



2017

THE ROCKEFELLER UNIVERSITY

Annual Report

The Rockefeller University is dedicated to improving human health through transformative discoveries and advanced education in the life sciences.

Each of our **81** laboratories is led by a Rockefeller scientist who reports directly to the president. We have **9** broad areas of research, but **0** formal departments and a lean administration with minimal bureaucracy.

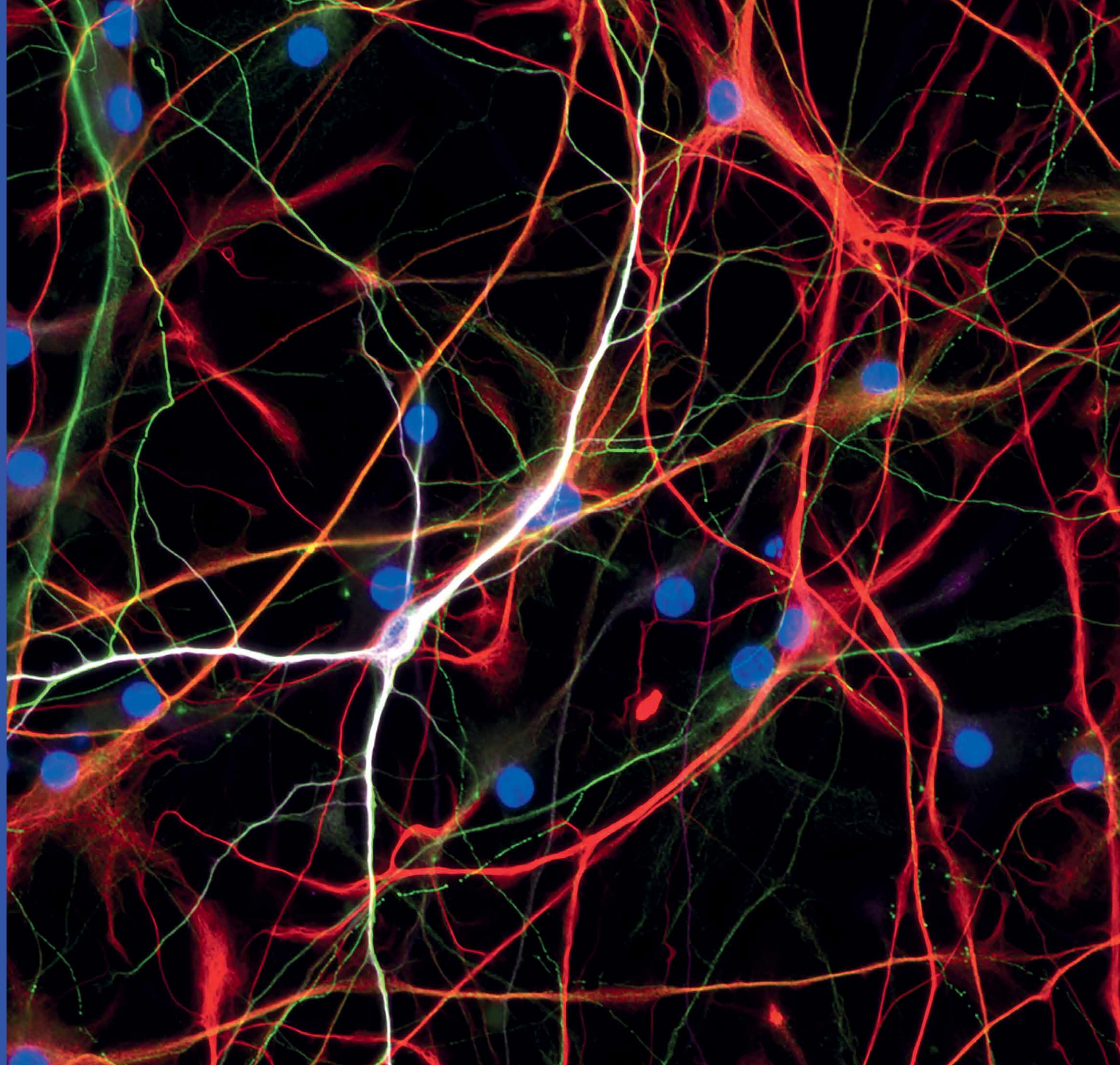
We are a vibrant, collaborative scientific community of approximately **200** graduate students, **325** postdocs, and **1,325** research and support staff.

Our **14**-acre campus on Manhattan's Upper East Side is the site of **481,000** square feet of lab space, as well as faculty and administrative offices, event facilities, and housing.

Rockefeller scientists have won **24** Nobel Prizes since our founding in 1901. **43** percent of our current faculty are members of the prestigious National Academy of Sciences.

We are a modern, thriving institution: We have an annual research budget of over **\$225** million and have invested over **\$2** billion in new facilities, scientific equipment, faculty recruitment, and research support since 2005.

Our graduate program attracts exceptional Ph.D. students from around the world. They pay **\$0** in tuition.



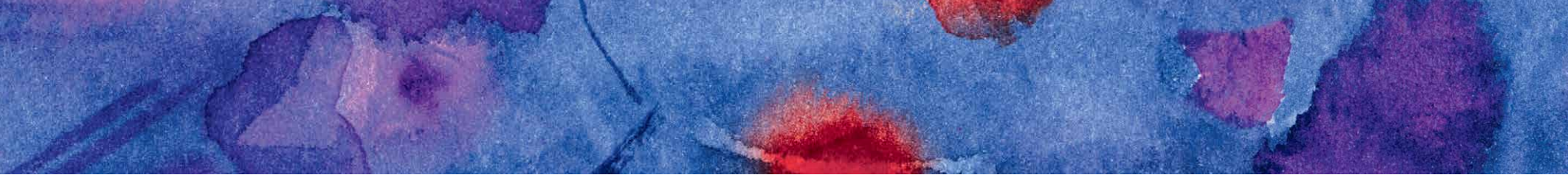
A microscopic image of cells, likely from a human embryo, showing various stages of development. The cells are stained with red and purple dyes, highlighting different structures and components. The background is a deep blue, and the overall image has a textured, almost painterly quality.

