Convergence

2018 Annual Report

RESEARCH CORPORATION
for SCIENCE ADVANCEMENT

Identifying New and Promising Pathways

"Science is a field which grows continuously with ever expanding frontiers. Further, it is truly international in scope. ...Science is a collaborative effort. The combined results of several people working together is often much more effective than could be that of an individual scientist working alone."

— John Bardeen, from his second Nobel Prize Banquet speech (10 December 1972). In Wilhelm Odelberg (ed.), Les Prix Nobel en 1972 (1973).

Research Corporation was established in 1912 by Frederick Cottrell as a not-for-profit, vertically integrated combination of a technology transfer program, a division that developed and installed the first industrial anti-pollution device (electrostatic precipitators for smokestacks), and a philanthropic arm that distributed net revenues to support scientific research in the nation's universities and colleges. Over the years, these three activities became three separate entities, and Research Corporation for Science Advancement (RCSA) now stands on its own as the philanthropic foundation that supports scientific research in the physical sciences.

Another part of the original Research Corporation became Research Corporation Technologies (RCT) in the 1980s. RCT created its own Frederick Gardner Cottrell Foundation, and we are very pleased that this foundation has now decided to partner with RCSA to expand our Scialog program. As a result, starting in 2020 we will begin a new series of Scialog conferences on topics to bring physical science approaches to bear on fundamental issues underlying the biomedical sciences.

Scialog is an approach to catalyze what is often referred to as "convergence"—interdisciplinary scientific collaboration with the potential to make advances that would likely not be possible from only one field. RCSA, in partnership with the Gordon and Betty Moore Foundation, the Heising-Simons Foundation, and the Alfred P. Sloan Foundation as primary co-sponsors, has organized Scialogs at the intersection of the physical and life sciences, in time domain astrophysics, and in the field of energy research. A manuscript describing Scialog is now in press at *ACS Energy Letters*.

RCSA also promotes convergence in education by bringing together innovative faculty from across the physical sciences to compare approaches that enhance student learning. RCSA selects early career faculty, who are top researchers and truly dedicated teachers, as Cottrell Scholars. Then, through the Cottrell Scholar Collaborative, RCSA builds a network of deeply committed teachers who can change the norms in science departments around the country to provide greater emphasis on effective learning outcomes. RCSA has been working closely with the Association of American Universities (the AAU) in these efforts.

As is evident from the Cottrell Scholar and Scialog programs, RCSA believes strongly in the power of collaboration—both institutional and individual—to achieve greater impact. New ideas come by bringing together people and organizations with different expertise, experiences, and viewpoints to challenge assumptions and to identify new and promising pathways. We are very excited to be working with so many other terrific organizations to support the work of early career science faculty. This report shows specifically how we carried out that approach over the past years.

Daniel Linzer *President and CEO*

Research Corporation for Science Advancement

Daniel Linzer

RCSA Community—Year in Review

December In Stockholm, Cottrell Scholar (2000) **Donna Strickland**, U Waterloo, became the third woman in history to accept a Nobel Prize in Physics. She was recognized for her work on chirped pulse laser amplification with her doctoral adviser **Gerard Mourou.** … **Michelle Digman**, biomedical engineering, UC Irvine, received a $500,000 NSF CAREER Award based in part on her research as a member of a **Scialog: Molecules Come to Life** team developing an imaging platform with fast orbital tracking to follow mitochondria with nanometer precision. Her team's Scialog award is funded by the **Gordon and Betty Moore Foundation**. … Cottrell Scholar (1996) **David Reitze**, executive director of the Laser Interferometer Gravitational-wave Observatory (LIGO) and a physics research professor at Caltech, was named a fellow of the American Association for the Advancement of Science (AAAS). He was honored for "outstanding leadership of LIGO into the era of the discovery of the first gravitational waves. **November** Cottrell Scholar (2006) **Adam Leibovich**, physics, U Pittsburgh, was elected a Fellow by the AAAS. He uses field theory techniques to study heavy quarks as a probe of these interactions, as he attempts to uncover physics beyond the Standard Model. … Cottrell Scholar (2016) **Yan Yu**, chemistry, IU Bloomington, led a study published in the journal ACS Nano noting that drug-delivering nanoparticles attach to their targets differently based upon their position when they meet. This may be significant because the movement of drug molecules when they bind to cell receptor sites could indicate the effectiveness of drug treatments. …

2018 Awards for Scientific Research and Education

Research Corporation for Science Advancement (RCSA) supports early career scientists at American colleges and universities through two major efforts, Cottrell Scholars and Scialog. RCSA strives to be broadly inclusive in support of its awardees, with all proposals passing a rigorous peer-review process. To learn more about our programs, visit the RCSA website at *rescorp.org*.

The Cottrell Scholar Program develops outstanding teacher-scholars. In 2018, Cottrell Scholar Program funding included $2.4 million for initial Cottrell Scholar Awards. Appointment as a Cottrell Scholar provides subsequent eligibility for competitive Cottrell Plus awards ($450,000 in 2018), and Cottrell Scholars Collaborative Awards ($100,000 in 2018).

