

Academic Leadership

2015 Annual Report



RESEARCH CORPORATION 
for SCIENCE ADVANCEMENT
A foundation dedicated to science since 1912.

Academic Leadership



Robert N. Shelton

The mission of Research Corporation for Science Advancement is to advance early stage, high-potential, basic scientific research.

This past year has been one of growth and expansion for RCSA programs and partnerships.

Moving forward from the planning year of 2014, the Foundation's Cottrell Scholar program, for the first time since its inception in 1994, incorporated early career faculty from primarily undergraduate institutions with their colleagues from research intensive institutions. By all accounts emanating from the 2015 CS conference, this combination produced a stimulating synergy of ideas and a wealth of potential projects to enrich the Cottrell Scholar Collaborative (CSC).

The CSC is a cross-disciplinary network of more than 360 Scholars who tackle projects with potential high impact. CSC's overarching goal is to improve undergraduate and graduate science education at colleges and universities across the country. Through this organization, as well as the FRED award and three new career advancement opportunities—TREE, LEAD, and SEED—created under the Cottrell Scholar program, RCSA seeks to recognize and nurture academic leadership in the physical sciences.

In 2015 the first of these new career advancement awards went to Cottrell Scholars Catherine J. Murphy, chemistry, University of Illinois, Urbana-Champaign; Mats Selen, physics, also University of Illinois, Urbana-Champaign; and Keivan Stassun, physics, Vanderbilt University. They received the TREE Award (Transformational Research and Excellence in Education) intended to recognize and advance truly superlative research and education. For more on these outstanding Cottrell Scholars as well as TREE, FRED, SEED and LEAD, please go to our website, www.rescorp.org/cottrell-scholars.

In addition, in 2014 Cottrell Scholars joined forces with representatives of the Association of American Universities (AAU) to conduct a workshop examining issues associated with implementing effective evaluation of teaching and learning in STEM; subsequently, participants in that effort published a report in *Nature*, **2015**, *523*, 283-284 calling for immediate change at all levels of research universities to improve the quality of university STEM education. This collaborative work also yielded an RCSA book, *Searching for Better Approaches: Effective Evaluation of Teaching and Learning in STEM* that was distributed to over 130 deans and provosts across the nation. These are just a few of the many projects the Cottrell Scholars and RCSA have developed to improve academic leadership. I'm sure you will be hearing about many more in the years to come.

Ultimately, academic leadership takes many forms and requires efforts on many levels. In 2015 the Foundation itself entered into a collaboration with the German-American Fulbright Commission (GAFC) to create a Cottrell Scholar-like program for Germany. The GAFC will organize and finance an annual competition for several Cottrell-Fulbright Scholars. The use of the term "Cottrell" is conditioned on the implementation of a rigorous peer review process of all proposals received by the GAFC, similar to the process used to evaluate RCSA Cottrell Scholar Award proposals. GAFC awardees are expected to attend CS conferences in the U.S.

Meanwhile, RCSA's other major program, Scialog (science + dialog), expanded into the interdisciplinary realm of the physics and chemistry of cell biology (in partnership with the Gordon and Betty Moore Foundation) and time-domain astrophysics, sponsoring separate, highly successful conferences in these two rapidly developing fields. In addition to funding cutting-edge, high-risk research, the Foundation's goal with Scialog, created in 2010, has always been to build new, cross-disciplinary communities of scientists to help humanity face tomorrow's uncertainties.

Community, by its very nature, requires a common focus as well as shared values. At RCSA we value innovative scientific research and the development of academic scientists skilled in advancing American competitiveness. I am proud to report that our efforts, and those of RCSA community members, did much to extend those fundamental values in 2015

Robert N. Shelton

President/CEO, Research Corporation for Science Advancement

Programs Overview 2015

Cottrell Scholar Awards

Creating a Community of Scientist-Educators

The Cottrell Scholar Program supports high-quality research and science education at U.S. universities and colleges. Scholars engage in an annual networking event and share insights and expertise through the Cottrell Scholar Collaborative. Awards under the Cottrell Scholar Program include:

Cottrell Scholar Award for outstanding teacher-scholars. Eligibility: Faculty at the end of third year of faculty appointment. \$100,000.

