



RIT'S Center for Advancing STEM Teaching, Learning & Evaluation

2016 – 2017 Annual Report



R·I·T
College of
Science



Table of Contents

About the Center.....	3
Flagship Programs.....	4
Research Initiatives.....	7
Members	9
Affiliated Personnel.....	10
Funding.....	11
Events.....	13
Publications.....	15
Presentations.....	17
Students Mentored.....	21
Other Notable Achievements.....	22
Web and Social Media Presence.....	23

About the Center

The Center for Advancing STEM Teaching, Learning & Evaluation is a network of faculty, projects and programs engaged in scholarship surrounding STEM education. Key Focus Areas are:

- 1) Discipline-based Education Research (DBER) - The Science & Math Education Research Collaborative (SMERC) conducts rigorous discipline-based education research on issues involving postsecondary student learning, and members have a track record of peer-reviewed publications and external funding.
- 2) Scholarship of Pedagogy - CASTLE supports faculty efforts on pedagogical scholarship, evaluation and assessment, and foster innovation in the classroom.
- 3) Educational Transformation - The Center promotes and fosters innovative curricula for national dissemination. The College hosts several externally funded model curricula, including: LivePhoto, Interactive VideoVignettes, and a Learning Assistant Program which transforms traditional lecture format to small group active learning.
- 4) Summer Math Applications in Science with Hands-on (SMASH) Experience – This week-long summer program for rising eighth-grade girls concentrates on building girls’ confidence in science and math through an on-campus experience in and out of the lab. SMASH’s curriculum focuses on improving the two attitudinal values, perceived usefulness of mathematics and mathematical self-efficacy, impacting math-related achievement. Scholarship support makes it possible for Rochester City School students to participate when they otherwise would not be able to attend.
- 5) Education and Careers of Groups Historically Excluded from the STEM Disciplines – In June of 2017, RIT was awarded a \$1 million Inclusive Excellence grant from the Howard Hughes Medical Institute to increase diversity and inclusivity among undergraduate science majors. CASTLE members and affiliates will develop, implement and evaluate the success during this 5-year initiative. Additionally, collaborations with Women in Science (WiSe), a CASTLE-affiliated program, continue to seek to engage women in the sciences and mathematics by offering information, equity and collaboration opportunities. The Center helps coordinate WiSe activities, and supports efforts to secure external funding through foundations and local and national industries.

The Center’s Mission is to:

improve science and math education and outreach initiatives at RIT and foster collaboration between science and math educators and education researchers.

The Center’s Vision is to:

- Nurture a community of faculty, administrators, and staff interested in STEM education and pedagogy. CASTLE facilitates dialog about evidence-based practices, discipline-based education research, and methods of assessment and evaluation.
- Establish a robust and sustainable infrastructure that transforms STEM educational practices, supports discipline-based education research, preparation, professional development, and outreach.
- Foster innovations in education by integrating an interdisciplinary community of scholars; promoting, sustaining, and evaluating reform efforts; advocating for diversity and access; and influencing policy, fundraising, and public outreach.

Flagship Programs



RIT HHMI Inclusive Excellence 5-Year Project

In June of 2017, the Howard Hughes Medical Institute awarded RIT \$1 million to conduct the 5-year project. Rochester Institute of Technology is one of 24 institutions nation-wide to conduct a 5-year project to increase diversity and inclusivity among undergraduate science majors, which includes developing a strategy for supporting their success. These initiatives will serve as national models for other institutions.

The project will increase infrastructure, resources and expertise to strengthen inclusion in STEM education—embracing perspectives, strengths and insight from a multicultural base of faculty, staff and students in the natural sciences. Included in this population are transfer students and first-generation students.

Over the 5-year project timeframe, the goal is to engage 70 percent of College of Science faculty (including new hires), and a majority of students in project activities. The intent is to then expand participation campus-wide.

Multiple aspects are key to a successful student experience. They include a strong support network, inclusive environment that encourages open and safe conversation and good listening, and tools to understand themselves and others. Focus is placed on impacting students across three areas with distinct objectives:

- **Research/Labs**—Objective: Engage faculty in discussion about identifying, recruiting, and mentoring a diverse student population in the research lab. Faculty workshops will discuss both general mentoring strategies (e.g. setting goals) as well as topics specific to the target populations (e.g. DHH communication strategies or mentoring across gender and racial divides). Close collaboration with existing institute programs that serve underrepresented students will increase recruitment and participation of targeted students.
- **Teaching/Classrooms**— Objective: Create new classroom materials that promote student metacognition (understanding how they individually learn best) and sense of identity, as these have been shown to address many negative cultural messages students receive about their place in science. Examples include short reflections on individual strengths (affirmation exercises) or how different disciplines connected (e.g. how math concepts arise in physics). Activities will be short, so faculty can incorporate 1-2/week without significantly impacting content and keeping continuity across campus.
- **Community/Theater**— Objective: Foster a welcoming and inclusive community through a series of community building events and “Playback Theater” workshops in which actors recreate participant narratives around issues of identity and inclusivity to create stronger bonds between faculty and students. The Community/Theater strand will work with existing (and create new) student and faculty/student groups across the college to identify common challenges in the culture.



Learning Assistant (LA) Program

Dedicated to the transformation of STEM courses – the LA Program creates environments in which students can interact with one another, engage in collaborative problem solving and articulate and defend their ideas.

Undergraduate LAs facilitate small-group or other interactions in the classroom. RIT's model is designed to: a) provide resources to help faculty implement pedagogical change in their classrooms, b) recruit and prepare talented STEM majors for teaching careers, c) engage faculty and departments in recruitment and preparation of future teachers and d) improve the quality of STEM education for all undergraduates.