ABOUT ROCKEFELLER

Our one and only mission: Bioscience

Beneath every medical breakthrough is a fundamental discovery about how life works. At Rockefeller, we specialize in discovery. We explore the tissues, cells, genes, proteins, molecules, and atoms that make up living beings. And our findings are the foundation of tomorrow's medicine.

A human embryo's earliest moments, captured for the first time in culture, are teaching scientists about how life begins and what goes wrong during miscarriage.




“At Rockefeller, curiosity is
justification enough to perform
high-risk experiments.”

KIVANÇ BIRSOY
Chapman Perelman Assistant Professor



All organisms need food. To understand metabolism—the process by which that food is turned into energy—we need to understand a complex network of genes that directs it, adjusting the process to meet the needs of the larger organism. For Rockefeller geneticist **Kivanç Birsoy** (left), this is an area rich with potential. Intervening in the metabolic process could, for instance, starve cancer cells before they grow into tumors. All we need to do is follow the genes.



HIV, like other viruses, has no reproductive machinery of its own—to survive, it must infiltrate its host's cells. Genetic “tagging” techniques have allowed researchers to visualize HIV's activity during the critical moments when it first infects a healthy cell.

OUR PEOPLE

Independent in spirit, united in purpose

A Rockefeller laboratory is a scientific colony unto itself. Our faculty members lead small teams of researchers—graduate students, postdocs, and technical staff—in a quest to reveal the inner workings of life. They have tremendous autonomy to conduct research on their own terms as well as the opportunity to collaborate closely with peers.



For humans, the ability to form and recall memories is what gives meaning to existence. **Priya Rajasethupathy** wants to know how molecules and neural circuits interact to store and retrieve information. Since any single memory can involve thousands of individual neurons, it's an ambitious pursuit. But she's made a key breakthrough, finding that some of these neurons serve as hubs, routing signals to the hippocampus where memories are stored. By studying the hubs, and the genes that control them, she's beginning to uncover mechanisms behind memory disorders.

“Immersion among brilliant scientists and access to state-of-the-art tools are critical to the process of discovery. Rockefeller provides both.”

PRIYA RAJASETHUPATHY
Jonathan M. Nelson Family Assistant Professor

The fruit fly is widely used in the sciences. Its short life span, simple behavior, and easily manipulated genome makes it an ideal subject for neuroscientists.

OUR LEADERS

Here, scientists drive

Our 81 heads of laboratories are leaders in their fields. So are their leaders. Rockefeller's top administrators, including our president and scientific vice presidents, all maintain active, vibrant research programs. They know exactly what it takes to keep a lab going.




“There’s a clarity of purpose
that’s evident at Rockefeller—
an exclusive focus on science for
the benefit of humanity that
doesn’t exist at other institutions.”

RICHARD P. LIFTON
President
Professor

Although he’s best known for his discovery of a link between salt and high blood pressure, **Richard P. Lifton’s** research isn’t about hypertension. It’s about the use of genetics to solve biological mysteries of all kinds—and about the power of basic science to improve our lives. Rick’s commitment to this mission, which he first adopted as an undergraduate student at Dartmouth, eventually led him to Rockefeller, where he not only pursues research into the mutations that underlie disease but also leads an institution that has spent 116 years conducting basic science in the pursuit of medical cures. As the university’s president since September, Rick’s most important job is to ensure Rockefeller scientists have the resources and support they need to do their work.





To understand life at its most basic level, you need to proceed atom by atom. Recent breakthroughs allow scientists to visualize the chemistry underlying individual proteins, and to build medicines from the ground up.

OUR EDUCATIONAL PROGRAMS

Exceptional science, exceptional students

Without students and trainees, little would occur at Rockefeller. It's their energy and curiosity that bring new knowledge to light. Our educational programs strive to equip students with the tools they need to make amazing discoveries, and become world leaders in science, industry, and policy.

“Rockefeller is singular in its ability to simultaneously challenge and support its students. It’s this balance that allows us to reach our full potential.”

MEGAN ELIZABETH KELLEY
Graduate Student



Some students join Rockefeller with a firm plan, right down to the mentor they'll work with and the thesis they'll write; others prefer to explore. At Rockefeller, both paths are encouraged. **Megan Elizabeth Kelley's** explorations took her through several labs, as well as to a special microscopy class off campus, and through a rotation with a new faculty member from Austria who hadn't even arrived yet. She ended up working on cell division, one of the most fundamental processes of life. As a second-year student in Tarun Kapoor's laboratory, she studies the structural reorganization that takes place in cells as they divide, a process that often goes awry in diseases such as cancer.

