



UNLOCKING
THE SECRETS
OF SCIENCE

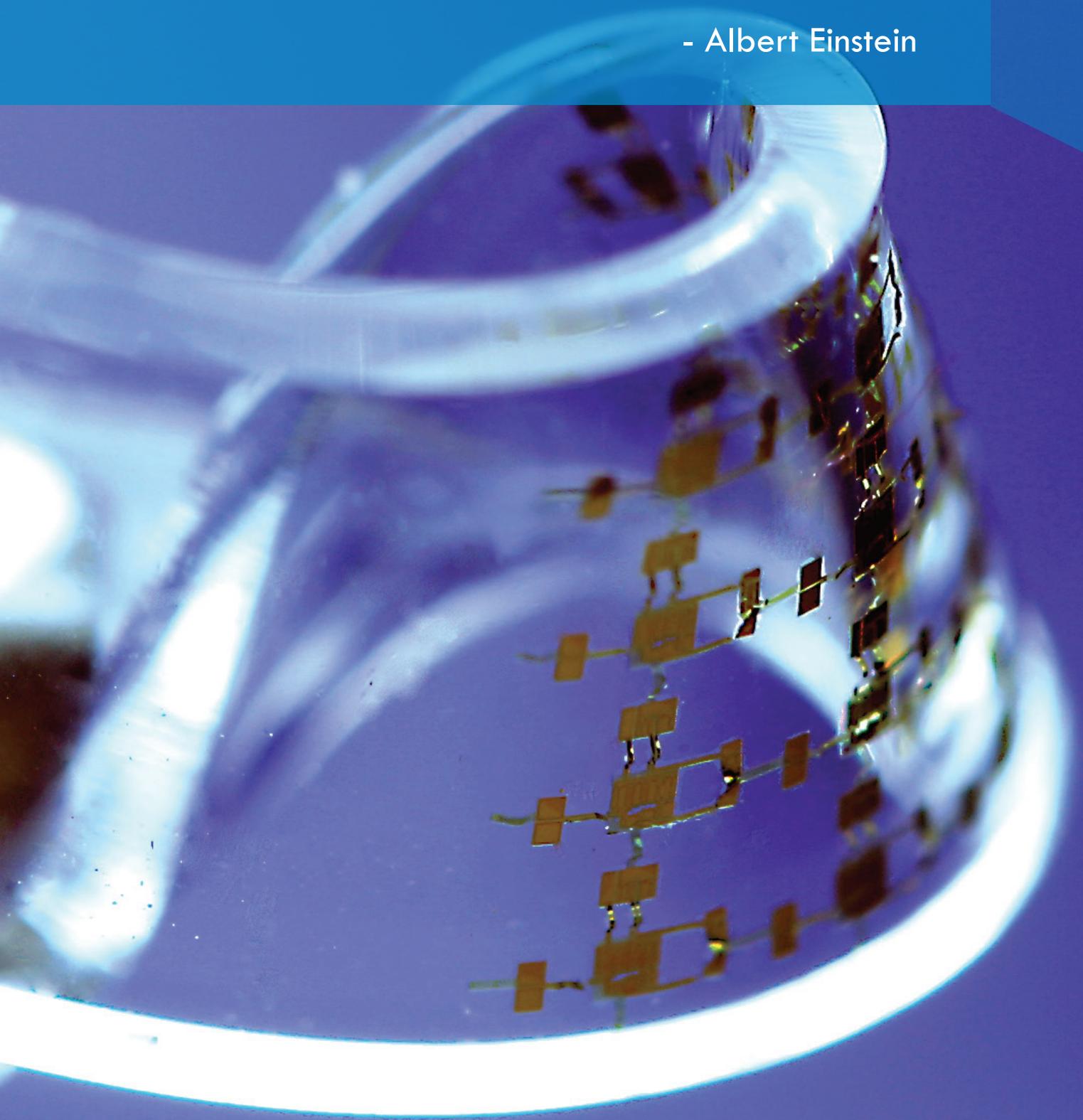
WHERE DISCOVERIES BEGIN



National Science Foundation

All our science, measured against reality, is primitive and childlike—and yet it is the most precious thing we have.

