RESEARCH CORPORATION
for SCIENCE ADVANCEMENT

2021 Annual Report

The Power of Collaboration

Letter from the President

Research Corporation for Science Advancement's programs focus on catalyzing collaborations and creating inclusive communities of scientists across the physical sciences and other, closely related fields. We take that same approach in the design and development of those programs by encouraging participation of a broad array of individuals and funders. Looking back on 2021, I want to call special attention to all these partners who believe in what we are doing to support early career scientists, and who have made it possible to target more resources to address significant needs and opportunities.

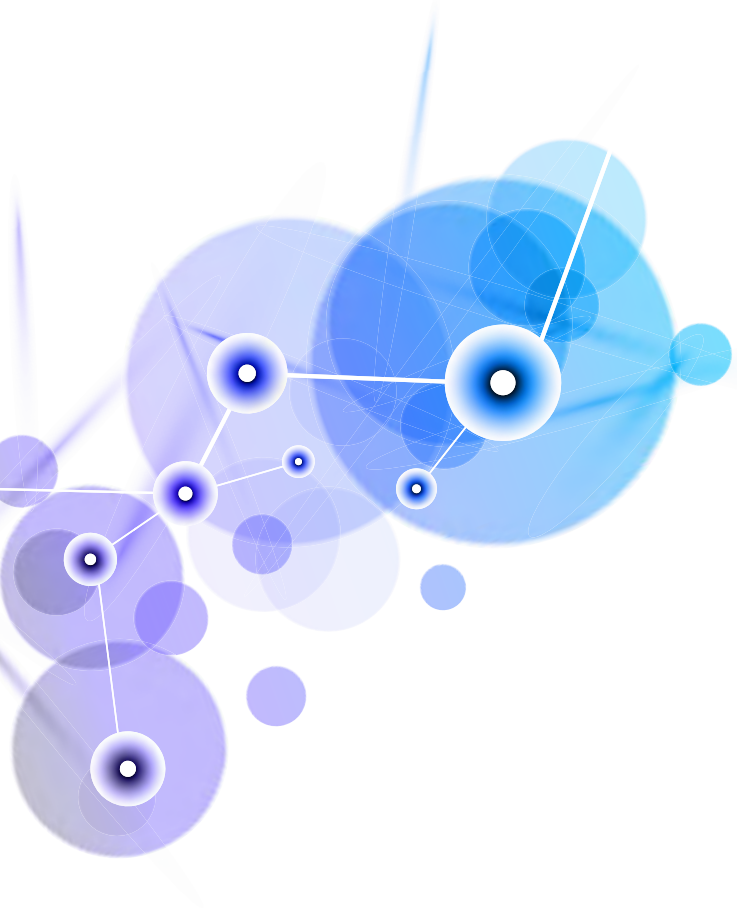
For our Cottrell Scholar community, the second year of partnership with the National Science Foundation enabled us to support a larger cohort of senior postdoctoral fellows whose plans were derailed by the pandemic as institutions canceled faculty searches. The case for RCSA to pivot and address this need was made by Cottrell Scholars, who saw firsthand the potential disruption for some of the most talented and accomplished scientists who were on the verge of launching their independent careers. The Cottrell Scholar community has been critically important in guiding the foundation to direct resources into additional initiatives, including a post-baccalaureate program and an expansion of our diversity, equity, and inclusion efforts.

For our Scialog program, 2021 marked the first year that we were able to offer Scialogs on six different themes of global importance. The shaping of these themes and the identification of early career faculty as Scialog Fellows arose from discussions with senior scientists, many of whom then served as Scialog Facilitators, and with other foundations and federal funding agencies that joined RCSA as cosponsors. That so many other funders worked with us on these initiatives is a vote of confidence in our programming. These partnerships allow us to achieve a much greater impact than we would have with just our own, limited resources, and greatly expand the network of scientists who benefit from cross-disciplinary interactions as they explore new research directions. Our thanks go to the Paul G. Allen Frontiers Group, the Chan Zuckerberg Initiative, the Frederick Gardner Cottrell Foundation, the Heising-Simons Foundation, the Gordon and Betty Moore Foundation, the Alfred P. Sloan Foundation, and the U.S. Department of Agriculture as our major cosponsors, and to Climate Pathfinders, the Kavli Foundation, and the National Aeronautics and Space Administration for their participation and support during the past year.

As you read through the many highlights of the past year, please join me in celebrating the organizations that helped make all this possible by joining with RCSA to support groundbreaking, basic research on critical challenges, and the scientists who carried out these studies and who are educating and training the next generation of scientific leaders.

Daniel Linzer
President & CEO
Research Corporation for Science Advancement

2021 Awards



In 2021, Research Corporation for Science Advancement supported early career scientists at colleges and universities in the United States and Canada through two core programs: the **Cottrell Scholar Program** and **Scialog**.

The **Cottrell Scholar Program** develops outstanding teacher-scholars recognized by their scientific communities for the quality of their research programs, innovation in education, and potential for academic leadership. In 2021, Cottrell Scholar Program funding included $2.5 million for 25 initial Cottrell Scholar Awards, $75,000 for three Cottrell Scholars Collaborative Awards, and $265,000 for eight Cottrell Plus Awards, which include the competitive SEED, STAR and IMPACT awards. A second year of Cottrell Fellowships awarded $971,250 to 14 Cottrell Scholars to support postdocs working in their labs or groups. Three of these awards were funded through a grant from the National Science Foundation.

Scialog promotes dialogue and community-building to catalyze transformational science through collaborative, interdisciplinary research. In 2021, RCSA awarded $1,424,000 to early career scientists for research through Scialog Collaborative Innovation Awards. The contributions of partner philanthropies toward Scialog awards brought this total to $7,065,000. Funding partners in 2021 included the Paul G. Allen Frontiers Group, the Chan Zuckerberg Initiative, the Frederick Gardner Cottrell Foundation, the Heising-Simons Foundation, the Kavli Foundation, the Gordon and Betty Moore Foundation, NASA, the Climate Pathfinders Foundation, the Alfred P. Sloan Foundation, and the U.S. Department of Agriculture.

Cottrell Scholar Awards

$100,000 is awarded to each scholar for a total of $2,500,000

Vinayak Agarwal

Chemistry, Georgia Institute of Technology

Unlocking Marine Eukaryotic Natural Product Biosynthetic Schemes in Research and Education

Rachel S. Bezanson

Astronomy, University of Pittsburgh

Building Bridges in the Steel City: Leveraging the Nearby to Follow Galaxies Across Cosmic Time

Joel F. Destino

Chemistry, Creighton University

Bottoms Up: Investigating the Growth and Glass-Forming Properties of Germania-Containing Colloids

Jeanine Amacher

Chemistry, Western Washington University

Investigating Sortase Enzyme Activity and Specificity Using Natural Sequence Variation and Ancestral Sequence Reconstruction

Laura Blecha

Physics, University of Florida

The Making of a Gravitational Wave Source: Probing the Role of Galaxy Assembly in Black Hole Binary and Triple Formation

Daniela Fera

Chemistry, Swarthmore College

Dissecting the Interactions and Conformations of Protein Kinases to Understand Biochemical Signaling

Jeffrey Bandar

Chemistry, Colorado State University

Salt-Promoted Electron Transfer Processes for Reductive Cross-Coupling Reactions

Justin R. Caram

Chemistry, University of California, Los Angeles

Chemical Physics Informed Design of SWIR Emissive Molecules

Alex Frañó

Physics, University of California, San Diego

Creating Artificial Angstrom-scale Periodic Potentials Using X-ray Standing Waves and Enhancing Creativity in Physics Education

Thomas L. Gianetti

Chemistry,
University of Arizona

Developing a Photo-Rechargeable and Symmetrical Organic Redox Flow Battery

Alexis C. Komor

Chemistry, University of California, San Diego

Harnessing Precision Genome Editing Tools to Study DNA Repair Proteins in Live Cells

Davit Potoyan

Chemistry,
Iowa State University

Uncovering Principles of Bio-molecular Condensation: from Single Molecules to Cellular Organelles

Natalie M. Gosnell

Astronomy, Colorado College

Constraining the Complexities of Stellar Activity with Sub-Subgiant Stars

Eli M. Levenson-Falk

Physics, University of Southern California

Creating Custom Quantum Environments with Superconducting Circuits (For Beginners)

Tyler D. Robinson

Astronomy,
Northern Arizona University

Understanding the True Utility of Prior Mass Constraints in Characterizing Exoplanet Atmospheres and Diversifying STEM at NAU

Christopher H. Hendon

Chemistry,
University of Oregon

Inorganic Defects in Metal-Organic Frameworks

Rosario Porras-Aguilar

Physics, University of North Carolina at Charlotte

Label-Free Reconfigurable Microscopy with High Specificity

Brian J. Shuve

Physics, Harvey Mudd College

Matter-Antimatter Asymmetry from Dark Matter Freeze-In

Marcelle Soares-Santos

Physics,
University of Michigan

Cosmology with Merging Black Holes and Neutron Stars

Rongsheng (Ross) Wang

Chemistry, Temple University

A Fluorine Displacement Based Bioorthogonal Labeling Approach to Interrogate Non-Histone Substrates of "Histone" Deacetylases

Gail Zasowski

Astronomy,
University of Utah

Understanding the Chemical Enrichment of Our Universe: Unifying Evidence from the Milky Way and Other Galaxies

Ruby May A. Sullan

Chemistry, University of Toronto-Scarborough

Multifunctional and Stimuli-Responsive Nanotherapeutic Platform for Targeted Disruption of Bacterial Biofilms

Leah S. Witus

Chemistry,
Macalester College

Investigation of Beta-Hairpin Hydrolytic Peptides and Development of an Advanced Undergraduate Scientific Communication Course

Alexandra Velian

Chemistry,
University of Washington

Synthesis of Functional Metal Chalcogenide Lattices Using Symmetry-Encoded, Atomically Precise Clusters

Joseph M. Zadrozny

Chemistry,
Colorado State University

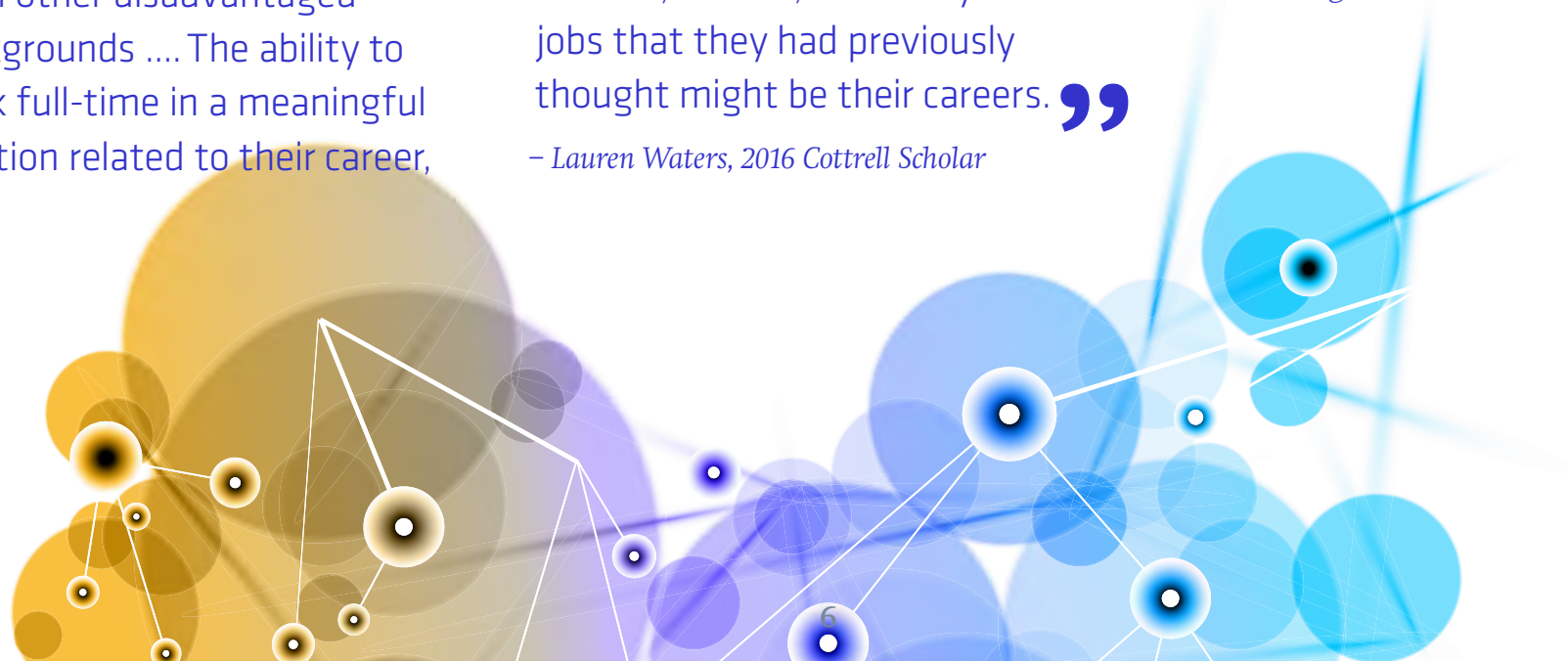
Harnessing Ligand-Shell Nuclear Spins to Control Molecular Spin Coherence

“**The awards** from RCSA supported not just me, but many research students, a large number of whom were first-generation, non-traditional, from underrepresented groups, from other disadvantaged backgrounds .... The ability to work full-time in a meaningful position related to their career, to discover that they can achieve great things in science, and to receive one-on-one guidance from a mentor can be life-changing for students who would otherwise spend their summers in retail, service, or factory jobs that they had previously thought might be their careers.”