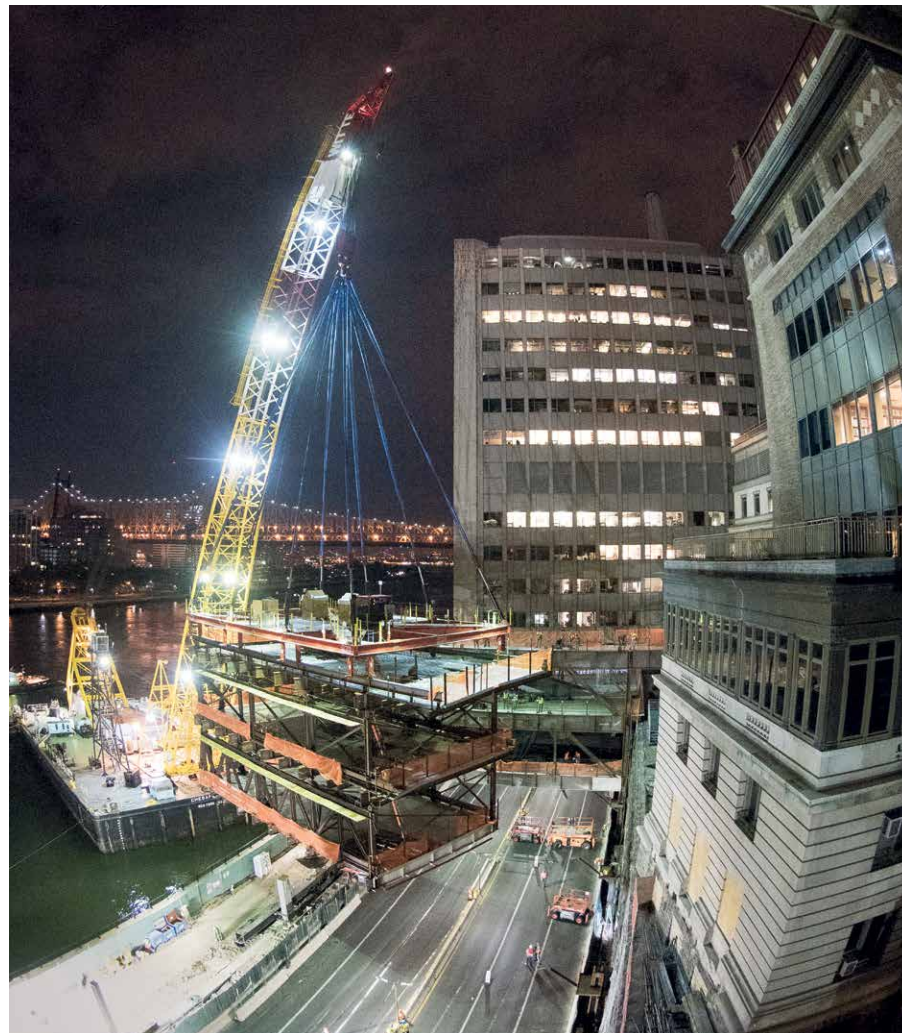


Architecture can have a profound impact on the way scientists work. By providing open spaces, ample seating, and visual connections between floors, our newest buildings encourage their occupants to think, communicate, and build relationships with their neighbors.

OUR CAMPUS

An environment that inspires

Our lush, leafy campus is an ideal place for quiet contemplation, and our laboratory buildings buzz with energy. Dramatic artwork and breathtaking views, as well as proximity to the world's best cultural institutions, help stimulate scientific thought.



In 2019, Rockefeller will open 160,000 square feet of new, open-plan laboratory space. The labs will provide well-equipped, modern facilities for the university's scientists. But they will also serve a second function, creating new land where previously there was none. The university's footprint will grow by nearly two acres when the project—the **Stavros Niarchos–David Rockefeller River Campus**—is complete, thanks to a campus extension going up just above the FDR Drive, a busy urban highway. Last summer, prefabricated modules making up the project's steel superstructure were placed using a 1,000-ton barge-mounted crane.

“Investments in our infrastructure are crucial. Our goal is to create an environment that not only meets our scientists’ technical needs, but also serves as a source of inspiration.”

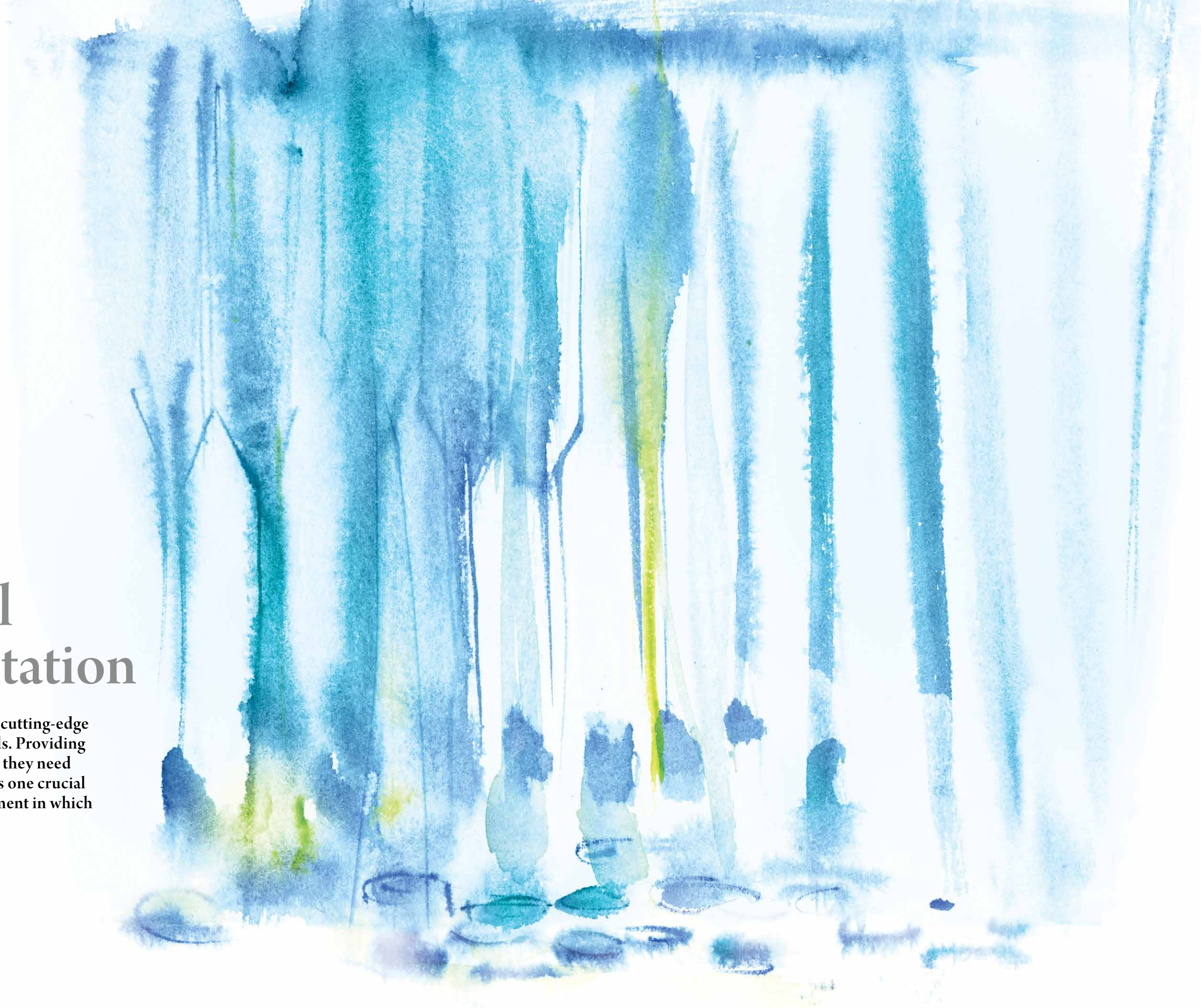
TIMOTHY P. O’CONNOR
Executive Vice President