- Albert Einstein



Unlocking the Secrets of Science

Every scientific discovery travels its own path from inspiration to success. Such breakthroughs have expanded our understanding of the world in which we live, led to life-saving medical advances, enhanced our national security, improved our everyday lives and yielded insights into the creation of the universe. The simple truth about fundamental scientific research is that before these discoveries were found, no one knew they were there. Such research takes time, inspiration, hard work – and timely funding support. The National Science Foundation (NSF) provides resources that help scientific researchers carry out their vital work. We are proud to be known as the nation’s key for unlocking the secrets of science.

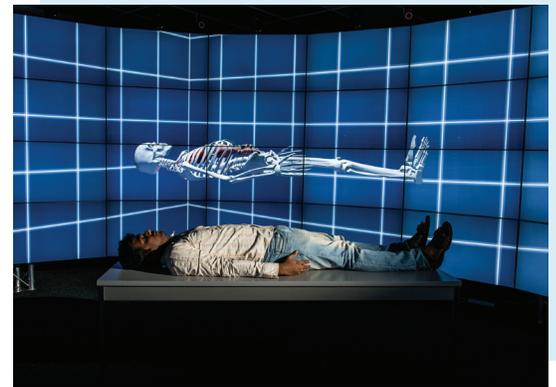
The economic impact of our support has been profound. With timely financial support, an inspired idea has the opportunity to move from fundamental research to applied research and, ultimately, into the marketplace. This proven template has led to innumerable scientific discoveries that have created millions of jobs, made our economy more competitive, improved our health, strengthened our security and underpinned our entire standard of living.

Our Broad-Based Mission

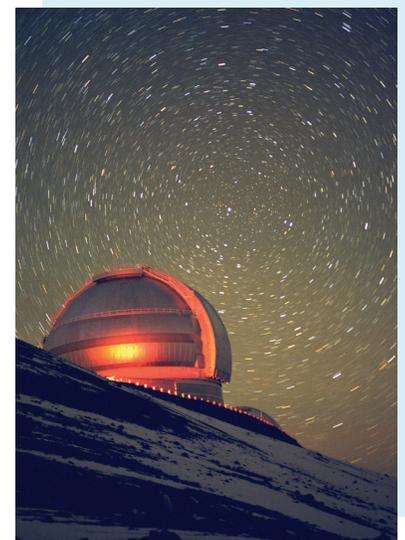
As the nation’s fundamental research funding agency, NSF is unique. Our mission is as broad as science itself. We support all fields of fundamental science and engineering (S&E), keeping our nation’s scientific enterprise focused on the furthest frontiers of research.

Our mandate includes biological science; computer and information science; education and human resources; engineering; geoscience; mathematical and physical science; and social, behavioral and economic science; as well as interdisciplinary research among these fields. We recognize and nurture emerging fields; encourage the most insightful ideas; and prepare future generations of scientists and engineers.

Each year, NSF awards thousands of grants that collectively advance America’s scientific capabilities and engage the talents of hundreds of thousands of researchers, postdoctoral fellows, trainees, teachers and students in every field of S&E. Collectively, NSF-funded researchers have won more than 200 Nobel Prizes for their work in the fields of chemistry, economics, physics and physiology and medicine. Because of this comprehensive commitment to science, NSF has helped keep our nation at the forefront of the S&E research and education enterprise for more than six decades.



State-of-the-art virtual reality systems provide keys to medical discoveries and diagnoses.



The Gemini North Observatory’s advanced optic system helps astronomers study the universe with unprecedented clarity.



Antarctic researchers explore shifts in Adelie penguin populations.