– Lauren Waters, 2016 Cottrell Scholar

“**Incredibly grateful** to RCSA for all of their support over the years and for relentless efforts to make academia more equitable and inclusive.”

– Sarbajit Banerjee, 2010 Cottrell Scholar and Scialog Facilitator



Cottrell Scholar Collaborative Awards

At the annual Cottrell Scholar Conference, participants are encouraged to form teams and develop collaborative projects with potential national impact in science education. Through the Cottrell Scholar Collaborative program, RCSA funded three projects in 2021 at $25,000 each to support efforts to make higher education more inclusive and equitable.

Cottrell Scholar Collaborative as Bridge for National DEI Efforts

This project seeks to develop connections and promote partnerships between Cottrell Scholars and scientific societies and identity groups in science. In addition to developing an action guide to how individual faculty can contribute to any of these programs, the project aims to host a workshop to help foster relationships among allied organizations and individuals.

Lead Cottrell Scholar:

Rory Waterman
Chemistry, University of Vermont

In collaboration with additional Cottrell Scholars:

Jeanine Amacher
Chemistry, Western Washington University

Penny Beuning
Chemistry, Northeastern University

Rachel Bezanson
Astronomy, University of Pittsburgh

Laura Blecha
Physics, University of Florida

Jeffery Byers
Chemistry, Boston College

Lou Charkoudian
Chemistry, Haverford College

Catherine Kealhofer
Physics, Williams College

Charles McCrory
Chemistry, University of Michigan

David Strubbe
Physics, University of California, Merced

Jesús Velázquez
Chemistry, University of California, Davis

Also with:

Philip “Bo” Hammer
University of Chicago

Cottrell Scholar Collaborative Awards

Art and the Creative STEM Classroom

This project seeks to build a community of STEAM educators to create evidence-based modules incorporating non-traditional activities such as drawing or making, 3D printing, and other creative skills into undergraduate physics and chemistry classrooms, with the aim of improving student understanding of basic concepts and problem-solving skills, improving student communication about scientific ideas, and improving retention of historically underrepresented groups.

Lead Cottrell Scholar:

Elisabetta Matsumoto
Physics, Georgia Tech

In collaboration with additional Cottrell Scholars:

Tim Atherton
Physics, Tufts University

Adam Leibovich
Physics, University of Pittsburgh

Gina MacDonald
Chemistry, James Madison University

Julio de Paula
Chemistry, Lewis and Clark College

Paul Raston
Chemistry, James Madison University

Jenny Ross
Physics, Syracuse University

A Cottrell Scholar Workshop on Authentic Grading in STEM and Holistic Evaluation of Students' Performance

This project seeks to help faculty develop more authentic and equitable assessments of student abilities by hosting a workshop for the participants to hear about different grading practices that are becoming more widely used in academia, and to extend the discussion toward a more holistic interpretation of students' abilities by going beyond measures like the GPA or GRE scores.

Lead Cottrell Scholar:

Mario Affatigato
Physics, Coe College

In collaboration with additional Cottrell Scholars:

Michael Dennin
Physics, University of California, Irvine

Daniela Fera
Chemistry, Swarthmore College

Alex Frañó
Physics, University of California, San Diego

Carla Fröhlich
Physics, North Carolina State University

Katie Mouzakis
Chemistry, Loyola Marymount University

Rosario Porras-Aguilar
Physics, University of North Carolina at Charlotte

Juliane Simmchen
Chemistry, Technische Universität Dresden

Hanadi Sleiman
Chemistry, McGill University

Claire Till
Chemistry, Humboldt State University

Lauren Waters
Chemistry, University of Wisconsin-Oshkosh

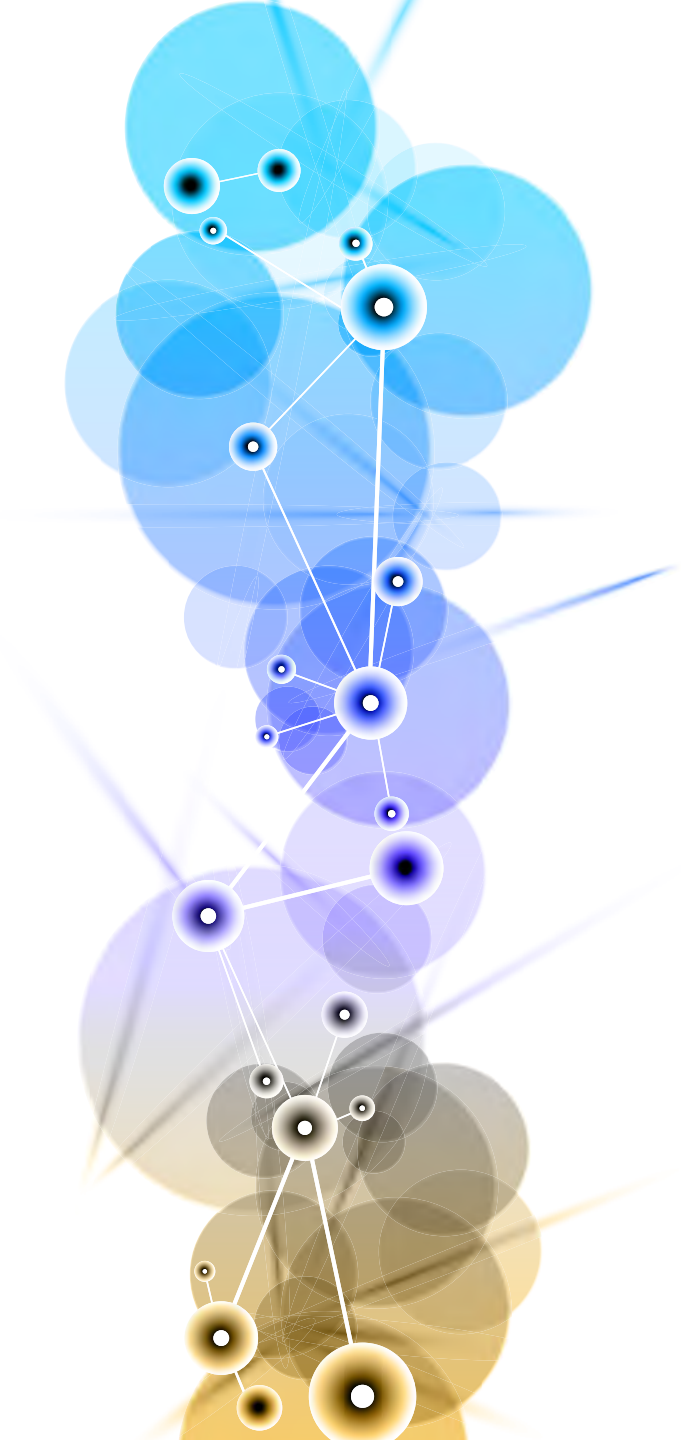
Also with:

Aaron Teator
Chemistry, University of Kansas

Cottrell Plus Awards

As their scientific careers advance, Cottrell Scholars are eligible to receive post-tenure Cottrell Plus Awards to further support their research and educational activities. In 2021, SEED, IMPACT and STAR awards were given. **SEED** (Singular Exceptional Endeavors of Discovery) Awards are competitive grants to launch new projects in research at $50,000 each or education at $25,000 each. (In 2021, all SEED awards were for research.)

STAR (excellence in Science Teaching And Research) Awards of $5,000 recognize the outstanding research and educational accomplishments of Cottrell Scholars and encourage the improvement of science education at American and Canadian universities and colleges. **IMPACT** Awards of $5,000 recognize the work of a Cottrell Scholar who has had a national impact in science through their leadership and service activities.



Cottrell Plus Awardees

SEED

David DeMille
Cottrell Scholar 2000
Physics,
University of Chicago
Developing a New Tabletop-scale Approach to Detect Particles One Million Times More Massive than the Higgs Boson

SEED

John-David Smith
Cottrell Scholar 2012
Astronomy,
University of Toledo
Tiny Grains Across the Cosmos —The First Physical Models of PAH Emission in Cosmological Simulations in Tissue Regeneration

STAR

Tim Clark
Cottrell Scholar 2007
Chemistry,
University of San Diego

SEED

Jonathan Friedman
Cottrell Scholar 2002
Physics,
Amherst College
Spin-Clock Transitions in Silica Defects

SEED

Ziqiang Wang
Cottrell Scholar 1996
Physics,
Boston College
Correlated and Topological Quantum States in Transition-metal Kagome Lattice Materials

STAR

Hanadi Sleiman
Cottrell Scholar 2002
Chemistry,
McGill University

SEED

Steven Majewski
Cottrell Scholar 1998
Astronomy,
University of Virginia
Optical Fibers for Astronomical Imaging: Development and Use of the DIstributed Field Fiber Imaging Testbed (DIFFIT)

IMPACT

Penny Beuning
Cottrell Scholar 2009
Chemistry,
Northeastern University

Cottrell Fellowships

RCSA awarded $971,250 to 14 Cottrell Scholars to support the work of postdoctoral fellows whose plans to start independent academic or research careers this year were delayed or derailed due to institutional hiring freezes resulting from the pandemic. Three of these awards were funded through a $225,000 grant from the National Science Foundation.

Funding was provided by (1) RCSA and (2) the National Science Foundation.

Timothy Atherton (postdoc **J. Anna Philips**) [1]
Tufts University
Understanding Students' Expectations for Agency in Hands-On Learning Environment

William Dichtel (postdoc **Anna Yang**) [1]
Northwestern University
Porous Polymer Adsorbent for Sequestering Emerging Contaminants from Water

Mircea Dincă (postdoc **Ruperto Mariano**) [1]
Massachusetts Institute of Technology
Mechanistic Studies of O_2 Electroreduction to H_2O_2 Using Conductive MOFs at Current Densities >100 mA cm^{-2}

Gordana Dukovic
(postdoc **Katherine E. Shulenberger**) [2]
University of Colorado Boulder
Light-Driven Catalysis: Mechanistic Insights into Quantum Dot-Enzyme Hybrid Systems

Keary Engle (postdoc **Malkanthi K. Karunananda**) [2]
Scripps Research Institute
Predictive Computational Models for the Development of Challenging Ni-Catalyzed Alkene Difunctionalizations with Transient Directing Groups

Claude-André Faucher-Giguére (postdoc **Luke Kelley**) [2]
Northwestern University
Multi-Messenger Signatures of Massive Black Hole Binaries

Joshua Figueroa (postdoc **Shuai (Vincent) Wang**) [1]
University of California, San Diego
Synthesis and Exploration of Carbyne Complexes of the Late 3d Transition Metals

Daniel Gamelin (postdoc **Matthew Crane**) [1]
University of Washington
Tailoring Spin Dephasing in Metal-Halide Perovskites for Next-Generation Computing Applications

Taekjip Ha (postdoc **Yang Liu**) [1]
Johns Hopkins University School of Medicine
Hijacking CRISPR-Cas9 as a Molecular Tool for Biology and Medicine

Alexis Komor (postdoc **Zsolt Bodai**) [1]
University of California, San Diego
Investigations of DNA Repair Genes' Involvement in Base Editing and Development of a Hands-On Undergraduate Course on Genome Editing at UCSD

Stella Offner (postdoc **Dávid Guszejnov**) [1]
University of Texas at Austin
The Role of Different Physical Processes in Star Formation

Eric Schelter (postdoc **Nate Hirscher**) [1]
University of Pennsylvania
Aerobic, Photolytic Upgrading of Hydrocarbon Feedstocks

