THE FRANKLIN INSTITUTE *Awards* & CONVOCATION

APRIL 28–MAY 2, 2025

The 2025 Franklin Institute

AWARDS CONVOCATION

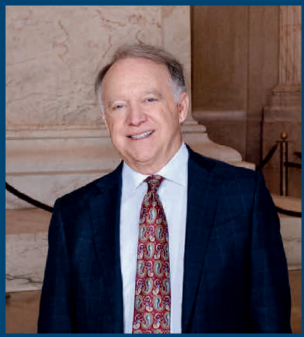
APRIL 28–MAY 2, 2025

Welcome to The Franklin Institute Awards, the oldest comprehensive science and technology awards program in the United States. It is an exciting time here at The Franklin Institute as we expand upon our 200-year journey of building relationships with our community around the importance of science and engineering, and sharing inspiring educational experiences with families, students, and adults from all over the world. We continue to celebrate the vital role that science and technology play in our lives, along with The Franklin Institute Awards Program's two-century legacy of honoring the most impactful discoveries and developments and those who have made them possible.

Since 1824, The Franklin Institute Awards has recognized more than 2,000 extraordinary individuals who have shaped our world through their groundbreaking contributions to science, engineering, and industry. This year, we are proud to add nine new laureates to this unparalleled league.

From miniaturizing electronics to designing materials for massive rockets, from transforming medical imaging to championing environmental restoration, and from capturing elusive biological processes to enabling the artificial intelligence revolution, this year's laureates each reflect Benjamin Franklin's trailblazing spirit. To honor them, we are pleased to present a series of in-person and hybrid events highlighting their stories and groundbreaking work. These programs provide the public with a special opportunity to interact with these remarkable individuals and learn about a broad range of scientific and engineering disciplines.

In this convocation book, you will find a schedule of events and biographies of this year's laureates. We invite you to read about them and attend the events to discover more. We think the members of our Class of 2025 will spark your curiosity as much as they have ours. We hope to see you, in person or online, to celebrate them and their astounding achievements.



Thomas J. Lynch

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Larry Dubinski

PRESIDENT AND CEO
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FOR MORE INFORMATION, CONTACT:

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www.fi.edu/awards

THE FRANKLIN INSTITUTE AWARDS

The Franklin Institute Awards dates back two centuries, to the first days of the Institute itself. When The Franklin Institute was founded in 1824 by a group of leading Philadelphians to train artisans and mechanics, Philadelphia was the largest city in the United States and the nation's innovation and manufacturing center. The same year, the Institute arranged the first of what became a series of regular exhibitions of manufactured goods. With the exhibitions came the presentation of awards—first certificates and later endowed medals—for technical achievement.

Since 1875, recipients have been selected by the Institute's Committee on Science and the Arts (CS&A), formerly known as the Committee on Inventions. This all-volunteer committee of distinguished scientists and engineers from academia and industry still selects recipients of the Benjamin Franklin Medals and NextGen Award, dedicated to their charge to recognize the world's most impactful advances in science and engineering.

> *Celebrating outstanding achievements in science and technology from around the world is an important way The Franklin Institute preserves Benjamin Franklin's legacy.*

In 1998, the Institute's long-standing endowed Awards Program was reorganized under the umbrella of the Benjamin Franklin Medals, presented in seven fields of science and engineering. The Bower Award for Business Leadership and the Bower Award and Prize for Achievement in Science were made possible by a bequest in 1988 from Philadelphia chemical manufacturer and philanthropist Henry Bower, the grandson of a 19th century Franklin Institute laureate. 2021 marked the launch of the Benjamin Franklin NextGen Award, the first new award to be established in more than 30 years, and the only award to specifically recognize young researchers whose work is proving transformational in their fields.

Through its Awards Program, The Franklin Institute seeks to provide public recognition and encouragement of excellence in science and technology. The list of Franklin Institute laureates virtually charts their advancement through the past two centuries—from the development of the typewriter to the dawn of quantum computing. The honor roll of more than 2,000 Franklin Institute Awards laureates includes Nikola Tesla, Marie and Pierre Curie, Rudolf Diesel, Orville Wright, Thomas Edison, Max Planck, Albert Einstein, Frank Lloyd Wright, Stephen Hawking, Gordon Moore, Jane Goodall, Elizabeth Blackburn, Steven Squyres, Dean Kamen, Subra Suresh, Cornelia Bargmann, Jim Allison, Frances Arnold, Kizzmekia Corbett, Katalin Karikó, Drew Weissman, and Lisa Su—to name but a few.

The Franklin Institute

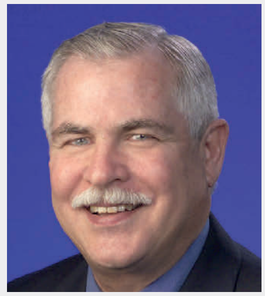
In the spirit of inquiry and discovery embodied by Benjamin Franklin, the mission of The Franklin Institute is to inspire a passion for learning about science and technology.

Since its founding on February 5, 1824, the The Franklin Institute has become a symbol of scientific progress, a leader in informal science education, and a hub for community engagement. For more than 200 years, it has inspired a curiosity and passion for science in millions, continuously evolving with the ever-changing landscape to find innovative ways to make science and technology accessible and engaging for all. Today, it is a dynamic center of activity, one of the nation's leading science centers, the most visited museum in the Commonwealth of Pennsylvania, and a cornerstone of Philadelphia's arts and culture sector.

THE FRANKLIN INSTITUTE LAUREATES

The Franklin Institute congratulates the 2025 Franklin Institute laureates, trailblazers in their fields who have benefitted humanity and deepened our understanding of the universe and its inhabitants.

Katharine N. Suding, Ph.D.
Bower Award and Prize for Achievement in Science

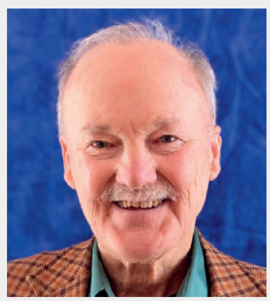


Kurt Edward Petersen, Ph.D.
Benjamin Franklin Medal in Electrical Engineering

Jamie Dimon
Bower Award for Business Leadership

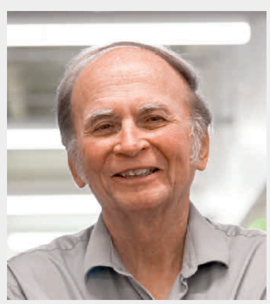
Steven M. Block, Ph.D.
Benjamin Franklin Medal in Life Science

Muyinatu A. Lediju Bell, Ph.D.
Benjamin Franklin NextGen Award



John W. Hutchinson, Ph.D.
Benjamin Franklin Medal in Mechanical Engineering

Naomi J. Halas, Ph.D.
Benjamin Franklin Medal in Chemistry



John P. Perdew, Ph.D.
Benjamin Franklin Medal in Physics

William James Dally, Ph.D.
Benjamin Franklin Medal in Computer and Cognitive Science

Awards Event Schedule

This year's slate of laureate programs includes in-person and hybrid events. All times listed are Eastern Time (ET) and are speaking program start times. Many in-person events offer refreshments and a registration period prior to the listed time. Please refer to ***www.fi.edu/awards-schedule*** *for more details, including featured speakers, location details, and participation instructions.*

WEDNESDAY, APRIL 30, 2025

8:30 AM–12:30 PM **HYBRID EVENT**

Small Tech, Big Impact: The Development and Commercialization of MEMS Sensors & Actuators

Laureate Symposium honoring Kurt Petersen, 2025 Benjamin Franklin Medal in Electrical Engineering

Hosted by the University of Pennsylvania Department of Electrical and Systems Engineering with additional support provided by IEEE Philadelphia Section

9:00 AM–12:00 PM **HYBRID EVENT**

Nanomaterials and Light Addressing Grand Challenges

Laureate Symposium honoring Naomi Halas, 2025 Benjamin Franklin Medal in Chemistry

Hosted by the University of Pennsylvania Department of Chemistry with additional support provided by VIEST: The Vagelos Institute for Energy Science and Technology and LRSM: The Laboratory for Research on the Structure of Matter, an NSF-funded Materials Research Science and Engineering Center

9:00 AM–12:00 PM **IN-PERSON EVENT**

Symposium on Structural Instabilities

Laureate Symposium honoring John Hutchinson, 2025 Benjamin Franklin Medal in Mechanical Engineering