Our Time-Tested Methodology

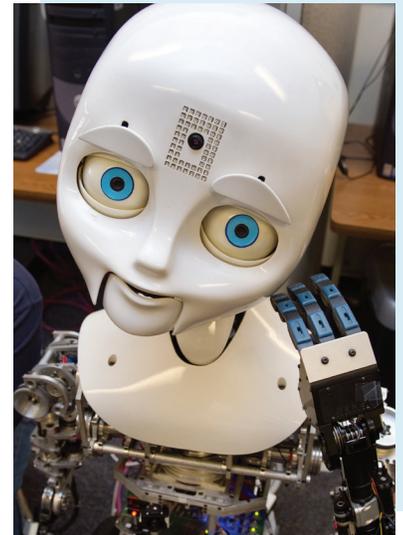
NSF's merit review process is widely regarded as the gold standard of scientific review and has been emulated in scientific communities around the world. Proposals submitted to NSF are subjected to a rigorous evaluation process to ensure that each proposal supported by the agency meets the highest standards in terms of intellectual merit and potential impact on society. On average, about 50,000 experts participate in the merit review process, sharing the benefit of their expertise and generously giving their time to serve on review panels each year.

NSF is the primary source of federal funding for non-medical basic research, providing approximately 12,000 new awards annually. Competition for funding is intense, with only about one out of five proposals ultimately being approved. The preponderance of NSF support is allocated as grants or cooperative agreements to individual researchers and groups at colleges, universities, academic consortia and small businesses.

NSF helps maintain America's position as the global leader in producing highest quality science on the cutting edge of discovery.



Bringing innovative technologies into the marketplace, industrial lasers use advanced manufacturing techniques.



Robot Nexi helps scientists identify human cues that define trustworthiness.

Through a variety of venues, NSF cultivates a world-class, diverse S&E workforce that is prepared to contribute to emerging scientific, engineering and technological fields. By integrating research and education, we help prepare researchers and technicians in industries whose discipline and skill make technological breakthroughs possible. The agency also continually develops a growing cadre of knowledgeable teachers across the country to educate the next generation of technicians in science, technology, engineering and mathematics (STEM) fields. Moreover, NSF augments the nation's research capabilities through investments in advanced instrumentation and facilities.

Our Real-World Impact

The strides of the last century demonstrate that scientific and technological leadership remains essential to our national well-being, economic growth and security. NSF's investments in S&E research, education and infrastructure strongly advance the creation of new knowledge, promote prosperity through job creation and technological innovation and target complex societal problems such as environmental sustainability, biomedical technology and natural hazards mitigation.

Through its support of basic research, NSF focuses the nation's technical talent on solving the grand challenges facing our technologically advanced society. The agency fosters critical investment efforts as part of our nation's larger research and development portfolio, including work in advanced manufacturing, cyberinfrastructure design and cybersecurity, nanotechnology and sustainability.

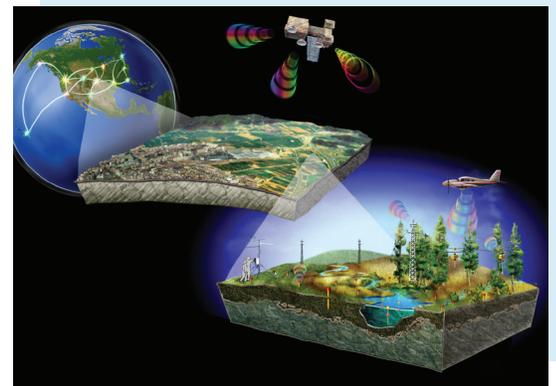
As a result of these efforts, NSF has catalyzed the development of innovative ideas in S&E and supported the people who generate them.

The discoveries that have resulted touch our lives every day. These are the products of a tradition that has, as a matter of national policy, fostered the discovery and development of new sciences and technologies.

For many years, NSF's research and education initiatives have been a vital investment in our country's future. They will continue to be a critical factor in maintaining the nation's technological leadership throughout the 21st century and will broadly impact world-wide economic vitality.



The Ocean Observatories Initiative will accelerate progress toward managing our ocean environment.



The National Ecological Observatory Network will collect environmental and ecological data from 60 U.S. sites.



NSF support provides laboratory opportunities for pre-service teachers to pursue cutting-edge research.

**NSF focuses the nation's technical talent
on solving grand challenges
facing modern society.**

Our Commitment to Meeting National Needs

For 60 years, NSF investments in fundamental research have fueled scientific, technological and engineering innovation. They have fostered long-term economic growth, educated the next generation of scientists and engineers and directly addressed national needs.