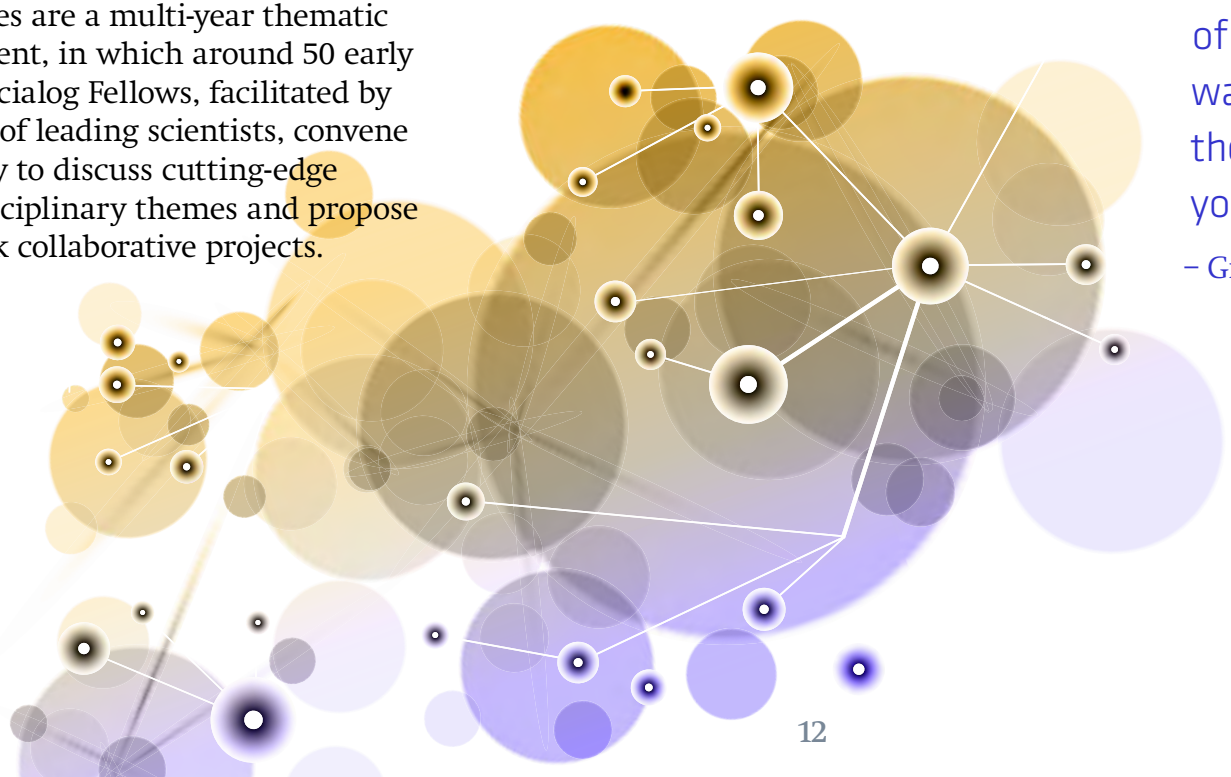
Keivan Stassun (postdoc **Nina Hernitschek**) [1]
Vanderbilt University
Machine-Learning Applications for Variable Stars in the LSST and TESS Astronomical Surveys

Ann West (postdoc **Meghan Kemper**) [1]
University of Oklahoma
Elucidating the Role of a Novel Response Regulator in Sporulation of Clostridiodes difficile

Scialog Collaborative Innovation Awards

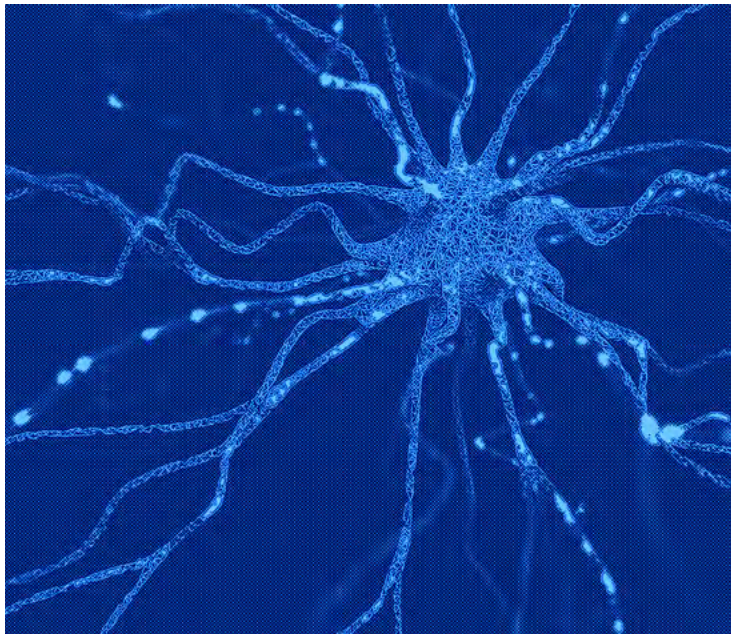
The Scialog program was created in 2010 by RCSA, which oversees its administration. Scialog—short for "science + dialog"—funds early career scientists to pursue transformative research with their fellow grantees on crucial issues of scientific inquiry. Scialog initiatives are a multi-year thematic investment, in which around 50 early career Scialog Fellows, facilitated by a group of leading scientists, convene annually to discuss cutting-edge multidisciplinary themes and propose high-risk collaborative projects.

Due to the pandemic, RCSA convened six virtual Scialog conferences in 2021. Through Scialog Collaborative Innovation Awards, RCSA along with its funding partners provided a total of $7,065,000 in seed funding for collaborative team projects.



> **"Conventional funding** sources provide specific guidelines and encourage you to 'color inside the lines.' What's nice about Scialog is it's a plain sheet of paper. You draw what you want, and the more interesting the drawing, the more colors you can bring to it, the better."
>
> – Greeshma Gadikota, Scialog awardee

Scialog: Advancing BioImaging
Year 1



Scialog: Advancing BioImaging
Year 1

Goal: To catalyze early career chemists, physicists, biologists, bioengineers and medical imaging specialists to collaborate on new and innovative projects to accelerate the development of the next generation of imaging technologies. Each of 23 individual awards was for $50,000 in direct costs.

Funding for the awards was provided by (1) RCSA and and the Frederick Gardner Cottrell Foundation (2) the Chan Zuckerberg Initiative.

Aseema Mohanty [1]
Electrical and Computer Engineering, Tufts University

Sixian You [1]
Electrical Engineering and Computer Science, Massachusetts Institute of Technology

NeedleScope: Developing the Smallest Microscope for Bioimaging

Nick Galati [1]
Biology, Western Washington University

Shannon Quinn [1]
Computer Science, University of Georgia

Doug Shepherd [1]
Physics, Arizona State University

4-D Molecular Tracking Using Kilohertz Framerate Multi-Modal Microscopy

Luke Mortensen [1]
Chemical, Materials and Biomedical Engineering, University of Georgia

Aniruddha Ray [1]
Physics and Astronomy, University of Toledo

Nanophotonic Probes for Ultra-Deep Functional Multiphoton Imaging

Yevgenia Kozorovitskiy [1]
Neurobiology, Northwestern University

Ping Wang [1]
Radiology, Michigan State University

Light-Sheet Imaging of 3D Bioprinted Islet Organoids Structure and Function

Benjamin Bartelle [2]
Biological and Health Systems Engineering, Arizona State University Fulton School of Engineering

Ulugbek Kamilov [2]
Computer Science and Engineering and Electrical and Systems Engineering, Washington University in St. Louis

Lu Wei [2]
Chemistry and Chemical Engineering, California Institute of Technology

Enabling Noninvasive Lipid Profiling with Intermodal Deep Learning

Aseema Mohanty [2]
Electrical and Computer Engineering, Tufts University

Srigokul Upadhyayula [2]
Molecular and Cell Biology, University of California, Berkeley

Chip-scale Light Sheet for High Spatiotemporal Resolution Imaging

Carolyn Bayer [2]
Biomedical Engineering, Tulane University

Allison Dennis [2]
Biomedical Engineering, Boston University

Deep Tissue Photoacoustic Imaging with Degradable Inorganic Nanoparticles

Carolyn Bayer [2]
Biomedical Engineering, Tulane University

Sapun Parekh [2]
Biomedical Engineering, University of Texas at Austin

Paris Perdikaris [2]
Mechanical Engineering and Applied Mechanics, University of Pennsylvania

Machine Learning to Identify Soft Tissue Molecular Signatures

Barbara Smith [2]
Biological and Health Systems Engineering, Arizona State University

Bryan Spring [2]
Physics, Northeastern University

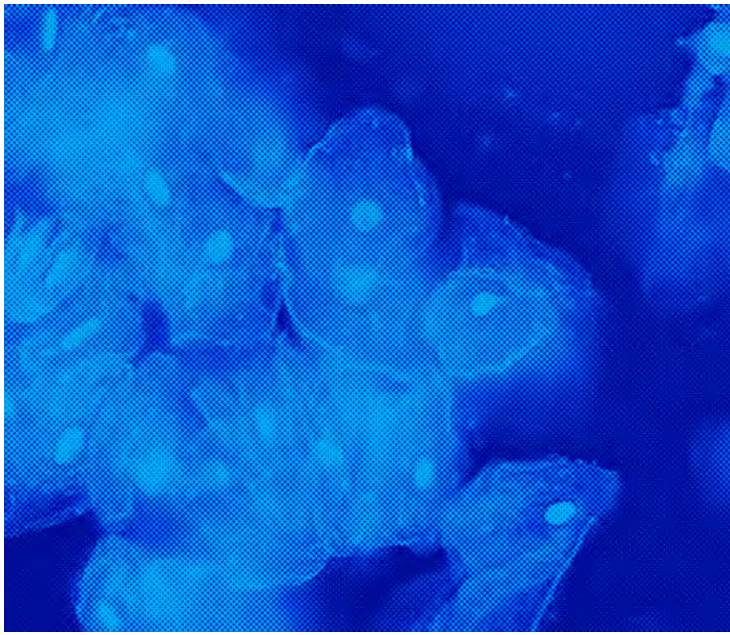
Microendoscopy-Guided Diagnosis and Treatment of Early-Stage Ovarian Cancer

Lisa Poulikakos [2]
Mechanical and Aerospace Engineering, University of California, San Diego

Douglas Shepherd [2]
Physics, Arizona State University

Wide-Field, Single-Pixel Fluorescence Imaging with On-Chip Nanophotonics

Scialog: Chemical Machinery of the Cell
Year 3



Scialog: Chemical Machinery of the Cell
Year 3

Goal: To spark collaborative research that could accelerate breakthroughs in fundamental understanding of chemical machinery and reactions in the intact cell. Each of the 24 individual awards was $55,000.

Funding was provided by RCSA and the Gordon and Betty Moore Foundation.

Julien Berro
Molecular Biophysics and Biochemistry, and Cell Biology, Yale University

Alexander Green
Biomedical Engineering, Boston University

Intercepting the Cell's Hidden Signals via Peptide-Activated RNA Switches

Caitlin Davis
Chemistry, Yale University

Lars Plate
Chemistry and Biological Sciences, Vanderbilt University

Structure-Function of Enzyme Filaments: Regulators of Cell Metabolism in Space and Time

W. Seth Childers
Chemistry, University of Pittsburgh

Stephen Fried
Chemistry, Johns Hopkins University

Ross Wang
Chemistry, Temple University

Toward an Atlas of All Biomolecular Condensates

W. Seth Childers
Chemistry, University of Pittsburgh

Elizabeth Read
Chemical and Biomolecular Engineering, University of California, Irvine

Haoran Zhang
Chemical and Biochemical Engineering, Rutgers University

Putting Bacteria to Sleep: Establishing an Artificial Circadian Clock

Maria Kamenetska
Chemistry and Physics, Boston University

Jan-Hendrik Spille
Physics, University of Illinois at Chicago

Lu Wang
Chemistry and Chemical Biology, Rutgers University

The Butterfly Effect in Cellular Phase Separation: from Molecular Interactions to Emergent Behavior

Jan-Hendrik Spille
Physics, University of Illinois at Chicago

Stephen Yi
Biomedical Engineering & Oncology, University of Texas at Austin

Visualizing Inheritance through the Lens of Phase Separation

Stephanie Gupton
Cell Biology and Physiology, University of North Carolina at Chapel Hill

Alexis Komor
Chemistry and Biochemistry, University of California, San Diego

Yan Yu
Chemistry, Indiana University

Elucidating the Polygenic Origins of Schizophrenia: Linking Protein Trafficking to Synapse Function

Ronit Freeman
Applied Physical Sciences, University of North Carolina at Chapel Hill

Lydia Kisley
Physics and Chemistry, Case Western Reserve University

Laura Sanchez
Pharmaceutical Sciences, University of Illinois at Chicago

Stretching Reality to Discover the (un)Knowns

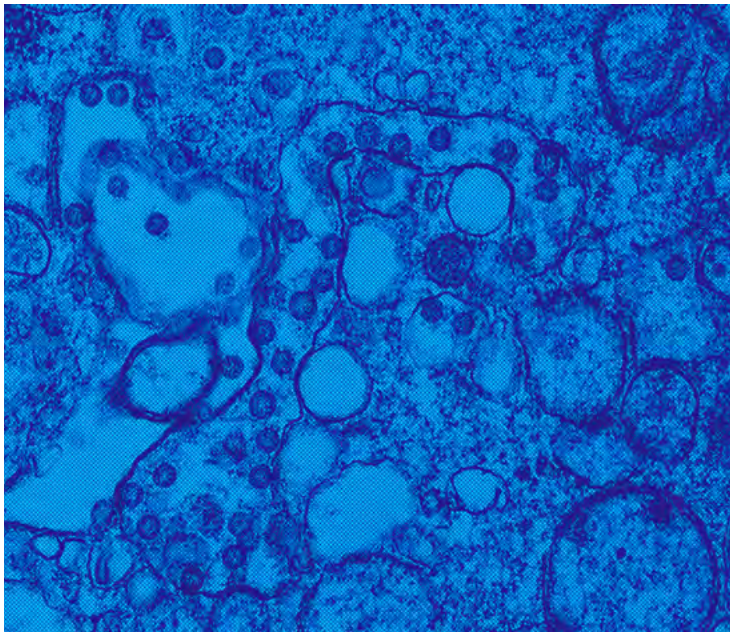
Stephen Fried
Chemistry, Johns Hopkins University

Tania Lupoli
Chemistry, New York University

Wenjing Wang
Chemistry and Life Sciences Institute, University of Michigan

Decoding Host-Pathogen Molecular Cross-talk via Unbiased Multiplex Profiling

Scialog: Mitigating Zoonotic Threats
Year 1



Scialog: Mitigating Zoonotic Threats
Year 1

Goal: To catalyze multidisciplinary teams of early career scientists to launch new research in the detection and mitigation of emerging animal-borne infectious diseases. Each of the 25 individual awards was for $50,000 in direct costs.

