

CASTLE

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

2015 – 2016 Annual Report



R·I·T


RIT
Science
+ **Math** 

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The CASTLE 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) Scholarship of Pedagogy - CASTLE supports faculty efforts on pedagogical scholarship, evaluation and assessment, and foster innovation in the classroom.
- 2) 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.
- 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 Explorations in Physics.
- 4) K-20 Teacher Recruitment, Preparation and Professional Development - CASTLE takes an active role in preparing the next generation of STEM teachers through undergraduate and graduate student education. Examples of activities include the RIT Learning Assistant program to recruit and prepare future secondary school teachers.
- 5) Education and Careers of Groups Historically Excluded from the STEM Disciplines - This includes collaborations with Women in Science (WiSe), a CASTLE-affiliated program that seeks 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 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, and promotes K-20 teacher and faculty recruitment, 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 include:

- The Science & Mathematics Education Research Collaborative (SMERC), a leading innovator in discipline-based education research.
- The *Learning Assistant* program, which facilitates faculty efforts at transforming classrooms and attracts students toward careers in 9-12 and post-secondary STEM education.
- Project *IMPRESS* (Incorporating Metacognitive Research and Practice to Ensure Student Success), which seeks to improve learning through direct instruction in metacognition, including accurate self-assessment and sense-making.

CASTLE Center Members



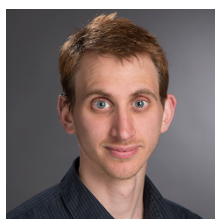
Jennifer Bailey
Lecturer, Kate Gleason College of Engineering



Kelly Norris Martin
Assistant Professor, School of Communication



Adwoa Boateng
COS Library Liaison, Research and Instruction Services



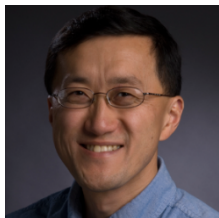
Corey Ptak
Program Coordinator, LA Program and Lecturer, Thomas H. Gosnell School of Life Sciences



Scott Franklin
Director, CASTLE and 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

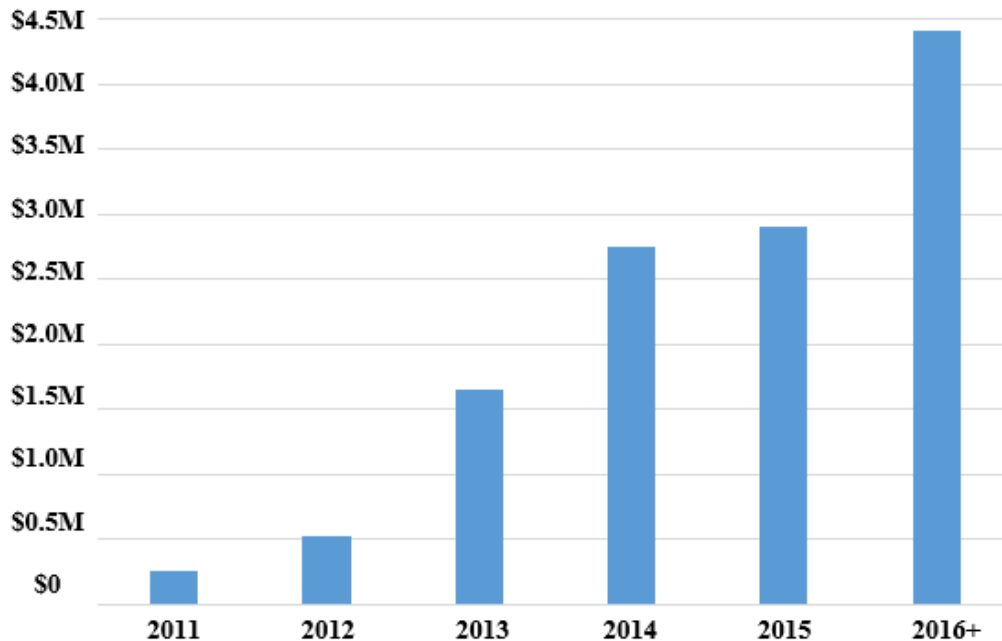
Affiliated Personnel

Elizabeth Cherry
Associate Professor, School of Mathematical Sciences
Jeremy Cody
Associate Professor, School of Chemistry & Materials Science

