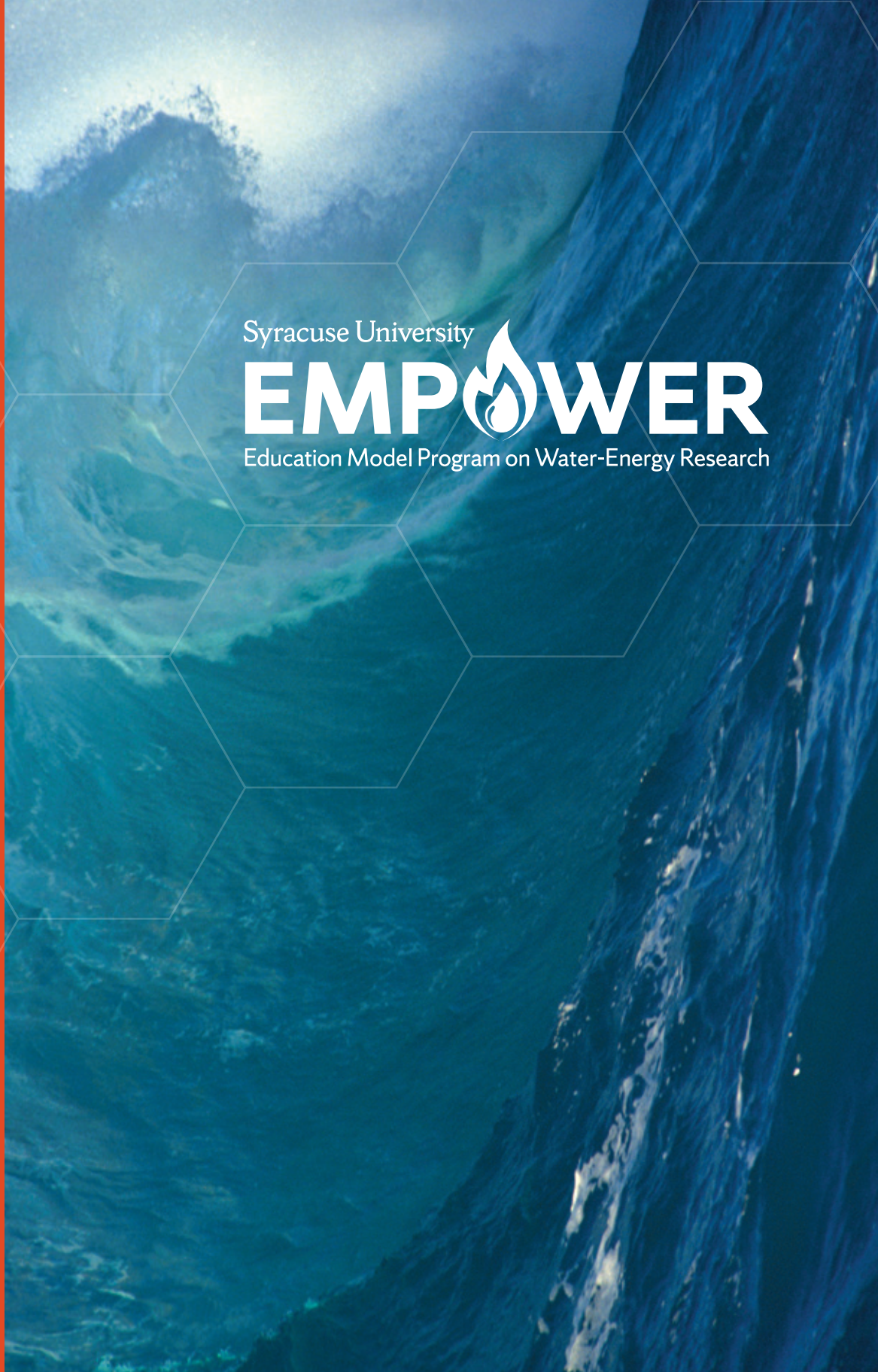
ANNUAL REPORT 2017



Syracuse University

EMPOWER

Education Model Program on Water-Energy Research

The program will broaden the students' scope outside of their area of expertise, and other skillsets to deal with the real world.