Funding was provided by RCSA and the U.S. Department of Agriculture.

Tavis Anderson
Virus and Prion Research Unit, USDA

Cheryl Andam
Biological Sciences, University at Albany, SUNY

Nicole Eikmeier
Computer Science, Grinnell College

Darwin's Naturalization Conundrum Predicts Inter-species Pathogen Transmission Potential

Bethany McGregor
Arthropod Borne Animal Diseases Research Unit, USDA

Paola Boggiatto
Infectious Bacterial Diseases Research Unit, USDA

Jason Ladner
Biology, Northern Arizona University

Enabling Comprehensive Immunoprofiling in Animals through a Combination of Xenosurveillance and Highly-multiplexed Serology

Laurene Tetard
Physics/Nanoscience Technology Center, University of Central Florida

Bethany McGregor
Arthropod Borne Animal Diseases Research Unit, USDA

Employing Color-Changing Nanomaterials to Improve |Vector-borne Disease Surveillance

Gonzalo Vazquez Prokopec
Environmental Sciences, Emory University

Tavis Anderson
Virus and Prion Research Unit, USDA

Invasion Ecology and Genomics of Emerging Tick Borne Arboviruses: Predicting Niche Expansion of Heartland Virus Following the Invasion of Asian Longhorned Ticks in the U.S.

Paola Boggiatto
Infectious Bacterial Diseases Research Unit, USDA

Liliana Salvador
Infectious Diseases and Institute of Bioinformatics, University of Georgia

Host Adaptation of Mycobacterium bovis: A Comparative Transcriptomics Study of M. bovis Infection in a Multi-host System

Pilar Fernandez
Paul G. Allen School for Global Animal Health, Washington State University

Matthew Hopken
National Wildlife Research Center, USDA

Characterizing the Socio-ecological Spillover Interface by Xenosurveillance of Pathogen Metacommunities Using a Novel Insect Group

Crystal Hepp
School of Informatics, Computing, and Cyber Systems, Northern Arizona University

Silvie Huijben
School of Life Sciences, Arizona State University

Kezia Manlove
Wildland Resources and Ecology Center, Utah State University

Estimating Aedes aegypti Spillover Potential and Evaluation of Current Mitigation Strategies

Joyce Jose
Biochemistry and Molecular Biology, Pennsylvania State University

Kristin Koutmou
Chemistry, University of Michigan

Discovering How RNA Epigenomic Modifications Impact Flavivirus Replication Speed and Fidelity

Hannah Frank
Ecology and Evolutionary Biology, Tulane University

Daniel Becker
Biology, University of Oklahoma

Jason Ladner
Biology, Northern Arizona University

Efrem Lim
School of Life Sciences, Arizona State University

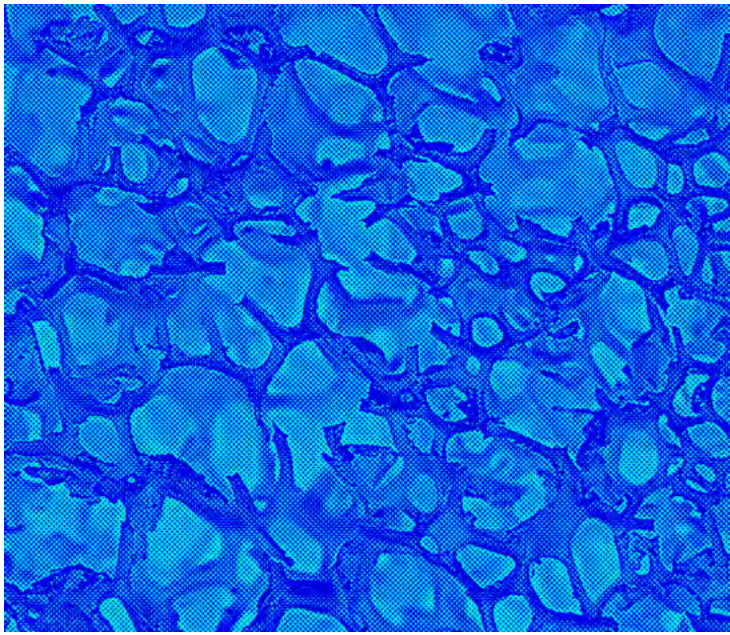
Zoonotic Implications of Host Genetics, Immunity, and Virome in Bats

Dana Mitzel
Foreign Arthropod-Borne Animal Disease Unit, USDA's National Bio and Agro-Defense Facility

Joyce Jose
Biochemistry and Molecular Biology, Pennsylvania State University

Understanding Viral Factors Responsible for Vector Adaptation and Spillover for Surveillance and Mitigation of Zoonotic Flaviviruses with Pandemic Potential

Scialog: Negative Emissions Science
Year 2



Scialog: Negative Emissions Science
Year 2

Goal: To catalyze chemists, engineers, environmental scientists and those in related fields to collaborate on innovative projects to advance fundamental understanding of capturing and utilizing or sequestering carbon and other greenhouse gases in the atmosphere and oceans. Each of the 22 individual awards was $55,000.

Funding was provided by (1) RCSA, with support from the Climate Pathfinders Foundation, and (2) Alfred P. Sloan Foundation.

Matthew Green [2]
Chemical Engineering, Arizona State University

Gary Moore [2]
School of Molecular Sciences,
Arizona State University

Emily Ryan [2]
Mechanical Engineering, Boston University

Electrocatalytic Activation and Cycling of Moisture-Swing Direct Air Capture Materials

Zhou Lin [1]
Chemistry, University of Massachusetts Amherst

Yayuan Liu [1]
Chemical and Biomolecular Engineering,
Johns Hopkins University

Sen Zhang [1]
Chemistry, University of Virginia

Carbon Dioxide-Methane Coupling with Electric-Field-Polarized Microelectrodes

Marta Hatzell [2]
Mechanical Engineering,
Georgia Institute of Technology

Kathryn Knowles [2]
Chemistry, University of Rochester

Jose Mendoza [2]
Chemical Engineering and Materials Science,
Michigan State University

Photochemical Amine Production from N_2 and CO_2

David Kwabi [2]
Mechanical Engineering, University of Michigan

Michael Nippe [2]
Chemistry, Texas A&M University, College Station

Carbon Dioxide Removal from Seawater Driven by a Visible Light-Induced pH Gradient

Matthew Green [1]
Chemical Engineering, Arizona State University

Katherine Hornbostel [1]
Mechanical Engineering and Materials Science,
University of Pittsburgh

Jenny Yang[1]
Chemistry, University of California, Irvine

Novel Membrane Design for Hybrid Ocean Capture and Desalination

Charles McCrory [2]
Chemistry, University of Michigan

Carlos Morales-Guio [2]
Chemical and Biomolecular Engineering,
University of California, Los Angeles

Electrified Low-Temperature Process for CO_2 Capture and Conversion (e-LT-C3)

Andrea Hicks [1]
Civil and Environmental Engineering,
University of Wisconsin-Madison

Chong Liu [1]
Chemistry and Biochemistry,
University of California, Los Angeles

Haotian Wang [1]
Chemical and Biomolecular Engineering,
Rice University

CO_2 Conversion to Bioplastics via Electrochemical-Bio Synthesis

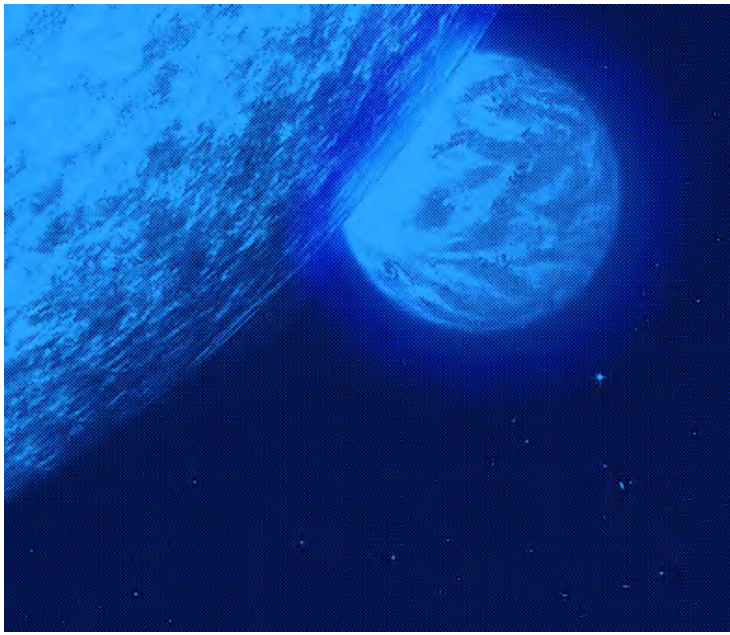
Adam Holewinski [1]
Chemical and Biological Engineering,
University of Colorado Boulder

Katherine Hornbostel [2]
Mechanical Engineering and Materials Science,
University of Pittsburgh

Yuanyue Liu [1]
Mechanical Engineering, University of Texas at Austin

Electric-Swing Solid State Sorbents for Direct Air Capture of CO_2

Scialog: Signatures of Life in the Universe
Year 1



Scialog: Signatures of Life in the Universe
Year 1

Goal: To catalyze cutting-edge research with the potential to transform our understanding of the habitability of planets, of how the occurrence of life alters planets and leaves signatures, and of how to detect such signatures beyond Earth. Each of the 20 individual awards was $55,000.

Funding was provided by (1) the Heising-Simons Foundation, (2) RCSA, (3) NASA, and (4) RCSA with Kavli Foundation support.

Greg Fournier [1]
Earth, Atmosphere and Planetary Sciences, Massachusetts Institute of Technology

Stilianos Louca [2]
Biology, University of Oregon

Can the Search for Oxygenated Atmosphere Biosignatures Lead to False Negatives?

Jen Glass [2]
Earth and Atmospheric Sciences, Georgia Institute of Technology

Edwin Kite [4]
Geophysical Sciences, University of Chicago

Smadar Naoz [2]
Physics and Astronomy, UCLA

Methane from Nontraditional Abiotic Sources and Potential for False Biosignature Positives

Marc Neveu [3]
Astronomy / Planetary Environments Laboratory, NASA Goddard Space Flight Center / University of Maryland

Ziming Yang [2]
Chemistry, Oakland University

How may Biosignatures in Icy Ocean Worlds be Affected by Plume Ejection?

Laurie Barge [3]
Planetary Sciences, NASA Jet Propulsion Laboratory

Jeffrey Marlow [2]
Biology, Boston University

Synthetic Mineral Geo-Electrodes for Detecting Life on Ocean Worlds

Rika Anderson [2]
Biology, Carleton College

Noah Planavsky [2]
Geology and Geophysics, Yale University

Long Term Controls on the Scope of Earth's Biosphere

Bradford Foley [1]
Geosciences, Pennsylvania State University

Kimberly Lau [1]
Geosciences, Pennsylvania State University

Stephanie Olson [1]
Earth, Atmospheric, and Planetary Science, Purdue University

Water, Water Everywhere … Drops to Drink but Nothing to Eat? A Model for the Evolution of Ocean Chemistry on Waterworlds

Aaron Engelhart [1]
Genetics, Cell Biology, and Development, University of Minnesota

Meredith MacGregor [1]
Astrophysical and Planetary Sciences, University of Colorado Boulder

Laura Schaefer [1]
Geological Sciences, Stanford University

Could Nucleic Acid-Based Life Survive on Oxygen-Rich M Dwarf Planets?