Hosted by Villanova University College of Engineering

2:00–3:30 PM **IN-PERSON EVENT**

Optical Tweezers: Light and Life, Studied One Molecule at a Time

Laureate Address by Steven Block, 2025 Benjamin Franklin Medal in Life Science

Hosted by the University of Pennsylvania Perelman School of Medicine Department of Physiology and Pennsylvania Muscle Institute

THURSDAY, MAY 1, 2025

8:30 AM–12:45 PM **IN-PERSON EVENT**

Density Functional Theory

Laureate Symposium honoring John Perdew, 2025 Benjamin Franklin Medal in Physics

Hosted by Temple University

10:30 AM–12:00 PM **HYBRID EVENT**

Equitable Medical Imaging

Laureate Address by Muyinatu Bell, 2025 Benjamin Franklin NextGen Award

Hosted by Temple University College of Engineering

1:00–3:00 PM **IN-PERSON EVENT**

Energy-Efficient AI

Laureate Symposium honoring William Dally, 2025 Benjamin Franklin Medal in Computer and Cognitive Science

Hosted by Penn Engineering

FRIDAY, MAY 2, 2025

10:00 AM–3:00 PM **IN-PERSON EVENT**

Building Resilience in Natural and Urban Environments Through Nature-Based Solutions

Symposium honoring Katharine Suding, 2025 Bower Award and Prize for Achievement in Science

Hosted by the University of Pennsylvania Penn Plant Adaptability and Resilience Center (PlantARC) and Department of Biology

Awards Week Sponsors

JPMorganChase

Morgan Lewis

Marsha and Jeffrey Perelman

THE FRANKLIN INSTITUTE *Awards*
CEREMONY & DINNER

THURSDAY, MAY 1, 2025
5:30 PM

Presented by BANK OF AMERICA

For event information, visit
www.fi.edu/awards/ceremony-and-dinner

Jami McKeon
2025 Awards Corporate Committee Chair

Barbara Klock, M.D.
Salem Shuchman
2025 Host Committee Chairs

David Greed
2025 Awards Corporate Committee Vice Chair

BOWER AWARD AND PRIZE FOR ACHIEVEMENT IN SCIENCE THEME - ECOSYSTEM RESTORATION

Katharine N. Suding, Ph.D.

Distinguished Professor, Ecology and
Evolutionary Biology
Fellow, Institute of Arctic and Alpine Research
University of Colorado
Boulder, Colorado

CITATION: For making transformative contributions to restoration ecology by increasing our understanding of degraded ecosystems and their recovery dynamics. Her work addresses urgent environmental and societal challenges, and guides policies and practices of ecological restoration, biodiversity conservation, and sustainable ecosystem management.

Growing up, Katharine Suding first experienced the natural beauty of western U.S. landscapes while tagging along with her geologist father on expeditions to old mine sites in the dry vast hinterlands. In the decades since, she has witnessed these same ecosystems, once pristine, become degraded due to human activity and environmental change. The problem is not unique to the American West. Ecosystems around the world are losing biodiversity and ecological complexity, posing significant risks for humanity's pollinators, water sources, and arable soils.

Suding became an ecologist partly to address the issue of Earth's declining ecosystems, joining a budding field called restoration ecology. She rose to become one of its pioneering voices, transforming it through groundbreaking experimentation, meticulous data analysis, and pragmatic land management strategies that have reshaped how scientists understand and heal damaged ecosystems. Her innovative research, often conducted in the overlooked corners of grasslands of the American West, has illuminated the complex interactions that govern ecosystem recovery, yielding insights vital for managing habitats in an era of rapid global change.

Raised with a deep curiosity about nature and the outdoors, Suding pursued an academic path that intertwined ecological theory with hands-on fieldwork. After earning her undergraduate degree at Williams College, she earned her Ph.D. in ecology at the University of Michigan in 1999. It was there that Suding began exploring the hidden rules behind plant communities and how disturbances like climate change, invasive species, and human activity influence biodiversity and ecosystem function. Upon completing her doctoral studies, Suding's interests turned toward the intersection of ecology, conservation biology, and environmental management. Restoration ecology, at the time, was largely defined by idealistic assumptions that ecosystems could be returned to stable, pristine states. By simply cordoning off a disrupted ecosystem, the thinking went, nature would recover. Suding challenged these ideas, recognizing that ecosystems are inherently dynamic, their recovery often unpredictable, nonlinear, and deeply influenced by a range of interacting factors.

Arriving at the University of California, Irvine as a faculty member in 2004, Suding began reshaping the theoretical foundations of restoration ecology. Her early work demonstrated the power of detailed, long-term ecological datasets to unravel complex relationships within ecosystems. Rather than relying solely on theoretical predictions, she championed rigorous empirical data collection, emphasizing the value of granular datasets that captured subtleties in plant-soil relationships, community dynamics, and ecological resilience. This empirical rigor transformed restoration ecology into a more predictive and reliable science, bridging the gap between abstract theory and tangible management practices.

After five years at the University of California, Berkeley, in 2014, Suding joined the faculty at the University of Colorado, a pivotal move that immersed her directly in the grasslands that she had explored during childhood. Suding and her research team established extensive experimental plots. These sites, nestled among the granite peaks and sprawling meadows of the Rocky Mountains, provided an ideal laboratory for studying how ecosystems respond to disturbances such as climate change, nitrogen deposition, and invasive species encroachment. Working in Colorado's high prairie required both scientific rigor and ecological sensitivity. Suding combined carefully controlled experiments with meticulous observations, recording every subtle shift in plant composition, soil nutrients, and microbial communities. Her detailed investigations illuminated previously hidden dynamics—such as the role certain plant species play as "ecosystem engineers," stabilizing soils, influencing nutrient cycles, and facilitating the recovery of diverse ecological communities.

One hallmark of Suding's groundbreaking approach was her focus on thresholds and feedback loops. Her experiments showed that ecosystems sometimes pass critical tipping points, beyond which recovery becomes significantly more challenging. In other words, restoring an ecosystem isn't always possible. Recognizing the thresholds enables restoration managers to strategically intervene before damage becomes irreversible. Where irreparable degradation occurs, Suding pioneered a pragmatic philosophy of restoring ecosystems, if not backward, then toward a goal of resilience. What this looks like is different for every ecosystem, but procedures generally employ research-backed modifications to ecological constituents aimed at fostering a state of robust complexity that will stand against pressures both present and expected, including human goals for the land.

Recognizing that restoration must be achievable in real-world scenarios, Suding has partnered closely with land managers, conservation organizations, and government agencies, guiding restoration plans across diverse ecosystems, from alpine tundra to grasslands and agricultural lands, significantly improving conservation outcomes far beyond the Rocky Mountains. Her detailed analyses and empirical datasets have become foundational resources for scientists and land managers alike, widely cited as definitive evidence of how ecosystems respond to disturbances and restorative efforts. Today, ecosystems worldwide are facing unprecedented pressures from climate change, invasive species, and human encroachment. Katharine Suding's pioneering approaches illuminate paths toward resilient, sustainable ecosystems capable of adapting to the ever-changing conditions of the modern world.

Previous Recipients of the Bower Award and Prize for Achievement in Science

1990/91	PAUL C. LAUTERBUR
1991/92	SOLOMON H. SNYDER
1992/93	DENIS PARSONS BURKITT
1993/94	ISABELLA L. KARLE
1994/95	CHEN NING YANG
1995/96	FREDERICK P. BROOKS
1997	RALPH L. BRINSTER
1998	SIR MARTIN REES
1999	RALPH J. CICERONE
2000	ALEXANDER RICH
2001	PAUL BARAN
2002	JOHN W. CAHN
2003	PAUL B. MACCREADY
2004	SEYMOUR BENZER
2005	HENRI B. KAGAN
2006	NARAIN G. HINGORANI
2007	STUART K. CARD
2008	TAKEO KANADE
2009	SANDRA M. FABER
2010	W. RICHARD PELTIER
2011	GEORGE M. CHURCH
2012	LOUIS E. BRUS
2013	KENICHI IGA
2014	EDMUND M. CLARKE
2015	JEAN-PIERRE KRUTH
2016	WILLIAM J. BORUCKI
2017	CLAUDE LORIUS
2018	PHILIPPE HORVATH
2019	FRANCES H. ARNOLD
2021	KUNIHIKO FUKUSHIMA
2022	PAUL SLOVIC
2023	DEB NIEMEIER
2024	DAVID A. WEITZ

Prior to 1997, awards were designated by the year of nomination. Subsequently, awards were identified by the year of presentation.