—External advisor

EMPOWER Leadership Team. From left, Peter Wilcoxen, Chris Junium, Chris Scholz, Laura Lautz, Don Siegel, Chris Johnson, Tara Kahan, and Charles Driscoll. Missing: Don Torrance and Kirk Knestis. Photograph courtesy of Deanna McCay.

EMPOWER NRT Leadership Team

The leadership team worked collaboratively in the development and submission of the EMPOWER NRT grant to the National Science Foundation as PI, co-PIs, and senior personnel. The team continues to collaborate on program development and administration.

Laura K. Lautz, *professor, Earth sciences, EMPOWER NRT PI and Program Director*
Charles Driscoll, *University professor, civil and environmental engineering*
Chris Johnson, *professor, civil and environmental engineering*
Chris Junium, *assistant professor, Earth sciences*
Tara Kahan, *assistant professor, chemistry*
Kirk Knestis, *Hezel Associates, assessment and evaluation*
Chris Scholz, *professor, Earth sciences*
Donald Siegel, *professor, Earth sciences*
Donald Torrance, *associate professor, broadcast and digital journalism*
Peter Wilcoxen, *professor, public administration and international affairs*

Deanna McCay, *program manager*
Patrick Fiorenza, *assessment*

EMPOWER NRT External Advisory Committee

EMPOWER is supported by an advisory committee, which is comprised of Ph.D. professionals in non-academic careers, including energy, advocacy, government research, environmental consulting, and STEM education.

Kevin Bohacs, *senior research scientist, ExxonMobil*
Gillian Daly, *risk assessor, Golder Associates Ltd.*
Steven Hamburg, *chief scientist, Environmental Defense Fund*
William Kappel, *hydrogeologist emeritus, U.S. Geological Survey*
Aisha Morris, *director, RESESS Internship Program*

empower.syr.edu

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Contents

The program will broaden the students' scope outside of their area of expertise, and other skillsets to deal with the real world.

—External advisor

I think these programs are so important.... It's not that students don't have job opportunities in academia; many students just don't want to go into that track. I think it's so important to prepare students for a variety of different jobs.

—External advisor

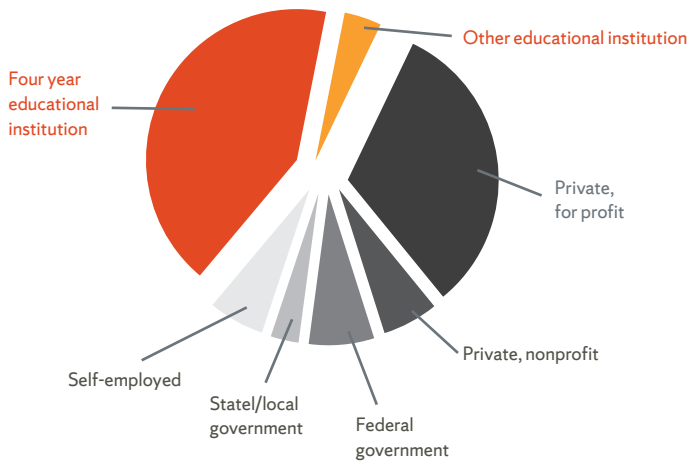
Without the EMPOWER program to push me outside of my comfort zone, I most likely would not have taken the [Environmental Law] course; however, it's been extremely helpful and applicable for my thesis and internship.

—EMPOWER trainee

National Trends in STEM Graduate Education

Where does the future lie for STEM graduate degree recipients?

More STEM graduates pursue non-academic careers



National trends in employment of doctoral scientists and engineers, by sector of employment and primary work activity. Source: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients, 2013.

More than half of Ph.D. scientists find employment in non-academic sectors; for engineering doctorate recipients, the percentage is even higher.[1] Employers expect STEM graduate degree holders to have more than advanced content knowledge in their area of study—they want graduates to develop "soft skills" in professionalism and work ethic, oral and written communication, teamwork, and problem solving.