2018 Cottrell Scholar Awards, $100,000 each

Ashleigh E. Baber, chemistry, James Madison University
Role of Surface Modifications on the Selectivity of Titania/Gold Inverse Model Catalysts

Louise Charkoudian, chemistry, Haverford College
Capturing Transient Interactions of Biosynthetic Proteins to Access New Chemical Diversity

Nathaniel Craig, physics, University of California, Santa Barbara
New Approaches to the Hierarchy Problem and Undergraduate Education

Claude-Andre Faucher-Giguere, astronomy, Northwestern University
The Physics, Observational Signatures, and Consequences of Galactic Winds Driven by Active Galactic Nuclei

Jarrod B. French, chemistry, SUNY-Stony Brook University
Structural Dynamics of Photoactive Proteins, and Crowdsourcing Structural Biology

John G. Gibbs, physics, Northern Arizona University
Investigating Shape-Dependent Emergent Collective Behavior in Artificial Active Matter Systems

Hayk Harutyunyan, physics, Emory University
Generation and Dynamics of Hot Electrons in Metal-semiconductor Hybrid Nanosystems

A. Meredith Hughes, astronomy, Wesleyan University
The Last Gasp of Planet Formation: Gas and Dust in Debris Disks

Evan N. Kirby, astronomy, California Institute of Technology
Heavy Metal: Identifying the Sites of Nucleosynthesis

Tim Kowalczyk, chemistry, Western Washington University
Mechanism and Computational Design of Energy Storage and Release in Molecular Photoswitches

Garret M. Miyake, chemistry, Colorado State University
Design Principles of Strongly Reducing Visible-Light Organic Photoredox Catalysts

Kater Murch, physics, Washington University in St. Louis
Exploring Thermodynamics of Single Quantum Systems with Continuous Measurement

Kerstin Nordstrom, physics, Mount Holyoke College
Flow in Amorphous Systems: Understanding Dynamics across Scales

Stella Offner, astronomy, University of Texas at Austin
Unveiling the Life Cycle of Stars through Cosmic Time and Enhancing Inclusivity in Astronomy

Federico A. Rabuffetti, chemistry, Wayne State University
Crystallochemical Principles of Energy Management in Solid-State Photoluminescent Materials

Chad M. Risko, chemistry, University of Kentucky
High Energy Density Metal Oxides for Energy Storage: In silico Electrochemistry to Control Interface Chemistry

Sean T. Roberts, chemistry, University of Texas at Austin
Tracking Singlet Fission with Ultrafast Time-resolved Microscopy and A Focused Research Experience for Community College Students

Eduardo Rozo, physics, University of Arizona
Shining a Light on the Dark Energy

The second-annual **Scialog: Advanced Energy Storage** conference was held in Tucson, AZ, with 58 Scialog Fellows in attendance. **Sarbajit Banerjee**, chemistry, Texas A&M, delivered the keynote speech: "Defining Conduction Pathways in Cathode Materials: Resolving Logjams through Atomistic Design and Mesoscale Structuring." **October** Cottrell Scholar (2005) **Teri Odom**, chemistry, Northwestern, was named a Fellow of the Optical Society of America. She was recognized for pioneering contributions to multi-scale plasmonic nanostructures and nanophotonics. ...The first-annual **Scialog: Chemical Machinery of the Cell** conference was held in Tucson. It was sponsored by Research Corporation, the **Gordon and Betty Moore Foundation**, the **Paul G. Allen Frontiers Group**, and the **National Institutes of Health**. Keynoters included chemists **Rommie Amaro**, UC San Diego, and **Neil Kelleher**, Northwestern. ...Scialog Fellow **Mansi Kasliwal**, Caltech, was named a Packard Fellow and will receive $875,000 to augment her Scialog funding to discover astrophysical transients such as stellar mergers, shocks, and enshrouded supernovae. ... **September** Four Cottrell Scholars were named 2018 American Physical Society Fellows: **Henriette Elvang**, (2013), U Michigan, for insights into gravitational field solutions with novel horizon geometries; **Duncan Lorimer** (2009), WVU, for the discovery of fast radio bursts and numerous contributions to pulsar science; **Teri Odom** (2005), Northwestern, for contributions to plasmonics, and to understanding plasmon-exciton interactions; **Jenny Ross** (2010), biophysics, U Mass, for significantly

advancing understanding of the self-organizational principles of the microtubule cytoskeleton. ... Two Cottrell Scholars, **Tom Maimone** (2016), UC Berkeley, and **Tehshik Yoon** (2007), UW-Madison, were recognized by ACS with Arthur C. Cope Awards. Sponsored by RCSA, the Cope honors a chemistry faculty member whose research in an undergraduate setting has contributed significantly to chemistry and to professional development of undergrads. ... **Carol Parish**, U Richmond, was designated a recipient of another RCSA-sponsored honor, the ACS Award for Research at an Undergraduate Institution. ...Cottrell Scholar (2004) **Carsten Ullrich**, physics, U Missouri, published results from his 2017 RCSA SEED award. The paper was selected as an Editor's Suggestion in Physical Review B. Ullrich fully characterized a simple model system, two interacting electrons on a two-point lattice (a "Hubbard dimer") in the presence of arbitrary magnetic fields. ... A Cottrell Scholar and a Scialog Fellow were named to the 2018 class of the Canadian Institute for Advanced Research (CIFAR) Azrieli Global Scholars: **Yogi Surendranath** (CS 2017), chemistry, MIT, and **Jenny Yang**, chemistry, UC Irvine (**Scialog: Advanced Energy Storage**). Both were cited for work in bio-inspired solar energy research. **August** Cottrell Scholar (2018) and Scialog Fellow **Luisa Whittaker-Brooks**, U Utah, was named one of the ACS Talented 12. She was cited for her explorations aimed at bringing together "optimized, advanced materials" in next-generation energy-producing devices. ... Cottrell Scholar (2015) **Luis Campos**, Columbia, joined the journal Chemical Science as an

