regulated and how they precisely control Th and ILC cell heterogeneity, plasticity, and stability has great implications for designing strategies to treat a broad range of immune-related diseases, including chronic bacterial and viral infections such as human immunodeficiency virus infection, autoimmune diseases, allergic diseases, and cancers. ●

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Also, we welcome "letters to the editor" for publication and your reactions to anything on the *Catalyst* pages.

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PHOTOGRAPHIC MOMENT

Total Eclipse of the Sun

While most NIHers enjoyed seeing a *partial* solar eclipse on August 21, 2017, **James Yang** had a spectacular view of the *total* solar eclipse in Newberry, South Carolina. Yang, an astronomy buff as well as an amateur photographer, took this photo using a Nikon D800 on an equatorially mounted five-inch refractor telescope. He put a homemade Mylar sun filter over the lens and removed it at totality. The camera was programed to take one image a second.

JAMES YANG, NCI

"It was great to be with so many people—you heard the entire town react at the same instant when the last light disappeared," said Yang. "For those who have never seen totality, 100 percent is very, very different than even 99 percent. As the last pinpoint of light is about to disappear, you can see atmospheric turbulence sharply projected on the ground by the point light source, and the light seems to move like the surface of the ocean."

Yang, a senior investigator in the National Cancer Institute's Surgery Branch, focuses on the immune response to tumor-associated antigens. He conducts clinical and scientific studies of T-cell adoptive therapy and other immunotherapies to treat melanoma as well as renal, lung, and pancreatic cancers. See more photos online at https://irp.nih.gov/catalyst/v25i5/ photographic-moment.

The NIH Catalyst is published bimonthly for and by the intramural scientists at NIH.

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