Paul Craig
School Head and Professor, School of Chemistry & Materials Science
Christina Goudreau Collison
Associate Professor, School of Chemistry & Materials Science

Kara Maki
Assistant Professor, School of Mathematical Sciences
Lea Vacca Michel
Associate Professor, School of Chemistry & Materials Science

During the 2015 – 2016 academic year CASTLE has led or collaborated on thirteen different grants that total over \$4.8 million. Center funding has risen dramatically over the past five years.



Current CASTLE Funding

Dates	Total Funding	Funding Details
10/1/2011 – 9/30/2016	\$215,989	Collaborative Research: LivePhoto Physics Interactive Video Vignettes; NSF-National Science Foundation; PI Robert Teese, Co-PI Thomas Reichlmayr
6/1/2013 – 5/31/2018	\$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
7/1/2013 – 6/30/2016	\$199,980	Collaborative Research: Transforming the Organic Chemistry Experience: Development, Implementation and Evaluation of Studio-Based Modules; NSF-National Science Foundation; PI Christina Collison, Co-PI Thomas Kim
9/1/2013 – 8/31/2016	\$599,920	Incorporating Modeling into Upper-Division Physics Labs; NSF-National Science Foundation; PI located in CU Boulder, Co-PI Benjamin Zwickl
9/1/2014 – 8/31/2017	\$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
9/1/2014 – 8/31/2017	\$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
9/1/2014 – 8/31/2017	\$133,868	Collaborative Research: Undergraduate Students' Epistemology and Expectations of Experimental Physics; NSF-National Science Foundation; PI Benjamin Zwickl

10/1/2014 – 9/30/2017	\$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
6/1/2015 – 5/31/2017	\$80,962	Collaborative Research: Role of Undergraduate Biochemistry Education in Protein Function Assignment; NSF-National Science Foundation; PI Paul Craig, Co-PI Herbert Bernstein
9/1/2015 – 8/31/2018	\$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
6/1/2016 – 5/31/2020	\$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
9/1/2016 – 8/31/2019	\$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-PI Dina Newman, Thomas Kim
9/1/2016 – 8/31/2019	\$299,982	Collaborative Transformation through Faculty Triads; NSF-National Science Foundation; PI Scott Franklin, Co-PI Sophia Maggelakis

Pending CASTLE Funding

Dates	Total Funding	Funding Details
9/1/2016 – 8/31/2019	\$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-PI Ben Zwickl, Scott Franklin
9/1/2016 – 8/31/2019	\$73,740	Collaborative Research: The PIPELINE Network; NSF-National Science Foundation; PI Linda Barton, Co-PI Ben Zwickl

CASTLE Center Events

1. The 3rd Annual CASTLE Symposium

The third annual CASTLE Symposium was held on Tuesday, May 17th 2016 in RIT's Student Innovation Hall. The symposium began with a poster session that showcased over 40 students and faculty research projects focused on improving STEM education. Scott Franklin, CASTLE Director, provided opening remarks and Provost Jeremy Haefner gave a keynote address. An award ceremony followed to honor recipients of the second "Science and Math Education Research Special Honor Award" and recognize the 2015 – 2016 academic year Undergraduate Learning Assistants.