Despite increasing rates of employment in non-academic sectors and increasing expectations for soft skills, professional development opportunities in graduate school are often limited. Professional development events are often offered outside of academic departments, requiring students to independently seek out opportunities, often with minimal facilitation by their mentors. In some fields, internship experiences are essential for career preparation, yet participation in internships is low.[2]

Recognizing the range of career options for graduate degree holders in STEM, as well as the need to align graduate education with the expectations of prospective employers, the National Science Foundation (NSF) created the NSF Research Traineeship (NRT) program. The purpose of this program is to encourage the development of new approaches to STEM graduate training, preparing graduate students for careers within and outside academe.[3]

1 Council of Graduate Schools and Educational Testing Service. (2012). Pathways Through Graduate School and Into Careers. Report from the Commission on Pathways Through Graduate School and Into Careers. Princeton, NJ: Educational Testing Service.

2 *American Geosciences Institute. (2016). Status of the Geoscience Workforce 2016. Alexandria, VA: American Geosciences Institute.*

3 *National Science Foundation Research Traineeship (NRT) Program. Solicitation NSF 16-503.*

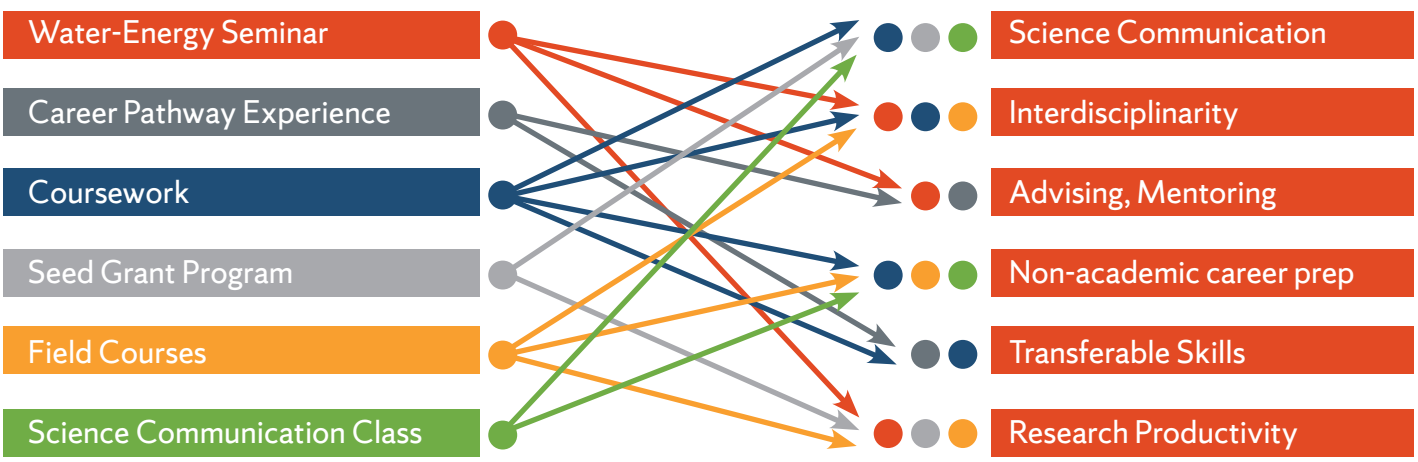
The EMPOWER Model for STEM Graduate Training