From supporting the fundamental discoveries that led to lasers, advanced manufacturing, Internet protocols and automated systems, NSF funding has been crucial for technological leaps that have improved health care, automotive safety, communications and many other technologies that impact our daily lives. The examples here, a few of many, epitomize the many advances supported by NSF that directly affect our everyday lives.



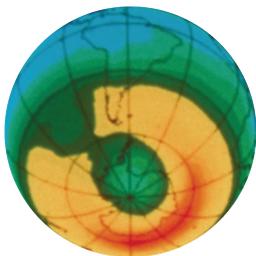
3-D Printing

One of the first practical 3-D printers was patented by NSF-funded researchers at MIT in 1993. Unlike earlier attempts, their machine had evolved to create objects made of plastic, ceramic and metal. The MIT-inspired 3-D printers are now in use all over the world by the aerospace, architecture, automotive, construction, engineering and medical industries. The technology has evolved not only to include the ability to print in full color, but the first affordable, simple-to-use, home 3-D printers are now available. This consumer friendly printer, which utilizes the original NSF-supported technology, has received both an American Technology Award for outstanding achievement in Technology Manufacturing and a Popular Mechanics 2012 Breakthrough Award for the first 3-D printer designed for the consumer.



Barcodes

NSF-funded research helped perfect the accuracy of scanners to read barcodes in order to speed shoppers' check-outs and track consumer buying trends. Information gleaned from barcodes helps all industries—from supermarkets to airlines—by determining what products are marketed and, sometimes more importantly, how, to whom and for what price goods are sold. More recently, the Department of Veterans Affairs (VA) implemented barcode, point-of-care in its facilities, cutting overall hospital medication error rates by up to 70 percent.



Closing the Ozone Hole

Within months of the first reports that chlorofluorocarbons might be damaging the world's protective layer of stratospheric ozone, NSF delivered sensors to Antarctica to measure ozone loss. In the U.S. alone, protecting our planet's stratospheric ozone will produce \$4.2 trillion in health benefits and prevent 6.3 million deaths from skin cancer from 1990 to 2165, according to the Environmental Protection Agency.



Any Device Anywhere

As part of its start-up funding, Qualcomm received a Small Business Innovation Research award from NSF. Over 21,000 employees and 170 locations later, this company has forever changed the face of digital wireless telecommunications products and services. Qualcomm is now worth more than \$100 billion.



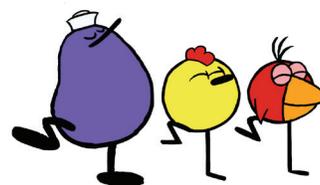
Safer Sutures and Surgeries

Infections at surgical incision sites are one of the most common post-surgical complications, keeping patients hospitalized longer and hospital bills higher. Responding to an urgent need for better antibacterial coatings on surgical sutures, NSF-supported scientists discovered a new coating that is almost 1,000 times more effective than the most widely used commercial coating.



Airwave Auctions

Since their inception in 1994, Federal Communications Commission spectrum auctions have raised more than \$60 billion for the U.S. Treasury. Research supported by NSF underpins the system to apportion airwaves, which is now emulated in several other countries.



Peep's Big Wide World

The animated series "PEEP and the Big Wide World" gives wings to the innovative idea of teaching science to preschoolers. Wry and distinctive visual humor, charming plotlines and the lovable characters Peep, Chirp and Quack, combine with a comprehensive science program to attract and engage kids three to five years old. Winners of both Emmy and Parent's Choice Awards, "PEEP" reaches millions of children each season, teaching them basic science concepts and skills like measuring, comparing and estimating.

Future Scientists and Engineers



NSF's Graduate Research Fellowship Program has supported more than 45,800 of the best and brightest scientists and engineers at a formative stage in their career since 1952. More than 40 fellows selected by NSF have become Nobel Laureates and more than 440 have become members of the National Academy of Sciences. Seventy percent of fellows go on to get their

doctorates—providing valuable intellectual capacity to our world-renowned research universities and high-tech industries.



Just Google It

In the 1990s, NSF led the multi-agency Digital Library Initiative (DLI) that funded research into the burgeoning field of accessible interfaces for net-based data collections. Two Stanford University grad students – Larry Page and Sergey Brin – worked on the DLI project, constructing an ambitious search engine prototype they called BackRub. (During this period, Brin was supported by an NSF Graduate Student Fellowship.) The rest, as they say, is history. Worth more than \$200 billion today, Google is an Internet powerhouse employing more than 30,000 people.