Learn more about Dr. Suding and her work at "Building Resilience in Natural and Urban Environments Through Nature-Based Solutions" on May 2.

— See page 4 for details.

LAUREATE SPONSOR:

Peter S. Petraitis, Ph.D.
Planning Chair, Committee on Science & the Arts
Vice Chair, CS&A Earth & Environmental Science Cluster
Professor of Biology, Emeritus
University of Pennsylvania
Member of the Committee on Science and the Arts since 2014

BOWER AWARD FOR BUSINESS LEADERSHIP

Jamie Dimon

Chairman and CEO
JPMorganChase
New York, New York

CITATION: For his steadfast leadership in building JPMorganChase into a diversified global financial institution and his powerful advocacy on behalf of the American business community and its worldwide role and responsibilities.

Jamie Dimon, Chairman and Chief Executive Officer of JPMorganChase, stands among the most influential business leaders of his generation, widely recognized for his stewardship of America's largest bank and his distinct vision of banking as a powerful engine for community growth and economic inclusion. Guided by his deeply held belief that the health of banks and their communities are fundamentally intertwined, Dimon has redefined how financial institutions can—and should—engage with society. Over decades of transformative leadership, particularly during times of crisis, he has emerged as an advocate for a more thoughtful, responsible, and community-oriented approach to finance.

Born in New York City, Dimon was introduced early to the world of finance, inspired by his father and grandfather, both stockbrokers. He attended Tufts University, majoring in economics and psychology, before pursuing an MBA at Harvard Business School.

Dimon's ascent through the banking world began when he joined American Express, working closely with legendary executive Sandy Weill. Their professional relationship flourished, leading Dimon to join Weill in building Citigroup, one of the largest financial institutions in the world. In 2004, Dimon became COO of JPMorganChase, quickly rising to CEO by the end of 2005. His arrival marked a transformative moment for the bank, infusing it with renewed focus, operational discipline, and strategic clarity. He reorganized business lines, emphasized transparency, and notably insisted on rigorous internal risk controls, including divestment of subprime mortgage securities—measures that would soon prove critical. As a global financial crisis began to unfold in 2007–2008, many banks found themselves dangerously exposed to complex mortgage securities. Under Dimon's disciplined approach, JPMorganChase emerged as a stabilizing force, uniquely positioned to navigate the turmoil.

In the darkest hours of the financial crisis, when uncertainty and fear gripped global markets, Dimon's decisive actions demonstrated both financial acumen and public responsibility. JPMorganChase acquired struggling investment bank Bear Stearns as well as Washington Mutual's banking operations after its collapse, transactions that were crucial to restoring confidence in the financial system and protecting consumer savings and deposits. Despite intense scrutiny and challenging integration processes, Dimon's strategy was ultimately vindicated: JPMorganChase not only weathered the storm but emerged stronger. Throughout the crisis, Dimon's leadership was widely credited with reassuring investors, regulators, and the public alike.

But Dimon's vision extends beyond financial discipline and market leadership. From his childhood in Queens, Dimon noted that his vibrant, multi-ethnic community was strengthened by a strong relationship between businesses and residents. He has consistently argued that banks have a unique responsibility to contribute positively to society, emphasizing investments in community development and economic equity.

Under Dimon's guidance, JPMorganChase launched ambitious initiatives to support underserved communities, notably in Detroit. At a time when the Motor City faced bankruptcy and population decline, Dimon committed hundreds of millions of dollars toward revitalizing neighborhoods, spurring small-business growth, and creating opportunities for local residents. This initiative became a blueprint for how private-sector institutions can collaborate with civic leaders to spark lasting, inclusive economic development.

Expanding beyond Detroit, Dimon led JPMorganChase to launch comprehensive investments in cities nationwide—including Chicago, Dallas, and Washington D.C. These efforts focused on affordable housing, workforce development, small business lending, and infrastructure improvement. Dimon emphasized that such investments were not simply acts of philanthropy but were sound business strategies.

Dimon's advocacy has not gone unnoticed. He has been recognized repeatedly by major financial publications as one of the world's most respected and effective business leaders. Yet, even amid such accolades, Dimon underscores his conviction that the truest measure of success is not quarterly earnings but the positive, tangible impact his institution has on society.

Today, Jamie Dimon continues leading JPMorganChase with the same principles he has championed for years. In an age of unprecedented global challenges, from economic inequality to climate risks, his steadfast insistence that banking must serve broader societal goals remains deeply influential. Whether addressing corporate boardrooms, policymakers, or everyday Americans, Dimon underscores that investing in people, communities, and the economy ultimately strengthens the banking system itself. In doing so, Jamie Dimon embodies a modern vision of business leadership—one defined not only by profits, but also by purpose, responsibility, and lasting societal impact.

Previous Recipients of the Bower Award for Business Leadership

1990/91	JAMES EDWARD BURKE
1991/92	DAVID TODD KEARNS
1992/93	ARNOLD O. BECKMAN
1993/94	ROBERT W. GALVIN
1994/95	JOAN GANZ COONEY
1995/96	DAVID PACKARD
1997	GEORGE B. RATHMANN
1998	JOHN C. DIEBEL
1999	P. ROY VAGELOS
2000	WILLIAM J. RUTTER
2001	IRWIN MARK JACOBS
2002	GORDON E. MOORE
2003	HERBERT D. KELLEHER
2004	RAYMOND V. DAMADIAN
2005	ALEJANDRO ZAFFARONI
2006	R. E. (TED) TURNER
2007	NORMAN R. AUGUSTINE
2008	FREDERICK W. SMITH
2009	T. BOONE PICKENS
2010	WILLIAM H. GATES III
2011	FRED KAVLI
2012	JOHN T. CHAMBERS
2013	MICHAEL S. DELL
2014	WILLIAM W. GEORGE
2015	JON M. HUNTSMAN
2016	PATRICK SOON-SHIONG
2017	ALAN R. MULALLY
2018	ANNE M. MULCAHY
2019	INDRA K. NOOYI
2021	ARTHUR D. LEVINSON
2022	STÉPHANE BANCEL, ALBERT BOURLA, AND ALEX GORSKY
2023	KENNETH C. FRAZIER
2024	LISA SU

Prior to 1997, awards were designated by the year of nomination. Subsequently, awards were identified by the year of presentation.

LAUREATE SPONSOR:

Michael Useem, Ph.D.
Chair, Bower Award for Business Leadership Selection Committee
William and Jacalyn Egan Emeritus Professor of Management
Faculty Director, Center for Leadership and McNulty Leadership Program
Wharton School of the University of Pennsylvania

BENJAMIN FRANKLIN NEXTGEN AWARD

Muyinatu A. Lediju Bell, Ph.D.

John C. Malone Associate Professor & PULSE Lab Director
Department of Electrical and Computer Engineering
Department of Biomedical Engineering
Department of Computer Science
Johns Hopkins University
Baltimore, Maryland

CITATION: For her contributions to the novel design of medical imaging systems involving ultrasound and light that make robotic and non-robotic guided surgery safer and more effective.

Muyinatu "Bisi" Bell has emerged as one of the most innovative minds in biomedical engineering, reshaping medical imaging through her pioneering work on photoacoustic imaging and advanced ultrasound technologies. Combining expertise in engineering, optics, acoustics, and artificial intelligence, Bell has developed groundbreaking methods that enable clearer, more accurate, and safer diagnostic tools, opening new possibilities for surgeons and clinicians alike. Her career stands as a powerful example of how interdisciplinary creativity and lived experience can transform medical practice and patient care.

Born in Brooklyn, New York, Bell displayed an early aptitude for math and science, excelling academically from childhood. She tested into Brooklyn Technical High School, then pursued higher education at the Massachusetts Institute of Technology (MIT), earning her bachelor's degree in mechanical engineering. Her time at MIT cultivated a fascination with the intricate connections between engineering and medicine, and she began to envision a career dedicated to developing technologies that improve human lives. She continued her studies at Duke University, earning her Ph.D. in biomedical engineering. As a postdoctoral fellow at Johns Hopkins University, Bell began forging the ideas that would define her ultimate professional trajectory—the integration of robotics, artificial intelligence, and real-time image processing into medical imaging.