Automation has played a key role in making the practice of science more efficient. For biochemists, robots with hundreds of liquid-dispensing tubes are capable of testing tens of thousands of chemical compounds in a single day.

OUR TECHNOLOGY

Instrumental instrumentation

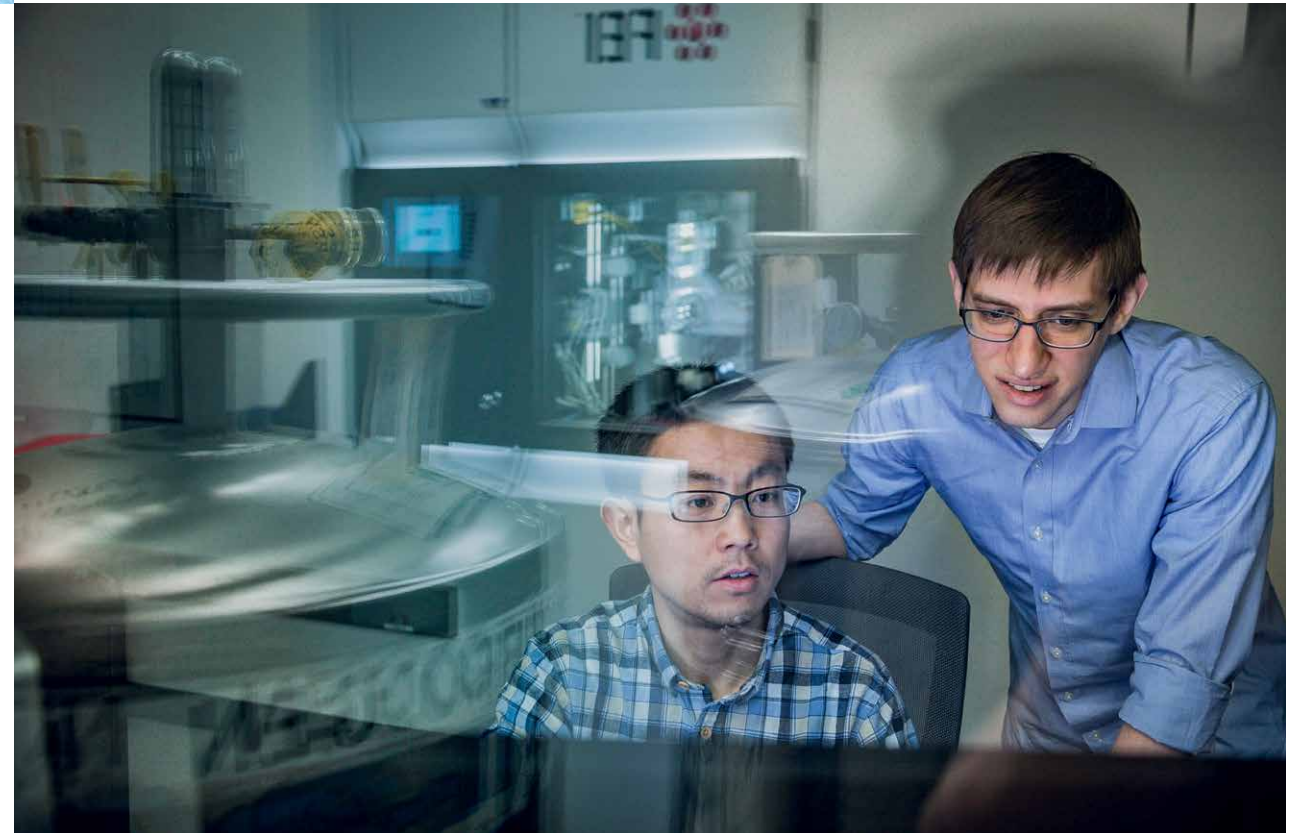
From microscopes to sequencers, cutting-edge biology requires cutting-edge tools. Providing our scientists with the technology they need to conduct pathbreaking science is one crucial way we work to create an environment in which modern science can flourish.