During the Fall 2016 semester the program had 32 Learning Assistants working with 21 Faculty Mentors in four College of Science departments (Biological Sciences, Chemistry, Mathematics/Statistics and Physics) two College of Applied Science & Technology departments (Manufacturing & Mechanical Engineering Technology, Electrical Engineering Technology). For the Spring semester there were 33 Learning Assistants working with 20 Faculty mentors within the same departments. A new relationship was formed with the American Sign Language and Interpreting Education department within NTID (National Institute for the Deaf) and three Learning Assistants were placed in Interpreting courses, mentored by 3 NTID faculty. Recruitment Fairs were held the previous semester to educate students on the Learning Assistant Program and provide them an opportunity to speak with past and current LAs about their experiences. The LA Program also hosted two teacher roundtables, bringing teachers from local schools on campus to speak with students interested in the teaching career path.



Incorporating Metacognitive Research and Practice to Ensure Student Success (IMPRESS)

This program seeks to improve learning through direct instruction in metacognition, including accurate self-assessment and sense-making. It is an intensive educational experience for first-generation and deaf/hard-of-hearing students that incorporates metacognition scientific inquiry. IMPRESS consists of (1) a Summer Experience, (2) First Year Courses and (3) the LA Program. During the summer, IMPRESS students spend two weeks together investigating complex, real-world problems. During the first-year IMPRESS students take select metacognition courses, while second year students are eligible for Learning Assistant positions. Throughout the 2016-2017 academic year there were 65 IMPRESS students. ADMIRE which stands for Academic Discourse on Metacognitive In Real Environments. They hosted their first social event "Connecting RIT: Surviving on Transfer Island" in April and they started the process of getting recognized by RIT as an official Student Government club. This project is funded through National Science Foundation contract # DUE 1317450.



Summer Math Applications in Science with Hands-On (SMASH) Experience for Girls

The SMASH Experience for Girls is a summer program is designed to increase middle-school girls' engagement and interest in STEM. This unique program brings forty rising eighth grade girls to RIT's campus, to spend a week working on mathematical modeling projects, designed to show the usefulness of mathematics in everyday

life; self-affirmation activities created to build confidence in math; and daily recreational activities, such as ice skating or a campus-wide STEM scavenger hunt. SMASH engages participants in mathematical modeling through a curriculum based on solving a crime scene involving activities in the College of Science's laboratories. The experience concludes with a hands-on event with representatives from local companies demonstrating to the girls the role of STEM in their industries, and a parent symposium where participants present a problem plaguing their local community and how mathematics could be used to solve this problem. In preparation for the summer experience, RIT undergraduate and graduate students, with interests in K-12 STEM education, under the mentorship of a local teacher create, test, and then facilitate all SMASH activities.

PEER Program

Professional-development for Emerging Education Researchers (PEER)

This discipline-based education research program holds the promise of satisfying expectations of both scholarship, which is increasing at teaching-centric institutions, and teaching effectiveness, a concern at all institutions. Additionally, junior education researchers seek more diverse training in research methods and theories. Emerging education researchers need support as they develop their research programs and expand their theoretical and methodological expertise, and they benefit from the guidance of knowledgeable peers and near-peers.

PEER-Rochester available projects include looking at the following questions:

- How do students collaborate within and among lab groups, and how does the nature of that collaboration change over the course of the summer experience? Network analysis is used to track collaboration within and among lab groups of 3-4 students.
- How do gender and ethnicity affect conversational equity in lab groups? Work is done in developing both quantitative and qualitative measures of equity, and comparing the measures among multiple groups.
- When former IMPRESS students return as learning assistants, how do their experiences in the program shape their interactions with students later on? The focus is on how learning assistant interactions with IMPRESS students change (or remain the same) as they move from participants to instructors.
- How does participation in the program affect student views of the nature of science and the role of experimentation? When students conduct experiments, researchers learn about ideas around what makes an experiment "good," and how table-top experiments are related to scientific practices.

World Location

Rochester, NY:	RIT IMPRESS Education Research Squad
Cologne, Germany:	Conducting Research in Active and Inclusive Pedagogies
Kibungo, Rwanda:	Big data analytics and Internet of things (IoT) in Education
Monterrey, Mexico:	Working groups for action research

Research Initiatives:



Science & Mathematics Education Research Collaborative (SMERC)

SMERC is the research arm of CASTLE. SMERC consists of a multidisciplinary group of Discipline Based Education Researchers (DBER), who study how students learn the STEM disciplines, apply science to problem solving, and become enculturated as scientists. This research advances fundamental knowledge of how people learn, and develops general theory that can be applied in practice. Individual projects include biology education, physics education, chemistry education, engineering education, and science/math communication. SMERC is the overarching team of researchers leading the following areas of research:



Photonics and Optics Workforce Education Research (POWER)

POWER unites higher education, discipline-based education research, and workforce development in order to investigate core aspects of typical undergraduate STEM programs: scientific content, mathematics, and communication. This project is funded through a National Science Foundation Education & Human Resources Core Research (ECR) grant DGE-1432578. This project is funded through a National Science Foundation Education & Human Resources Core Research (ECR) grant DGE-1432578.



Molecular Biology Education Group (MBER) is a collaborative research lab co-led by Dr. Dina Newman and Dr. Kate Wright, faculty in the Gosnell School of Life Sciences at RIT. The team studies how students think about molecular biology concepts and develops tools for improving biology education.

Areas of Interest

1. **Student mental models of molecular processes that involve DNA, and how novices differ from experts.** Much of our work has focused on student understanding of meiosis, which led to the development of a new framework, The DNA Triangle.
2. **How visual representations of molecular processes impact student understanding.** Work thus far has focused on the use of arrow symbols by experts and the interpretation of these symbols by learners. We are currently developing a framework that combines elements of visual communication with evidence-based pedagogy.
3. **How physical models can be used to improve student learning about molecular processes.** This work is done in collaboration with the Center for Biomolecular Modeling at the Milwaukee School of Engineering (<http://cbm.msos.edu/>), where many 3-D models have been developed. These models provide the basis for activities that promote deep conceptual learning of processes that are not easy to observe directly.