Bell's doctoral research laid the foundation for these future innovations, focusing on techniques to overcome the limitations of conventional ultrasound imaging. Ultrasound had long been widely used due to its affordability and safety but often suffered from image quality challenges. Traditional ultrasound machines work by sending acoustic waves through the body and converting the reflections into imagery. Natural variations in human anatomy and tissue properties lead to multiple unpredictable reflections, which appear in imagery as noise or "clutter." Because of clutter and other limiting factors, ultrasound struggles to detect subtle differences in tissue types, such as differentiating between tumors and fluid-filled cysts, or precisely delineating the margins of known structures in the heart walls. Recognizing that the same limitations exist when ultrasound is combined with light, Bell explored the potential of photoacoustic imaging, which is an innovative technique that combines laser-induced light pulses with ultrasound detection. She demonstrated the ability of photoacoustic imaging to provide richer, more detailed tissue characterization by exploiting differences in optical absorption among various tissues.

Her pioneering efforts in ultrasound and photoacoustic imaging evolved into the creation of novel imaging algorithms capable of removing clutter and clarifying subtle anatomical features in real time. By incorporating advanced deep learning algorithms, Bell has successfully developed methods that help clinicians automatically distinguish between healthy and diseased tissues, and dramatically improve diagnostic accuracy, surgical guidance, and ultrasound efficacy for people with darker skin tones (light absorption by melanin in skin contributes to acoustic clutter). These algorithms, trained on extensive clinical data, stand to significantly reduce surgical complications and improve patient safety, especially in delicate procedures like neurosurgery and cancer surgery.

In 2017, Bell joined the faculty of Johns Hopkins University as an assistant professor in the Department of Electrical and Computer Engineering. At Hopkins, she founded and currently leads the Photoacoustic and Ultrasonic Systems Engineering (PULSE) Lab, a research group dedicated to pushing the boundaries of biomedical imaging technology. Under Bell's leadership, the PULSE Lab has become internationally recognized for its innovations in both photoacoustic imaging and advanced ultrasound, particularly in developing image guidance techniques that significantly enhance surgical accuracy and patient outcomes for a wider diversity of people.

One of her most recent innovations is her groundbreaking application of photoacoustic imaging to guide robotic surgery. In procedures traditionally dependent on visual inspection alone, surgeons face significant challenges detecting hidden blood vessels, nerves, and other important structures. Bell's photoacoustic technologies produce high-resolution, real-time images of critical anatomical structures, even beneath opaque tissues. The integration of this technology into robotic surgical platforms has been hailed as a transformative advancement, enabling surgeons to navigate complex surgical sites and reduce the risk of inadvertent injury to vital tissues.

Bell's tireless efforts extend beyond research. She is deeply involved in translating her laboratory discoveries into practical clinical tools, working closely with hospitals, surgeons, and medical technology companies. By bridging academia and industry, Bell ensures that her technologies are not only scientifically innovative but also practically implementable, scalable, and widely accessible. She regularly partners with leading clinicians, demonstrating how engineering breakthroughs can directly enhance surgical precision and patient care.

Beyond her technical achievements, Muyinatu Bell serves as a powerful advocate for greater representation in STEM. Recognizing the challenges faced by women and minoritized groups underrepresented in engineering and science, she frequently speaks at educational events, promotes outreach initiatives, and actively mentors the next generation of diverse engineering leaders. Her presence inspires many aspiring engineers and scientists to pursue careers where they can make tangible impacts on society.

Muyinatu Bell's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1906	HENRY EMERSON WETHERILL
1972	OTTO HERBERT SCHMITT
1973	WILLARD S. BOYLE AND GEORGE E. SMITH
1977	GODFREY N. HOUNSFIELD
1983	PAUL C. LAUTERBUR
1990	MARLAN O. SCULLY
2005	ALEJANDRO ZAFFARONI
2009	RUZENA BAJCSY
2016	PATRICK SOON-SHIONG

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Bell and her work at "Equitable Medical Imaging" on May 1.

— See page 4 for details.

LAUREATE SPONSOR:

Fauzia Ahmad, Ph.D.
Vice Chair, CS&A Electrical Engineering Cluster
Associate Professor, Department of Electrical and Computer Engineering
Member of the Committee on Science and the Arts since 2016

BENJAMIN FRANKLIN MEDAL IN CHEMISTRY

Naomi J. Halas, Ph.D.

University Professor
Stanley C. Moore Professor of Electrical and Computer Engineering
Rice University
Houston, Texas

CITATION: For the creation and development of nanoshells—metal-coated nanoscale particles that can capture light energy—for use in many biomedical and chemical applications.

Light might seem intangible, elusive even, but in the hands of Naomi Halas, it transforms into a finely tuned instrument capable of unlocking unprecedented advancements across medicine, energy, environmental science, and beyond. At Rice University, Halas developed a pioneering class of engineered nanoparticles—known as nanoshells—whose optical properties can be adjusted with a precision akin to tuning a radio dial. This crucial insight ushered in a revolutionary phase in nanophotonics, a discipline in which scientists control and manipulate light at scales as minuscule as billionths of a meter, yielding breakthroughs once perceived as mere science fiction.

At their core, nanoshells are exquisitely small spherical particles consisting of a dielectric or nonconductive core, typically composed of silica, encased within an ultra-thin metallic layer, most commonly gold. Halas discovered that by varying the size of the core and thickness of the metal coating, one can dictate the specific wavelengths of light the nanoshells either absorb or scatter. This deceptively straightforward yet profound concept formed the foundation of transformative technologies, particularly drug-free, infrared light-induced cancer therapies.

When injected into the bloodstream, nanoshells will accumulate selectively at tumor sites—tumors generate porous and malformed blood vessels and the minuscule nanoshells leak in. Once illuminated by near-infrared light that can pass harmlessly through the body, the nanoshells absorb the energy and convert it efficiently into heat. Remarkably, this localized heating effect destroys malignant cells, sparing adjacent healthy tissue from collateral damage. Clinical trials have demonstrated transformative efficacy of nanoshell-based treatments, particularly in prostate cancer. Studies reported that patients treated with nanoshell-enhanced photothermal therapy experienced complete tumor reduction with essentially none of the well-known deleterious side effects of conventional prostate cancer treatments, highlighting its potential as a safe and effective alternative to traditional therapies such as radiation therapy or chemotherapy.

Halas's journey toward these transformative discoveries began early, rooted deeply in her fascination with the interdisciplinary nexus of physics, chemistry, and engineering. Following her Ph.D. studies in physics at Bryn Mawr College, where she pursued breakthrough research in ultrafast optical sciences at IBM Research, Halas pursued postdoctoral research at AT&T Bell Laboratories focusing on light-induced processes in semiconductors. When she joined Rice University, she was able to combine her diverse scientific expertise into a cohesive, groundbreaking research program. It was there, during the 1990s, that she conceptualized and executed her initial, now-celebrated experiments involving nanoshells. These early successes laid the groundwork for a robust research environment that has since significantly expanded the applications of plasmonic nanostructures, connecting fields as diverse as biomedicine, environmental cleanup, and sustainable energy solutions.

The scientific community quickly grasped the extraordinary implications of Halas's inventions. She has been widely recognized for not only her scientific ingenuity but also a remarkable ability to unify and integrate distinct academic disciplines. At Rice, Halas is not only an innovator but also a visionary leader, directing highly interdisciplinary research initiatives. These programs are purposefully designed to leverage the full potential of nanophotonics, addressing some of humanity's most urgent challenges.

Beyond cancer therapy, Halas's nanoshell technology has inspired a range of practical applications in other critical areas. Her research has significantly influenced solar water treatment and light-based chemistry. By carefully structuring nanoshells to maximize their interaction with sunlight, Halas's work contributes to significantly improved energy capture and conversion efficiencies, potentially reshaping the landscape of renewable energy technology. Nanoshells also show great potential for use in advanced sensing devices, including biosensors capable of detecting certain disease biomarkers at extraordinarily low concentrations and the detection of environmental contaminants in human tissues.

Halas's impact extends even further, inspiring collaborative global efforts aimed at tackling environmental pollution through nanotechnology. Her group has explored using plasmonic nanoparticles to catalyze chemical reactions using light, not heat, offering powerful new methods for water purification and pollution reduction.

Today, Halas remains at the forefront of exploration in nanophotonics, continually pushing the boundaries of what is feasible at infinitesimally small scales. Her ongoing research is characterized by a steadfast commitment to innovation, developing ever-more sophisticated applications. Her scientific pursuits vividly illustrate the immense untapped potential of light, something that is both ubiquitous and often overlooked in its remarkable capabilities. Through her tireless ingenuity, she continuously demonstrates that, when skillfully manipulated, light can serve as a powerful force for advancing human health, enhancing quality of life, and fostering environmental sustainability on a global scale.