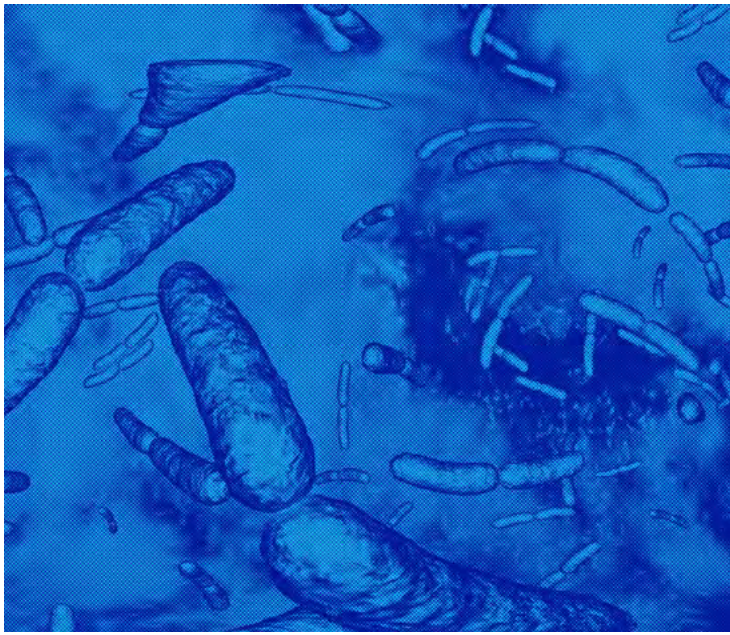
Edwin Kite [1]
Geophysical Sciences, University of Chicago

Stilianos Louca [1]
Biology, University of Oregon

Chris Reinhard [1]
Earth and Atmospheric Sciences, Georgia Institute of Technology

Stochastic Simulation of Evolving Planetary Biospheres

Scialog: Microbiome, Neurobiology and Disease
Year 1



Scialog: Microbiome, Neurobiology and Disease
Year 1

Goal: To catalyze interdisciplinary teams including chemists, physicists, biologists and neurophysiologists to collaborate on new projects to advance fundamental understanding of the gut-brain axis and the roles microbiota play in neurodegenerative disorders. Each of the 14 individual awards was $55,000.

Funding was provided by RCSA, the Paul G. Allen Frontiers Group, and the Frederick Gardner Cottrell Foundation.

Elaine Hsiao
Integrative Biology and Physiology, University of California, Los Angeles

Amina Schartup
Scripps Institution of Oceanography

Mei Shen
Chemistry, Neuroscience Program, Beckman Institute, University of Illinois at Urbana-Champaign

Harnessing the Microbiome to Combat the Neurotoxic Effects of Dietary Mercury

Nandita Garud
Ecology and Evolutionary Biology, University of California, Los Angeles

Will Ludington
Embryology, Carnegie Institution

Do Aging Microbiomes Evolve Pathogenicity Via Gene Shedding? Using Evolutionary Theory to Deconstruct Microbiome-based Neurodegeneration

David Durgan
Anesthesiology, Baylor College of Medicine

Abhishek Shrivastava
Life Sciences, Arizona State University

Do Bacterial Outer Membrane Vesicles (OMVs) Act as Modulators of Microbiota-brain Communication Involved in the Development of Neurological Diseases?

Faranak Fattahi
Biochemistry and Biophysics, University of California, San Francisco

Mark Mimee
Microbiology and Pritzker School of Molecular Engineering, University of Chicago

Species-specific Modulation of Human Enteric Neurons by Gut Microbiome Metabolites

Maayan Levy
Microbiology, University of Pennsylvania

Ashley Ross
Chemistry, University of Cincinnati

Kai Zhang
Biochemistry, University of Illinois at Urbana-Champaign

Engineering Enteric Neuron Activity to Enhance Antimicrobial Immunity in the Gut

Carolina Tropini
Microbiology and Immunology, School of Biomedical Engineering, University of British Columbia

JP Yu
Radiology, Psychiatry, and Biomedical Engineering, University of Wisconsin-Madison

Impact of Missing Microbes on Brain Development

2021 Year in Review

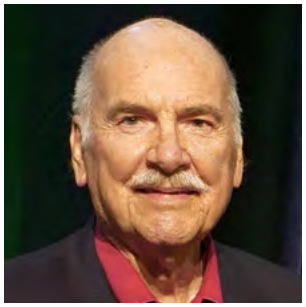
January

2019 Scialog: Time Domain Astrophysics team award recipients **James Davenport**, Astronomy, University of Washington, and **Timothy Brandt**, Physics, University of California, Santa Barbara, presented a paper analyzing more than 125 years of astronomical observations of a nearby eclipsing stellar binary called HS Hydrae at the 237th meeting of the American Astronomical Society, and their work was selected for an invited press conference at the meeting.

Pablo Jarillo-Herrero, Massachusetts Institute of Technology, received the NAS Award for Scientific Discovery for his pioneering developments in nanoscience and nanotechnology. The biennial award was endowed by RCSA and the Frederick Gardner Cottrell Foundation in honor of former RCSA president **John P. Schaefer**. It was presented, along with a medal, a $50,000 prize, and $50,000 to support the recipient's research, during the National Academy of Sciences' 158th annual meeting.

Scialog: Chemical Machinery of the Cell Fellow and team award recipient **Juan Perilla**, Chemistry and Biochemistry, University of Delaware, who is researching the mechanical properties of virus particles, was quoted in a New York Times article: *"If You Squeeze the Coronavirus, Does it Shatter?"*

Jennifer Wilcox, Scialog: Negative Emissions Science Facilitator and Science Advisory Committee member, became Principal Deputy Assistant Secretary for Fossil Energy for the U.S. Department of Energy. Her work will help set policy for the transition to a clean-energy economy.



John P. Schaefer

Jennifer Wilcox

Scialog: Advanced Energy Storage Fellows and collaborative award recipients **Matthew McDowell**, Materials Science and Mechanical Engineering, Georgia Tech, and **Partha Mukherjee**, Mechanical Engineering, Purdue, and their coworkers have observed the behavior of electrode materials inside solid-state lithium batteries as they charge and discharge. The research was reported in the January 28 edition of Nature Materials. **Neil Dasgupta**, Mechanical Engineering, University of Michigan, is also a member of the team. Their research could help pave the way for better battery design.

February

Have signs of life been detected on Venus? A team led by Scialog: Signatures of Life in the Universe Facilitator **Victoria Meadows** weighed in on the controversy in a New York Times article, *"Life on Venus? The Picture Gets Cloudier,"* which referenced the team's paper in The Astrophysical Journal Letters exploring the detectability of phosphine and sulfur dioxide in the Venetian atmosphere. The team includes SLU Fellows **Giada Arney**, Planetary Systems Laboratory, NASA Goddard Space Flight Center, and **Edward Schwieterman**, Earth and Planetary Sciences, University of California, Riverside, and Facilitators **Niki Parenteau** and **Shawn Domagal-Goldman**.

Four Scialog Fellows (one also a Cottrell Scholar) were selected as Allen Distinguished Investigators for research projects in the emerging field of immunometabolism. Scialog: Microbiome, Neurobiology and Disease Fellows **Nandita Garud**, Department of Ecology and Evolutionary Biology, University of California, Los Angeles, and **Carolina Tropini**, Microbiology and Immunology, University of British Columbia, will explore the variation between patients with inflammatory bowel disease. Cottrell Scholar 2014 and Scialog: Chemical Machinery of the Cell awardee **Jennifer Prescher**, Chemistry, University of California, Irvine, will work with Molecules Come to Life awardee **Michelle Digman**, Biomedical Engineering, University of California, Irvine, to research tools to better understand the immune system.

Two Cottrell Scholars and six Scialog Fellows were awarded 2021 Sloan Research Fellowships: CS 2020 **Carlos Baiz**, Chemistry, University of Texas at Austin; CS 2018 **Luisa Whittaker-Brooks**, Chemistry, University of Utah; Time Domain Astrophysics Fellow **Timothy Brandt**, Physics, University of California, Santa Barbara; Negative Emissions Science Fellow **Robert Gilliard**, chemistry, University of Virginia; Chemical Machinery of the Cell Fellow **Julia Kalow**, Chemistry, Northwestern University; Chemical Machinery of the Cell Fellow **David Limmer**, Chemistry, University of California, Berkeley; Chemical Machinery of the Cell Fellow **Steven Townsend**, Chemistry, Vanderbilt University; and Advanced Energy Storage and Negative Emissions Science Fellow **Haotian Wang**, Chemical and Biomolecular Engineering, Rice University.

Two Cottrell Scholars received 2021 Analytical Division Awards from the American Chemical Society. CS 2009 **Lane Baker**, Chemistry, Indiana University at Bloomington, received the Award in Electrochemistry. CS 2002 **Neil L. Kelleher**, Chemistry, Northwestern University, received the Award in Chemical Instrumentation.

Scialog: Molecules Come to Life Fellows **M. Lisa Manning**, Physics, Syracuse University, and **Margaret Gardel**, Physics, University of Chicago, published a paper in the Proceedings of the National Academy of Sciences. Manning, who is also a 2015 Cottrell Scholar, says their research into the architecture and mechanics of epithelial tissue was set in motion by the collaboration developed through a 2015 Scialog team award.

March

How do conferences spark scientific collaborations? **Emma Zajdela** and **Daniel Abrams**, Applied Mathematics, Northwestern University, are working with RCSA data analyst **Kimberly Huynh** and program directors **Andrew Feig** and **Richard Wiener** to study data on interactions at Scialog conferences and create dynamical models for understanding the rapid formation of teams of researchers who have not previously collaborated. Zajdela gave a presentation on this research at the American Physical Society's March meeting.

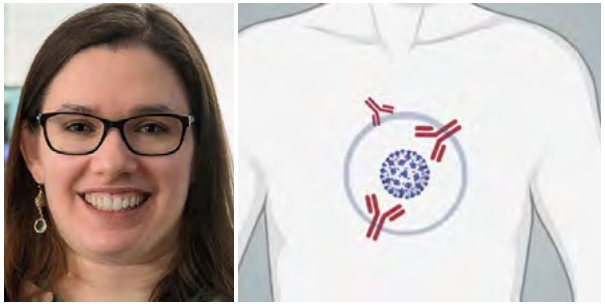
RCSA Senior Program Director **Richard Wiener** chaired a session on communicating science to the public at the 2021 APS March Meeting. Invited presenters included **Ira Flatow** of Science Friday, **Ann Merchant** of the National Academy of Sciences, and **Dennis Overbye** of The New York Times.

Scialog: Negative Emissions Science Fellow **Robert J. Gilliard Jr.**, Chemistry, University of Virginia, received Organometallics' 2021 Distinguished Author Award.

Fulbright-Cottrell Scholar 2016 **Olalla Vazquez**, Chemistry, Philipps-Universität Marburg, was named recipient of the Ars legendi Faculty Prize

for excellent university teaching. Her course on epigenetics combines lectures, discovery-based research, and science communication.

Designing a course for her 2021 Cottrell Scholar proposal led to a pandemic hobby for **Leah Witus**, Chemistry, Macalester College. That hobby, making animated science videos, resulted in an unexpected research project that offered timely and useful insights into public health messaging around COVID-vaccine hesitancy. Her findings were featured in an article in The New York Times, and her video explaining mRNA vaccines for English-speaking viewers of all ages was later released in Spanish and Arabic as well.



Leah Witus and her video explaining mRNA vaccines

April

More than 50 Fellows from multiple disciplines and institutions across the U.S. and Canada gathered virtually April 22-23 for the inaugural meeting of Scialog: Microbiome, Neurobiology and Disease, a three-year initiative to brainstorm creative, new research ideas that could advance our understanding of the gut microbiome and its relationship to the brain and neurobiology.

Two Cottrell Scholars and a Scialog Fellow were keynote speakers April 7 at the American Chemical Society meeting. The National Science Foundation-sponsored session *"Toward Sustainable Chemistry—Reinventing Catalysis,"* led by Division of Chemistry Director **David Berkowitz**, included presentations from: CS 2004 **Paul Chirik**, Chemistry, Princeton University; Scialog: Advanced Energy Storage Fellow **Jenny Yang**, Chemistry, University of California, Irvine; and CS 2007 **Tehshik Yoon**, Chemistry, University of Wisconsin, Madison.

Scialog: Time Domain Astrophysics Fellows **Yue Shen**, Astronomy, University of Illinois at Urbana-Champaign, and **Nadia Zakamska**, Physics and Astronomy, Johns Hopkins University, published a paper in Nature Astronomy based on their 2018 Scialog-seeded team project.

Cottrell Scholar 2004 and Scialog: Time Domain Astrophysics Facilitator **Vicky Kalogera**, Physics and Astronomy, Northwestern University, was awarded a 2021 Guggenheim Foundation Fellowship.

Two Cottrell Scholars were elected to the American Academy of Arts and Sciences: CS 2004 **Vicky Kalogera**, Physics and Astronomy, Northwestern University; and CS 1994 **Nancy Makri**, Chemistry, University of Illinois at Urbana-Champaign. Members are leaders from around the world who serve as experts on challenges facing society, identify solutions, and promote nonpartisan recommendations that advance the public good.