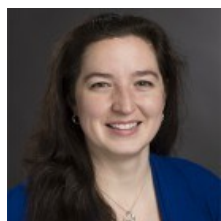
4. **Development of assessments and activities for undergraduate instructors teaching molecular biology concepts.** Based on our investigations of student thinking about biology, we have developed numerous activities that demonstrably improve learning for undergraduates at all levels. We have also created the Central Dogma Concept Inventory (CDCI), which can be used to assess student understanding of Central Dogma processes.
5. **Interactive video vignettes for teaching key ideas that are difficult for students.** Together with Dr. Robert Teese (School of Physics and Astronomy at RIT) and Dr. Jean Cardinale (Alfred University), we have developed a suite of interactive, web-based activities that can be used to introduce or clarify key concepts and big ideas in biology (<https://www.rit.edu/cos/interactive/>). This project is funded by NSF (DUE-1432286, DUE-1432303).
6. **Undergraduate research.** In addition to mentoring RIT undergraduates on research projects during the academic year in the MBER lab, Drs. Wright and Newman lead an NSF-funded summer REU program (DUE-1359262) that brings students from all over the U.S. to learn about Discipline-Based Undergraduate Research and undertake cutting edge projects in the field (<https://www.rit.edu/science/smerc/reu>).

REU Experience

Research Experience for Undergraduates (REU)

A hands-on research experience for undergraduates in the emerging area of Discipline-Based Education Research (DBER). One subfield of DBER relates to the use of models and representations in STEM. This NSF-funded Research Experience for Undergraduates (REU) program accepted its second cohort in early January. Research mentors and ten REU students from across the country spent the January intersession in a virtual “January Jump-Start” designed to give research mentors and students a chance to meet and start project work before the onsite experience at RIT this summer. The 2017 REU student cohort were from the following colleges: University of Alabama at Birmingham, California State University Monterey Bay, University of West Alabama, University of Seattle, Kansas State University, Chicago State University, University of Colorado Denver, Western Illinois University, and Elizabeth City State University. Undergraduate students spent time reading and discussing DBER literature with the entire group using an online reading/annotation tool. Mentors and students also engaged in Skype and email communication to discuss research interests, individual projects and research ethics. This “Jump Start” gave students the chance to become involved in the design of summer research projects and to get acquainted with each other. The program continued on June 4th when the students arrived at RIT for the nine week on-campus summer experience portion. They continued their mentored research projects but also participated in two weekly workshops, one focused on Professional Development and the other focused on DBER research methods, in addition to a number of social activities. All ten REU students presented at RIT’s Undergraduate Research Symposium on August 4th, the conclusion of the summer experience. This project is funded through National Science Foundation contract # DUE 1359262.

CASTLE Center Core Members—Managing CASTLE Programs & Projects



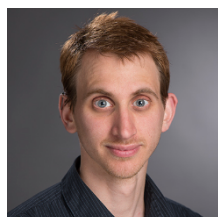
Jennifer Bailey
Senior Lecturer, Kate Gleason
College of Engineering



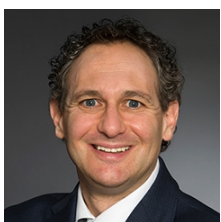
Lindsay Owens
Postdoctoral Researcher,
School of Chemistry and
Material Sciences



Adwoa Boateng
COS Library Liaison, Research
and Instruction Services



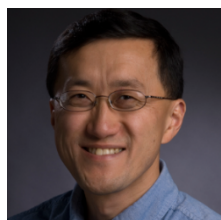
Corey Ptak
Program Coordinator, LA
Program and
Lecturer, Thomas H. Gosnell
School of Life Sciences



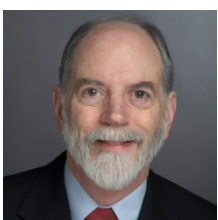
Scott Franklin
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Professor, School of
Physics and Astronomy



Susan Rothwell
Postdoctoral Researcher,
School of Physics and
Astronomy



Thomas Kim
Associate School Head and
Associate Professor, School of
Chemistry & Materials Science
On Leave



Robert Teese
Assistant Professor, School of
Physics and Astronomy



Anne Leak
Postdoctoral Researcher, School
of Physics and Astronomy



Leslie Kate Wright
Associate Professor, Thomas
H. Gosnell School of Life
Sciences



Dina Newman
Director, SMERC and
Associate Professor, Thomas H.
Gosnell School of Life Sciences



Benjamin Zwickl
Assistant Professor, School of
Physics and Astronomy



Kelly Norris Martin
Assistant Professor, School of
Communication

Affiliated Personnel—Contributing to CASTLE Programs & Projects



Linda Barton
Associate Professor, School of
Physics and Astronomy



Christina Goudreau Collison
Associate Professor, School of
Chemistry & Materials Science



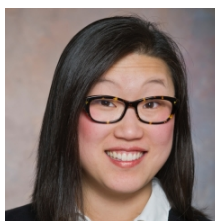
Elizabeth Cherry
Associate Professor, School of
Mathematical Sciences



Kara Maki
Assistant Professor, School of
Mathematical Sciences



Jeremy Cody
Associate School Head and
Associate Professor, School of
Chemistry & Materials Science