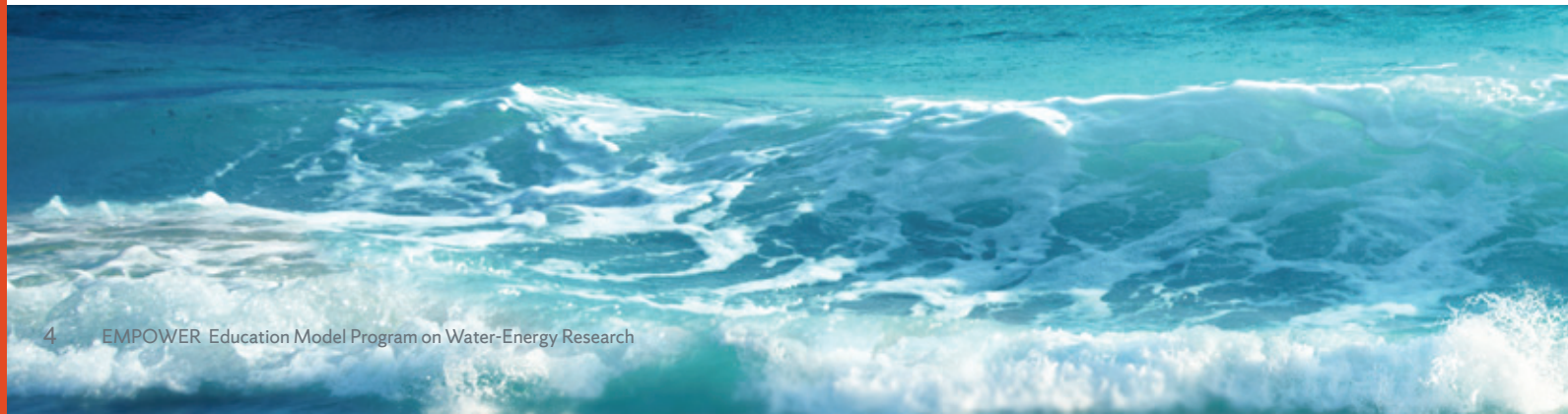
Merging STEM Research with Professional Development

EMPOWER was one of only eight NRT programs funded out of over 250 grant applications submitted in the initial call for proposals from NSF. EMPOWER, or the "Education Model Program on Water-Energy Research," is supported by a 5-year, $3 million grant from the NRT program. The NRT provides one-year $32,000 stipends for up to 46 graduate students and supports the development of a series of training elements. EMPOWER admitted its first cohort of students in 2016.

The water-energy research theme, a priority research area nationally, spans the full hydrocarbon energy cycle: from geologic origins and production of hydrocarbon fuels; to their use and effects in energy, industry and transportation; and how these phases of the energy cycle interface with the hydrologic cycle, with particular emphasis on water quality.

Graduates of EMPOWER are likely to pursue careers in business, government, not-for-profits, or academia, each requiring specialized professional skills. Therefore, EMPOWER designed a series of training elements to equip students with the skills needed for the range of careers options in water and energy.





University Investment in EMPOWER

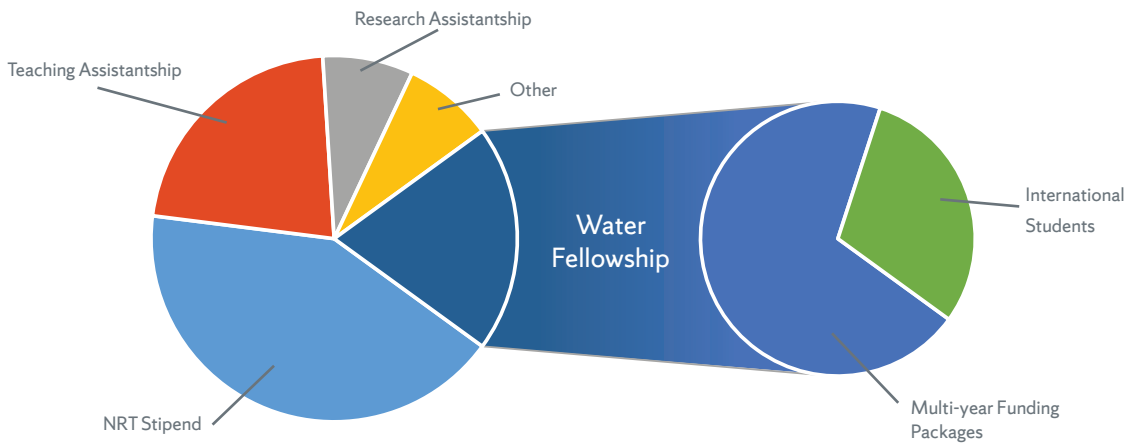
Leveraging Resources to Maximize Impact

EMPOWER grew out of Syracuse University's "Water Science & Engineering Initiative." In 2013, the University Provost and Vice Chancellor allocated support for: (1) four University Water Fellowships per year and (2) the Water-Energy Seminar Series. University support has been ongoing since then and continues to play an essential role in EMPOWER.