Lisa M. Ryno, chemistry,
Oberlin College
Investigating the Impact of fliA Overexpression on the Formation and Composition of E. coli Biofilms at Different Temperatures

Alexander M. Spokoyny, chemistry,
University of California, Los Angeles
Atomically Precise Nanomaterials Based on Inorganic Clusters

Grace Y. Stokes, chemistry,
Santa Clara University
Thermodynamic Studies of Peptoid-Lipid Interactions

Brett VanVeller, chemistry,
Iowa State University
Surfing the Excited-state Energy Surface towards New Photo Reaction Strategies

Abigail G. Vieregg, physics,
University of Chicago
An Interferometric Technique for Discovering the Highest Energy Neutrinos

Luisa L. Whittaker-Brooks, chemistry,
University of Utah
Manipulating Spin and Charge Transport Dynamics in Organic-Inorganic Interfaces and Addressing the Disparity between General Chemistry and Reality

Total: $2,400,000


Ashleigh E. Baber


Jarrod B. French


Louise Charkoudian


John G. Gibbs


Nathaniel Craig


Hayk Harutyunyan


Claude-Andre Faucher-Giguere


A. Meredith Hughes


Evan N. Kirby


Kerstin Nordstrom


Sean T. Roberts


Grace Y. Stokes


Tim Kowalczyk


Stella Offner


Eduardo Rozo


Brett VanVeller


Garret M. Miyake


Federico A. Rabuffetti


Lisa M. Ryno


Abigail G. Vieregg


Kater Murch


Chad M. Risko


Alexander M. Spokoyny


Luisa L. Whittaker-Brooks

associate editor. His research interests lie in polymer chemistry, self-assembly, and organic electronic materials. … Cottrell Scholar (2001) **Bert Chandler**, chemistry, Trinity U, and a member of the Cottrell Scholar Selection Committee, was a keynote speaker at the Gold 2018 Conference in Paris. He spoke on "O2 activation over Au: three decades of lessons from CO oxidation and PrOx." … RCSA Board of Directors member **Catherine Murphy**, U Illinois Urbana-Champaign, was listed as a "Must-See Presenter" at the 256th-annual national meeting of the ACS. She discussed "Exploring the art and science of colloidal gold." Also at the Boston meeting, Cottrell Scholar (2015) **Jill Millstone**, U Pittsburgh, delivered a Kavli Foundation Emerging Leader lecture on metal-ligand chemistry; and Cottrell Scholar (2008) **Tehshik Yoon**, UW-Madison, received the Organic Letters Outstanding Publication of the Year Award. He spoke on "Expanding the scope of photocatalytic synthesis." … Also in August, six of the eight announced 2018 Henry Dreyfus Teacher Scholar Awards went to RCSA Cottrell College Award (CCSA) winners—**Nathan Bowling**, U Wisconsin-Stevens Point (CCSA 2008); Justin Hines, Lafayette College (CCSA 2012); **Jeff Knight**, U Colorado-Denver (CCSA 2013); **Korin Wheeler**, Santa Clara U (CCSA 2011); **Nathan Wright**, James Madison U (CCSA 2014); and **Kristin Wustholz**, William & Mary (CCSA 2014). … Cottrell Scholar (2010) **Jennifer Ross**, U Mass, received a $1.1M NSF grant to work at understanding how the cell's microtubule turnover and crosslinking control the organization and dynamics of the mitotic spindle. … The **Scialog: Molecules Come**

to Life team of **Pankaj Mehta**, physics, Boston U, and **Alvaro Sanchez**, biology, Yale, published August 3rd in Science detailing the results of their Scialog project on emergent simplicity in microbial communities. **July Scialog: Advanced Energy Storage** keynote speaker (2017) **Amy Prieto**, chemistry, Colorado State, discussed her work to commercialize a safer, more customizable battery in Chemical & Engineering News. Prieto is the founder, CEO, and chief scientific officer of Prieto Battery, Inc. … In 2018 RCSA's Cottrell Plus SEED (Singular Exceptional Endeavors of Discovery) Award was limited to chemistry. There were three winners: **Julio C. de Paula**, Lewis & Clark College, "Applications of Atomic and Molecular Spectroscopy to Chemical Analysis;" **David L. Patrick**, Western Washington U, "Shape Engineered Organic Single-Crystals;" and **Hai Lin**, U Colorado Denver, "Combining Artificial Neural Networks and Quantum Chemistry for Simulations of Proton Transfer." … RCSA selected **William Dichtel**, chemistry, Northwestern, as the 2018 recipient of the $250,000 Cottrell Frontiers in Research Excellence and Discovery (FRED) Award. Dichtel, a 2012 Cottrell Scholar, was recognized for his pioneering efforts to develop new methods to polymerize diverse monomers into ordered, two-dimensional polymers. … Cottrell Scholar (2018) **Luisa Whittaker-Brooks**, chemistry, U Utah, received a U.S. Department of Energy Early Career Research Program Award. She is investigating the properties of two-dimensional hybrid organic-inorganic materials for use as detectors of low-energy infrared photons. … Cottrell Scholar (2002) **Andrew Feig**, Wayne State, and Cottrell Scholar (1999) **Scott Miller**, Yale,

2018 Cottrell Scholars Collaborative Awards

At the annual Cottrell Scholar Conference, faculty are encouraged to devise collaborative projects to enhance science education and scientist career development.