Lea Vacca Michel
Associate Professor, School of
Chemistry & Materials Science

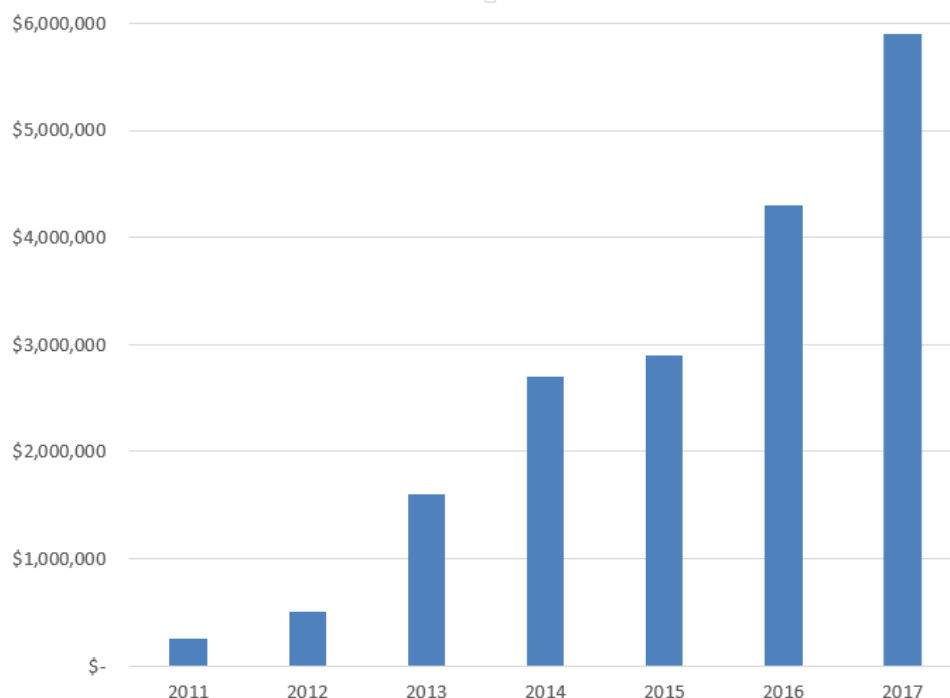


Paul Craig
School Head and
Professor, School of Chemistry
& Materials Science



Casey Miller
Associate Dean for Industrial
Partnerships and
Associate Professor, School of
Chemistry & Material Sciences

During the 2016 – 2017 academic year CASTLE has led or collaborated on seventeen different grants that total over \$5.9 million. Center funding has risen dramatically over the past five years.



Current CASTLE Funding

Dates	Total Funding	Funding Details	Personnel
6/2013-5/2018	\$899,898	Metacognition: A Transformative Approach to Retaining Deaf/HoH and first generation STEM Majors; NSF-National Science Foundation	PI Scott Franklin, Co-PI Elizabeth Hane
7/2013-6/2017	\$199,980	Collaborative Research: Transforming the Organic Chemistry Experience: Development, Implementation and Evaluation of Studio-Based Modules; NSF-National Science Foundation	PI Christina Goudreau, Co-PI Thomas Kim
9/2014-8/2018	\$399,309	Transfer of Math, Physics, and Communication Skills Into the Entry-level Photonics Workforce; NSF-National Science Foundation	PI Benjamin Zwickl, Co-PI Kelly Norris Martin
9/2014-8/2018	\$372,580	Collaborative Research: Development and Assessment of Interactive Video Vignette Modules for Biology Teaching; NSF-National Science Foundation	PI Robert Teese, Co-PIs Leslie Kate Wright and Dina Newman
9/2014-8/2018	\$133,868	Collaborative Research: Undergraduate Students' Epistemology and Expectations of Experimental Physics; NSF-National Science Foundation	PI Benjamin Zwickl

10/2014-9/2018	\$339,825	REU Site: Model-Based Reasoning and Representations in STEM Learning at the Rochester Institute of Technology; NSF-National Science Foundation	PI Leslie Kate Wright, Co-PI Dina Newman
6/2015-5/2018	\$111,002	Collaborative Research: Role of Undergraduate Biochemistry Education in Protein Function Assignment; NSF-National Science Foundation	PI Paul Craig, Co-PI Herbert Bernstein
9/2015-8/2018	\$270,225	The Access Network: Supporting Retention and Representation in Physics through an Alliance of Campus-Based Diversity Programs; NSF-National Science Foundation	PI Scott Franklin, Co-PI Corey Ptak
6/2016-5/2020	\$649,626	Collaborative Research: Exploring factors that shape education and workplace training on essential 21 st Century Competencies: A translational study in Four High-STEM Job Regions; NSF-National Science Foundation	PI Benjamin Zwickl, Co-PI Kelly Norris Martin
9/2016-8/2019	\$419,284	Collaborative Research: Transforming the Organic Chemistry Lab Experience: Implementation and Evaluation of a Remformed Organic Lab Curriculum Across Institutions; NSF-National Science Foundation	PI Christina Goudreau, Co-PIs Dina Newman, Thomas Kim
9/2016-8/2019	\$299,982	Collaborative Transformation through Faculty Triads; NSF-National Science Foundation	PI Scott Franklin, Co-PI Sophia Maggelakis
9/2016-8/2019	\$428,237	Collaborative Research: NRT-IGE: Deploying Holistic Admissions and Critical Support Structures to Increase Diversity and Retention of US Citizens in Physics Graduate Programs; NSF-National Science Foundation	PI Casey Miller, Co-PIs Ben Zwickl, Scott Franklin
9/2016-8/2019	\$73,740	Collaborative Research: The PIPELINE Network; NSF-National Science Foundation	PI Linda Barton, Co-PI Ben Zwickl
10/2016-9/2018	\$18,072	NSF Includes: A National Network for Access and Inclusion in Physics Graduate Education; NSF-National Science Foundation / APS-American Physics Society	PI Casey Miller
1/2017-12/2017	\$99,680	Integrated Photonics Workforce Needs Assessment for New York State; DOD – Department of Defense	PI Ben Zwickl, Co-PIs Anne Leak, Kelly Martin
7/2017-6/2020	\$253,051	Collaborative Research: Data Integration in Undergraduate Mathematics Education; NSF-National Science Foundation	PI Paul Wenger, Co-PIs Matthew Hoffman, Carl Lutzer
7/2017-6/2022	\$1,000,000	HHMI USE Inclusive Excellence 2017; HHMI-Howard Hughes Medical Institute	PI Scott Franklin, Co-PIs Jennifer Connelly, Elizabeth Hane, Lea Michel, Dina Newman