“The world-class cryo-electron microscopy facility is a major reason I came to Rockefeller. This technology allows me to do things I wouldn’t be able to do any other way.”

GREGORY M. ALUSHIN
Assistant Professor



For structural biologists, resolution is everything. In their quest to understand the machinations of biology at the level of individual atoms, they need to focus on objects just a few millionths of a millimeter in size. Rockefeller’s **two cryo-electron microscopes** use extremely cold temperatures to lock specimens in a state that closely mimics their native environment, and advanced cameras and software to visualize the structures of intricate protein complexes. The technology is cracking open molecular mysteries that many thought would never be solved.

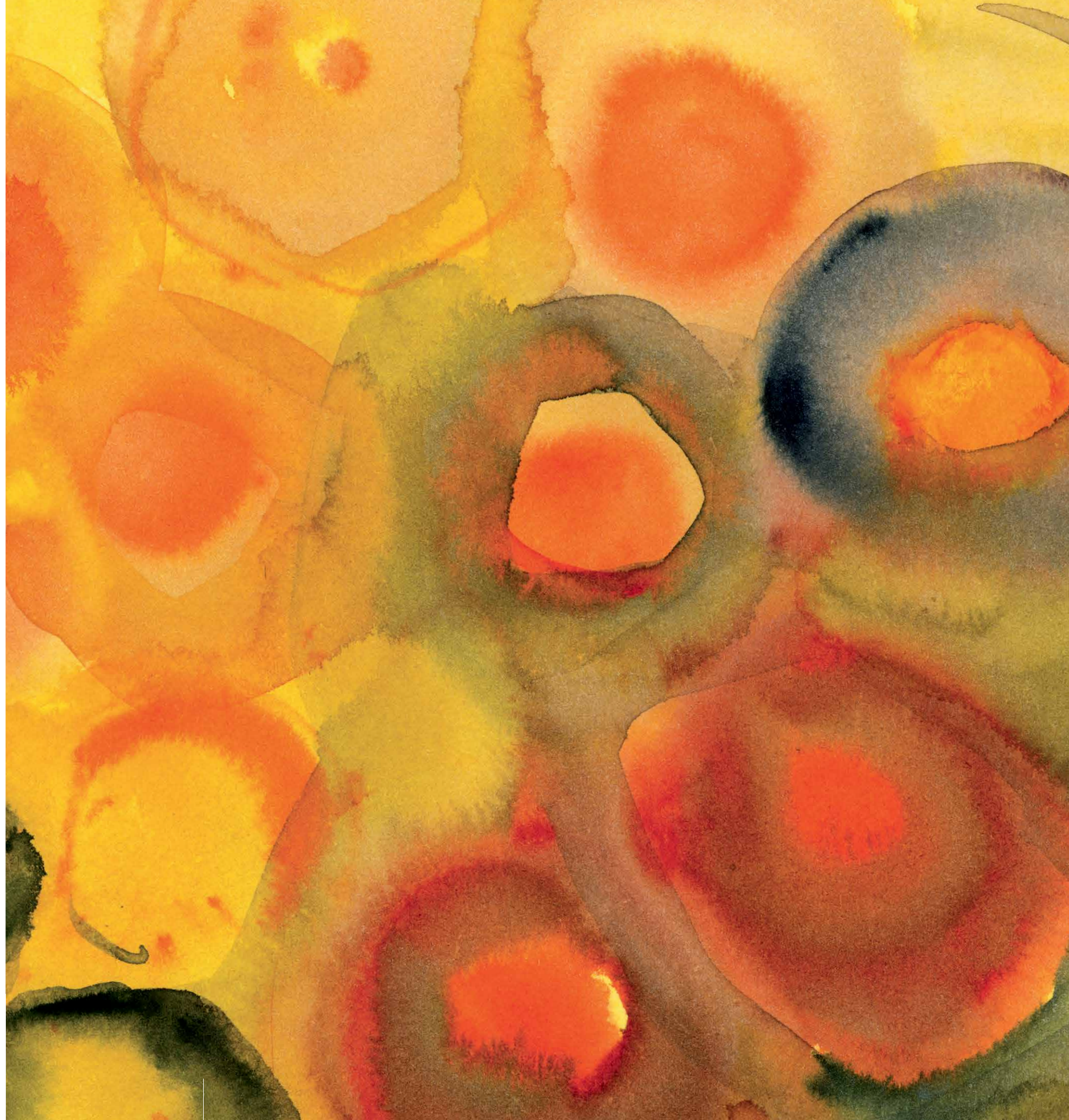
For **Gregory M. Alushin** (right), it’s helping answer questions about how cells generate and respond to mechanical forces by using tiny chains of repeating proteins known as actin filaments. Because exposure to mechanical forces can cause cells to change their behavior, understanding the role of these filaments could shed light on a variety of diseases, including cancer, muscular dystrophy, and developmental disorders.

Much of what we have learned about our own cells—how they divide, grow, and multiply—comes from studying yeast. Scientists commonly use fluorescent tags and genetic modifications to study what happens in the cell cycle when certain proteins are missing.