Career Advancement Awards (available to Cottrell Scholars who are at least six years beyond the initial Cottrell Scholar Award):

- **Transformational Research and Excellence in Education (TREE)**. Celebrates outstanding achievements in research and education. \$25,000
- **Leadership Enrichment and Development (LEAD)**. Offers leadership development opportunities. \$25,000
- **Singular Exceptional Endeavors of Discovery (SEED)**. Supports the very first instances of highly creative projects and encourages out-of-the-box ideas. \$50,000 (research)/\$25,000 (education)

Frontiers in Research Excellence and Discovery (FRED). This highly competitive award supports the early stages of exceptionally creative, high-risk/high-reward research. Tenured Cottrell Scholars who are within 5-10 years of receiving a CSA. \$250,000

Science + Dialog

A Research Process Aimed at Accelerating Breakthroughs

Scialog funds network building among early career scientists, encouraging them to conduct discovery research. Scialog demonstrates that small, but well targeted grants to highly innovative cross-disciplinary teams with high-risk, untested ideas can be highly impactful—especially when these scientists are brought together in a unique environment and challenged to form collaborations based on ideas that emerge from multidisciplinary dialog. Scialog is intended to incentivize collaborative idea generation across disciplines among carefully chosen cohorts. The goal is rapid progress on the frontiers of science. Scialog conferences in 2015 included:

Time Domain Astrophysics: Stars and Explosions: aims to bring together theorists, observers and computational scientists to identify critical lines of inquiry needed to maximally exploit synoptic optical surveys. The hope is to identify highly innovative research that would benefit the most from current optical facilities and set the stage to maximize the benefit of new facilities, such as the Large Synoptic Survey Telescope (LSST) to be commissioned by 2022.

Molecules Come to Life: co-sponsored by the Gordon and Betty Moore Foundation, this initiative focuses on the quantitative connection between molecular phenomena and phenomena at the cellular systems level. Theorists and experimentalists from physics, biology and chemistry tackle deep questions about life such as: What are the fundamental principles that make a collection of molecules within a cell produce behaviors we associate with life? How do molecules combine and dynamically interact to form functional units in cells? How do metabolism and signaling lead to cellular homeostasis? How do cells make decisions about which genes to express?

The logo for Scialog, featuring the word "scialog" in a lowercase, sans-serif font. The "s" is blue, and the rest of the letters are grey. A registered trademark symbol (®) is located to the upper right of the "g".

Nudging Academic Scientists in the Right Direction



Mats Selen

“The staff of RCSA are dedicated to their mission of supporting groundbreaking research and helping innovative young scientists develop into the academic leaders of tomorrow.”

After some serious reflection on my life, I have to acknowledge that I have been lucky. Really lucky. The kind of luck in which just the right people pop up at just the right time to provide opportunities and advice and pats on the back—family, friends, mentors, colleagues, all giving countless little nudges to keep things going in more or less the right direction.

Without a doubt, the single biggest and most persistent architect of these nudges has been the Research Corporation for Science Advancement.

Twenty summers ago, when my youngest daughter was five, when I didn't have a beard and didn't wear glasses, I packed my family in our first minivan and drove from Illinois to Arizona to attend my first Cottrell Scholar meeting. I had no idea that the people I would meet there would be friends and colleagues for the rest of my career, nor did I know the extent to which I would come to admire and appreciate the work of this organization. Now, twenty years later, I am struggling to write this introduction because I know that no matter what I say, my words will not properly convey the importance of the role that RCSA has played in my personal and professional development over the years. The funds I received from RCSA were important, but after a few years these were a mere memory. In contrast, the most profound and lasting aspect of that first Cottrell Scholar meeting has been social—it was getting to know and develop lifelong relationships with a group of truly amazing people.

The staff of RCSA are dedicated to their mission of supporting groundbreaking research and helping innovative young scientists develop into the academic leaders of tomorrow. The staff are all truly accomplished in their own fields, yet they devote themselves and the resources of their organization to the success of their fellow scientists and to the betterment of our society through research and education. The young scientists supported by RCSA are all uniquely gifted educators and researchers, of course, but the great thing is that these accomplished and highly driven scientists are also compassionate, patient, and generous human beings, very similar to the RCSA staff that selected them.

The feeling I get at an RCSA gathering is one of a very nurturing family—of belonging and encouragement and thoughtful discourse with like-minded people. I am always a bit sad when these meetings end—an emotion I certainly don't experience at the end of most workshops and conferences—but the ideas and hope and energy I leave with each time stay with me and give context to everything I do back at Illinois.

Thank you, RCSA. You are an unwavering force for good in STEM research and education, and when future scientists reflect on the past, your impact will certainly be judged to have been profound.