Pending CASTLE Funding

Dates	Total Funding	Funding Details	
9/2017-8/2020	\$97,372	Collaborative Research: Using protein function prediction to promote hypothesis-driven thinking in undergraduate biochemistry education; NSF-National Science Foundation	PI Paul Craig, Co-PIs Herbert Bernstein, Jeffery Mills, Suzanne O’Handley
9/2017-8/2020	\$285,193	Quiet Science: Working with Deaf and Hard of Hearing Students in a Bench Science/Wet-Lab Research Setting; NSF-National Science Foundation	PI Lea Michel, Co-PIs Austin Gehret, Jessica Trussell
10/2017-9/2022	\$366,149	Integrative Experimental and Multiscale High Resolution Modeling of Cardiac Arrhythmias to Optimize Low Energy Anti-fibrillation Pacing (LEAP); DHHS – National Institutes of Health	PI Elizabeth Cherry

CASTLE Center Events

1. The 4th Annual CASTLE Symposium

The 4th annual CASTLE Symposium was held on Wednesday, May 17th 2017 in the Center for Integrated Manufacturing Studies (CIMS Conference Room). The symposium began with a poster session that showcased more than 40 student and faculty research projects focused on improving STEM education. Provost Jeremy Haefner and College of Science Dean Sophia Maggelakis provided opening remarks. An award ceremony followed to honor recipients of the third “Science and Math Education Research Special Honor Award” and recognize the 2016 – 2017 academic year Undergraduate Learning Assistants.

- a. 2016 Science and Math Education Research Special Honor Award Recipients
 - i. Dr. Michelle Chabot, School of Physics & Astronomy
 - ii. Elizabeth Bremer, Integrating Metacognitive Practices and Research to Ensure Student Success (IMPRESS)
 - iii. Scott Bell, Learning Assistant, Mechanical Engineering Technologies
- b. 2016 – 2017 Undergraduate Learning Assistants:
 Norfatini Adlina Omar, Brandon Alerte, Effiba Armah, Guy Azriel, Scott Bell, Sanketh Bhat, Joshua Bush, Christian Cammarota, Jordan Cardenas, Ana Cartaya, Devon Christman, Brianna Conrad, Joseph Cutungo, Brooke D’Arcy, Arturo De Santiago, Cayla Denning, Andrew Fleisher, Megan Freeman, Kevin Gates, Maryah Glover, Daniellle Granata, James Hahn, Addie Howard, SM Huq, Michael Johnson, Debbie Kamau, Amber Kudla, Spenser Lionetti, Gaetano Loweecey, Katie Luedders, Bryanne McDonough, Renee Meinhold, Alana Moraes, Darlene Navas, Emilyn Nguyen, Julia Okvath, Jacob Palmerio, Sean Peterson, Anthony Reiter, Hailey Richmond-Boudewyns, Will Rudan, Britta Schwall, Trevor Seiders, Zihe Shang, Nick Smith, Yaroslav Tochinski, Daniel Vasconcellos, Chris Webster, Brian Yu, Zaima Zeniya.

- c. 2016 – 2017 Learning Assistant Mentors:
Greg Babbit, Dawn Carter, Michelle Chabot, Steven Ciccarelli, Marge Corillo, Michael Cromer, Kristina Driscoll, Scott Franklin, Elizabeth Hane, Karl Korfmacher, Premalata Kumar, Bernadette Lanciau, Joseph Lanzafame, Charles Lusignan, Daniel Maffia, Campbell McDermid, Aaron McGowan, Dina Newman, Deana Olles, Mark Olles, Corey Ptak, Alan Raisanen, Connie Shannon, Rob Szalapski, Billy Vazquez, Paul Wenger, Kate Wright, Niki Zacharakis, Ben Zwickl

2. CASTLE/SMERC Seminar Speakers

- a. Nicholas Palumbo, University of Rochester, January 25, 2017, 1pm-2pm—“Innovative Methodological Approaches to DBER: An Examination of Research Projects in Literacy and STEM.
- b. Gina M. Quan, University of Maryland, February 3, 2017, 3pm-4pm—“Attending to Scientific Practices within Undergraduate Research Experiences.”
- c. Angela Johnson, St. Mary’s College, February 28, 2017, 2pm-3pm, Workshop—“Building STEM Cultures Where Students Can Thrive.”
- d. Angela Johnson, St. Mary’s College, March 1, 2017, 12pm-1pm—“Intersectionality, Culture and Identity in Inclusive STEM Departments.”
- e. Stacey Lowery Bretz, Miami University, March 3, 2017, 2pm-3pm—“Measuring Meaningful Learning in the Undergraduate Chemistry Laboratory.”
- f. Sara Brownell, Arizona State University, March 7, 2017, 1pm-2pm—“Hidden Inequities in Active Learning Classrooms: How Groups of Students are Differentially Impacted by Active Learning.”

3. Learning Assistant Program Fall/Spring Recruitment Fairs

The LA Program hosted two recruitment fairs, one in the Fall semester (October 14) and one in the Spring semester (March 31), and is a great opportunity for interested students. The recruitment fairs start with a presentation by the Program Director, Scott Franklin, and Program Manager, Corey Ptak, providing more details on the program including expectations and commitments. After the Q & A session during the presentation a student panel of current Learning Assistants speak about their experiences and the benefits of the program. Students are then encouraged to visit with a faculty mentor from the department they are interested in being an LA for.