Through this Cottrell Scholars Collaborative program, RCSA funded four projects in 2018 at $25,000 each.

As their faculty careers advance, Cottrell Scholars are eligible to apply for Cottrell Plus Awards to support their research and teaching, and are eligible for recognition through Cottrell Plus prizes.

Catalyzing Joint Research between Predominantly Undergraduate (PUI) and Research (R1) Institutions through the Cottrell Scholars Collaborative

Principal Investigators:

Mario Affatigato, physics, Coe College
Kathryn Haas, chemistry, Saint Mary's College
Mark Bussell, chemistry, Western Washington University
Justin Hines, chemistry, Lafayette College
Olalla Vazquez, chemistry, Philipps-Universität Marburg, Germany (through Fulbright Cottrell)
Rigoberto Hernandez, chemistry, Johns Hopkins University.

Collaboration with nine additional Cottrell Scholars.

Development of a Faculty Empowerment Network (FEN) for Tenure Track Faculty in Chemistry and Physics

Principal Investigator:

Amanda Wolfe, chemistry, University of North Carolina Asheville

Collaboration with five additional Cottrell Scholars.

Partnering with CUREnet and Professional Societies for Dissemination of CURE Curricula

Principal Investigators:

Jen Heemstra, chemistry, Emory University
Casey Londergan, chemistry, Haverford College
Rory Waterman, chemistry, University of Vermont.

Collaboration with eight additional Cottrell Scholars, with Erin Dolan (University of Georgia, CUREnet) and Lisa Elfring (University of Arizona).

Cottrell Scholars Collaborative (CSC) for a Science Communication Enabled Community

Principal Investigator:

Scott Shaw, chemistry, University of Iowa

Collaboration with eight additional Cottrell Scholars, with Toby Smith (Association of American Universities) and Brooke Smith (Kavli Foundation).

were named ACS Fellows. ...By mid-July Cottrell Scholar (2016) **Di Xiao**, a theoretical condensed matter physicist at Carnegie Mellon, had nine publications for the year, including papers in Small, Nature Photonics, Nature Nanotechnology, Science, Nature Communications, and Nature Physics, several of which acknowledge Research Corporation. ... A **Scialog: Molecules Come to Life** team comprised of physicists **Rae Robertson-Anderson**, U San Diego; **Jenny Ross**, U Mass; **Moumita Das**, RIT; and biologist **Michael Rust**, U Chicago, received a $1 million grant from **W.M. Keck Foundation** to create a revolutionary class of autonomous materials that can harness biologically derived molecular components to perform user-defined motion and work. ... The 24th-annual **Cottrell Scholar Conference** was held in Tucson beginning July 11 with a focus on key issues in STEM education. Also at the conference, 2017 FRED Award-winner **Sara Skrabalak**, chemistry, Indiana U, discussed her work in designer metal nanostructures for anti-counterfeit and anti-tamper applications. ... **Aaron Leconte**, chemistry, Claremont Colleges, was awarded a National Science Foundation CAREER grant to continue the work he launched with a CCSA. It involves engineering DNA polymerases for novel functions. **June** The Third Annual **Scialog: Time Domain Astrophysics** conference began June 1 in Tucson with 50 conferees focused on the recent data release of Gaia's 3D census of the Milky Way. Keynote speakers included **Boris Gänsicke**, U Warwick; **Hans-Walter Rix**, Max Planck Institute for Astronomy, and **Keivan Stassun**, Vanderbilt. ... CCSA winner **Joe Reczek**, chemistry, Denison U,

and colleagues, made the cover of Advanced Materials with a paper on films of organic charge-transfer liquid crystals originally developed in his lab with RCSA funding. ... Organometallics, an ACS journal, released a virtual issue dedicated to undergraduate research contributions. It contained 24 articles, 15 of them from PUI faculty supported by RCSA's CCSA program, now merged with Cottrell Scholars. Five of the 15 faculty (**Tim Clark**, U San Diego; **Jeff Johnson**, Hope College; **John Gilbertson**, Western Washington U; **Dipannita Kalyani**, St. Olaf College; and **Matt Whited**, Carleton College) were named Cottrell Scholars when the programs merged. ... CCSA recipient **Paul Cadden-Zimansky**, Bard College, and five undergrad co-authors, published a paper in the Journal of Physics Communications regarding anomalous conductance in hybrid graphene crystals. ... RCSA Senior Program Director **Silvia Ronco** attended the Fulbright-Cottrell Junior Faculty Professional Development Workshop 2018 in Berlin, Germany. Among the workshop facilitators were six American Cottrell Scholars—**Andrew Feig**, chemistry, Wayne State; **Rory Waterman**, chemistry, U Vermont; **Kathryn Haas**, chemistry, St. Mary's College; **Carla Fröhlich**, astrophysics, North Carolina State; **Rigoberto Hernandez**, chemistry, Johns Hopkins; and **Jairo Sinova**, physics, Johannes Gutenberg-U. ... Scialog Fellow **Matteo Cantiello** co-authored a paper in Physical Review Letters which was designated an Editor's Suggestion. The topic: hydrodynamic simulations of gamma ray jets emerging from a collision of neutron stars detected in 2017 by the nearly simultaneous arrival on Earth of gravitational waves and a gamma-ray

2018 Cottrell Plus Awards

Cottrell Scholars are eligible for a suite of awards after they have received tenure, awards collectively known as Cottrell Plus. These include SEED, FRED, TREE (Transformational Research and Excellence in Education) and LEAD awards.