OUR LEGACY

116 years of excellence

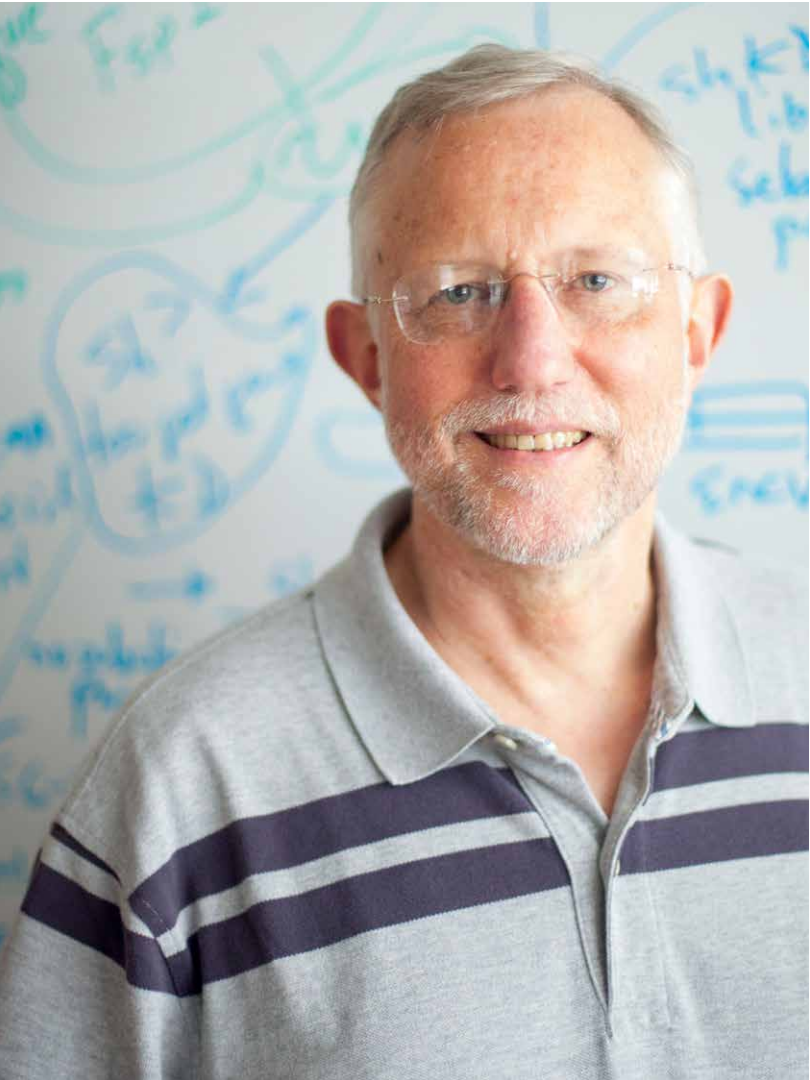
From our earliest days—when our focus was on infectious disease—to the advances in genomics, neuroscience, and immunotherapies that have defined twenty-first century bioscience, Rockefeller science has consistently led the world. We've cured disease, founded new fields of research, and picked up 24 Nobel Prizes and 22 Lasker Awards along the way.