- a. 2016 Science and Math Education Research Special Honor Award Recipients
 - i. Thomas Kim (School of Chemistry and Material Sciences)
 - ii. Jessica Small (Center for Advancing STEM Teaching, Learning & Evaluation)

- b. 2015 – 2016 Undergraduate Learning Assistants: Ashley Adair, Jordan Bailey, Tyler Becker, Michael Begonja, Scott Bell, Jennifer Bober, Joshua Bush, Devon Christman, Mollie Corrigan, Joseph Cutugno, Brooke D'Arcy, Callie Donahue, Iman Faird, Daniel Flanagan, Shantel Forrest, Megan Freeman, Alec Freyn, Benjamin Hamilton, Ahmad Aflah Hanafiah, S M Huq, Abdul Karim Khaidi, Amber Kudla, Devonna Leslie, Carlos Linares, Spenser Lionetti, Gaetano Loweecey, Samuel Lum, Alexandra Mace, Robert Masti, Bryanne McDonough, Renee Meinhold, Jazrina Mohd Jasmin, Erinn Molina, Evan Ney, Christian Pape, Sean Peterson, David Quach, Deondre Roseboro, Kaitlin Schmidt, Ryan Scott, Jacob Shawley, Delanie Spangler, Melissa St. Preux, Reilly Thate, Yaroslav Tochinski, Marc Toro, Matthew Turczmanovicz, Daniel Vasconcellos

- c. 2015 – 2016 Learning Assistant Mentors: Aaron McGowan, Alan Raisanen, Bernadette Lanciaux, Billy Vazquez, Birgit Coffey, Candice Baldwin, Charles Lusignan, Corey Ptak, Dawn Carter, Deana Olles, Dehui Hu, Dina Newman, Elizabeth Hane, Jeyhan Kartaltepe, Joseph Lanzafame, Joel Shore, Kate Wright, Mark Olles, Michael Caldwell, Michelle Chabot, Moumita Das, Olga Tsukernik, Phil Shaw, Scott Franklin

2. CASTLE/SMERC Seminar Speakers

- a. Michael Wittmann, The University of Maine – Friday, September 11th 2015 – "Listening for Deep Understanding of Energy"

- b. Amy Gaffney, University of Kentucky – Monday, October 12th 2015 – "Communication for learning: Building understanding and skills in the science classroom"

- c. Jeffrey R. Raker, University of South Florida – Wednesday, March 30th 2016 – "Understanding the meaning ascribed by students to representations used in organic chemistry"

- d. Allison Godwin, Purdue University – Tuesday, April 5th 2016 – "The Importance of STEM Identities: Using Structural Equation Modeling to Understand Engineering Choice"

- e. Luanna Prevost, University of South Florida – Wednesday, April 13th 2016 – "Assessing student writing in biology using lexical analysis and machine learning"

3. Learning Assistant Program Fall/Spring Recruitment Fairs

The LA Program hosted two recruitment fairs, one in the Fall semester (October 9th) and one in the Spring semester (April 8th), and is a great opportunity for interested students. The recruitment fairs start with a presentation by the Program Director, Scott Franklin, and Program Coordinator, 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. 2016 Northeast Regional Learning Assistant Workshop

The LA Program hosted the Learning Assistant Alliance 2016 Northeast Regional Learning Assistant Workshop on April 1st and 2nd. The workshop brought 30 participants from 12 universities, including Nazareth, St. John Fisher, University of Delaware, Winston-Salem State and SUNY Fredonia. Faculty, program coordinators and administrators attended a series of informational sessions on a variety of topics to gain insight on how the Learning Assistant Program is transforming STEM education at RIT.

5. RIT REU Symposium

Over the summer RIT hosted 6 National Science Foundation Research Experiences for Undergraduates (REU). The PIs of each of the REU Programs, led by Kate Wright, organized a full-day interdisciplinary research and graduate school symposium held on Thursday, July 21st 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 and participate in Q & A sessions about their experiences. Over 50 students undergraduate attended and 10 graduate students presented.

CASTLE-Affiliated Programs



RIT's Science and Mathematics Education
Research Collaborative

SMERC (Science and Mathematics Education Research Collaborative): A multidisciplinary group of faculty conducting education research in physics, biology, chemistry, biochemistry and mathematics. SMERC runs a weekly journal club and monthly seminar series and consults with faculty interested in incorporating research-based methods and assessment into their classrooms.