In every endeavor, Naomi Halas's groundbreaking work not only reshapes scientific understanding but also tangibly impacts society, underscoring the profound potential of harnessing something as fundamental and universal as light.

Naomi Halas's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1909	MARIE CURIE
1912	ALBERT A. MICHELSON
1913	CLEVELAND ABBE
1920	SVANTE AUGUST ARRHENIUS
1934	IRVING LANGMUIR
1941	CHANDRASEKHARA VENKATA RAMAN
1959	CHARLES H. TOWNES
1974	ROBERT H. DICKE
1974	PETER SOROKIN
1996	RICHARD E. SMALLEY
1997	FEDERICO CAPASSO
2009	GEORGE M. WHITESIDES
2012	LOUIS E. BRUS
2016	ROBERT S. LANGER
2019	ELI YABLONOVITCH
2023	NADER ENGHETA

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Halas and her work at "Nanomaterials and Light to Address Grand Challenges" on April 30.

— ***See page 4 for details.***

LAUREATE SPONSOR:

Christopher B. Murray, Ph.D.
Richard Perry University Professor of Chemistry and Materials Science and Engineering
University of Pennsylvania
Member of Committee on Science and the Arts since 2012

BENJAMIN FRANKLIN MEDAL IN COMPUTER AND COGNITIVE SCIENCE

William James Dally, Ph.D.

Chief Scientist and Senior Vice President of Research
NVIDIA
Santa Clara, California

Adjunct Professor of Electrical Engineering and Computer Science
Stanford University
Stanford, California

CITATION: For his contributions to the design of affordable, high-performance, parallel computer systems, a core technology that has enabled the rapid advancement of Artificial Intelligence and other applications that require massive amounts of computation.

Since computers first migrated into homes and businesses, the global appetite for faster, more powerful computing has surged relentlessly. In the CPU (central processing unit) industry, the relationship between supply and demand is a unique, perpetual cycle: the demand for more powerful computing spurs innovation, which then drives demand for even more powerful computing. This conundrum is also what drives computer scientist William Dally, guiding his pioneering innovations in parallel computing architectures, stream processing, and graphics processing units (GPUs)—technologies at the heart of modern revolutions in high-performance computing and artificial intelligence.

Historically, computing was dominated by serial processing—a technique of executing instructions one after another in a linear sequence, on a single chip. In the 1980s, as demands on computing power grew in response to increasingly complex applications and massive datasets, the CPU industry focused on designing serial chips that doubled in power with each new generation. Dally recognized this approach could not be sustained indefinitely. The electrical properties of silicon and physical constraints on transistor density would eventually cause CPU speeds to plateau.

Decades before this came to pass, Dally had worked to fully exploit the power of parallel computing—a type of computer architecture that combined multiple processing cores into a single processor, distributing the workload to overcome speed limits. Although parallel computation had previously been theorized and explored in academia, Dally transitioned these ideas into practical, transformative hardware implementations. His insights became foundational to stream processing, a technique that efficiently manages extensive data by breaking it into parallel streams that can be simultaneously processed. This innovation has significantly accelerated high-performance tasks that many industries rely on today, including scientific simulations, real-time data analytics, complex computational modeling, and graphical display applications.

Born with an intrinsic curiosity about machinery, electronics, and how things work, Dally's interest in technology was evident from an early age. His passion guided him to pursue a B.S. in electrical engineering at Virginia Tech. He continued his academic journey, earning an M.S. in electrical engineering at Stanford University, and subsequently obtaining his Ph.D. at the California Institute of Technology. Following his doctorate, Dally joined MIT, where he led groundbreaking research on interconnection networks—systems critical for communication between processors in parallel architectures—and contributed substantially to theoretical and practical understandings of parallel processing. His influential tenure at MIT laid a robust foundation for later achievements when he joined the faculty at Stanford University. There, Dally eventually chaired the Computer Science Department, fostering a vibrant research community that set the stage for pivotal advancements across modern computing technologies.

Dally's relentless pursuit of efficient parallel designs directly contributed to the creation of technologies central to today's GPUs. Initially conceived as specialized hardware designed strictly for graphical rendering tasks, GPUs experienced a fundamental transformation largely through Dally's efforts. Under his guidance and influence, GPUs evolved into versatile parallel computing engines capable of handling broader computational tasks beyond graphics. As GPUs began demonstrating unprecedented capabilities in processing scientific workloads, AI researchers recognized their immense potential. GPUs quickly became indispensable tools in training deep neural networks, catalyzing an unprecedented AI revolution that has reshaped industries ranging from healthcare and finance to autonomous vehicles and robotics.

Today, as chief scientist at NVIDIA, Dally plays a pivotal role in steering the company's expansive research and innovation efforts, pushing the boundaries of GPU performance, machine learning efficiency, and high-speed networking technologies. At NVIDIA, Dally oversees critical advancements that allow GPUs to process enormous datasets at lightning speed, facilitating significant breakthroughs in AI-driven technologies. His work is accelerating a new era of supercomputing, underpinning revolutionary applications including photorealistic virtual environments, real-time natural language processing, autonomous systems, and the AI-assisted early detection and diagnosis of diseases.

Beyond his technical achievements, Dally is also renowned for his exceptional mentorship and deep commitment to education. Over the decades, he has mentored numerous students and professionals, many of whom have risen to prominent roles within academia, industry, and entrepreneurship. His students often credit their success to Dally's rigorous standards, clear vision, and patient yet demanding approach to research and learning.

As a visionary inventor, dedicated educator, and respected industry leader, Bill Dally has profoundly reshaped the landscape of modern computing. By championing the practical realization of parallelism, Dally has transformed once-speculative ideas into tangible technologies that power everything from sophisticated scientific modeling and weather prediction to transformative medical diagnostics and autonomous vehicle technology. His groundbreaking contributions serve as enduring testimony to the transformative power of innovative thinking, rigorous engineering, and a clear vision of technology's potential to reshape society and expand the horizons of human capability.

William Dally's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureates by a shared intellectual thread.

1928	VANNEVAR BUSH
1932	MONROE CALCULATING MACHINE CO.
1949	J. PRESPER ECKERT, JR. AND JOHN WILLIAM MAUCHLY
1955	CLAUDE ELWOOD SHANNON
1964	HOWARD HATHAWAY AIKEN
1966	JACK S. KILBY AND ROBERT N. NOYCE
1979	SEYMOUR R. CRAY
1979	MARCIAN E. HOFF, JR.
1996	FREDERICK P. BROOKS
2000	JOHN COCKE
2016	YALE N. PATT

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Dally and his work at "Energy-Efficient AI" on May 1.

— See page 4 for details.

LAUREATE SPONSOR:

Camillo J. Taylor, Ph.D.
Vice Chair, CS&A Computer and Cognitive Science Cluster
Raymond S. Markowitz President's Distinguished Professor, Department of Computer and Information Science and GRASP Laboratory
University of Pennsylvania
Member of the Committee on Science and the Arts since 2007

BENJAMIN FRANKLIN MEDAL IN ELECTRICAL ENGINEERING

Kurt Edward Petersen, Ph.D.

Member
Silicon Valley Band of Angels
San Francisco, California

CITATION: For his pioneering research and development of micro-electromechanical systems (MEMS) technology—microscopic systems that merge mechanical and electrical parts—which has wide-ranging applications such as pacemakers, inkjet printers, optical projectors, and airbags.

Kurt Petersen stands prominently as a pioneer of some of the smallest technological marvels in existence. Micro-Electromechanical Systems—commonly known as MEMS—technology is a groundbreaking engineering discipline that merges electronics and mechanical elements at microscopic scales. Over decades of meticulous research, inspired entrepreneurship, and passionate advocacy, Petersen has not only advanced MEMS through his innovative personal contributions but also guided the technology's development from a laboratory curiosity into a thriving global industry, creating a world filled with microscopic devices that enable smartphones, automobiles, biomedical instruments, and countless other products essential to modern life.

Born and raised in California, Petersen was fascinated early on by electronics and mechanical systems. These two fields were generally considered separate and disconnected by both academia and industry as Petersen pursued his Ph.D. in electrical engineering at MIT in 1975. After finishing at MIT and joining IBM's prestigious Almaden Research Center that same year, Petersen found himself suddenly amidst researchers bridging the gap between the two disciplines. His curiosity piqued by an out-of-place ink stain in one of the facility's corridors, he followed its trail into a nearby lab where he encountered engineers etching some of the first inkjet printer nozzles into tiny silicon chips. Inspired by the possibilities, Petersen was soon etching his own silicon chips, tiny switches complete with moving parts only visible under a microscope.