4. RIT Graduate Research Symposium for REU Students

Over the summer RIT hosted 7 National Science Foundation Research Experiences for Undergraduates (REU). The PIs of each of the REU Programs, (including Kate Wright, PI of the DBER REU program) organized a half- day interdisciplinary research and graduate school symposium held on Friday, June 30th for all undergraduate students from the REU program. Graduate students were invited by each PI and were asked give a short presentation on their current graduate level research/studies.

Publications

The CASTLE Center had 13 publications between 5 faculty members during the 2016-2017 academic year.

1. Leak, A. E., Rothwell, S. L., Olivera, J., **Zwickl, B.**, Vosburg, J., **Martin, K. N.** (2017). Examining problem solving in physics-intensive Ph. D. research. *Physical Review Physics Education Research*, 13(2).
2. Mandell, H., & **Martin, K. N.** (2017). Honor in the face of shame: The semiotics of the American flag at political-sex-scandal press conferences. *Journal of Visual Literacy*, 1-20
3. **Martin, K. N.**, & Gaffney, A. L. H. (2016). Telling and showing: The intersection of visual communication content knowledge and pedagogical strategies in STEM. *Visual Communication Quarterly*, 23(2), 119-132.
4. **L Kate Wright**, Christina M Catavero, **Dina L Newman**, (2017) The DNA Triangle and Its Application to Learning Meiosis, *CBE-Life Sciences Education* 16 (3), ar50
5. **L Kate Wright**, **Dina L Newman**, Jean A Cardinale, **Robert Teese**, (2016) Web-Based Interactive Video Vignettes Create a Personalized Active Learning Classroom for Introducing Big Ideas in Introductory Biology, *Bioscene: Journal of College Biology Teaching* 42 (2), 32-43
6. **Newman DL, Wright LK**, (2017) "Meiosis: A Play in Three Acts Starring DNA Sequence. *CourseSource* Vol 04. DOI: 10.24918/cs.2017.9
7. Charles Henderson, Mark Connolly, Erin L Dolan, Noah Finkelstein, **Scott Franklin**, Shirley Malcom, Chris Rasmussen, Kacy Redd, Kristen St. John (2017) "Towards the STEM DBER Alliance: Why We Need a Discipline-Based, STEM-Education Research Community" *Journal of Geoscience Education* 65 (3), 215-218, August 2017
8. Andamlak Terkik, Emily Prud'hommeaux, Cecilia Ovesdotter Alm, Christopher Homan, **Scott Franklin** (2016) "Analyzing Gender Bias in Student Evaluations." *COLING*, pp. 868-876, 2016/5
9. **Scott V Franklin**, Mark D Shattuck Handbook of Granular Materials *CRC Press*, 2016/3/9
10. Mark D Shattuck, **Scott V Franklin** "Packings: Static" pp.215 *Handbook of Granular Materials*, 2016/3/9
11. Sulisay Phonekeo, Tanvi Dave, Matthew Kern, **Scott V Franklin**, David L Hu (2016) "Ant aggregations self-heal to compensate for the Ringelmann effect" *Soft matter* 12 (18), 4214-4220
12. **Robert B. Teese**, Priscilla W. Laws, and Kathleen Koenig (2016). Interactive Video Vignettes, *Selected Papers from the 20th International Conference on Multimedia in Physics Teaching and Learning*, Munich, Germany, September 9-11, 2015, Edited by Lars-Jochen Thoms and Raimund Girwidz, 11-16.

Manuscripts Under Review

1. **Anne E. Leak**, Zackary Santos, **Kelly N. Martin**, Brandon Clark, Erik Reiter, Brianna Santangelo, Kirk Winans, Nickolas Young, & **Benjamin Zwickl**. “Where Does Learning Happen?: Mapping the Relationships Between Science Education and Optics Industries.
2. Pelaez N, Anderson TR, Gardner SM, Yin Y, Abraham JK, Bartlett EL, Gormally C, Hoover M, Hurney CA, Long TM, **Newman DL**, Sirum K, Stevens MT (2016, in review). “Forging Productive Partnerships to Promote Student Competence in Biological Experimentation.” Submitted to *BioScience*.

Presentations

1. Leak, A. E., Vosburg, J., **Martin, K. N.**, Olivera, J., **Zwickl, B.** (2016). Examining problem-solving in physics-intensive PhD research, *Proceedings of the 2016 Physics Education Research Conference*, Sacramento, CA, July 20-12, edited by D. L. Jones, Lin Ding, and Adrienne Traxler.
2. **Zwickl, B.**, Leak, A. E., Olivera, J., Vosburg, J., **Martin, K. N.** (2016). Characterizing problem types and features in physics-intensive PhD research. *Proceedings of the 2016 Physics Education Research Conference*, Sacramento, CA, July 20-12, edited by D. L. Jones, Lin Ding, and Adrienne Traxler.
3. **Zwickl, B.** (2017) Applied Physics Education: PER focused on Physics-Intensive Careers, *APS April Meeting Abstracts*
4. Dina Zohrabi Alaei, Kellianne Kornick, Eleanor C Sayre, **Scott V Franklin** (2017) “What Physicist Mean By The Equals Sign In Undergraduate Education” *APS April Meeting Abstracts*, 2017/1
5. Laura Wood, Amanda Matheson, **Scott Franklin** (2017) “Fostering Student Introspection through Guided Reflection Forms” *APS April Meeting Abstracts*, 2017/1
6. Eleanor C Sayre, **Scott V Franklin**, Mary Bridget Kustusch (2017) “Professional development workshops for physics education research” *APS April Meeting Abstracts*, 2017/1
7. Kellianne Kornick, Dina Alaei, Eleanor Sayre, **Scott Franklin** (2017) “What Physicists Mean By the Equals Sign in Undergraduate Education”, *APS April Meeting Abstracts*, 2017/1
8. Charles Bertram, Anne Leak, Eleanor C Sayre, Mary Bridget Kustusch, **Scott V Franklin** (2016) “Student Conceptions of Expertise” Singapore: International Society of the Learning Sciences
9. Matthew Hill, **Scott Franklin** (2016) “Rheology of U-Shaped Granular Particles” *APS Meeting Abstracts*, Volume 61, Number 2, Monday–Friday, March 14–18, 2016; Baltimore, Maryland
10. George McMurdy, **Scott Franklin**, Charles Bachmann (2016) “Enhanced Flow of Granular Material” *APS Meeting Abstracts*, Volume 61, Number 2, Monday–Friday, March 14–18, 2016; Baltimore, Maryland
11. **Scott Franklin**, Matthew Kern, Sulisay Phonekeo, David Hu (2016), “Extensional Rheology of Fire Ant Aggregates”, Volume 61, Number 2, Monday–Friday, March 14–18, 2016; Baltimore, Maryland
12. **Scott Franklin** “My Role in RIT's Women in Science Group: Privilege and Pitfalls” *2016 Summer Meeting: Supporting Women in Physics: How Everyone Can Play a Role* Sacramento, California
13. **Corey Ptak** (2016) “Using Mindfulness and metacognition to support and retain first generation and deaf and heard of hearing students” *APS April Meeting 2016* Volume 61, Number 6
14. **Robert B. Teese**, Keith R. Stein, Chad W. Hoyt and Nathan C. Lindquist (2016). “Web-Based Interactive Video Activities for Undergraduate Advanced Laboratories.” *50th Anniversary GIREP Seminar*, September 2016, Krakow, Poland.