Water Fellowships and Tuition Waivers: Syracuse University offers essential support that has increased participation in EMPOWER. Students awarded NRT Fellowships must meet NSF-defined eligibility requirements; therefore the University Water Fellowships provide critical flexibility to (a) support exceptional international students, (b) provide multi-year funding packages to outstanding domestic Ph.D. students, and (c) provide fellowships to non-STEM students interested in water-energy research.

Further University support has been provided through tuition waivers from the participating colleges (Arts & Sciences, Engineering & Computer Science, Maxwell). These waivers are granted to all students on EMPOWER NRT Fellowships and University Water Fellowships.

Trainee Funding



The Water-Energy seminar is absolutely a cornerstone in the EMPOWER NRT Trainee experience. It combines technical development and professional development with the opportunity to build a network of peer colleagues.

—EMPOWER trainee

Having a physical space to meet on a regular basis provides a sense of community. Suite 333 is collaborative space where we network, eat lunch, and prepare for seminars.

—EMPOWER trainee

EMPOWER trainees using the EMPOWER Office Suite.

Renovation of Collaborative Space: In 2016, the Geology Library was completely gutted and renovated to create the EMPOWER Office Suite, consisting of two conference rooms, small meeting spaces, a study area, and five offices. The extensive renovation was made possible by the generous financial support of the Provost and Vice Chancellor's Office.

Water-Energy Seminar Fund: The one-credit Water-Energy Seminar has been offered every semester since Fall 2013. Currently team-taught by EMPOWER faculty, the seminar features current water-energy research, professional development activities, and a visiting lecture series. The seminar, which is almost exclusively supported by University funds, provides a unifying experience for EMPOWER students across the range of disciplines.

Water-Energy Seminar by the Numbers

65 participants in professional development events

20 visiting guest speakers since 2015

10 events led by SU personnel

7 collaborating SU programs

6 seminar instructors

Interdisciplinarity

Integrating STEM Disciplines Across Schools and Colleges

Drawing from four University colleges and 10 academic departments, EMPOWER students and faculty comprise a team of over 40 individuals engaged in research at the Water-Energy Nexus. NRT participants include trainees, the leadership team, affiliated faculty (faculty who serve as thesis advisors for trainees), and faculty advising our professional development specialization area (PDSA).

Professional Development Specialization Area (PDSA) Coursework: EMPOWER trainees take coursework across the University to enhance their professional skills. Certificates of Advanced Study (CAS), offered through Syracuse University's renowned professional schools, provide experience in areas such as entrepreneurship, management, policy, teaching, and law.

If students do not pursue a CAS, they tailor their own program of study aligned with their professional interests. EMPOWER is piloting a new CAS in response to interests of students and assessment outcomes.

Interdisciplinary Collaboration: EMPOWER trainees have the unique opportunity to engage with faculty, staff, and students from outside their home academic department through the Water-Energy Seminar. Such engagement has resulted in collaborative research and successfully funded proposals.

Professional Development Courses by the Numbers

Number of classes taken in each college:

iSchool	Maxwell	Whitman	Law
2	3	9	1
SUNY ESF	**Education**	**E&CS**	**Newhouse**
2	3	1	9

Classes taken 21

Colleges involved 8

Trainees who have taken professional development classes 20

Professional development specialization area (PDSA) coursework is supported by faculty from several academic units. From left, David Dreisen (Law College), Peter Wilcoxen (Public Administration and International Affairs), John Tillotson (Department of Science Teaching), and Todd Moss (Whitman School of Management).

This seminar is an excellent avenue for interdisciplinary collaboration among graduate students at SU and ESF, and the syllabus material is practical, useful and important.