DBER REU (DBER Research Experience for Undergraduates): 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 2016 REU student cohort were from the following colleges: Cal State Monterey Bay, Colorado School of Mines, Drake University, Ohio State University, Rochester Institute of Technology, Seattle Pacific University, The College of New Jersey, University of Maine, University of Nebraska-Lincoln and University of Wisconsin-Madison. 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 5th 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 5th, the conclusion of the summer experience. This project is funded through National Science Foundation contract # DUE 1359262.



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 2015-16 semester the Program had 31 Learning Assistants working with 17 Faculty Mentors in four College of Science departments (Biological Sciences, Chemistry, Mathematics/Statistics and Physics) and the Manufacturing & Mechanical Engineering Technology department within the College of Applied Science & Technology. For the Spring semester there were 33 Learning Assistants working with 16 Faculty mentors within the same departments. 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. This project is funded through National Science Foundation contract # DUE 1239994.



IMPRESS (Integrating Metacognitive Practices and Research to Ensure Student Success): 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 2015-2016 academic year IMPRESS hosted four mixers with activities that encouraged metacognition. This project is funded through National Science Foundation contract # DUE 1317450.



Summer Math Applications in Science with Hands-On (SMASH) Experience: The SMASH Experience for Girls is a summer program design 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. In prior years, SMASH engaged 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.



Photonics and Optics Workforce Education Research (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 National Science Foundation contract # DUE 1317450.

EMPOWER STEM Study (Collaborative with University of Wisconsin Madison) The purpose of the EMPOWER project is to document how faculty and workplace trainers think about and teach/train four critical 21st century competencies - communication, teamwork, problem-solving, and self-regulation - and the socio-technical systems within colleges, universities and companies that shape teaching, training and learning.

PIPELINE Project (multi-institution) Research on Integrating entrepreneurship, innovation, and industry training in physics programs.

Epistemology and experimental physics lab project (Collaborative with University of Colorado Boulder)



Molecular Biology Education Research Group

MBER has three distinct sections of research in molecular biology education research (see below).

Conceptual Meaning Underlying Visual Representations in Molecular Biology

The inability of students to identify, construct, and utilize scientific representations is a complex phenomenon. Much of the previous work on how students use graphical representations has focused on identifying misconceptions, but the impediments to student understanding appear to be the result of fragmented or inaccurate conceptual knowledge, faulty mental models, and an inability to translate between different conceptual models or representations. Dr. Dina Newman (Biology) and Dr. Kate Wright (Biology) investigate how students interpret and understand canonical representations in cellular and molecular biology. Past work has shown that typical representations do not prime students to think about molecular mechanisms associated with information flow and exchange. Work from a former REU student has contributed to the development of a new framework for teaching and learning meiosis. Work from another REU student is contributing to a new collaboration with biomedical illustrators to articulate and test new design principles for biology symbolism.

Developing and Evaluating Curricula Emphasizing Modeling and Representation

Traditional, “cook book” introductory science laboratory curriculum is unexciting, repetitive and often a reason that undergraduate students leave the STEM disciplines. Investigative laboratory courses, at the introductory level, however, have been correlated with increased retention of STEM undergraduates. One of the goals of MBER, then, is to develop and evaluate inquiry-based curricula that emphasizes the scientific practice of modeling.

Collaboration with NSF funded project Connecting Researchers, Educators and Students (CREST)

Collaborating with developers of the NSF-funded project *Connecting Researchers, Educators and Students* (CREST) to bring physical models of biomolecules into the introductory biology classroom in order to improve conceptual understanding of structure-function relationships that drive biological phenomena. Previous REU students investigated how physical, interactive models of genetic information flow helped promote conceptual change in biology students

Publications

The CASTLE Center had 11 publications between 8 faculty members during the 2015-2016 academic year.