Cottrell Scholar 2000 **Wilfred van der Donk**, Chemistry, University of Illinois at Urbana-Champaign, and Scialog: Chemical Machinery of the Cell Facilitator **Judith Frydman**, Biology and Genetics, Stanford University, were among 120 new members elected to the National Academy of Sciences in recognition of their distinguished and continuing achievements in original research.

Four Cottrell Scholars and two Scialog Fellows were honored as 2021 Camille Dreyfus Teacher-Scholars: CS 2020 **Carlos Baiz**, Chemistry, University of Texas at Austin, **Song Lin**, Chemistry, Cornell University, and **Brenda Rubenstein**, Chemistry, Brown University; CS 2018 **Luisa Whittaker-Brooks**, Chemistry, University of Utah; and Scialog: Chemical Machinery of the Cell Fellows **Julia Kalow**, Chemistry, Northwestern University, and **Markita Landry**, Chemical and Biomolecular Engineering, University of California, Berkeley. Whittaker-Brooks is also a Fellow for two Scialog initiatives, Advanced Energy Storage and Negative Emissions Science.

Cottrell Scholar 2013 **Ognjen Š. Miljanić**, Chemistry, University of Houston, was the latest RCSA grantee to publish an op-ed piece after participating in a training program designed to increase the diversity of voices, expertise and experience reflected on the nation's editorial pages. CS 2010 **Jenny Ross**, Physics, Syracuse University, and CS 2019 **Kerstin Perez**, Physics, Massachusetts Institute of Technology, also published opinion pieces following the training. The training came as a result of the 2019 Cottrell Scholar Conference, which focused on communicating science. It featured a session by The Op-Ed Project, a nonprofit that trains people to communicate effectively and publish their informed opinions. Following the conference, RCSA supported 25 scientists in attending The OpEd Project's *"Write to Change the World"* workshops.

May

More than 50 early-career chemists, physicists, biologists, bioengineers and medical imaging specialists gathered May 20-21 to launch Scialog: Advancing BioImaging, a three-year initiative aiming to accelerate the development of the next generation of imaging technologies. It is sponsored by RCSA, the Chan Zuckerberg Initiative, and the Frederick Gardner Cottrell Foundation.

A group of Cottrell Scholars led by **Snezana Stanimirovic**, Astronomy, University of Wisconsin – Madison, produced a comic strip for

Snezana Stanimirovic and the Galaxy Scouts comic

elementary school students highlighting the life and research of scientists. Funded by RCSA and the Astronomy Department at the University of Wisconsin– Madison, the comic is a collaboration between a team of Cottrell Scholars (in addition to Stanimirovic, CS 2010 **Sarbajit Banerjee**, Chemistry, Texas A&M; CS 1999 **Karen Bjorkman**, Astronomy, University of Toledo; CS 2009 **Mike Gladders**, Astronomy, University of Chicago; and CS 2009 **Yadong Yin**, Chemistry, University of California, Riverside) and science illustrator **Jan Lin**, with assistance from **Philip "Bo" Hammer**, University of Chicago. The story was developed and initial sketches of characters done by physicist-artist team **Rebecca Thompson** and **David Ellis**, the creators of Spectra. Stanimirovic said the group developed the idea at the 2012 Cottrell Scholars Conference during a discussion about designing a novel outreach project to encourage young people's interest in science.

The result of their collaboration is *"Galaxy Scouts: Space-Ventures with Stella and Riley,"* a comic series aimed at students in the 2nd-4th grades. It follows two 10-year-olds, Stella and Riley, and their travels through space. The comic is available for download on RCSA's website.

June

What makes a world habitable? How can we tell if certain molecules are signs of life? These questions and more were discussed at the first meeting of Scialog: Signatures of Life in the Universe, held virtually June 10-11, 2021. The initiative is cosponsored by the Heising-Simons Foundation, with additional support from the Kavli Foundation.

The Heising-Simons Foundation, a cosponsor of two Scialog initiatives, launched a new site called *1400Degrees.org* highlighting the contributions of women and people of marginalized genders who are transforming physics and astronomy. Cottrell Scholars and Scialog participants listed include: **Chung-Pei Ma**, Astronomy, University of Pennsylvania; **Cindy Regal**, Physics, University of Colorado Boulder; **Courtney Dressing**, Astronomy, University of California, Berkeley; **Emily Rauscher**, Astronomy, University of Michigan; **Gurtina Besla**, Astronomy, University of Arizona; **Huey-Wen Li**, Physics, Michigan State University; **Jackie Faherty**, Astrophysics, The American

Museum of Natural History; **Jennifer Sokoloski**, Astronomy, Columbia University; **Juna Kollmeier**, Astrophysicist, Carnegie Institution for Science; **Katherine de Kleer**, Geological and Planetary Sciences, Caltech; **Kathryn Johnston**, Astronomy, Columbia University; **Kerstin Perez**, Physics, Massachusetts Institute of Technology; **Leslie Rogers**, Astronomy, University of Chicago; **Lisa Kaltenegger**, Astronomy, Cornell University; **Mansi Kasliwal**, Astronomy, California Institute of Technology; **Nikole Lewis**, Astronomy, Cornell University; **Quinn Konopacky**, Physics, University of California, San Diego; **Raffaella Margutti**, Physics and Astronomy, Northwestern University; and **Smadar Naoz**, Physics and Astronomy, UCLA.

Two Scialog Fellows received 2021 Beckman Young Investigator Awards: Negative Emissions Science Fellow **Robert Gilliard**, Chemistry, University of Virginia, and Chemical Machinery of the Cell Fellow **Tania Lupoli**, Chemistry, New York University. The awards are given to foster the invention of methods, instruments, and materials that will open new avenues of research in science.

Juliane Simmchen, Physical Chemistry, Technische Universität Dresden, and **Simon Stellmer**, Physics and Astronomy, University of Bonn, were named recipients of the 2021 Fulbright-Cottrell Award for excellence in research and teaching, becoming welcomed members of the Cottrell Scholar community.

Juliane Simmchen and Simon Stellmer

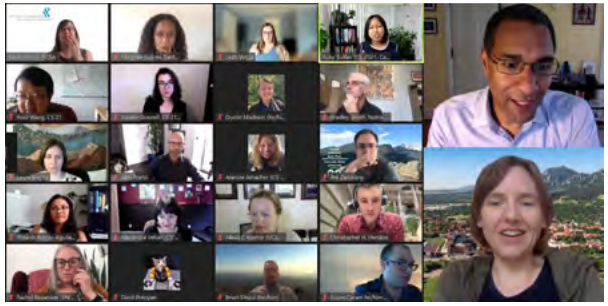
Four members of the RCSA community were among 31 rising stars named finalists for the Blavatnik National Awards for Young Scientists: Cottrell Scholar 2014 and Scialog Solar Energy Conversion awardee **Shannon Boettcher**, Chemistry, University of Oregon; CS 2014 **Mircea Dincă**, Chemistry, Massachusetts Institute of Technology; CS 2012 and FRED Award recipient **Sara Skrabalak**, Chemistry, Indiana University Bloomington; and Scialog Chemical Machinery of the Cell Fellow **Wenjun Zhang**, Chemical and Biomolecular Engineering, University of California, Berkeley.

RCSA Senior Program Director **Silvia Ronco** concluded her term as 2020-2021 president of the Council on Undergraduate Research. In recognition of her contributions, RCSA funded a CUR-administered award in Silvia's name. which will be given to a physical scientist for outstanding mentoring of undergraduates in research.

July

How can we turn the lessons of the pandemic into sustainable, positive change in academia? *"Reimagining Higher Education"* was the theme of the virtual 2021 Cottrell Scholar Conference held July 7-9, 2021. With more than 150 participants, it was the largest conference yet. CS 1996 **Sean Decatur**, president of Kenyon College, gave a thoughtful and inspiring keynote address, *"Building More Equitable Colleges and Universities in the Aftermath of COVID."*

Cottrell Scholar 1999 **Karen Bjorkman**, provost and executive vice president for academic affairs at The University of Toledo, was elected to the board of directors of AURA, the Association of Universities for Research in Astronomy. AURA is responsible for the operation of the National Science Foundation's National Optical-Infrared Astronomy Research Laboratory, the National Solar Observatory, and the Space Telescope Science Institute.



Cottrell Scholar Conference

2014 Cottrell Scholar **Mircea Dincă**, Chemistry, Massachusetts Institute of Technology, was named one of three laureates of the 2021 Blavatnik National Awards for Young Scientists in recognition of his work developing metal-organic frameworks.

August

Cottrell Scholar 2009 **Lane Baker**, Chemistry, Indiana University, and Cottrell College Science Award recipient **Tim Hanks**, Chemistry, Furman University, were elected 2021 American Chemical Society Fellows for their outstanding achievements in and contributions to science, the profession, and ACS.

Three members of RCSA's Scialog community were among nine researchers chosen to receive U.S. Department of Energy funding for Direct Air Capture of CO2. They are: Negative Emissions Science Fellow and awardee **Burcu Gurkan**, Chemical and Biomolecular Engineering, Case Western Reserve University; Advanced Energy Storage Fellow and awardee **Joaquin Rodriguez-Lopez**, Chemistry, University of Illinois at Urbana-Champaign; and Negative Emissions Science Facilitator **Jeff Long**, Chemistry, University of California, Berkeley.

Chemical & Engineering News named 2020 Cottrell Scholar and Scialog Advanced Energy Storage and Negative Emissions Science Fellow **Jesús Velázquez**, Chemistry, University of California, Davis, one of its 2021 Talented 12 for engaging in "world-changing work" studying materials that could mitigate climate change or clean up water.

Several Cottrell Scholars who participated in an RCSA-sponsored project to use Python to enhance science education have contributed to a new American Chemical Society Symposium Series book, *"Teaching Programming across the Chemistry Curriculum."* CS 2003 **Daniel Crawford**, Chemistry, Virginia Polytechnic Institute, wrote the preface, and CS 2019 **Jay Foley**, Chemistry, William Paterson University, CS 2018 **Grace Stokes**, Chemistry, Santa Clara University, and CS 2012 **Geoffrey Hutchison**, Chemistry, University of Pittsburgh, authored chapters.

September

Cottrell Scholar 2017 **Amanda Wolfe**, Chemistry, University of North Carolina at Asheville, was awarded a nearly $385,000 grant from the National Institute of Allergy and Infectious Disease to address a growing threat to human health, multidrug resistant Pseudomonas aeruginosa (MDRPA) infections. Her project will explore targeted development and selective delivery of small molecule antibiotics for the treatment of these infections. Wolfe also serves on the Cottrell Scholar Program Committee.

A 2018 Scialog: Advanced Energy Storage team award for collaborative research resulted in one of August's most-read articles in ACS Energy Letters. The paper—by AES Fellows **Partha Mukherjee**, Mechanical Engineering, Purdue University; **Venkat Viswanathan**, Mechanical Engineering, Carnegie Mellon University; and **Lauren E. Marbella**, Chemical Engineering, Columbia University—opens up new possibilities in the design of metal-anode-based batteries to prevent dendrite formation.

If anyone out there were looking, which nearby stars are in the right place to spot Earth? Scialog: Signatures of Life in the Universe Facilitator **Lisa Kaltenegger**, Astronomy, Cornell University, penned a fun article in Nautilus based on a 2021 Nature paper she wrote with Scialog: Time Domain Astrophysics Fellow **Jackie Faherty** on past, present and future stars with a "perfect cosmic front seat to Earth."

2015 Cottrell Scholar and Scialog: Microbiome, Neurobiology and Disease Facilitator **Emily Balskus**, Chemistry, Harvard University, was one of 33 biomedical researchers named 2021 Howard Hughes Medical Institute Investigators. She studies microbial metabolism and its influence on the human microbiome.

The 2022 American Chemical Society National Award for Research at an Undergraduate Institution, sponsored by RCSA, was awarded to **Chip Nataro**, a professor of chemistry at Lafayette College.

Six members of the RCSA community were named American Chemical Society 2022 national award winners. Cottrell Scholar 2008 **Matthew Disney**,

Scripps Research Institute, won the Nobel Laureate Signature Award for Graduate Education in Chemistry as preceptor with student **Alicia Angelbello**. CS Selection Committee member and Scialog: SEC participant **Susan M. Kauzlarich**, University of California, Davis, won the ACS Award in Inorganic Chemistry. CS 2020 **Song Lin**, Cornell University, won the National Fresenius Award. CS 2019 **Alison Narayan**, University of Michigan, won the Arthur C. Cope Scholars Award. Scialog: CMC Fellow **Gabriela S. Schlau-Cohen**, Massachusetts Institute of Technology, won the ACS Award in Pure Chemistry. CS 2019 **Justin I. Wilson**, Cornell University, won the Harry Gray Award for Creative Work in Inorganic Chemistry by a Young Investigator.