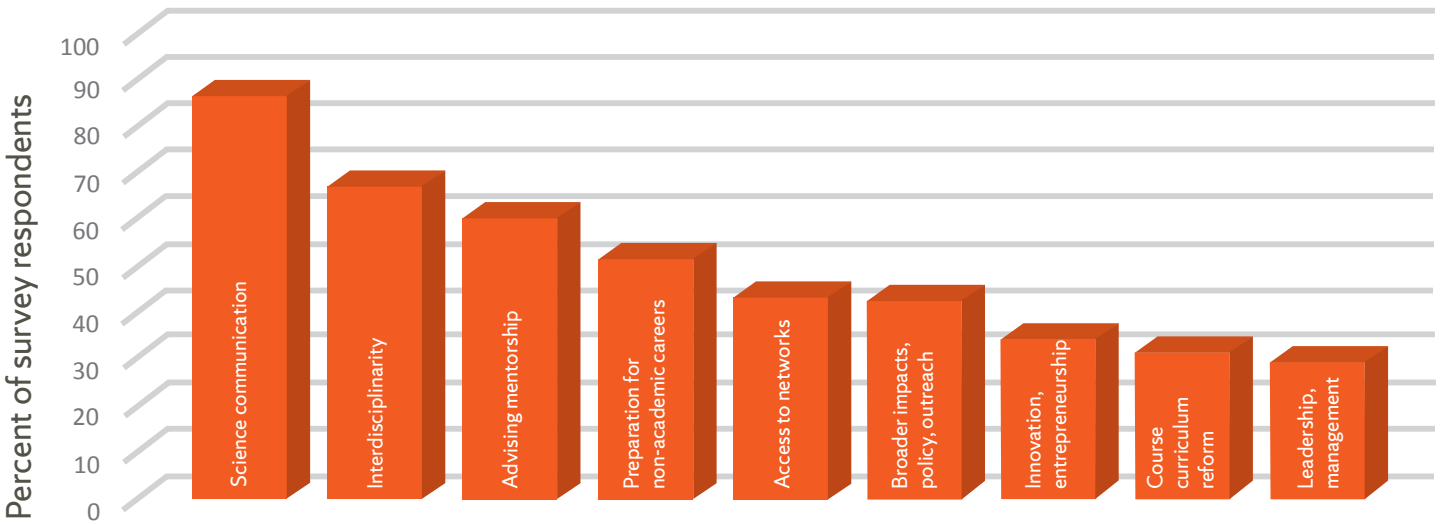
—EMPOWER trainee

Professional Development

Preparing STEM Graduates for Academic and Non-academic Careers

EMPOWER's professional development opportunities are designed to address the most critical issues in graduate education, as identified by U.S. graduate students.

Critical Issues in Graduate Education



Critical issues in STEM graduate education as identified by U.S. graduate students. Source: National Science Foundation, Division of Graduate Education (2013). Innovation in Graduate Education Challenge.

EMPOWER trainees at the AAAS meeting. From left, JR Slosson, Caitlin Eger, Megan Daley, Alexa Stathis, Yige Yang, and Sara Alesi.

I was able to correspond with other trainees (from various departments) and receive feedback on my research project. This helped me in composing the paper that I submitted to a peer-reviewed journal.

—EMPOWER trainee

Career Pathway Experience: Each trainee completes an off-campus experience to gain technical and professional skills.

Recent EMPOWER student experiences include:

- Adjunct instructor for undergraduate courses at a four-year college
- Three-month internship with the U.S. Geological Survey
- Summer internship at environmental consulting firm
- AAAS Mass Media Fellowship at the LA Times

Seed Grant Program: Students may apply for grants to support specific lines of research and professional development activities. To date, EMPOWER's seed grant program has provided funding for **7** proposals, including **2** collaborative proposals, totaling **$19,500**. **12** trainees have received support from seed grants: trainees have attended **4** different academic conferences, participated in **2** technical workshops, and completed lab work for **1** student-centered emerging research line.

Other Professional Development Activities: EMPOWER, through the Water-Energy Seminar, additionally offers professional development workshops and events. Many of these activities are open to all STEM graduate students.

Ph.D. student Alex Johnson discusses his research with Earth sciences professor Linda Ivany.