15. Priscilla Laws, David Skoloff, Ronald Thornton, Robert **Teese**, and Kathy Koenig, (2016). “ILDs and other strategies that enable students to understand Newton's Third Law,” *2016 Summer Meeting of the AAPT*, Sacramento.
16. **Robert Teese** and Thomas Reichlmayr, “Vignette Studio software for interactive online teaching,” *2016 Summer Meeting of the AAPT*, Sacramento.
17. K. Koenig, **R. Teese**, P. Laws, D. Jackson, and M. Willis (2016). “Interaction Effects of Video Vignettes on Student Understanding.” *2016 Winter Meeting of the AAPT*, New Orleans.

Presentations at RIT Undergraduate Research Symposium on August 4th, 2017

1. Benjamin Archibeque, **Scott Franklin** "Emergent Nature of Science Beliefs during a Field Experience" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
2. Daniel Gysbers, **Scott Franklin** "Jamming of 2-D Sheared Granular Particles" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
3. Sean Peterson, **Scott Franklin** "Properties of Critically Packed Spherocylinders" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
4. Elisabeth Rennert, **Scott Franklin** "Simulation of 2d Granular Shear in an Annular Geometry" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
5. Felicia Davenport, Natasha Graham, Eleanor Sayre, **Scott Franklin** "Use of Arrows in Problem Solving" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
6. Nicole Aledo, **Scott Franklin** "Evolution of physics identity throughout an undergraduate's career" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY.
7. Alexandria Cervante, **Kelly Norris Martin** "Values and Perceptions of Communications in Photonics and Optics" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
8. Patrick Rynkiewicz, **Dina L. Newman** "Digging Deeper into Student Ideas and Measuring Effectiveness of IVVs" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
9. Daniel Mendoza, Kaitlyn Elliott, **L.Kate Wright** "Arrows in Biology:How Design Theory Affects Scientific Visual Literacy" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
10. Grace Elizabeth, **L.Kate Wright** "Evaluating Representations of Meiosis in Textbooks Using the DNA Triangle" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
11. Kaitlyn Elliott, Daniel Mendoza, **L.Kate Wright** "Investigating Molecular Biology Understanding Through Drawing Assessment" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
12. Abby Rocha, **Benjamin M Zwickl** "Mathematical Practices Prevalent in STEM Careers" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
13. Erik Reiter, **Benjamin M Zwickl** "Relating Authentic Science and Engineering Practices With Guidelines for ST" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY

14. Jessica Hathaway, **Benjamin M Zwickl** "How New Hires in STEM Careers Perceive and Value Mathematics" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
15. Kingston Chen, **Benjamin M Zwickl** "The Roles of Math Skills and Tools in Scientific Academia and Industry" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
16. Alicia Eglin, **Christina Goudreau Collison** "The Impact of Ternary Blends on Solution Processed Organic Photovoltaics" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
17. Bradley Phelps, **Christina Goudreau Collison** "Small Molecule Organic Solar Cells Employing Compatibilizer Additive" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
18. Kaitlyn Houghtling, **Christina Goudreau Collison** "Studies towards the total synthesis of trocheliophorolide A" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
19. Matthew Bonney, **Christina Goudreau Collison** "Impact of alkyl chain length and hydroxyls on squaraine-based photovoltaics" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
20. Matthew Jackson, Fidel Amezcua, **Christina Goudreau Collison** "Design, implementation, and evaluation of a novel organic chemistry lab" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY
21. Brianna Miskovitz, **Paul Craig** "Pulling a Plug-in from its Roots and Planting a KDTree" *Rochester Institute of Technology Undergraduate Research Symposium*. August 4, 2017. Rochester, NY

Students Mentored

The SMERC group plays a large role in mentoring Rochester Institute of Technology undergraduate students, as well as undergraduate students from other universities, to support experiential learning. SMERC members' consistent involvement with student-centered research aligns with RIT's strategic plan of becoming a student-centered research university.