SEED Awards are competitive grants to launch new projects in research at $50,000 each or education at $25,000 each.

FRED winners are awarded $250,000 for a high-risk/high-reward project with the potential to transform a significant area of research.

TREE winners are awarded $25,000 each for excellence in reasearch and education and LEAD winners are awarded $25,000 each for leadership initiatives. 2018 was the final year for the TREE and LEAD awards.

2018 SEED Awardees

Julio C. de Paula, chemistry,
Lewis & Clark College
Chemical Analysis: Free REsources for Undergraduate Education

David L. Patrick, chemistry,
Western Washington University
Shape Engineered Organic Single-Crystals

Hai Lin chemistry,
University of Colorado Denver
Combining Artificial Neural Networks and Quantum Chemistry for Simulations of Proton Transfer through Channels and Transporters

2018 FRED Awardee

William Dichtel,
Robert L. Letsinger Professor of Chemistry,
Northwestern University
To develop new methods to polymerize diverse monomers into ordered, two-dimensional polymers with unprecedented control of their covalent structure, crystal size and shape, and higher-order assembly.

2018 TREE Awardees

Martin Gruebele, chemistry,
University of Illinois

Teri Odom, chemistry,
Northwestern University

George Shields, chemistry,
Furman University

2018 LEAD Awardee

Penny Beuning
chemistry,
Northeastern University

Note: The TREE and LEAD awards will be replaced in future years by two prizes: Cottrell Plus STAR (excellence in Science Teaching And Research) and Cottrell Plus IMPACT (recognizing the work of Cottrell Scholars who have had a national impact in science through their leadership and service activities).

burst. ... The June 11 issue of Chemistry & Engineering News highlighted Stanford chemical engineer **Stacey Bent**'s research on the cover and in an article about selective surface patterning for next-generation microelectronics. Bent has been a Cottrell Scholar since 1999. ... Cottrell Scholar (2017) **Nathaniel Gabor**, UC Riverside, published a paper entitled, "Electron quantum metamaterials in van der Waals heterostructures," in Nature Nanotechnology. This paper followed an earlier Nature Nanotechnology publication by Gabor, and both papers acknowledged Research Corporation support. ... **May** Cottrell Scholar (2007) **Jeanne Hardy**, chemistry, U Mass, received the school's inaugural Mahoney Life Sciences Prize. Hardy's research focuses on a key protein linked to neurological disorders such as Alzheimer's disease. ... Three Cottrell Scholars were elected to the **National Academy of Sciences** (NAS) in recognition of their distinguished and continuing achievements in original research. They were **Lars Bildsten** (CS 1998), Frederick W. Gluck Chair in Theoretical Physics and director, Kavli Institute for Theoretical Physics, UC Santa Barbara. He is also a member of the RCSA Board of Directors. **Vicky Kalogera** (CS 2004), Daniel I. Linzer Distinguished University Professor of Physics and Astronomy and director, Center for Interdisciplinary Exploration and Research in Astrophysics, Northwestern. **David Mac Millan** (CS 2001), James S. McDonnell Distinguished University Professor of Chemistry, Princeton. There are now 11 Cottrell Scholars who are members of NAS. **April** Cottrell Scholar (2013) **Eric J. Schelter**, U

Penn, was written up in Chemical & Engineering News for his work with a methanol dehydrogenase (MDH) enzyme that has a rare-earth element, lanthanum, at its heart, allowing a rare autotrophic microbe, *Methylacidiphilum fumariolicum*, to function. … Scialog Fellows **Brian K. Hammer**, microbiology, Georgia Tech; **Raghuveer Parthasarathy**, physics, U Oregon; and **Joao Xavier**, a researcher at the Memorial Sloan-Kettering Cancer Center, produced a paper for the Proceedings of the National Academy of Sciences revealing a "remarkable and unexpected" discovery concerning how cholera invades a host organism. They witnessed a 200-percent increase in the strength of intestinal contractions soon after exposure to the cholera-causing bacterium *Vibrio cholera*e, leading to expulsion of native gut bacteria due to toxic proteins injected by *Vibrio*'s harpoon-like injection system. … Cottrell Scholar (1995) **Tom Solomon**, Bucknell U, published a paper in Physical Review E which was designated an Editors' Suggestion. It presents an experimental study on chemical reaction fronts propagating in fully three-dimensional fluid flows, and shows there can be one-way barriers that hinder the motion of fronts. … Cottrell Scholar (2012) and FRED Award-winner **Will Dichtel**, Northwestern, was among only 16 researchers in the natural sciences and two in chemistry named in a new class of 173 Guggenheim Foundation fellows. … Cottrell Scholars **Kristen Nordstrom** (2018), Mount Holyoke, and **Jennifer Ross** (2010), U Mass, were among co-authors of a paper, "For SHE's a Jolly Good Fellow?" —a Back Page feature on the subject of gender inequity in the April

2018 Scialog Collaborative Innovation Awards

Through the 2018 Scialog Collaborative Innovation Awards program, Research Corporation for Science Advancement (RCSA) and three of its sister science philanthropies funded a total of $2.9 million in seed funding for cutting-edge research on the topics: **Advanced Energy Storage, Chemical Machinery of the Cell, Time Domain Astrophysics, and Molecules Come to Life.**

The program was created in 2010 by RCSA, which oversees its administration. Scialog—which stands for "science dialogue"—funds early career scientists to pursue transformative research, in dialogue with their fellow grantees, on crucial issues of scientific inquiry. In the round of conferences for 2018, The Alfred P. Sloan Foundation, the Gordon and Betty Moore Foundation and the Heisings-Simons Foundation contributed considerable funding to support Scialog collaborative projects.