RCSA launched its newest Scialog initiative, Mitigating Zoonotic Threats, with a virtual meeting September 30-October 1, 2021. In the planning stages even before the SARS-CoV-2 epidemic began, the initiative is sponsored by RCSA and two U.S. Department of Agriculture agencies working together at the National Bio and Agro-Defense Facility – the Animal and Plant Health Inspection Service (APHIS) and the Agricultural Research Service (ARS). The meeting brought together 75 participants from a variety of disciplines to catalyze new research in the detection and mitigation of emerging animal-borne infectious diseases. Keynote speaker **Christine Kreuder Johnson** of the EpiCenter for Disease Dynamics, University of California, Davis, set the stage for discussions with her talk, *"Catalyzing Innovation for Surveillance of Emerging Pandemic Threats in an Era of Accelerated Global Change."*

October

David W.C. MacMillan, Chemistry, Princeton University, became the second Cottrell Scholar and 42nd RCSA-supported scientist to be awarded a Nobel Prize. He shares the award in chemistry with Benjamin List, Max-Planck-Institut für Kohlenforschung, for the development of asymmetric organocatalysis, a precise new tool that made a great impact on pharmaceutical research and has made chemistry greener. MacMillan's Cottrell Scholar award in 2001 was for *"Enantioselective organocatalysis: A new and broadly useful strategy for asymmetric synthesis using organic catalysts."*

2004 Cottrell Scholar **Paul Chirik**, Chemistry, Princeton, received the 2020 Linus Pauling Award at a symposium October 9 at the University of Washington.

Scialog: Negative Emissions Science Fellow **Marta Hatzell**, Mechanical Engineering, Georgia Institute of Technology, was named a 2021 Moore Inventor Fellow.

David MacMillan

Christine Kreuder Johnson

Ibrahim Cissé, Physics, Massachusetts Institute of Technology, was announced as a 2021 MacArthur Fellow. Cissé is a Scialog: Molecules Come to Life Fellow and 2016 team award recipient.

Two members of the 2020 class of Cottrell Scholars –**Frank Leibfarth**, Chemistry, University of North Carolina at Chapel Hill, and **Brenda Rubenstein**, Chemistry, Brown University, who is also a Scialog: Mitigating Zoonotic Threats Fellow–were named to the Popular Science Brilliant 10, a roster of early-career scientists and engineers developing ingenious approaches to problems across a range of disciplines.

Scialog: Advancing Bioimaging Fellow **Candace Fleischer**, Radiology and Imaging Sciences, Emory University, received a $1.5 million New Innovator Award from the National Institutes of Health. Her "metaboloradiomics" research approach could open new understanding of how metabolic diseases affect the brain and other organs.

A Scialog: Advanced Energy Storage team whose 2019 award sparked a successful collaboration to advance fundamental understanding of the electrochemical interface received $1.8 million in U.S. Department of Energy funding to take their research on a new path into the area of direct air capture of CO2. **Joaquín Rodríguez-López**, Chemistry, University of Illinois at Urbana-Champaign, will collaborate with **Veronica Augustyn**, Materials Science and Engineering, North Carolina State University, and **Jahan Dawlaty**, Chemistry, University of Southern California, on this project: *"Reversible Electrochemical Capture/Release of Carbon Dioxide Mediated by Electrostatically Enhanced Charge Transfer."*

2019 Scialog: Advanced Energy Storage team award recipients **Neil Dasgupta**, Mechanical Engineering, University of Michigan, Ann Arbor, Matthew McDowell, Materials Science and Mechanical Engineering, Georgia Institute of Technology, and **Partha Mukherjee**, Mechanical Engineering, Purdue University, published a joint paper in ACS Energy Letters based on their collaborative Scialog project. Featured on the journal's cover, the article is titled *"Challenges and Opportunities for Fast Charging of Solid-State Lithium Metal Batteries."*

Two Scialog Fellows and one Facilitator were among 10 scientists who were named recipients of 2022 awards from the Biophysical Society. Molecules Come to Life awardee **Suckjoon Jun**, Physics and

Joaquín Rodríguez-López, Veronica Augustyn, Jahan Dawlaty

Molecular Biology, University of California, San Diego, was honored for groundbreaking research on the biophysical mechanisms of bacterial cell size control. Chemical Machinery of the Cell Fellow **Gabriela Schlau-Cohen**, Chemistry, Massachusetts Institute of Technology, was honored for elucidating structural and energetic dynamics of biological and bio-inspired systems through her innovative applications of spectroscopic methods. CMC Facilitator and 2000 Cottrell Scholar **Paul R. Selvin**, Physics, University of Illinois at Urbana-Champaign, was honored for novel and ongoing contributions to development of single-molecule biophysics and application to important biophysical research problems.

The American Physical Society announced its election of Fellows for 2021, including several members of the RCSA community—Scialog: Molecules Come to Life Fellow **Ibrahim I. Cissé**, Physics, Max Planck Institute; Cottrell Scholar 2000 **Michael Dennin**, Physics, University of California, Irvine; CS 2009 **Maura McLaughlin**, Physics, West Virginia University; CS 2017 **Monika Schleier-Smith**, Physics, Stanford University; and CS 2010 **Kyle M. Shen**, Cornell University.

The American Physical Society gave its 2022 Excellence in Physics Education Award to the **TEAM-UP Task Force** "for groundbreaking analysis revealing sources of persistent underrepresentation of African-Americans in physics and astronomy; recommendation of data-driven, systemic strategies to increase the number of African-American physics bachelor's degree recipients; and ways to catalyze cultural change." RCSA provided funding to support the task force's important work.

The American Physical Society's 2022 Prize for a Faculty Member for Research in an Undergraduate Institution, sponsored by RCSA, was awarded to **Derek F. Jackson Kimball**, California State University—East Bay, for innovative methods in dark matter detection, exemplary contributions to research, and high impact teaching to a diverse undergraduate student body using research projects.

The American Physical Society's spring 2022 prize and award recipients include Cottrell Scholar 2020 and Scialog: Negative Emissions Science Fellow **Jesús Velázquez**, Chemistry, University of California, Davis, and Scialog: Time

Domain Astrophysics Fellow **Enrico Ramirez-Ruiz**, Astronomy and Astrophysics, University of California, Santa Cruz. Velázquez received the 2021 Stanford R. Ovshinsky Sustainable Energy Fellowship for transformative research advancing the production of solar fuels, elucidating fundamental design principles underpinning negative emissions science, and for articulating a bold vision of a sustainable chemical industry using CO_2 instead of fossil fuels. Ramirez-Ruiz received the 2021 Dwight Nicholson Medal for Outreach for innovations in mentoring that have demonstrated how members of historically marginalized populations can thrive, lead, and advance scientific enterprise in astronomy and related fields.

Two Cottrell Scholars were featured in a Physics Magazine interview with five women who have recently won major prizes. CS 2000 **Donna Strickland** (Nobel Prize in Physics, 2018) and CS 2017 **Monika Schleier-Smith** (MacArthur Fellowship, 2020) shared their thoughts on carving out a career in physics and what their awards mean to them.

Two Cottrell Scholars were included on the Analytical Scientist's 2021 Power List of 100 influential scientists: CS 2009 **Lane Baker**, Chemistry, Indiana University Bloomington, and CS 2002 **Neil Kelleher**, Chemistry, Northwestern University. (Neil is also a Scialog: Chemical Machinery of the Cell Facilitator and a COVID-19 Initiative awardee.).

November

The second meeting of Scialog: Negative Emissions Science was held November 4-5, 2021. Sponsored by RCSA and the Alfred P. Sloan Foundation, the initiative challenges participants from institutions around the U.S. and Canada to explore together how to advance fundamental science in the design of novel approaches for removing and utilizing or sequestering greenhouse gases. To accompany the initiative, the journal iScience released a series of open-access articles called *"Spotlight on Scialog: Negative Emissions Science."* Through the collaboration of Cell Press, RCSA and the Alfred P. Sloan Foundation, and curated with iScience Consulting Editor and NES Fellow **Marta Hatzell**, Mechanical Engineering, Georgia Institute of Technology, this collection contained collaborative, forward-looking perspectives and research articles by a number of Scialog participants.

Included in the collection:

- A "Backstory" feature with Hatzell and **Jennifer Wilcox**, Principal Deputy Assistant Secretary for Fossil Energy at the Department of Energy, discussing the role of newcomers to the field of negative emissions science, multidisciplinary approaches to doing research, and the challenges of CO2 removal and carbon sequestration. Hatzell is a Fellow and Wilcox is a Facilitator of Scialog: Negative Emissions Science.
- A "Backstory" article by RCSA's **Richard Wiener** and **Andrew Feig**, and the Alfred P. Sloan Foundation's **Evan Michelson**, explaining how cosponsoring the Scialog: Negative Emissions Science initiative is bringing together a diverse group of early career scientists to meet perhaps the greatest challenge of our time, addressing and mitigating global climate warming.
- An article by four Scialog: Negative Emissions Science Facilitators—**Roger Aines**, **Sarbajit Banerjee**, **Jordi Cabana** and **Christopher Jones** (plus 2020 Cottrell Fellowship recipient **Rachel Davidson**)—sharing their thoughts on what the field needs to move forward.
- *"Perspective and Challenges in Electrochemical Approaches for Reactive CO_2 Separations"* from Scialog Fellows **Burcu Gurkan**, Chemical and Biomolecular Engineering, Case Western Reserve University; **Xiao Su**, Chemical and Biomolecular Engineering, University of Illinois at Urbana-Champaign; and **Shaama Mallikarjun Sharada**, Chemical Engineering and Materials Science, University of Southern California.

Cottrell Scholar 2006 **Hai Lin**, Chemistry, University of Colorado Denver, won a nearly $460,000 grant from the National Institutes of Health to pursue an unexpected avenue of research that grew out of his 2018 SEED Award project. The knowledge gained

from this research could be used to develop new therapies for tooth decay prevention.

Cottrell Scholar 2019 **Emily Levesque**, Astronomy, University of Washington, gives a behind-the-scenes look at the work of astronomy in her book, "The Last Stargazers."

Geraldine Richmond, a 1980 RCSA grantee with long ties to the foundation, was confirmed as Under Secretary of Science and Energy at the U.S. Department of Energy. An exceptional physical chemist and champion of women in science, she served RCSA as former presidential advisory committee member and delivered the keynote at two Cottrell Scholar conferences, most recently in 2017.

The National Academy of Medicine elected 100 new members who have made major contributions to the advancement of the medical sciences, health care, and public health. They include Scialog: Advancing Bioimaging Facilitator **Samuel Achilefu**, Washington University School of Medicine; Cottrell Scholar 2003 and Scialog: Molecules Come to Life Facilitator **Taekjip Ha**, Johns Hopkins University; and Scialog: Mitigating Zoonotic Threats Facilitator and keynote speaker **Christine Kreuder Johnson**.

Gudmundur Stefánsson, a student working on a precision photometry project that got its start at Scialog: Time Domain Astrophysics in 2015, won the prestigious Robert J. Trumpler award, given each year to a Ph.D. thesis in North America of unusual importance to astronomy. Currently a Henry Norris Russell postdoctoral fellow at Princeton University, Stefánsson helped develop a novel Engineered Diffuser that being used by an increasing number of telescopes around the world to achieve high-precision ground-based differential photometry. The concept was developed and proposed by **Suvrath Mahadevan**, Astronomy and Astrophysics, Penn State; **Leslie Hebb**, Physics, of Hobart and William Smith Colleges; and **John Wisniewski**, Physics and Astronomy, University of Oklahoma.

A cross-disciplinary team of Scialog: Molecules Come to Life Fellows was awarded a 4-year $1.8M National Science Foundation grant to continue research that began with a Scialog award in 2015. The team includes: **Rae Robertson-Anderson**, Physics and Biophysics, University of San Diego; **Megan Valentine**, Mechanical Engineering, University of California, Santa Barbara; **Jennifer Ross**, Physics, Syracuse University; Michael Rust, Genetics and Cell Biology, University of Chicago; and **Moumita Das**, Physics and Astronomy, Rochester Institute of Technology. Their project, *"Living Biotic-abiotic Materials with Temporally Programmable Actuation,"* aims to use biological building blocks to create self-directed and reconfigurable materials capable of producing force and motion.

Three RCSA grantees were among eight young faculty in the chemical sciences named 2021 Henry Dreyfus Teacher-Scholars for their scholarship and commitment to undergraduate education.

Grace Stokes, Chemistry, Santa Clara University, is a 2018 Cottrell Scholar and Scialog: Chemical Machinery of the Cell Fellow. **Christine Phillips-Piro**, Franklin & Marshall College, and **Amanda Murphy**, Western Washington University, are both recipients of Cottrell College Science Awards.

Sarbajit Banerjee, Chemistry, Texas A&M University, won the 2021 Stanley C. Israel Regional Award for Advancing Diversity in the Chemical Sciences for the American Chemical Society Southwest Region. Banerjee is a 2010 Cottrell Scholar, a Facilitator for two Scialog initiatives—Advanced Energy Storage and Negative Emissions Science—and was a Fellow for Solar Energy Conversion.