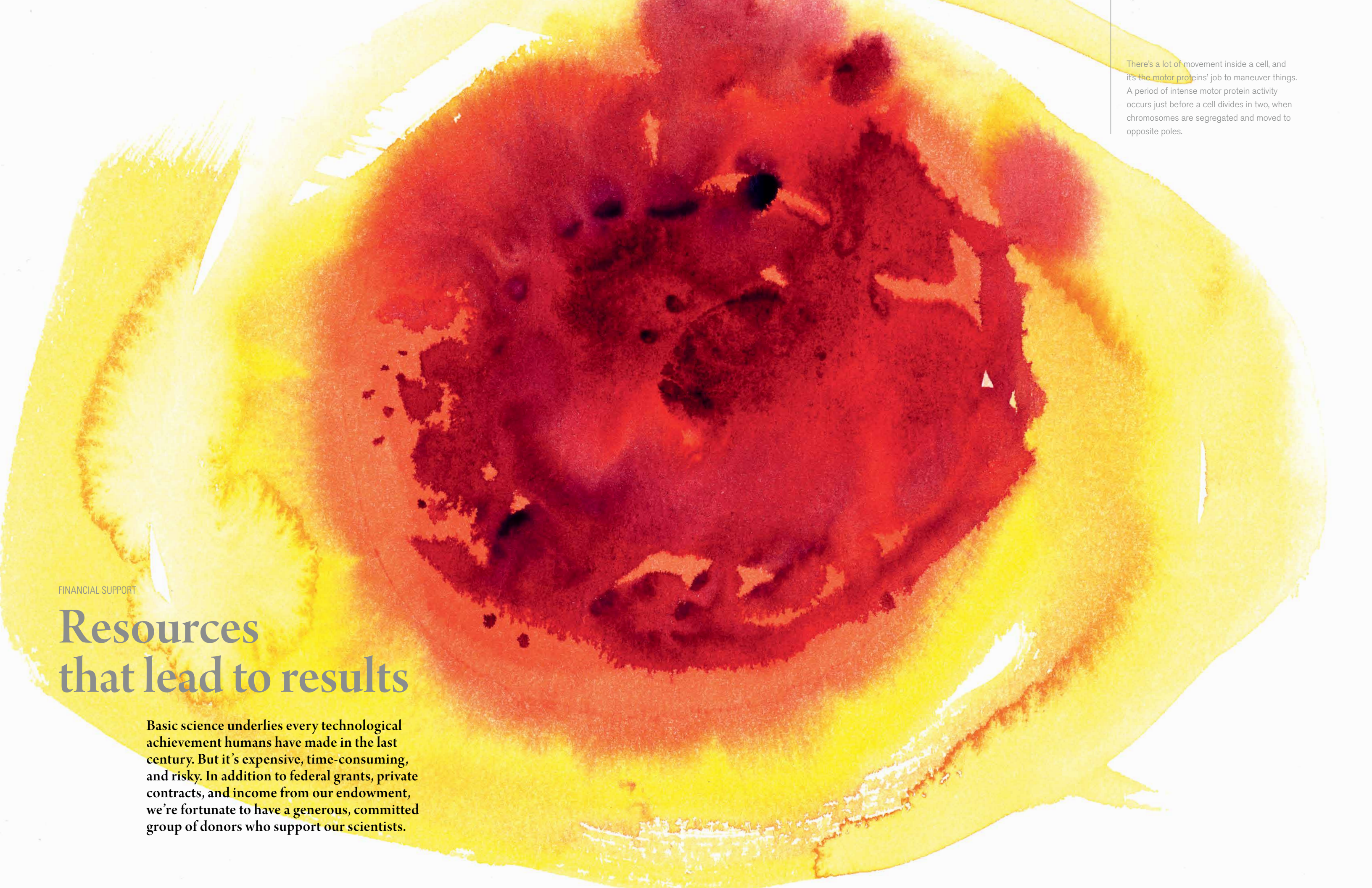


“No one knows when or where the next global health threat will emerge. Only with continued investment in basic science will we make progress against disease.”

CHARLES M. RICE
Maurice R. and Corinne P. Greenburg Professor in Virology

Before you can cure a disease, you must be able to study it. **Charles M. Rice**, who works on hepatitis C, spent years trying to coax the virus to replicate in the laboratory to create a platform for testing possible therapies. When he and his collaborators finally succeeded, the rest of the pieces quickly fell into place, and by 2013 the first truly effective hepatitis C drug had hit the market. Charlie's achievement—for which he was awarded the 2016 Lasker-DeBakey Clinical Medical Research Award, the country's most prestigious science prize—means some 170 million people finally have a cure for their disease.





There's a lot of movement inside a cell, and it's the motor proteins' job to maneuver things. A period of intense motor protein activity occurs just before a cell divides in two, when chromosomes are segregated and moved to opposite poles.

FINANCIAL SUPPORT

Resources that lead to results

Basic science underlies every technological achievement humans have made in the last century. But it's expensive, time-consuming, and risky. In addition to federal grants, private contracts, and income from our endowment, we're fortunate to have a generous, committed group of donors who support our scientists.



A particularly vulnerable time in any scientist's career comes several years into their appointment, after startup funds have been spent. **Joelle Kayden**, the daughter of two physician-scientists, understands this problem better than most. A \$7 million gift she directed to the university from the Jensam Foundation, named for her grandparents, provides the opportunity for Rockefeller laboratory heads to receive a substantial influx of new funding—\$250,000 each—upon their promotion to associate professor. The new initiative, named the Gabrielle H. Reem and Herbert J. Kayden Early-Career Innovation Award in honor of Joelle's parents, gives promising young scientists a much-needed boost, and helps encourage highly innovative research that would not qualify for support from conventional funding sources.

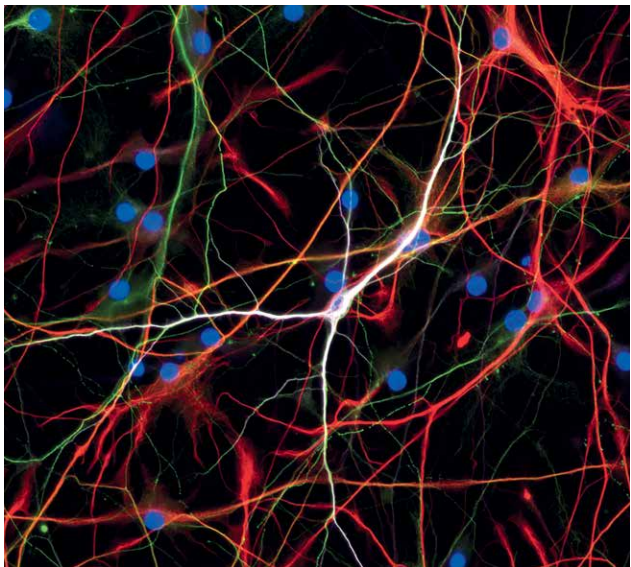
“My gift, which honors my late parents, is an investment in science, but each award is also an investment in a brilliant young scientist during a critical stage in his or her career.”

JOELLE KAYDEN

Founder and Managing Member, Accolade Partners

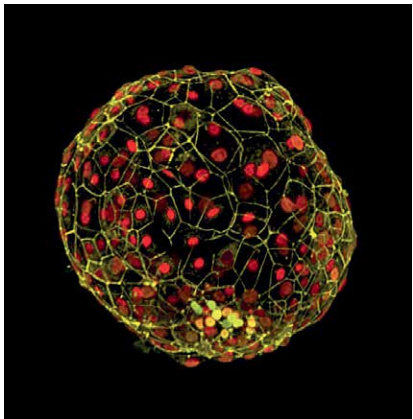
Member, The Rockefeller University Council

Science is full of beauty. The artwork used throughout this book has been inspired by discoveries made in Rockefeller laboratories in 2016. The artist, Deborah Ross, is best known for her paintings of wildlife.



▲ COVER

Researchers in **Marc Tessier-Lavigne's** laboratory use human neurons, derived from stem cells, to study dementia in the lab. With gene-editing technology, they created cells that closely resemble those found in Alzheimer's disease—cellular models that can be used to better study debilitating brain disorders.