The following pages include a breakdown of 2018 Scialog funding by topic.

Advanced Energy Storage

Goal: to catalyze theorists, computational scientists, and experimentalists across multiple disciplines to collaborate on developing new and innovative projects to accelerate fundamental science driving advances in energy storage.

Funded by the Sloan Foundation

Kah Chun Lau, physics,
California State University, Northridge
Yuan Yang, physics, Columbia University
Tianbiao Leo Liu, chemistry, Utah State University, UT

Water in Redox Active Ionic Liquid (WIL) Electrolytes for Energy Storage

Candace Chan, materials science,
Arizona State University
Hui (Claire) Xiong, materials science,
Boise State University
Anne C. Co, chemistry, Ohio State University

Solid Electrolyte Interphase (SEI) "Skin Grafts"

Venkat Viswanathan, mechanical engineering, Carnegie Mellon University
Lauren E. Marbella, chemical engineering,
Columbia University
Partha Mukherjee, mechanical engineering,
Purdue University

e-COBRA: eutectic Co-deposition Based Rechargeable Anodes

Total: $330,000

Funded by RCSA

Luisa L. Whittaker-Brooks, chemistry, University of Utah
Partha Mukherjee, mechanical engineering,
Purdue University
Beth S. Guiton, chemistry, University of Kentucky

Probing the Mechanistics of a Molecularly Tailored Solid/Solid Interface

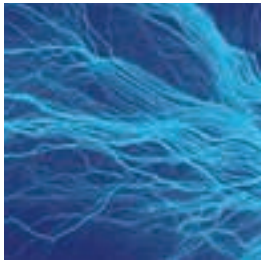
Bryan McCloskey, chemical and biomolecular engineering, University of California, Berkeley
Louis Piper, physics, SUNY - Binghamton University

Scaling the sensitivity gap to probe interfaces of high-voltage cathodes

Yuan Yang, physics, Columbia University
Shyue Ping Ong, nanoengineering,
University of California, San Diego
Yan-Yan Hu, chemistry, Florida State University

Solid Electrolytes with Entropy-Enhanced Ionic Conductivity and Stability for High-Energy-Density Lithium Batteries

Total: $330,000



edition of American Physical Society News. ... Four Cottrell Scholars were named Fellows of the American Association for the Advancement of Science (AAAS): **Peter Dorhout** (CS 1994), current president of the ACS, vice president for research at Kansas State and a member of the RCSA Board of Directors; **Sean Decatur** (CS 1996), president of Kenyon College; **Jeffrey Johnson** (CS 2008), chemistry, Hope College; and **Karen Bjorkman** (CS 1999), dean of the College of Natural Sciences and Mathematics and professor of astronomy at U Toledo. **March** Cottrell Scholar (2005) **Teri Odom**, Northwestern, and the executive editor of ACS Photonoics, was the subject of an ACS video highlighting her research and her concern for her students. Odom is a 2018 RCSA TREE Award winner and a 2016 RCSA SEED Award winner. ... With launch funding from RCSA, the American Institute of Physics (AIP) TEAM-UP Task Force began investigating reasons for the persistent underrepresentation of African American undergraduate students in physics and astronomy. The Task Force is conducting its work over a two-year period. ... Cottrell Scholar (2014) **Jenn Prescher**, UC-Irvine, was identified by Chemical & Engineering News editors as a must-see presenter at the ACS National Meeting. She discussed spying on cellular communication with chemical probes and non-invasive imaging as part of a symposium on Chemical Tools for Investigating Biological Systems. ... Cottrell Scholar (2018) and Scialog Fellow **Luisa Whittaker-Brooks**, chemistry, U Utah, delivered the Stanford R. Ovshinsky Sustainable Energy

Fellowship Talk at the APS March Meeting. The Ovshinsky Fellowship recognizes and offers seed funding for promising exploratory research aimed at energy sustainability. ... Cottrell Scholar (2001) **Bert Chandler**, Trinity U, along with a number of colleagues, published in Nature Chemistry on how benzyl alcohol oxidation Hammett studies can be used to characterize differences in the catalytic activity of gold nanoparticles hosted on various metal-oxide supports. This knowledge has important implications for many industrial processes. **February** The annual **Cottrell Scholars Collaborative Academic Leadership Workshop** was held in late February at ACS headquarters in Washington, D.C., with 35 people in attendance. The intensive 48-hour event was open to faculty in the physical sciences interested in becoming future academic leaders. The event featured sessions led by current and former institutional administrators—including RCSA President **Daniel Linzer**, the former provost of Northwestern. Other participating mentors included 2018 ACS President **Peter Dorhout,** ACS Board Member **Rigoberto Hernandez** and a number of Cottrell Scholars. ... RCSA Board Member **David L. Wenner's** love of physics was featured in Physics Today. The magazine did an extensive write-up of Wenner's private library, which held original works from Copernicus, Maxwell, Einstein and others. The Niels Bohr Library and Archives, part of the American Institute of Physics, has since acquired Wenner's physics collection. ... Cottrell Scholar (2006) and Scialog Fellow **Keivan Stassun**, senior associate dean for graduate education and research,

Chemical Machinery of the Cell

Goal: To catalyze breakthroughs in developing our fundamental understanding of chemical processes in the living cell that will lead to a new era of advancement in cell biology.