Chemical & Engineering News highlighted the research of 1997 Cottrell Scholar **Yi Lu**, chemistry, University of Illinois at Urbana-Champaign. Lu's work on a tool to measure lithium levels in neurons could help adjust dosages for people with bipolar disorders and increase understanding of the drug's mechanism of action.

Two Cottrell Scholars—2014 **Mircea Dincă**, Chemistry, Massachusetts Institute of Technology, and 2019 **Katherine A. Mirica**, Chemistry, Dartmouth College—were interviewed in a Chemical & Engineering News feature on the new applications chemists are finding for the conductive properties of metal-organic frameworks.

December

The Mining Foundation of the Southwest inducted RCSA's founder, **Frederick Gardner Cottrell**, into the American Mining Hall of Fame. Former RCSA president **John P. Schaefer** accepted the award at the event, which honored Cottrell's legacy as an inventor and philanthropist.

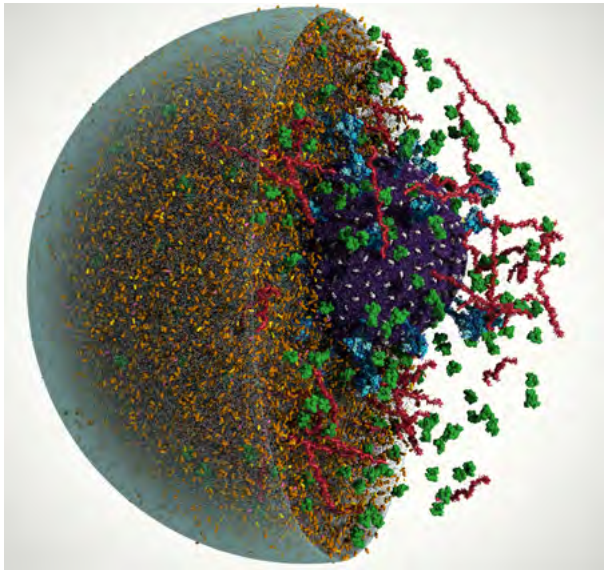
1995 Cottrell Scholar **Eberhard Bodenschatz**, Physics, who helped found the Cottrell-Fulbright Scholars program in Germany, published a timely new study on the effectiveness of face masks. His team from the Max Planck Institute for Dynamics and Self-Organization in Göttingen investigated to what extent masks protect under which wearing conditions.

Scialog: Negative Emissions Science awardee **Andrea Hicks**, Civil and Environmental Engineering, University of Wisconsin-Madison, won a 2021 Laudise Medal from the International Society for Industrial Ecology.

2000 Cottrell Scholar **David Vanden Bout** was appointed dean of the College of Natural Sciences at the University of Texas at Austin.

RCSA's quick support of COVID research at the start of the pandemic in 2020 helped catalyze several projects with remarkable results:

- The project *Pan-Covid-19 MultiValent Binders (MVBs) to Block Virus Entry* was a collaboration between Scialog: Chemical Machinery of the Cell Facilitator **Rommie Amaro**, Chemistry and Biochemistry, University of California, San Diego, CMC Fellow Ronit Freeman, Biomaterials, University of North Carolina at Chapel Hill, and Cottrell Scholar 2001 **Carlos Simmerling**, Chemistry, Stony Brook University. Modeling work by Amaro and Simmerling, which led to a deeper understanding of the dynamics of the spike protein and how it interacts with cell surface receptors, was reported in The New York Times. A second part of this work, which helped to explain how virus particles maintain their integrity in water droplets, was also featured in the Times. Alongside the modeling work, Freeman's group was working on new ways to detect the virus. During the pandemic, they developed, patented and quickly brought to mass-market production a glycopolymer-based lateral flow assay for detecting SARS-CoV-2 and its rapidly emerging variants.



Delta SARS-CoV-2 model from the Amaro Lab

- The project *Establishing Swift, Sensitive, and Selective (3S) Sensing Technologies – Going Beyond RT-PCR* brought together the complementary skills of Freeman and Cottrell Scholar 2013 **Zachary Schultz**, Chemistry and Biochemistry, The Ohio State University. They published a paper in ACS Sensors providing a new route to address SARS-CoV-2 and potentially future virus outbreaks and are now in discussion with companies to license the technology they have patented.

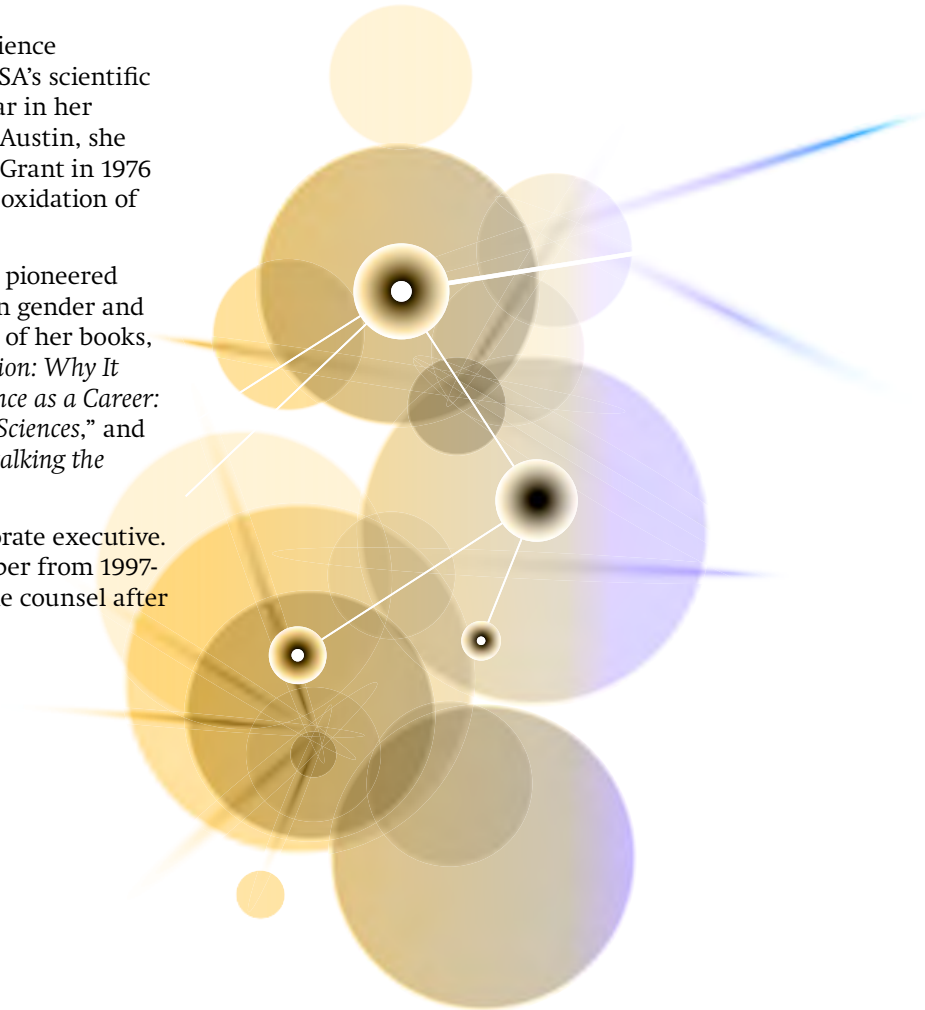
- With the project *Electric Field-Driven Antigen Enrichment to Achieve Detection of SARS-CoV-2 Nucleocapsid Protein in Urine at the Point-of-Need*, Cottrell Scholar 2019 **Robbyn Anand**, Chemistry, Iowa State University, was able to translate her lab's work developing a method that integrates a lateral flow assay with electrokinetic enrichment of antigens to the detection of SARS-CoV-2. Anand has received a provisional patent on the method and is currently exploring methods to scale up testing capacity.
- The project *Targeting the SARS-CoV-2 Frameshift Site Pseudoknot* enabled the labs of two 2017 Cottrell Scholars, **Amanda Hargrove**, Chemistry, Duke University, and CS **Katie Mouzakis**, Chemistry, Loyola Marymount University, to take on new research directions and identify promising lead molecules that directly bind the SARS-CoV-2 target RNA and inhibit its function. In addition, in an effort to remotely engage undergraduate students in research, Mouzakis integrated the SARS-CoV-2 collaborative project into two of her biochemistry laboratory courses. This work was included in a peer-reviewed pedagogical publication in the Biophysicist in 2021.

In Memoriam

Marye Anne Fox, National Medal of Science recipient and longtime member of RCSA's scientific community. As a young teacher-scholar in her first year at the University of Texas at Austin, she received a Frederick Gardner Cottrell Grant in 1976 to study the ketone-photosynthesized oxidation of methionine.

Sheila Tobias, author and activist who pioneered research into the relationship between gender and math anxiety. RCSA published several of her books, including "*Science Teaching as a Profession: Why It Isn't, How It Could Be*," "*Rethinking Science as a Career: Perceptions and Realities in the Physical Sciences*," and "*They're Not Dumb, They're Different: Stalking the Second Tier.*"

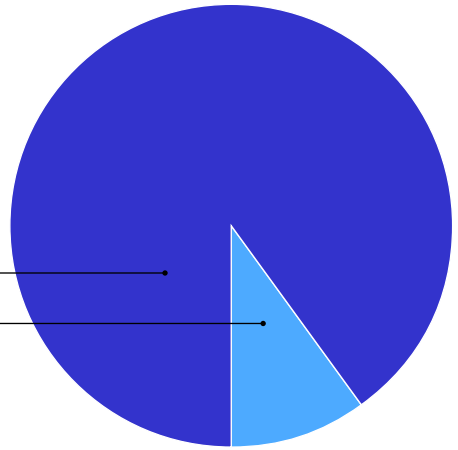
Robert Holland Jr., engineer and corporate executive. Holland served RCSA as a Board Member from 1997-2010 and continued to provide valuable counsel after his term ended.



2021 Financial Summary

Program Expenses, including Grants and Awards **90%**

General and Administrative Costs **10%**



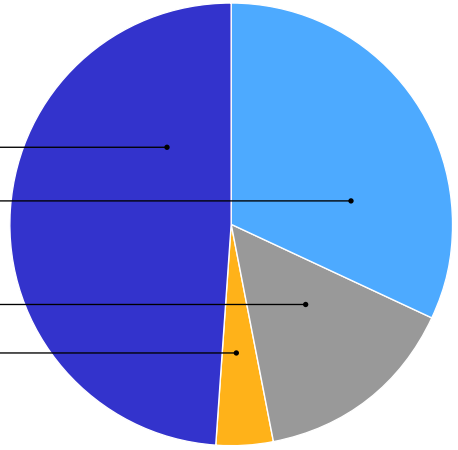
Total Expenses $10.8 million

Scialog Collaborative Awards (*includes $2.3M in partner funded awards administered by RCSA and excludes $2.5M in non-administered partner funded awards*) **49%**

Cottrell Scholar Awards **32%**

Cottrell Career Advancement, Fellowships (*includes $103K in partner funded awards administered by RCSA*), Collaborative Awards **15%**

Discretionary Grants and Special Initiatives **4%**



Grants and Awards $7.6 million

Net Assets at Beginning of Year **$215.6 million**
Net Assets at End of Year **$239.1 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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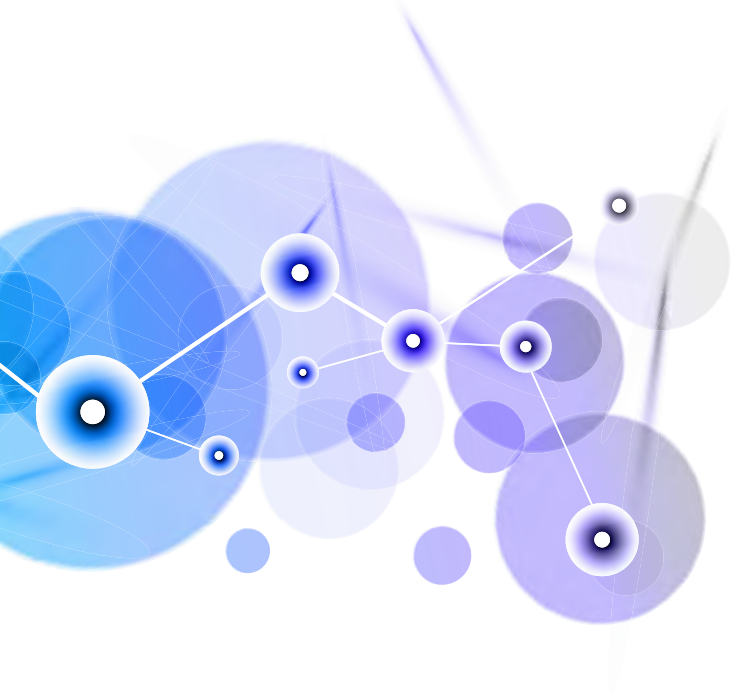

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