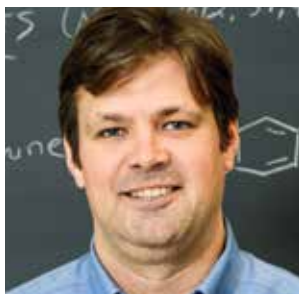
Mats Selen

Cottrell Scholar, 1996

Physics professor, University of Illinois at Urbana-Champaign

In 2015 Selen was named outstanding Doctoral and Research Universities Professor of the Year by the Council for Advancement and Support of Education (CASE) and the Carnegie Foundation for the Advancement of Teaching. He was also recipient of a Cottrell Scholar TREE Award.

Sampling of Cottrell Scholar Achievements 2015



William Dichtel

William Dichtel, a 2012 Cottrell Scholar, was named a MacArthur Genius Fellow and a Kavli Emerging Leader in 2015. An associate professor of Chemistry at Cornell University, Dichtel pioneered development of covalent organic frameworks (COFs), porous polymers formed from molecules with specific shapes that simultaneously polymerize and assemble into ordered, two-dimensional grids or three-dimensional scaffolds. These structures exhibit ultra-high surface areas, as much as the area of a football field inside a gram of material. This quality makes them potentially useful for chemical processing, sensing trace substances, chemical and electrical storage, as well as water purification and other processes not yet imagined. Challenging long-held assumptions about polymerization in two and three dimensions, Dichtel is currently developing new methods to study COF formation. His work has already yielded improved stability in these increasingly important materials. But besides his achievements as a leading figure in chemistry, Dichtel has worked with other Cottrell Scholars and the Association of American Universities (AAU) on a major initiative to improve the quality of undergraduate teaching and learning in STEM fields at AAU-member institutions. Much of their efforts were focused on developing methods to encourage colleagues to seek out new and innovative ways to recognize and reward teaching excellence.



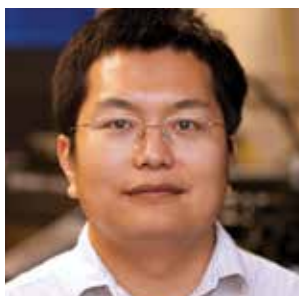
M. Lisa Manning

In 2015 Cottrell Scholar and Scialog fellow **M. Lisa Manning**, physics, Syracuse University, made outstanding statistical physics contributions to the fields of granular materials, jamming, and biological cell dynamics. She and her colleagues published papers in *Nature Materials* and *Nature Physics* and contributed to a dozen other publications. The Manning group is interested in non-equilibrium collective behavior in both biological and non-biological systems. The unifying principle, she notes, is that physics-based statistical mechanics models can provide insight into the emergent behavior of large groups of strongly interacting objects (granular particles, biological cells, atoms, droplets) at high densities. "The systems we study can be thought of as disordered (as opposed to crystalline) 'materials' with many metastable mechanical states, and we explore the dynamics and thermodynamics of these materials." She divides her work into two categories: biological tissues and active matter, and flow in disordered solids. Manning became a Cottrell Scholar in 2015, and she also attended the 2015 Scialog: Molecules Come to Life conference in Tucson, where she became part of a three-member team attempting to develop an innovative approach for measuring how the forces exerted by individual cells are able to mold bodily tissues into three-dimensional shapes.



Catherine J. Murphy

Catherine J. Murphy, a 1996 Cottrell Scholar and 2015 TREE Awardee was elected to the National Academy of Sciences in 2015, one of the highest professional honors among researchers. The Markunas Professor of Chemistry at the University of Illinois at Urbana-Champaign, Murphy develops methods to manufacture tiny nanorods of gold, silver and copper, investigating their uses for imaging cells, chemical sensing and photothermal therapy. Murphy is the associate director of the Frederick Seitz Materials Research Laboratory, and also is affiliated with the Micro and Nano Technology Laboratory and the Beckman Institute. In the mid-1990s Murphy was among the first inorganic chemists to start a program in the synthesis, functionalization, and utilization of inorganic nanomaterials. Her early work on unpassivated II-VI semiconductor “quantum dots” as chemical sensors was well ahead of its time. This work is still highly cited and influential today. Thompson Reuters recently identified her as 10th among the 100 most frequently cited material scientists in the world for the first decade of the 21st century. In addition she is a champion of undergraduate research and a long-time contributing author to the most widely used introductory general chemistry textbook, *Chemistry: The Central Science*. Murphy is also one of the few tenured faculty members who regularly teaches Illinois’ first-year general chemistry course.