Plant Genomes Seed Tomorrow's Agriculture

For many grocery shoppers, those perfect red tomatoes from the store just can't match the flavor from the home garden. Researchers recently decoded the gene that contributes to the home-grown taste of tomatoes. In fact, the entire genome of the tomato has been decoded, adding it to our library of other completed crop genomes such as corn, rice, soybean and wheat. Patiently studying the thousands of genes that make up a plant's DNA, scientists are now using this knowledge to develop crops that will grow faster, use less water, be more disease-resistant and better satisfy consumers' taste buds.



Saving the Bee

More than one-third of the world's fruits, vegetables and flowering plants are dependent on pollination by bees. All told, the pollination services provided by honeybees in North America are currently valued at about \$20 billion annually—not counting the value of honey and beeswax. Hence, when honeybee keepers reported 30 to 90 percent losses in their hives, NSF-funded researchers buzzed into action. The result: A hygienic bee now sold throughout the U.S. that decreases disease transmission and increases an entire colony's resistance to disease.

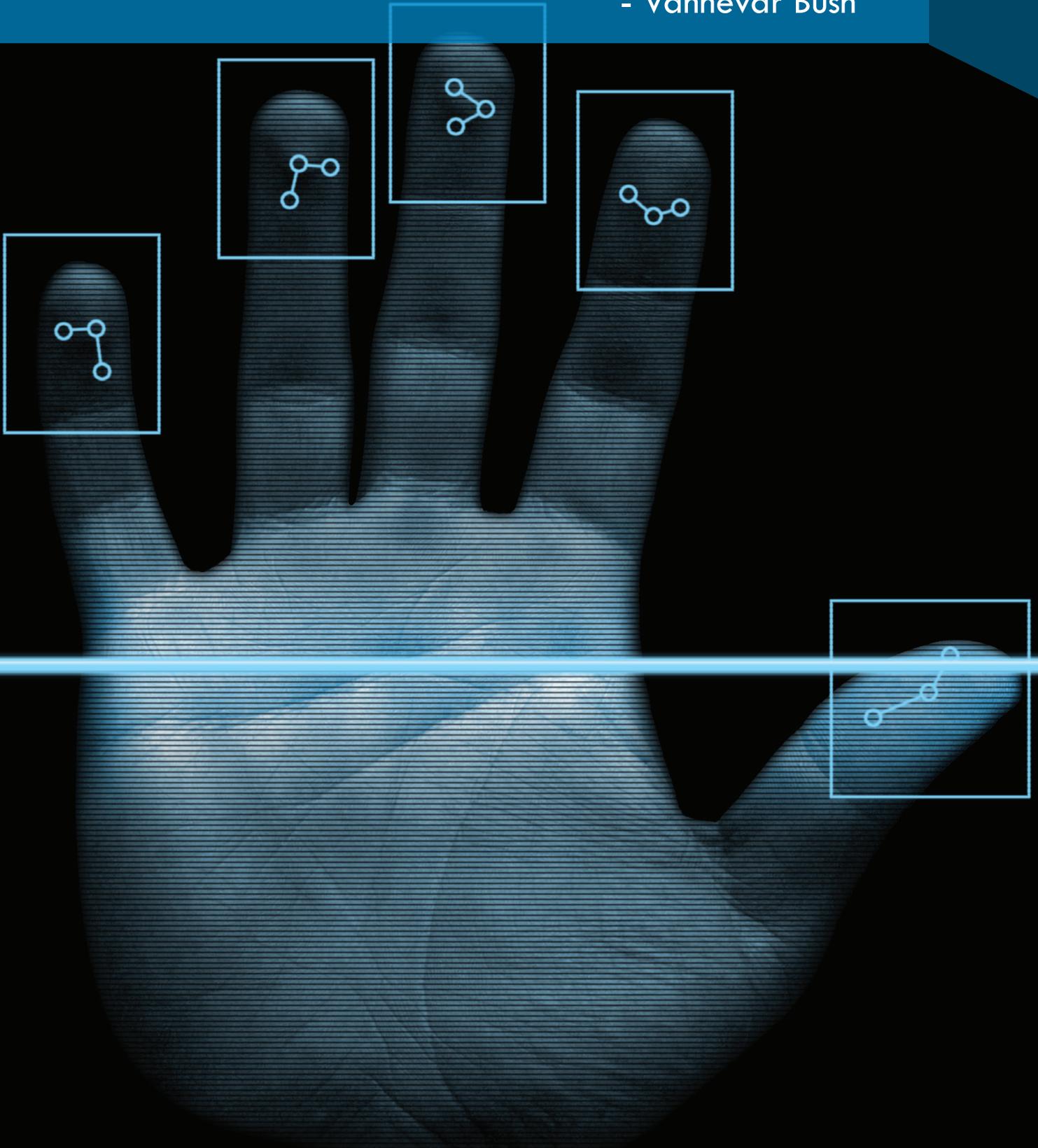


Building a Stronger Bulletproof Vest