1. Bertram, C., **Leak, A.**, Sayre, E. C. Kustus, M. B. and **Franklin, S.**, “Student Conceptions of Expertise.” Proceedings of the 12th International Conference of the Learning Sciences, p. 920-933, Singapore, (2016).
2. Bethany R. Wilcox, **Benjamin M. Zwickl**, Robert D. Hobbs, John M. Aiken, Nathan M. Welch, and H. J. Lewandowski, “Alternative Model for Administration and Analysis of Research-based Assessments,” *Phys. Rev. Phys. Educ. Res.* **12**, 010139 (2016).
3. **Benjamin M. Zwickl**, Javier Olivera, Kelly Norris Martin, and Kirk M. Winans, “Preparing Students for Physics-intensive Careers in Optics and Photonics,” *2015 Physics Education Research Conference Proceedings*, pp. 391-394 [College Park, MD, July 29-30, 2015]
4. Dehui Hu and **Benjamin M. Zwickl**, “Framework for Students' Epistemological Development in Physics Experiments,” *2015 Physics Education Research Conference Proceedings*, pp. 143-146 [College Park, MD, July 29-30, 2015]
5. **Benjamin Zwickl**, **Anne E. Leak**, Javier Olivera, Jarrett Vosburg, **Kelly N. Martin**, “Characterizing Problem Types and Features in Physics-Intensive PhD Research,” 2016 PERC Proceedings [Sacramento, CA, July 20-21, 2016], edited by D. L. Jones, Lin Ding, and Adrienne Traxler.
6. **Anne E. Leak**, Jarrett Vosburg, **Kelly N. Martin**, Javier Olivera, **Benjamin Zwickl**. “Examining Problem-Solving in Physics-Intensive PhD research,” 2016 PERC Proceedings [Sacramento, CA, July 20-21, 2016], edited by D. L. Jones, Lin Ding, and Adrienne Traxler.
7. **Benjamin Zwickl**, Javier Olivera, **Kelly N. Martin**, & Kirk Winans.”Preparing Students for Physics Intensive Careers in Optics and Photonics, 2015 PERC Proceedings [College Park, MD, July 29-30, 2015].
8. **Newman DL**, **Fisk JN**, **Snyder CM**, **Wright LK** (2016). “Development and Validation of the Central Dogma Concept Inventory.” *CBE-Life Sci Educ*, 15(2):ar9. doi: 10.1187/cbe.15-06-0124
9. Masoud Golshadi, **Leslie K. Wright**, Ian M. Dickerson and Michael G. Schrlau. “High Efficiency Gene Transfection of Cells through Carbon Nanotube Arrays,” (2016) Small doi:10.1002/sml.2015403878.
10. **Newman, Dina L.**, Snyder, Christopher W., Fisk, J. Nick and **Wright, L. Kate**. “Development of the Central Dogma Concept Inventory (CDC) Assessment Tool,” (2016) CBE Life Sciences Education. 15(2):ar9. doi: 10.1187/cbe.15-06-0124
11. **Wright, LK**. “Building a Model of Tumorigenesis: A Small Group Activity for a Cancer Biology/Cell Biology Course,” (2015) CourseSource. Vol. 2, 1-6.

Manuscripts Under Review

1. **Anne E. Leak**, Jarrett Vosburg, **Kelly N. Martin**, Javier Olivera, & **Benjamin Zwickl**. “Examining Problem-solving in Physics-intensive PhD Research.”
2. **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.”
3. **Newman DL, Wright LK** (2016, in review). “Teaching Meiosis Based on DNA Sequence.” Submitted to *CourseSource*.
4. 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*.
5. **Wright LK, Newman DL**, Cardinale J, **Teese R** (2016, in review). Online Interactive Video Vignettes Create a Personalized Active Learning Classroom for Introducing Big Ideas in Introductory Biology. Submitted to *Bioscene*.