Funded by the Moore Foundation

Juan R. Perilla, chemistry, University of Delaware
Gulcin Pekkurnaz, neurobiology,
University of California, San Diego
Abhishek Chatterjee, chemistry, Boston College
Finding Mitochondrial Memory

Gulcin Pekkurnaz, neurobiology,
University of California, San Diego
Jennifer A. Prescher, chemistry,
University of California, Irvine
Markita del Carpio Landry, chemical and biomolecular engineering, University of California, Berkeley
Optical Mind Reading

Jing-Ke Weng, biology,
Massachusetts Institute of Technology
Alice Soragni, biochemistry,
University of California-Los Angeles
Kathryn L. Haas, chemistry, Saint Mary's College
A plant cell-based platform to target human proteostasis diseases

Jennifer M. Heemstra, chemistry, Emory University
Abhishek Singharoy, molecular sciences,
Arizona State University-Tempe Campus
Kamil Godula, chemistry,
University of California, San Diego
What does "self" look like?

Total: $956,250

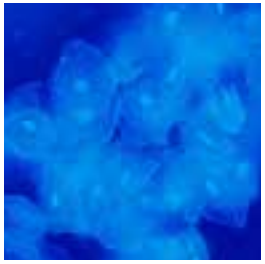
Lu Wei, chemistry, California Institute of Technology
Judith Su, optical sciences and biomedical engineering,
University of Arizona
Understanding Biological Systems Using Resonator-Mediated Single-Molecule Raman Detection and Spectroscop

David Limmer, chemistry,
University of California, Berkeley
Christian Kaiser, biology, Johns Hopkins University
Rebecca Voorhees, biology,
California Institute of Technology
Breaking the central dogma: Reverse translation of the proteome

Funded by RCSA

Joshua Widhalm, horticulture, Purdue University
Jing-Ke Weng, biology,
Massachusetts Institute of Technology
Markita del Carpio Landry, chemical and biomolecular engineering,
University of California, Berkeley
Synthetic organelle biology: Engineering photosynthetic animal cells

Total: $165,000



Time Domain Astrophysics

Goal: To accelerate our understanding of stars and their life-cycles, as well as to promote innovative projects based on new emerging datasets from Gaia and other space-based surveys that are likely to be disruptive for astrophysics

Funded by the Heising-Simons Foundation

Timothy Brandt, physics,
University of California, Santa Barbara
Jackie Faherty, astronomy,
The American Museum of Natural History
Acceleration Today: Finding, Weighing, and Characterizing New Degenerate Companions to Nearby Stars

Sergey Koposov, physics, Carnegie Mellon University;
Joshua Peek, astronomy, Space Telescope Science Institute
Data at Your Fingertips: A Real-Time Discovery Engine for Gaia

Kaitlin Kratter, physics, University of Arizona Foundation
Nicholas M. Law, physics,
University of North Carolina at Chapel Hill
James Fuller, physics, California Institute of Technology
Quickening Heartbeats: Measuring Tidal Orbital Decay in Eccentric Young Binaries

Yue Shen, astronomy,
University of Illinois at Urbana-Champaign
Nadia Zakamska, physics, Johns Hopkins University
Discovery of Sub-kpc Binary SMBHs from Gaia with Variability-Induced Astrometric Jitter

Gail Zasowski, physics, University of Utah
Carles Badenes, physics, University of Pittsburgh
Mapping Explosive Enrichment

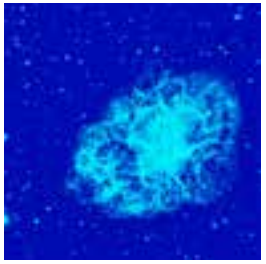
Total: $550,000

Funded by RCSA

Keith Hawkins, astronomy, University of Texas at Austin
Gail Zasowski, physics, University of Utah
Kaitlin Kratter, astronomy, University of Arizona
A Gaia-Enabled View of Chemical Homogeneity

Daniel Huber, astronomy, University of Hawaii
Melissa Ness, astronomy, Columbia University
Expanding the Time-Domain Revolution: Stellar Parameters from Every Light Curve