Recent professional development activities include:

- Networking workshop led by Dan Olson-Bang, Graduate Career Services
- Myers-Briggs Type Indicator workshop led by Kate Lewis, biology
- STEM Career Services campus visit, including public lecture and career counseling sessions
- Environmental Consulting career panel with Syracuse University alumni

Science Communication

Communicating Science to Technical and Non-Technical Audiences

Science communication training is an essential component of EMPOWER. All trainees take "Multimedia Reporting on Climate Change and Sustainability," which is offered through the S.I. Newhouse School of Public Communications. In the class, EMPOWER students learn alongside undergraduate journalism students and other STEM graduate students. The culmination of the class is the creation of a website that contains multimedia projects created by each student, including podcasts, virtual reality demonstrations, videos, and webpages.

Activities offered through the Water-Energy Seminar are designed to develop the oral and written communications skills desired by employers in academic and non-academic careers. For example, student-authored news pieces are posted on EMPOWER's website; "Sketch Your Science" encouraged students to distill complex research ideas into a simple story; and the NSF Mock Panel provided students the opportunity to act as peer reviewers for NSF proposals.

EMPOWER offers additional professional development opportunities in science communication, including an AAAS Science Communication Workshop, a networking workshop, and a webpage development seminar.

EMPOWER external advisor Aisha Morris participates in a Future STEM Leaders Workshop at the NRT Annual Meeting. Photo courtesy of the Maryland Language Science Center, University of Maryland.

It has been a pleasure to work with grad students with such varying backgrounds and other disciplines because it helps me to look at things in a different way. Everyone has something unique to contribute.

—EMPOWER trainee

5 student-authored publications this year

33 conference presentations this year

Internationalization

Developing a Global Context for Understanding the Water-Energy Nexus

EMPOWER is piloting a two-course field program in the northeastern U.S. and Rwanda that weaves together the program's research themes. The international field course will be offered for the first time in Summer 2018 and will be a collaboration between EMPOWER and the University of Rwanda. In addition to having Rwandan faculty assist with instruction, EMPOWER is exploring the possibility of advanced undergraduates at the University of Rwanda participating in the class.

Funding through EMPOWER and the University Water Fellowships has allowed students to pursue international research endeavors. One in four EMPOWER trainees is involved in international research projects in diverse settings ranging from the Middle East to South America.

The Water-Energy Seminar provides additional opportunities for students to learn about international issues by inviting guest speakers who are involved in research outside of the US.

Diversity and Inclusion

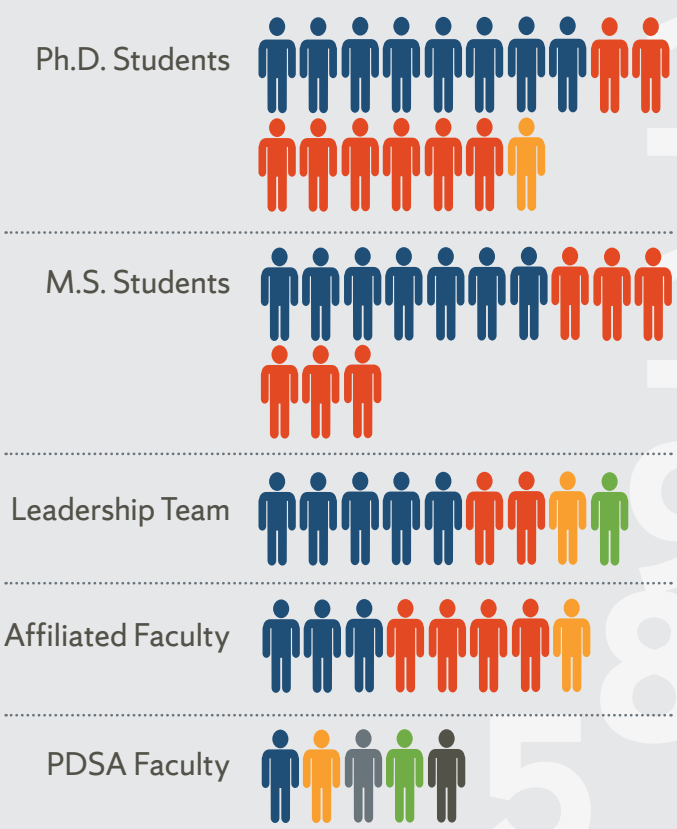
Developing a Diverse Cohort of STEM Graduate Students

EMPOWER is committed to increasing participation in STEM by women and underrepresented minority students. To date, 65 percent of EMPOWER trainees have been women and 10 percent underrepresented minority students. We offer underrepresented minority students a second year of NRT fellowship support in an effort to increase recruitment, participation, and retention of a diverse cohort.