Spider silk fibers combine enormous strength and elasticity. Scientists are unlocking the secrets of silk for a range of human applications, including surgical sutures, artificial ligaments and tendons, automotive air bags and even improved bulletproof vests. The ultimate goal: to give military and law enforcement lighter, more flexible and effective ballistic protection.

Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living and to our cultural progress.

- Vannevar Bush



More Ways

NSF Research Impacts Our Lives

The full story of NSF-funded technological breakthroughs is far more extensive than can be addressed in this brief brochure. The innovations we have helped develop have enriched people's lives and brought economic benefits in the billions of dollars. As we continue to responsibly invest in promising research and education, we will expand the possibilities for dramatic advances in all areas of S&E, adding to this partial list of other NSF-funded innovations that impact our lives.

American Sign Language dictionary
Anti-counterfeiting techniques
Anti-virus software
Artificial retinas
Biometric identification
Bionic limbs
Customized therapeutics and vaccines
DNA fingerprinting
Doppler radar
Driverless cars
Fiber optic cable
Improvised explosive device detection
The Internet
Laser eye surgery
Magnetic resonance imaging
Nanocrystals for solar cells
Radio-frequency identification
Search-and-rescue robots
Small business incubation
Smart concrete
Touchscreen technology application
Tracking and remediation of oil spills



Mobile Doppler radar gathers more precise data about severe weather events in near-real-time.