Total: $220,000



Vanderbilt College of Arts and Science, was named winner of the 2018 AAAS Mentor Award. Stassun was selected for personally mentoring dozens of underrepresented minority students and for building "innovative mentoring models that bridge critical attrition points in the development of underrepresented minority physicists and astronomers." ... Cottrell Scholar (2010) and Scialog Fellow **Sarbajit Banerjee**, Texas A&M, and co-workers, including Scialog Fellow **Jordi Cabana**, U Illinois Chicago, announced a breakthrough in multivalent cation batteries—the first viable intercalation cathode for Mg-ion batteries that exhibits high voltage, high capacity, and excellent cyclability. Their paper was published in the Cell Press journal Chem. ... Cottrell Scholar (2004) **Bhuvnesh Jain**, U Penn, and a co-worker published a paper in Physical Review Letters which was designated an Editor's Suggestion and was also highlighted in Physics. Their work was one of four papers limiting the possibilities for viable theories of gravity as alternatives to General Relativity.
January ACS announced Cottrell Scholar (2015) **Emily Balskus**, Harvard, would be honored with an Arthur C. Cope Scholar Award. Balskus was cited for "transforming our understanding of the chemistry and biology of microbes and their communities and for elucidating their remarkable mechanism for chemical production."... Cottrell Scholar (2015) and Scialog Fellow **Lisa Manning**, Syracuse U, and co-workers, including former Scialog facilitator **Cristina Marchetti**, also Syracuse, published a paper in Physical Review Letters, subsequently highlighted in Physics. The researchers presented a model for cellular populations incorporating neighbor-specific

interactions to explain sharp boundaries observed around biological tissues. … In mid-January RCSA co-sponsored an **APS Conference for Undergraduate Women in Physics** at the Rochester Institute of Technology. More than 150 students attended. Cottrell Scholar (2009) **Kathy Aidala**, Mount Holyoke, gave one of the keynote talks, and CCSA recipients and RIT faculty **Moumita Das** and **Scott Franklin** served on the organizing committee. … Cottrell Scholar (2009) **Penny Beuning** was named RCSA's 2018 LEAD Award winner just as she was assuming the role of director of graduate studies for the Northeastern Department of Chemistry and Chemical Biology. She said the LEAD Award would help her develop programming to maximize effectiveness in her new role. … Cottrell Scholar (2016) **Sharon Gerbode**, Harvey Mudd College, and eight undergraduates published a paper in Physical Review Letters on how to sculpt a crystal. The paper has been designated an Editor's Suggestion and was also highlighted in Physics. Gerbode and her students developed a new technique using optical blasting, which allows for complete control over the shapes of individual sub-crystals within a larger crystal and could lead to new ways to modify material properties. … And last, but certainly not least, Cottrell Scholar (1994) **Peter K. Dorhout**, a member of the RCSA Board of Directors, appeared on the cover of Chemical & Engineering News January 1 in his role as president of the American Chemical Society. Dorhout is also vice president for research and a professor of chemistry at Kansas State University. In a lengthy article he pledged to concentrate his leadership role in the year ahead on engaging industry to enhance education and to "improve the face of chemistry."

Molecules Come to Life—2017 Second Year

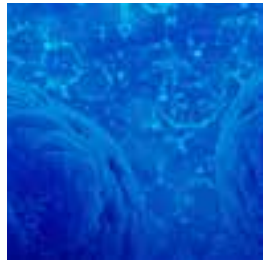
Goal: To bring together early career scientists from physics and biology interested in pursuing collaborative, high-risk, highly impactful discovery research on untested ideas in physical cell biology.

Funded by RCSA

Minsu Kim, physics, Emory University
Kirill S. Korolev, physics, Boston University
The Evolutionary Dynamics of Temporal Division of Labor

Laura Lackner, molecular biosciences, Northwestern University
Suckjoon Jun, physics, University of California, San Diego
Principles of Organelle Copy Number Homeostasis

Total: $220,000

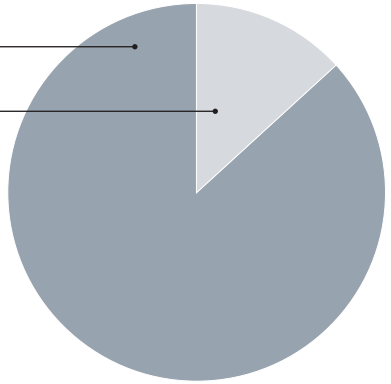


2018 Financial Summary

Where Our Money Goes

Program Expenses, Including Grants & Awards **86%**

General & Administrative Costs **14%**



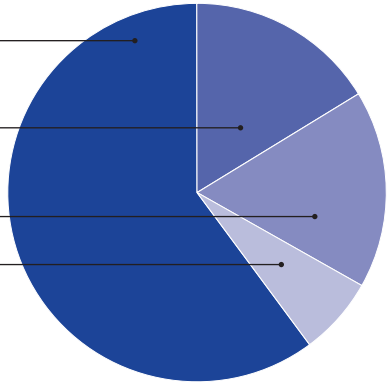
Total Expenses $7.4 million

Cottrell Scholars Awards **59%**

Scialog Collaborative Awards (excludes $1.9 million in partner awards) **23%**

Cottrell Career Advancement, FRED, & Collaborative Awards **14%**

Discretionary Grants & Special Initiatives **4%**



Grants and Awards $4.0 million

Net Assets at Beginning of Year **$171.8 million**
Net Assets at End of Year **$163.9 million**

The financial activities of Research Corporation for Science Advancement were audited by Beach Fleischman, PC. For the complete audited financial statements, please visit our website at rescorp.org.

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Vice President and Chief Financial Officer

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Executive Vice
President,
Emerita, Sandia
National Laboratories

Active Emeriti
Stuart Crampton
Robert Hallock
Robert Holland, Jr.
Suzanne Jaffe
Gayle Jackson
Elizabeth McCormack
Patrick Osmer
John Schaefer

RCSA provides catalytic funding for research and sponsors conferences to support:

- Early career faculty
- Innovative ideas for basic research
- Integration of research and science teaching
- Interdisciplinary research
- Building the academic leadership of the future

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