Presentations

1. **Ben Zwickl**. “Intersecting PER and workforce development: Mathematics, Problem Solving and More,” Physics Education Research Seminar at Michigan State University, East Lansing, MI, April 13, 2016
2. **Ben Zwickl**. “Taking PER Into the Workplace: A Study of Math, Physics, and Communication in Physics-intensive Careers,” Texas Tech University Physics Department Colloquium, Lubbock, TX, May 5, 2016
3. **Ben Zwickl**. “Finger Lakes Advanced Manufacturing Enterprise Panel on Optics Workforce,” Monroe Community College, Rochester, NY January 29th, 2016.
4. **Ben Zwickl**. “Physic Education Research on Laboratory Skills and Careers in Physics,” Physics Colloquium at Amherst College, Amherst, MA, Oct 27, 2015
5. Jarrett Vosburg, **Ben Zwickl**, Javier Olivera, Kingston Chen, **Anne E. Leak**, **Kelly N. Martin**, Joshua Deslongchamps. “Preparing Undergraduates for Solving Problems in PhD-Level Research”. *American Association of Physics Teachers (AAPT) Summer Meeting*. July 16-20, 2016. Sacramento, CA.
6. **Anne E. Leak & Benjamin Zwickl**. “Defining Professional STEM Practice.” In Symposium organized by Leslie Atkins Elliott & Angela Little. “Iteration, Ownership, and Emotions: Examining How Classroom Experiences in Physics Move Outside the Classroom.” *Physics Education Research Conference (PERC)*. July 20-21, 2016. Sacramento, CA.
7. **Anne E. Leak, Kelly N. Martin, & Benjamin Zwickl**. “Studying the Skills Needed for Success in Optics Careers.” *SPIE Optifab*. October 14, 2015. Rochester, NY.
8. **Benjamin Zwickl**. “Preparing Students for Research Excellence in Optics and Photonics.” *46th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP)*. June 8-12, 2015. Columbus, OH.
9. Cardenas JJ, **Wright LK**, **Newman DL** (July, 2016) “Arrows in Biology Drawings: Missing the Point of the Figure.” 6th Annual Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.
10. **Wright LK** and **Newman DL** (July, 2016) “Development of a new Theoretical Framework and its Application to Learning Meiosis.” 6th Annual Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.
11. **Wright LK**, **Newman DL**, Lewis K, Snyder C, Fisk JN (July, 2016) “Development of the CDCI-SHiNE Web Application for Analysis of Data Generated by a Multiple Select Assessment Instrument.” 6th Annual Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.
12. Cardinale J, **Newman DL**, **Wright LK**, **Teese R** (July, 2016) “The Effectiveness of Interactive Video Vignettes as Tools for Teaching and for Insight Into Student Thinking.” 6th Annual Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.
13. **Newman DL**, **Wright LK**, Jasmi JM, Cardinale J, **Teese R** (April, 2016) “Interactive Video Vignettes: a Tool for Teaching and Insight into Student Thinking.” *Envisioning the Future of Undergraduate STEM Education (EnFUSE): Research and Practice*. Washington, D.C.
14. Cardinale JA, Osborne A, Kovach M, Kennedy-Trumbull M, Schramm L, **Newman D**, **Wright LK**, **Teese R** (April, 2016) *The Effectiveness of Interactive Video Vignettes to address introductory students’*

common biological misconceptions and promote learning of core biology concepts. *Envisioning the Future of Undergraduate STEM Education (EnFUSE): Research and Practice*. Washington, D.C.