Xiaodong Xu

In 2015 **Xiaodong Xu**, a 2014 Cottrell Scholar, physics, University of Washington, published more than a dozen papers in high-impact journals, including seven acknowledging his Research Corporation award, “Valley Quantum Optoelectronics of Monolayer Semiconductors.” RCSA funded Xu to investigate a new class of quantum optoelectronic materials known as “atomically thin transition metal dichalcogenides” (TMDs). The seven 2015 publications included two papers in *Nature Nanotechnology*, and one each in *Nature Physics*, *Nature Communication*, and *Nature Materials*, and two in *Physical Review Letters*. His main research interest is to systematically understand and control the energy flow among photons, electrons, and phonons in carbon-based nanomaterials for the purpose of developing new energy-harvesting technologies at the single molecular level. He and his associates design and fabricate carbon-based nanoscale devices with in situ tunable electronic properties. They also investigate energy flow dynamics and mechanisms by spatial, photon energy and time-resolved scanning photocurrent microscopy and optical spectroscopy; and they are attempting to integrate carbon-based nanostructures with other advanced photonic systems such as plasmonics and silicon waveguides. Among other possibilities, Xu’s work has tremendous potential to help create the next generation of transistors in electronic devices.

Much of their efforts were focused on developing methods to encourage colleagues to seek out new and innovative ways to recognize and reward teaching excellence.

Financial Summary 2015

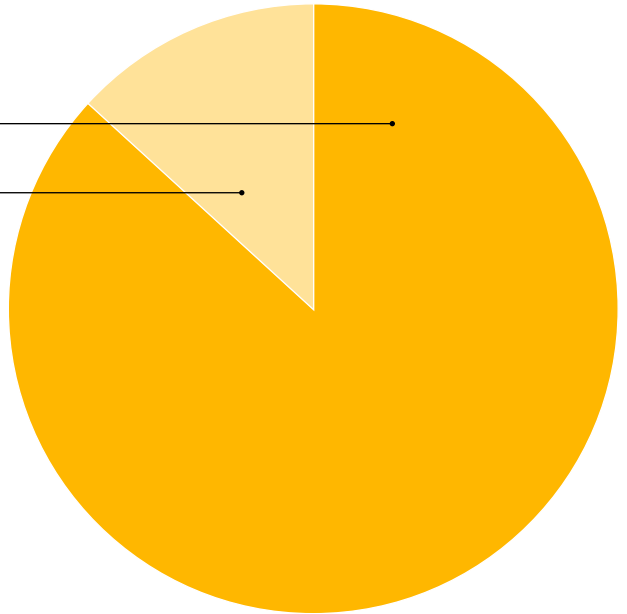
The financial activities of Research Corporation for Science Advancement were audited by Beach Fleischman, PC. For the complete audited financial statement, please visit our website at rcsa.org.

Where Our Money Goes

Total Expenses \$6.3 million

Program Expenses, Including Grants & Awards **87%**

General & Administrative Costs **13%**



Grants and Awards \$3.5 million

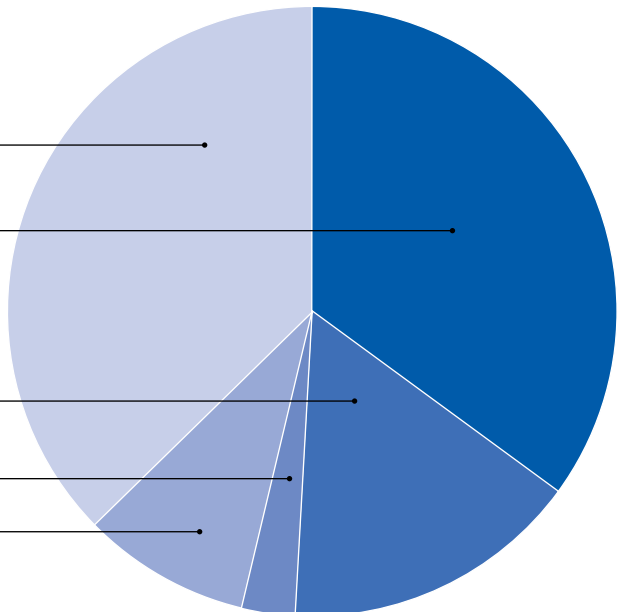
Cottrell College Science **37%**

Cottrell Scholars **35%**

Scialog **16%**

Cottrell TREE & LEAD Awards **3%**

Discretionary Grants & Special Initiatives **9%**



Net Assets at Beginning of Year \$154.0 million

Net Assets at End of Year \$146.5 million

RCSA Board of Directors 2015

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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