At IBM, Petersen made some of his most transformative early contributions, fundamentally shaping MEMS fabrication methods. Notably, in 1982, he authored a seminal paper, "Silicon as a Mechanical Material," which remains one of the most cited and influential publications in the MEMS community. This landmark paper definitively established silicon's unique capabilities as an ideal material for micromechanical systems, and its insights helped launch an entire industry around silicon-based MEMS devices.

Petersen's insight into silicon's mechanical properties set the stage for revolutionary technologies that continue to influence fields as diverse as healthcare, automotive safety, consumer electronics, and environmental sensing. His research team at IBM developed methods for micromachining silicon, enabling the production of sensors, actuators, resonators, microvalves, and switches at microscopic dimensions. These devices could interact physically with their environments in entirely new ways, opening possibilities for applications ranging from airbag sensors and inkjet printers to advanced biomedical implants.

Recognizing early on that MEMS would achieve its full potential only through commercialization, he transitioned into entrepreneurship, co-founding several startups that became foundational to the MEMS industry. In 1982, Petersen co-founded Transensory Devices, one of the earliest MEMS-based sensor companies, introducing innovative pressure and acceleration sensors to commercial markets. Later, as co-founder and CTO of NovaSensor in 1985, Petersen spearheaded the development of silicon pressure sensors, transforming medical diagnostics and automotive safety. NovaSensor quickly established itself as a market leader, demonstrating Petersen's ability to translate cutting-edge research into highly successful commercial products. He then co-founded Cepheid in 1996, focusing on MEMS-based biomedical diagnostics. Cepheid developed powerful, miniature diagnostic systems that could rapidly detect pathogens, contributing significantly to point-of-care medical testing. The successful commercialization of these innovative MEMS technologies further solidified Petersen's reputation as a pioneering entrepreneur.

As his startups flourished, Petersen simultaneously became a passionate advocate for the entire MEMS community. Recognizing the importance of collaboration and community-building, he tirelessly promoted interactions between industry, academia, and government funding agencies. He co-founded influential forums, workshops, and conferences, notably the International Conference on Solid-State Sensors, Actuators, and Microsystems (often referred to simply as Transducers), which rapidly became the preeminent gathering of MEMS researchers worldwide. Through these initiatives, Petersen significantly accelerated MEMS development, bringing coherence and momentum to what had previously been a fragmented and dispersed research community.

His role as an advocate was equally significant in influencing policy and funding. Petersen consistently highlighted MEMS's transformative potential, championing substantial investment from government agencies, industry groups, and venture capitalists. His articulate vision, combined with the demonstrated success of his entrepreneurial ventures, inspired significant public and private support, fueling rapid expansion of the MEMS industry in the United States and abroad.

Throughout his distinguished career, Petersen's contributions have been widely recognized by prestigious awards and honors, but his most enduring legacy may be the vibrant global MEMS community he helped cultivate. His unwavering commitment to mentorship and collaboration inspired generations of MEMS researchers and entrepreneurs, many of whom today occupy leading roles across academia, government laboratories, and industry. Today, MEMS devices are integral to daily life, from accelerometers in smartphones and gaming systems to sophisticated medical implants that save lives. Kurt Petersen's pioneering research, entrepreneurial foresight, and mentoring and community-building efforts were instrumental in making this possible. By demonstrating how microscopic engineering can profoundly impact the human experience, Petersen forever reshaped our relationship with technology, cementing his place as a transformative figure in modern engineering history.

Kurt Petersen's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1894	JARVIS B. EDSON
1899	WILFRED LEWIS
1919	JOHN WALTER LEDOUX
1932	THOMAS R. HARRISON
1941	BENJAMIN JAMES WILSON
1966	JACK S. KILBY AND ROBERT N. NOYCE
1975	MARTIN MOHAMED ATALLA
1975	FREDERICK P. HERMAN, STEVEN R. HOFSTEIN, AND FRANK R. WANLASS
1993	LEROY L. CHANG
1994	MARVIN H. CARUTHERS
1995	ALFRED Y. CHO
1999	RICHARD W. SHORTHILL AND VICTOR VALI
2002	GORDON E. MOORE
2007	ROBERT H. DENNARD
2010	GERHARD M. SESSLER AND JAMES E. WEST
2011	GEORGE M. CHURCH
2013	SUBRA SURESH
2018	MANIJEH RAZEGHI
2022	P. DANIEL DAPKUS AND RUSSELL DUPUIS

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Petersen and his work at "Small Tech, Big Impact: The Development and Commercialization of MEMS Sensors & Actuators" on April 30.

— See page 4 for details.

LAUREATE SPONSOR:

Jan Van der Spiegel, Ph.D.
Professor of Electrical and Systems Engineering
University of Pennsylvania
Member of the Committee on Science and the Arts since 2015

BENJAMIN FRANKLIN MEDAL IN LIFE SCIENCE

Steven M. Block, Ph.D.

Stanford W. Ascherman Professor of the Sciences, Emeritus
Department of Applied Physics and Department of Biology
Stanford University
Stanford, California

CITATION: For leadership in developing methods and applications for nanoscale manipulations with light ("optical tweezers") to elucidate biological mechanisms.

How can one possibly measure the miniscule forces that drive life's fundamental processes? How does one hold onto something as small and elusive as a single biomolecule? These questions have long captivated biophysicist Steven Block, who harnessed the power of light to probe the invisible realm of biomolecular motors. Through his pioneering application and refinement of optical traps, also known as "optical tweezers," Block opened a new window into the machinery of living cells, transforming our ability to study biology at its smallest scales.

In 1986, physicist Arthur Ashkin of Bell Laboratories demonstrated how laser light could be used to form an optical trap. The optical trap relies on a simple yet extraordinary principle: a focused beam of infrared laser light exerts radiation pressure, sufficient to apply mechanical forces that can capture and manipulate micrometer-scale objects in fluid, such as bacteria, gently grasping them without causing permanent damage. (In 2018, Ashkin would receive the Nobel Prize in Physics for this pioneering work.) Block saw the potential to adapt Ashkin's method to study individual biomolecules, including both proteins and nucleic acids, in real time as these work, by attaching molecules of interest to microscopic beads held by optical tweezers. Among these biomolecules are tiny, motor-like protein machines that are critical for cellular functions, such as replicating and transcribing DNA, or physically separating the chromosomes during cell division, or transporting molecular cargo throughout the cell.

Growing up with a fascination for both physics and the elegance of living systems, Block found his calling at the intersection of these fields. After completing his bachelor's and master's degrees in physics at the University of Oxford, he went on to receive a second master's in biology from the University of Colorado before earning his Ph.D. in biophysics at the California Institute of Technology in 1983. This was followed by postdoctoral work at Stanford University that refined his focus on single-molecule biophysics. He went on to faculty positions at the Rowland Institute for Science and Princeton University before joining Stanford University in 1999, where he is currently a professor emeritus of applied physics and biological sciences. At Stanford, he established a lab that became a hub for groundbreaking experiments, merging precision instrumentation with creative scientific questions to reveal hidden details of life's molecular engines.

Like many transformative ideas, optical trapping in biology faced initial skepticism—could laser beams actually hold biomolecules firmly enough to be measured without interfering with their function? Block's rigorous experiments and elegant demonstrations silenced any doubts. His work inspired new methods and tools that spread to research labs worldwide, enabling further breakthroughs in understanding, for example, the complex process of folding and assembly in proteins and nucleic acids. By coupling sophisticated optical systems with sensitive detection methods, Block set a standard for investigating the mechanical underpinnings of life with a precision once thought impossible.

By manipulating single molecules—including motor proteins such as kinesin or the enzyme RNA polymerase—researchers could, for the first time, watch these molecular machines carry out their reactions, literally taking one step at a time. By so doing, Block and his colleagues illuminated core mysteries of how cells can move, transport cargo, and read genetic information.