15. DeOca K, **Wright LK**, and **Newman DL** (April, 2016) “DNA Sequence is the Key to Understanding Meiosis,” presented at the National Council on Undergraduate Research 30th Annual Meeting, Asheville, NC.
16. DeOca K, **Wright LK**, and **Newman DL** (March, 2016) “DNA Sequence is the Key to Understanding Meiosis,” presented at the Association of Southeastern Biologists, Concord, NC.
17. Cardenas J, Lu A, **Wright LK**, **Newman DL** (November, 2015) “Arrows, Arrows, Everywhere in Biology Drawings.” Rochester Academy of Science Fall Paper Session, Canandaigua, NY.
18. Jasmi JM, Cardinale J, **Teese R**, **Wright LK**, **Newman DL** (November, 2015) “Evidence of Student Learning with Interactive Video Vignettes in Biology.” Rochester Academy of Science Fall Paper Session, Canandaigua, NY.
19. Fisk NJ, Snyder C, **Newman DL**, **Wright LK** (November, 2015) “Development of CDCI-SHiNE, An R-Based Web Application for the Analysis of Results from the Central Dogma Concept Inventory.” Rochester Academy of Science Fall Paper Session, Canandaigua, NY.
20. **Newman DL**, DeOca K, Catavero CM, Zajicek E, **Wright LK** (October, 2015) “Teaching Meiosis Brings Together Concepts from Four Different Areas.” American Society of Human Genetics Annual Meeting, Baltimore, MD.
21. Cardinale JA, **Wright LK**, **Newman DL**, House C, **Teese R**. (September, 2015) “The Effectiveness of Interactive Video Vignettes as New Media Resource to Maximize Student Learning of Biology Concepts.” PKAL Upstate NY Regional Network Fall Meeting. Fredonia, NY.
22. **L. Kate Wright**, **Dina Newman**. “Development of a new Theoretical Framework and its Application to Learning Meiosis.” *Society for the Advancement of Undergraduate Education Conference. 6th Annual Conference*. Minneapolis. MN. July 14-17, 2016.

Presentations at RIT Undergraduate Research Symposium on August 5th, 2016

1. Brianna Santangelo, **Anne E. Leak**, Nicholas T. Young, **Benjamin Zwickl**. “Learning to Use and Communicate Math in the Optics Workforce.” *Rochester Institute of Technology Undergraduate Research Symposium*. August 5, 2016. Rochester, NY.
2. Nicholas T. Young, Brianna Santangelo, **Anne E. Leak**, **Benjamin Zwickl**. “Mathematical Tools and Representations Used by Employees of Optics and Photonics Companies.” *Rochester Institute of Technology Undergraduate Research Symposium*. August 5, 2016. Rochester, NY.
3. Zackary Santos, Brandon Clark, **Anne E. Leak**, **Kelly N. Martin**, Erik Reiter, Brianna Santangelo, Nicholas Young, **Benjamin Zwickl**. “Correlations Between Undergraduate Education and the Local Photonics Workforce.” *Rochester Institute of Technology Undergraduate Research Symposium*. August 5, 2016. Rochester, NY.
4. Erik Reiter, Zackary Santos, **Anne E. Leak**, **Benjamin Zwickl**. “Necessary Skills for Success in the Rochester Optics Workforce.” *Rochester Institute of Technology Undergraduate Research Symposium*. August 5, 2016. Rochester, NY.

5. Clark, B., **Martin, K. N.** (2016, August). "Perception of Communication Within the Local Optics Workforce." *Rochester Institute of Technology Undergraduate Research Symposium*, Rochester, NY.
6. Clark, B., **Martin, K. N.** (2016, August). "Basic Visual Principles for Physics Undergraduates." *Rochester Institute of Technology Undergraduate Research Symposium*, Rochester, NY.
7. Clasen C., Stefkovich S, **Wright LK, Newman DL.** (August, 2016) "3D Hands-on Model Activities Combat Misconceptions about Genetic Information Flow." RIT Undergraduate Research Symposium, Rochester, NY.
8. Cardenas JJ, Lewis KL, **Newman DL, Wright LK.** (August, 2016) "Arrows in Biology Drawings: Missing the Point of the Figure." RIT Undergraduate Research Symposium, Rochester, NY.
9. Miller K, **Kim TD.** (August, 2016) "Heuristics Students Use to Solve Hydrogen Bonding Problems." RIT Undergraduate Research Symposium, Rochester, NY
10. Palmer K, **Ptak C.** (August, 2016) "Developing Sophisticated Viewpoints on Climate Change With In-class Debate Exercise." RIT Undergraduate Research Symposium, Rochester, NY
11. Marmor W, Kipsang R, **Kim TD, Goudreau Collison C.** (August, 2016) "Transformation of the Organic Chemistry Laboratory: Assessment of Instructor Practice and Meaningful Learning in a Modular Organic Laboratory Sequence." RIT Undergraduate Research Symposium, Rochester, NY.
12. **Teese, Robert,** Laws, Priscilla, Koenig, Kathleen, "Interactive Video Vignettes," *Selected Papers from the 20th International Conference on Multimedia in Physics Teaching and Learning*, pp. 11-16, [Munich, Germany, September 11, 2015], edited by Lars-Jochen Thoms and Raimund Girwidz.