Scott Franklin

- DBER REU: Ben Archibeque (Kansas State University), Nicole Aledo (University of West Alabama), Felicia Davenport (Chicago State University)
- COS Summer Undergraduate Research Fellows: Elizabeth Rennert, Daniel Gysbers
- Other Summer Undergraduate Researchers: Sean Peterson, Nelmy Robles-Serrano

Ben Zwickl

- DBER REU: Brianna Santangelo (The College of New Jersey), Nicholas Young (The Ohio State University), Abby Rocha (Western Illinois University), Jessica Hathaway (Elizabeth State University)
- Undergraduates: Erik Reiter (Rochester Institute of Technology), Zackary Santos (Rochester Institute of Technology), Kingston Chen (Rochester Institute of Technology)

Ben Zwickl and Kelly Norris-Martin (co-mentored)

- Husein Lokhandwaia (RIT MS student in Communication)
- Anita Raghuraman (RIT MS student in Communication)

Dina Newman

Masters Student: Cal Palumbo

Dina Newman and Kate Wright (co-mentored)

- DBER REU: Grace Dy (University of Washington), Kaitlyn Elliott (University of Colorado-Denver), Mohammed Jan (University of Alabama-Birmingham), Daniel Mendoza (University of Alabama-Birmingham)
- Undergraduates: Ashley Adair, Hanna Berga, Jordan Cardenas, Callie Donahue, Patrick Rynkiewicz

Dina Newman and Tina Goudreau (co-mentored)

- DBER REU: Fidel Amecuza (Chicago State University)

Kelly Norris-Martin

- DBER REU: Alexandria Cervante (California State University, Monterey Bay)
- Katherine Gardener (RIT Advertising and Public Relations)

Other Notable Achievements

Scott Franklin

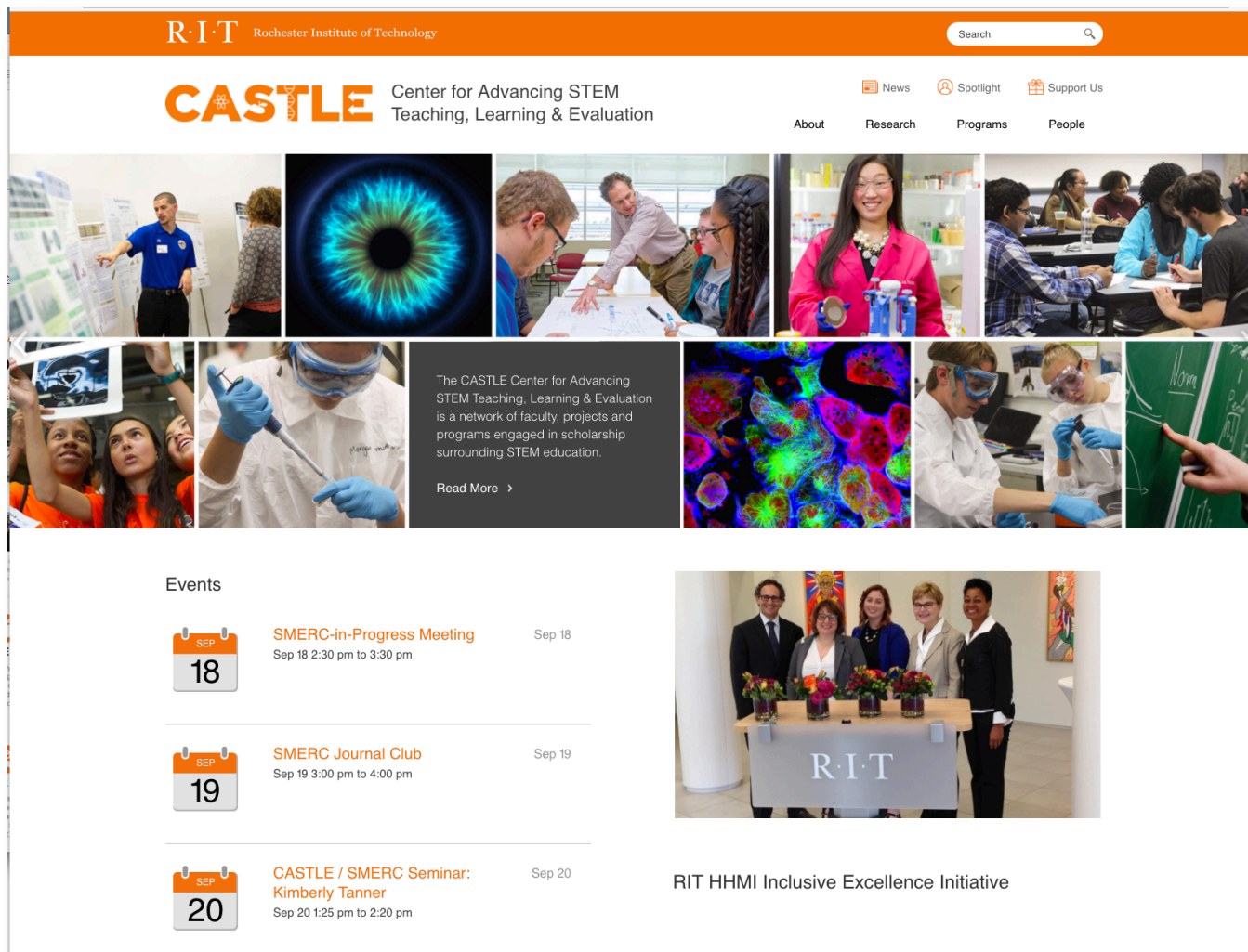
- 2017 Isaac L. Jordan Sr. Faculty Pluralism Award
 - A university-wide award program that recognizes faculty members for their significant contributions to enhance diversity at RIT.

Lea Vacca Michel

- 2017 Edwina Award
 - Honor given to a faculty or staff member for his/her significant contributions to enhance gender diversity and inclusiveness at Rochester Institute of Technology.

Web and Social Media Presence

In 2017 a new, responsive CASTLE website was designed and implemented. The site is located at rit.edu/castle. It serves as a home-base for all CASTLE-affiliated programs, research and initiatives.



Social media direct links to Facebook and Twitter pages for CASTLE, IMPRESS and DBER all reside on the CASTLE website.