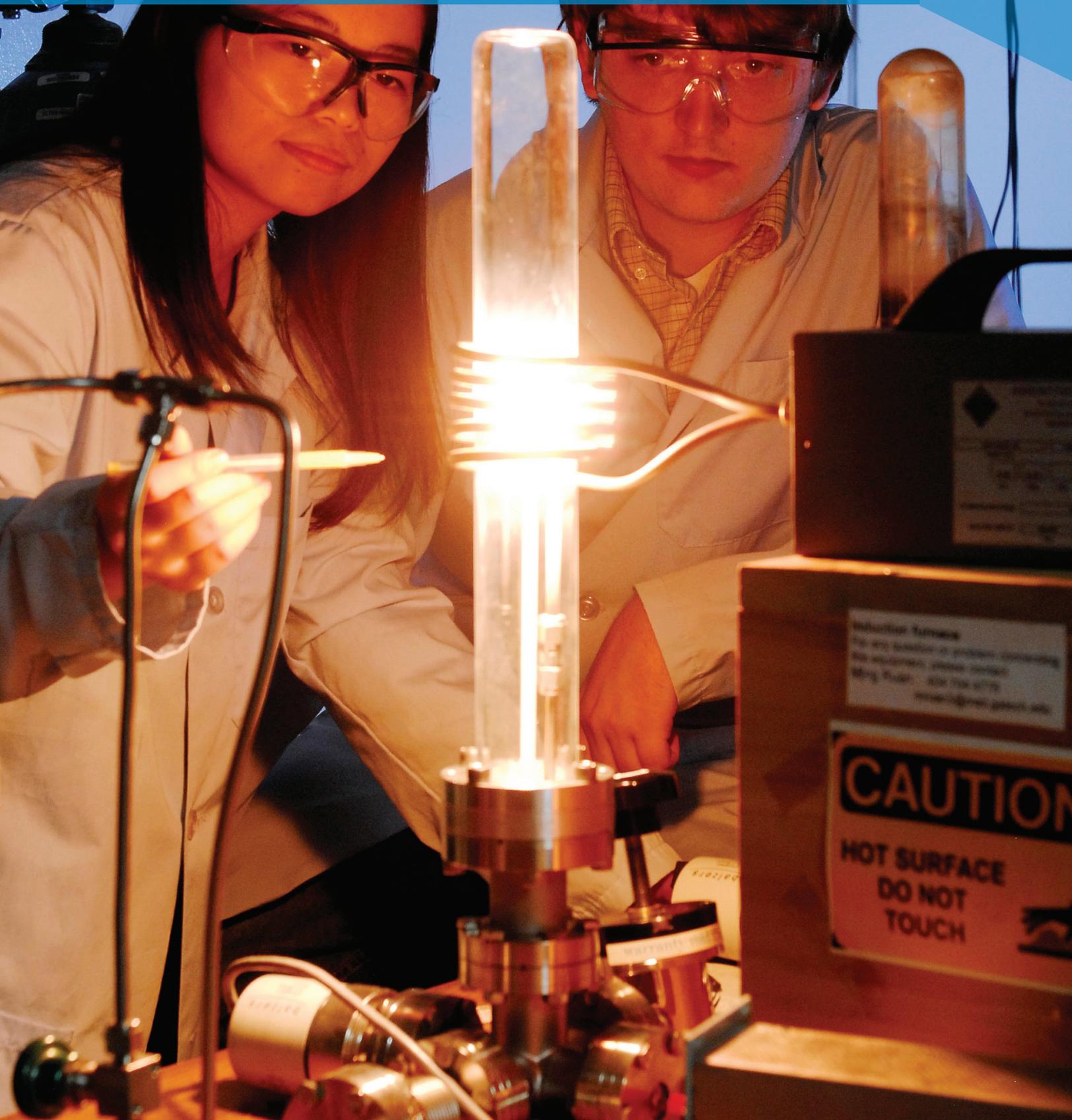
Magnetic resonance imaging (MRI) technology grew out of NSF-supported fundamental physics, mathematics and computer science research.



Using supercomputers from NSF's TeraGrid network, researchers simulated the movement of the Deepwater Horizon oil spill.

NSF's job is to keep science and engineering visionaries focused on the furthest frontier, recognize and nurture emerging fields, prepare the next generation of scientific talent and ensure all Americans understand what science and technology have to offer.

- Rita R. Colwell



NSF

at a Glance

NSF by the Numbers

\$8 billion

FY 2017 Budget Request

24 percent

NSF's share of total federal support for basic research conducted at academic institutions

12,000

Competitive awards funded by NSF in FY 2015

23 percent

Success rate of proposals submitted to NSF

49,600

Proposals evaluated in FY 2015 through competitive merit review

231,000

Number of proposal reviews in FY 2015

35,000

Number of experts who participated in the merit review process

1,859

Colleges, universities and other institutions in all U.S. states and territories receiving NSF funding in FY 2015

350,000

Number of people NSF supported directly in FY 2015 (researchers, postdoctoral fellows, trainees, teachers and students)

217

Number of Nobel Laureates supported by NSF

95 percent

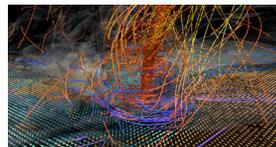
Proportion of NSF funding allocated through grants and cooperative agreements

National Science Foundation

is an independent federal agency that supports fundamental research and education across all fields of S&E. NSF is divided into seven directorates and one program office.