EMPOWER benefits from the guidance of Aisha Morris, a member of our external advisory committee and director of the RESESS (Research Experiences in Solid Earth Sciences) program, which provides summer research experiences for underrepresented minority undergraduate students in the geosciences. We partner with WiSE (Women in Science and Engineering) to offer joint professional development programming and are developing avenues for student recruiting, including working with the National GEM Consortium.

Different from many STEM graduate training programs, the EMPOWER NRT provides fellowship support for both M.S. and Ph.D. students. Research shows that M.S. programs can be a pivotal pathway for recruiting underrepresented minority and women students transitioning from undergraduate to graduate programs in STEM.

EMPOWER Personnel



I think this program will be a very good case study and example of how researchers with somewhat disparate interests can join together and build something greater than the parts.

—EMPOWER faculty

College of Arts and Sciences

College of Engineering and Computer Science

Maxwell School of Citizenship and Public Affairs

S.I. Newhouse School of Public Communications

Martin J. Whitman School of Management

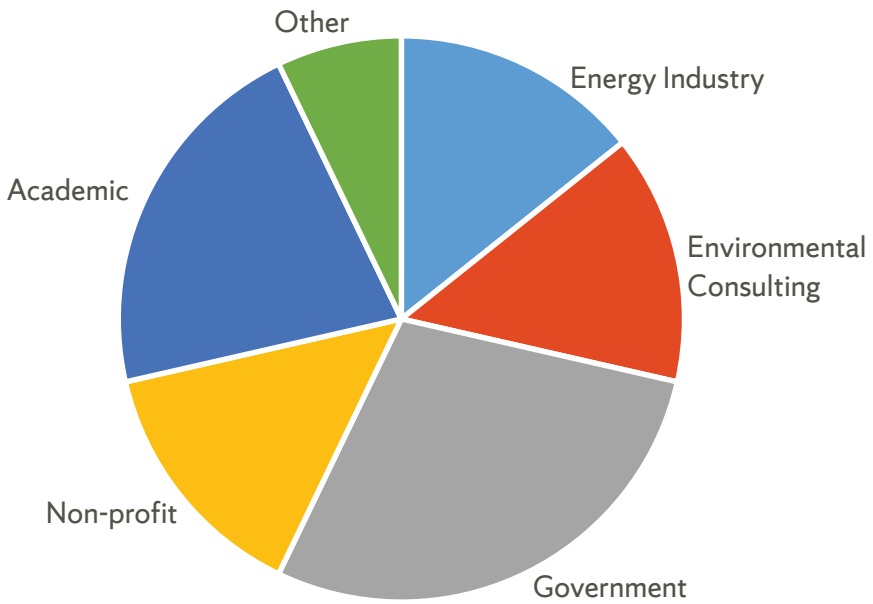
College of Law

Impact on Students

Evaluation of Program Outcomes

Through surveys and interviews with faculty, external advisors, and students, EMPOWER regularly assesses program effectiveness and solicits feedback to inform improvement. Surveys of students at the beginning and end of the academic year show strong benefits of participation in the program.

Career interests of EMPOWER students



To what extent do you agree with the following: Percent choosing "agree" or "strongly agree"

I am aware of different types of careers in my field.

Fall 2016	Spring 2017
57	75

I believe the water-energy nexus is a critical national discussion, and I want to be a part of it.

Fall 2016	Spring 2017
93	94

I feel prepared to pursue multiple career paths.

Fall 2016	Spring 2017
43	56

I understand how the research I will be doing can influence areas related to business, law, policy, and communication.

Fall 2016	Spring 2017
64	75

Syracuse University