One of Block's hallmark achievements was demonstrating how the twin heads of the kinesin protein literally "walk" along microtubules, carrying vital cellular cargo in discrete steps covering just a handful of nanometers. By attaching microscopic beads to the tail of the kinesin protein and then using optical tweezers to hold these beads, his team successfully measured the piconewton-scale forces and the nanometer-scale distances associated with kinesin function. They showed that motor proteins can generate sufficient force to move comparatively heavy loads (on a cellular scale), despite their diminutive size. Later, he further refined and adapted single-molecule optical techniques to record the still smaller, angstrom-scale steps—an angstrom is one tenth of a nanometer—taken by RNA polymerase, the enzyme responsible for reading the genetic code, revealing how it travels from base to base along the double helix of DNA.

Although his work dives deeply into the hidden realm of molecular forces and motions, Block has never lost sight of the bigger picture: understanding how life works at its most fundamental level. From clarifying how cells transport nutrients to illuminating how our genetic machinery avoids errors, his efforts have shown that the smallest of interactions can shed light on the largest mysteries of biology. Over the course of his career, he has mentored an entire generation of scientists who continue to expand the power and reach of single-molecule techniques in laboratories throughout the globe.

Today, Steven Block's fusion of physics and biology stands as a testament to the power of interdisciplinary thinking. His optical traps—those gentle beams of light—have not only captured molecules but have also captured the imagination of scientists determined to explore life's processes with unprecedented detail. Through his vision and leadership, Block has expanded our ability to understand the invisible forces that power life.

Steven Block's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1921	CHARLES FABRY
1926	FRANK TWYMAN
1930	WILLIAM H. BRAGG
1942	JESSE WAKEFIELD BEAMS
1949	THEODOR SVEDBERG
1959	CHARLES H. TOWNES
1961	NICOLAAS BLOEMBERGEN AND H.E. DERRICK SCOVILL
1962	ALI JAVAN
1962	THEODORE H. MAIMAN
1975	MILDRED COHN
1979	RICHARD GEORGE BREWER
1985	WILLIAM COCHRAN
1987	GERD BINNIG AND HEINRICH ROHRER
1989	CHARLES W. OATLEY
1990	PAUL C. LAUTERBUR
2014	JOACHIM FRANK

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

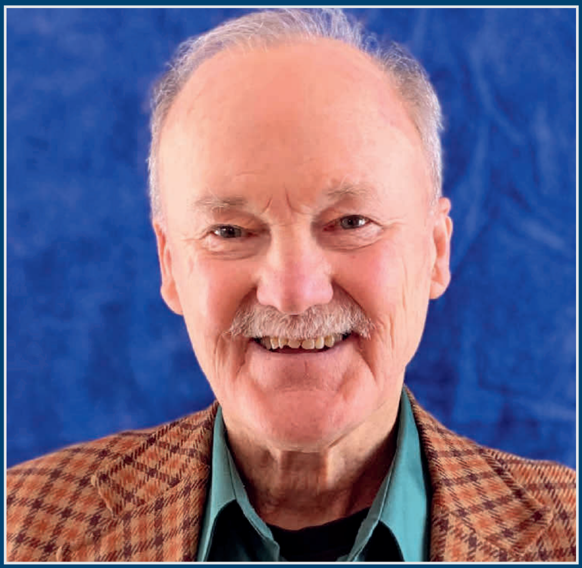
Learn more about Dr. Block and his work at "Optical Tweezers: Light and Life, Studied One Molecule at a Time" on April 30.

— See page 4 for details.

LAUREATE SPONSOR:

Frank A. Ferrone, Ph.D.
Professor, Department of Physics
Drexel University
Member of the Committee on Science and the Arts since 1992

BENJAMIN FRANKLIN MEDAL IN MECHANICAL ENGINEERING



John W. Hutchinson, Ph.D.

Abbott and James Lawrence Professor of Engineering Emeritus
Paulson School of Engineering and Applied Sciences
Harvard University
Cambridge, Massachusetts

CITATION: For outstanding contributions in the development of theories of the stability and failure of materials and structures, which have had profound impact on critical technologies for aerospace, energy systems, and nanoscale materials.

Think of an eggshell, a shape leveraged by nature for its efficiency in providing reasonable protection and structural integrity, and you can extrapolate why engineers in the aerospace, automotive, and energy sectors use shell structures to protect technology. Characterized by graceful curves and minimal thickness, they serve as the casings, hulls, and capsules for rockets, phones, fuel tanks, and more. However, the very qualities that make shells advantageous—thinness and curvature—render them vulnerable to buckling and instability. Engineer John Hutchinson has profoundly shaped our understanding of these vulnerabilities, particularly through his groundbreaking contributions to the study of shell buckling and its implications for rocketry and high-pressure vessels.

After earning his bachelor's degree in engineering mechanics from Lehigh University, Hutchinson's pioneering work began during his graduate studies at Harvard, culminating in his Ph.D. in mechanical engineering in 1963. Early on, he identified critical gaps in classical theories of structural mechanics, which often overlooked the influence of small imperfections on the stability of shell structures.

His research was justified by the failure rate of rocket shells in the 1960s U.S. space program. Apollo engineers, ever conscious of weight, would design the shells of the Saturn V to the minimum thickness specified by material models of the time, only to witness the shells buckle from the crushing forces of the rocket's weight pushing down against the massive upward thrust of its engines. Adding to their frustration, the location of shell buckling would be inconsistent between tests, making spot-reinforcement impossible. This resulted in rocket shells being designed to be thicker and heavier than theoretically needed.

Knowing that traditional models assumed perfect geometries and uniform material properties, which rarely matched real-world conditions, mechanics experts as early as the mid-1940s began to realize that exceedingly small deviations in geometry or subtle variations in thickness could drastically decrease a shell's load-bearing capacity, triggering unexpected and potentially catastrophic failures. Hutchinson's contribution came from systematically investigating these imperfections and their outsized effects on structural stability. Through a blend of theoretical analysis and computational modeling, and comparison with empirical experimentation, Hutchinson demonstrated that shells of all types, not just rockets, could buckle under significantly lower stresses than classical theories predicted. He developed sophisticated mathematical models that accurately captured how minor, microscopic imperfections, introduced during manufacturing or otherwise, became amplified under stress, leading to catastrophic failure. The research influenced industry-wide shifts in design philosophies, leading directly to the adoption of rigorous inspection protocols and design standards, especially in critical industries like aerospace and energy, where safety and reliability are paramount.

Global space programs took notice. Prior to the research in which Hutchinson participated, rocket components were often over-engineered, leading to increased weight, reduced payload capacity, and inefficiencies. By precisely identifying how imperfections lead to buckling and failure, Hutchinson enabled aerospace engineers to optimize designs, making rockets lighter, more reliable, and capable of carrying heavier payloads into orbit and beyond.

Additionally, Hutchinson's influential work in fracture mechanics complements his buckling research. Investigating crack propagation at microscopic scales, he uncovered critical insights into how damage initiates and spreads through structures, helping engineers understand how seemingly minor cracks could quickly lead to catastrophic failures. This understanding was critical for safety-critical structures such as offshore drilling platforms and pressurized vessels in chemical and energy industries.

Now the Abbott and James Lawrence Professor of Engineering Emeritus at Harvard, Hutchinson has cemented his academic legacy in tangible outcomes, such as his mentorship of students who developed improved computational methods for predicting rocket shell buckling, directly impacting NASA's rocket design protocols. His interdisciplinary collaborations have led to significant innovations, including integrating advanced finite element analysis with physical experiments to identify and rectify flaws in high-pressure fuel tanks before catastrophic failures could occur. Hutchinson's team notably enhanced predictive modeling for automotive crashworthiness, allowing manufacturers to more accurately simulate collisions and reinforce vehicle structures effectively prior to physical testing.

In industry, Hutchinson's research has directly influenced safety standards and manufacturing practices. Industries ranging from aerospace to automotive to energy have adopted his findings into their operational frameworks, implementing rigorous inspection protocols to identify imperfections early. This proactive stance significantly reduced failure rates in pressure vessels, pipelines, and critical aerospace components.

Today, John Hutchinson's contributions remain central to ongoing innovations in structural engineering. By elucidating the subtle mechanics of structural stability and failure, Hutchinson has helped ensure the safety, efficiency, and reliability of essential structures upon which modern society depends. His career exemplifies how fundamental research can profoundly shape practical engineering, making even the most delicate shell structures robust enough to withstand the demanding conditions of contemporary industrial applications.

John Hutchinson's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1958	STEPHEN P. TIMOSHENKO
1962	ALAN HOWARD COTTRELL
1968	POL EDGARD DUWEZ
1979	GEORGE R. IRWIN
1996	JAMES R. RICE
2007	MERTON C. FLEMINGS
2012	ZVI HASHIN
2013	SUBRA SURESH
2024	MARY C. BOYCE

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Hutchinson and his work at "Symposium on Structural Instabilities" on April 30.