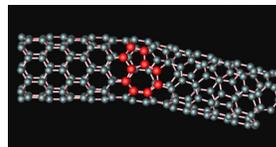
Biological Sciences



Computer & Information Science & Engineering



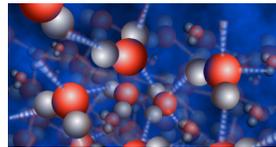
Education & Human Resources



Engineering



Geosciences



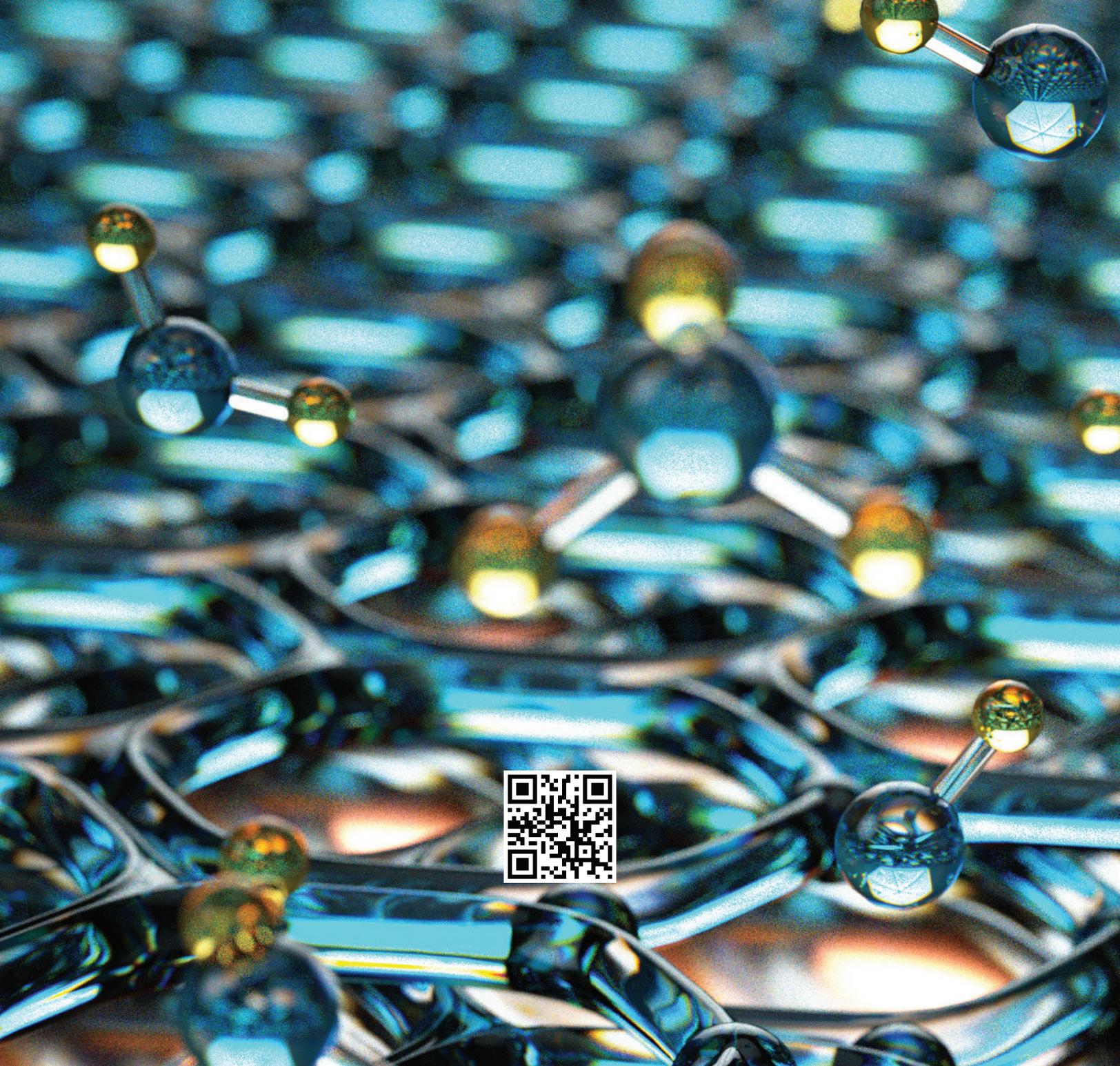
Mathematical & Physical Sciences



Social, Behavioral & Economic Sciences



International & Integrative Activities



NSF 13-079
Revised January 2015



National Science Foundation

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