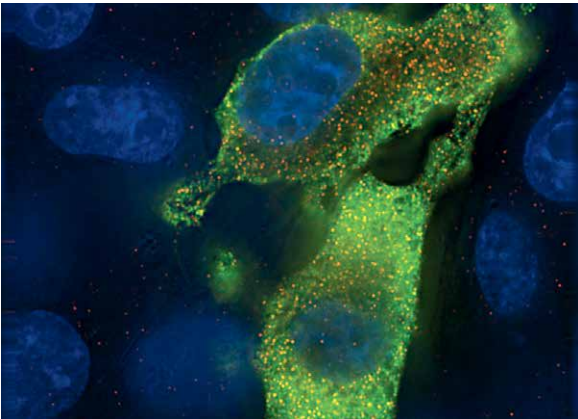


▲ ABOUT ROCKEFELLER, PAGE 2

By borrowing a technique first developed in mice, **Ali H. Brivanlou** successfully coaxed human embryos to grow in culture for 14 days after fertilization, a breakthrough that has allowed his team to study the very earliest stages of human life from an entirely new perspective.

▼ OUR PEOPLE, PAGE 6

To study how HIV infects its host cell—crucial knowledge needed to develop effective therapies—scientists must be able to see, step by step, when individual proteins become active. Using a new tagging technique, **Mark Muesing**, **Michael P. Rout**, and **Brian T. Chait** were able to identify previously unknown proteins that are directly involved in infectious processes.



▲ OUR LEADERS, PAGE 10

How do fruit flies make decisions? Although some of their behaviors are innate, others can change based on experiences they have. An experiment in **Vanessa Ruta's** lab, in which flies were exposed to positive and negative stimuli, found that a common brain chemical, dopamine, reroutes messages within the brain to vary the flies' reactions.

▼ OUR EDUCATIONAL PROGRAMS, PAGE 14

Structural biologists have a powerful new tool at their disposal: **cryo-electron microscopy**. By freezing samples at extremely cold temperatures, rather than fixing them with chemicals, the technology uses sophisticated sensors and processing software to generate very high-resolution images, even down to the scale of single atoms.



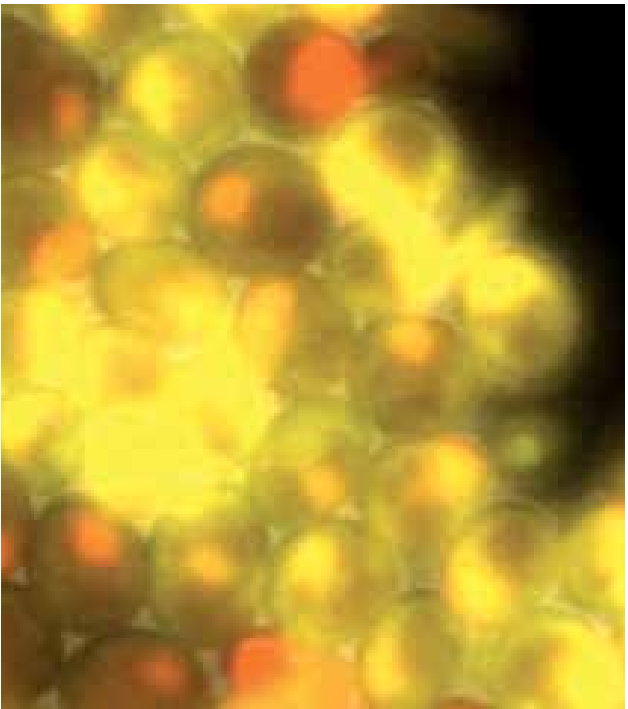
▼ OUR TECHNOLOGY, PAGE 22

In Rockefeller's **High Throughput Screening Resource Center**, robots help test biologic samples against libraries of nearly 300,000 compounds, flagging any that show reactions. Identifying therapeutically active substances is a crucial tool for basic science, and a key step in the drug discovery chain.



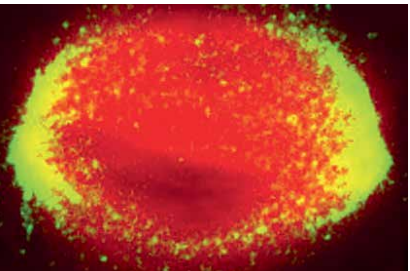
▲ OUR CAMPUS, PAGE 18

The university's **Collaborative Research Center**, built in 2012, houses nearly a third of our laboratories. Its centerpiece is a seven-story glass atrium, which provides ample space for individuals and small groups to congregate.



▲ OUR LEGACY, PAGE 26

Timing is critical for cells undergoing division, and a group of proteins known as cyclins are the official timekeepers. It's a fact that **Frederick R. Cross** confirmed with an experiment showing that cells lacking cyclins completely fail to execute the division cycle—refuting work that suggested oscillations in gene expression might play a key role.



▲ FINANCIAL SUPPORT, PAGE 30

Although scientists have a pretty good handle on the molecular biology underlying cell division, they know little about the mechanics of it. Using lasers, a team led by **Tarun Kapoor** tracked the activity of the structural microtubules that align chromosomes, finding that the force they apply is a function of their overlap with one another—a perfect mechanism for keeping the whole structure in balance.



DAVID ROCKEFELLER (1915–2017)

Seventy-six years ago, when David Rockefeller joined the Board of The Rockefeller Institute for Medical Research, the era of modern biology was just beginning. DNA had recently been discovered, and the invention of the electron microscope was starting to crack open long-held cellular secrets.

The institution was poised to make great discoveries, and David, together with President Detlev Bronk, embarked on a bold period of reinvention to capitalize on the momentum. It was a historic period for Rockefeller, resulting in a new educational mission, a newly remodeled campus, and new sources of funding. With David as chairman of the Board, and Bronk as president, the modern Rockefeller University took shape.

David remained actively involved with Rockefeller for the rest of his life. He served as chairman until 1975, and remained an active member of the community, attending Board meetings as well as concerts, lectures, and other events, well into his 90s. His impact on the institution that bears his name is immeasurable, and his spirit will live on in every scientific advance made in the university's laboratories and in every young scientist who earns a Rockefeller Ph.D.

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