— See page 4 for details.

LAUREATE SPONSORS:

C. Nataraj, Ph.D.
Chair, CS&A Civil and Mechanical Engineering Cluster
Moritz Endowed Professor of Engineered Systems
Director, VCADS Research Center
Department of Mechanical Engineering
Villanova University
Member of the Committee on Science and the Arts since 2008

BENJAMIN FRANKLIN MEDAL IN PHYSICS

John P. Perdew

Professor of Physics
Department of Physics and Engineering Physics
Tulane University
New Orleans, Louisiana

CITATION:
For designing a method based on quantum mechanics that is widely used by researchers to computationally predict physical properties of atoms, molecules, fluids, and solids.

Understanding how electrons interact within atoms, molecules, and solids has been a central challenge of modern physics and chemistry, especially as scientists increasingly look to metamaterials as a potentially transformative technological frontier. Metamaterials are engineered structures, materials designed at the molecular level to exhibit properties not found in nature, that could revolutionize fields ranging from telecommunications to energy to biomedicine. Achieving the precise understanding necessary to create these novel materials hinges critically on the ability to model electron motion accurately.

Theoretical physicist John Perdew has devoted his career to refining one of the most powerful tools for investigating the electronic structures of materials: density functional theory (DFT). Through his groundbreaking improvements to density functionals, Perdew has enabled researchers worldwide to explore materials and chemical phenomena with unprecedented precision.

Perdew developed an early curiosity about how the world works at its most fundamental level. That curiosity guided him toward physics, a path he followed from Gettysburg College, where he earned his bachelor's degree, to Cornell University, where he completed his Ph.D. in 1971. Perdew's deep knowledge of theoretical physics enabled him to make breakthrough developments at a pivotal moment in the evolution of computational methods.

While quantum mechanics had long provided the basis for understanding electronic structure, it remained a major undertaking to calculate properties of real materials composed of large numbers of interacting electrons. While the equations of quantum mechanics proposed by Schrödinger allowed physicists to make predictions for systems with a few interacting electrons, these calculations require large computer resources and cannot be extended to much bigger systems.

Seeking a solution, Perdew became drawn to the possibilities of density functional theory. First proposed in 1927 and proved by Hohenberg, Kohn, and Sham to be a rigorous theory in the 1960s, DFT captured the attention of physicists and chemists by offering a more computationally efficient way to investigate electronic structures. Rather than tracking every electron's motion individually, which would require a many-electron wavefunction in a high-dimensional space, DFT uses the overall electron density in just three dimensions. The energy formula of this method includes, however, a term called the "exchange-correlation energy," whose exact form is un-computable and must be approximated. This term describes correlations of electron-electron motions. Similar to how dancers influence each other's movements on a crowded dance floor, electrons affect one another through their electric charges, subtly altering each electron's path and energy. Exchanges of electrons are similar to changes of partners in mixed dances. The challenge of accurately describing these interactions within the DFT framework made the first DFT approximation accurate only for metals, a small percentage of materials. Developing robust approximations for electron-electron correlations and exchanges would become central to Perdew's career.

Before Perdew entered the field, DFT employed the local density approximation (LDA), with inputs that dated to 1930. Researchers recognized this shortcoming and developed more refined methods incorporating density gradients. However, all such methods initially proposed performed worse than LDA. It was Perdew who, with David Langreth, discovered the reasons for the poor performance of early gradient expansions and developed methods to cure these problems. This effort resulted in methods called the generalized gradient approximation (GGA), leading to more accurate descriptions of electron interactions than in the case of LDA. The widely used Perdew-Burke-Ernzerhof (PBE) functional, introduced in collaboration with Kieron Burke and Matthias Ernzerhof in the 1990s, became a cornerstone for computational physics and chemistry. PBE's balanced approach offered enhanced accuracy while maintaining computational feasibility, quickly becoming the standard for modeling electronic structures. With Mel Levy and other collaborators, Perdew discovered many unexpected mathematical features of the exact density functional for the exchange-correlation energy, including some which he and others built into PBE and later approximations.

As computational resources expanded, Perdew and collaborators continued pushing boundaries, guiding the development of meta-GGA functionals. These advanced functionals incorporate additional information, such as electron kinetic energy density, enabling even greater precision in describing chemical bonding and electronic properties, particularly in challenging materials.

Throughout his distinguished academic career at institutions like Tulane University, where he began his teaching career in 1977 and returned to in 2023, and Temple University, where he taught from 2013 to 2023, Perdew has mentored numerous researchers who have themselves become influential in quantum theory.

His work transcends the realm of the academia, giving both academic and industrial researchers a viable method for pursuing metamaterials, as well as impacting industries ranging from pharmaceuticals to renewable energy and electronics. By systematically improving density functional theory, Perdew has transformed theoretical concepts into practical, powerful tools that drive innovation across science and technology. His ongoing efforts continue to address unresolved issues, like strongly correlated electron systems, ensuring DFT remains robust, relevant, and indispensable for future discoveries. John Perdew's enduring legacy illustrates the profound impact that careful, incremental refinements of scientific theories can achieve, underscoring his role as one of the great minds in theoretical physics and computational materials science.

John Perdew's Laureate Legacy

The laureate legacy recognizes previous laureates connected to the current laureate by a shared intellectual thread.

1950	EUGENE P. WIGNER
1952	JOHN BARDEEN
1952	WOLFGANG PAULI
1969	HENRY EYRING
1975	JOHN BARDEEN
1978	FRANK H. STILLINGER
2002	NORMAN L. ALLINGER
2017	MARVIN L. COHEN
2021	ROBERTO CAR AND MICHELE PARRINELLO

Please note that the laureate legacy does not represent a comprehensive list of all Franklin Institute medalists.

Learn more about Dr. Perdew and his work at "Density Functional Theory" on May 1.

— See page 4 for details.

LAUREATE SPONSOR:

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The mission of The Franklin Institute's Committee on Science and the Arts is to sustain the scientific character of The Franklin Institute through the investigation of worldwide scientific and technological achievements and its recommendations for the awarding of Benjamin Franklin Medals, the Benjamin Franklin NextGen Award, and the Bower Award and Prize for Achievement in Science. The Committee maintains high standards for awarding the medals using the following selection criteria:

- The committee carefully selects candidates using a thorough case investigation process to recognize those scientists and engineers who lead their fields, expand knowledge, and serve humanity.
- Individuals must be nominated for an invention, discovery, technological development, or a body of such work reflecting uncommon insight, skill, or creativity on the part of the candidate.
- The work must have significant scientific value or proven utility. It must have provided significant direction for future research, solved an important problem, or provided great benefit to the public.
- Candidates for the award must be living persons.
- The Committee considers individuals from all over the world.

Committee members who become case sponsors represent their nomination cases before the full committee for review and action. Following successful case presentations, including the review of letters of evaluation solicited from preeminent experts in the field of the case, nominations are forwarded to the Institute's Board of Trustees for final review and approval. During the following spring, medalists are brought together at The Franklin Institute for the annual Awards Ceremony and Dinner and Awards Week celebration of science.

The all-volunteer Committee on Science and the Arts is composed of scientists and engineers from academia and industry. Meeting regularly throughout the year, it has a reputation for diligence and integrity. The committee's work reflects the mission of The Franklin Institute and provides a valuable service to the public and to the scientific community.

List as of March 31, 2025

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Every dollar raised through The Franklin Institute Awards Ceremony and Dinner underwrites the Institute's efforts to make STEM learning accessible and inclusive, creating wow moments that spark a passion for discovery and invention in future generations.

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*Please note, award selection committees are independent and unaffiliated with event committees and fundraising initiatives. Sponsorships are sought only after the laureates have been selected.

Award Endowments

The Franklin Institute and its Committee on Science and the Arts are proud to celebrate pioneering excellence in science and technology. Since 1824, the Institute has selected individuals to receive premiums, certificates, and medals for outstanding scientific or technological accomplishments and inventions. The Benjamin Franklin Medalists' Fund was established in 2017 by The Morel Family Foundation and provides honoraria for Benjamin Franklin Medalists and NextGen Awardees. We are deeply indebted to them and to the individuals whose generosity established the following funds that support the Bower Awards and the Benjamin Franklin Medals:

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– Poor Richard Improved, 1746