Students Mentored During 2015-2016 Academic Year

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: Amanda Matheson (Colorado School of Mines), Laura Wood (Seattle Pacific University)
- Undergraduate: Kellianne Kornick
- CASTLE Undergraduate Research Fellowship: Chris Webster

Ben Zwickl

- DBER REU: Brandon Clark (University of Maine), Brianna Santangelo (The College of New Jersey), Nicholas Young (Ohio State University)
- Kayla Adgate (Mentored with Dehui Hu), Erik Reiter, Zack Santos, Kirk Winans (Mentored with Kelly Martin, Masters student)

Dina Newman and Kate Wright

- DBER REU: Jordan Cardenas (Rochester Institute of Technology), Catherine Clasen (Drake University), Megan Stefovich (University of Wisconsin-Madison)
- Masters Students: Nick Fisk, Sarah Deaton
- Undergraduates: Hanna Berga, Jordan Cardenas, Callie Donahue, Katie Lewis, Andy Lu, Maria Nadeau, Christopher Snyder

Corey Ptak

- DBER REU: Katie Palmer (California State University, Monterey Bay)

Kelly Norris-Martin

- DBER REU: Brandon Clark (University of Maine)
- Kirk Winans (Mentored with Ben Zwickl, Masters student)

Tom Kim

- DBER REU: Kathryn Miller (University of Nebraska – Lincoln)
- William Marmor, Rodgers Kipsang (both co-mentored with Tina Goudreau Collison)

Other Notable Achievements

Ben Zwickl

- Provost's Learning Innovations Grant Recipient
 - Creating a Flipped Lab Environment for University Physics 1, 7/1/2016-1/31/2017, Awarded \$4500

Kate Wright and Dina L. Newman

- Dean's Research Initiation Grant Recipients
 - "Visual Communication Theory Meets Biology Education Research: Helping Students to See What Experts See", 11/2015-10/2016, Awarded \$15,000. Surveys and interviews established that arrows are overused, ambiguous and misleading in biology instructional materials, presentation at a national conference, and a mini-conference for professional illustrators and publishers where a set of principles for illustrations was developed

Web and Social Media Presence


The CASTLE website is located at castle.rit.edu. It serves as a home-base for all CASTLE-affiliated programs: SMERC, LA Program, IMPRESS, DER REU, SMASH and POWER.

SCIENCE +MATH^{at}RIT

CENTER FOR ADVANCING STEM TEACHING, LEARNING, AND EVALUATION

Welcome to CASTLE

A network of affiliated faculty, projects, and programs engaged in scholarship surrounding science and math education



CASTLE arose from the realization that existing collaborations would be enhanced by a formal structure that emphasized opportunities for synergies. The center's mission is to improve STEM education and outreach initiatives at RIT and foster collaboration between STEM educators and education researchers.

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- IMPRESS
- SMASH
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Contact

Scott Franklin
Director

Jessica Small
Senior Staff Assistant

CASTLE at RIT

SMERC

A multidisciplinary group of faculty conducting research in physics, biology, chemistry, biochemistry, and mathematics education research.

LA Program

Dedicated to the transformation of STEM courses. It involves creating environments in which students can interact with one another, engage in collaborative problem solving, and articulate and defend their ideas.

IMPRESS

An intensive educational experience for select RIT students that incorporates metacognition into the study of science, technology, engineering and mathematics (STEM) studies

DBER REU

A hands-on research experience for undergraduates in the emerging area of Discipline-Based Education Research (DBER) hosted by SMERC.

SMASH

An on-campus five-day summer math and science experience for girls entering eighth grade.

Research

CASTLE is one of six research centers that encourage collaboration across disciplines to reach innovative solutions.

