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**Nomination Portfolio for the University System of Georgia
2019 Regents' Scholarship of Teaching and Learning Award**

TABLE OF CONTENTS

<u>Nomination Letter</u>	<u>1</u>
<u>Teaching Philosophy and Impact on Student Learning</u>	<u>3</u>
<u>Impact of Scholarship of Teaching and Learning on the Discipline</u>	<u>6</u>
<u>Condensed Curriculum Vita</u>	<u>15</u>
<u>Letter of Support from Dr. Marguerite Brickman</u>	<u>18</u>
<u>Letter of Support from Dr. Paula Lemons</u>	<u>20</u>



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USG Regents' Scholarship of Teaching and Learning Award Committee
270 Washington Street, SW
Atlanta, GA 30334

Dear Members of the Scholarship of Teaching and Learning Award Committee,

It is with great pleasure that I write this letter in support of Dr. Tessa Andrews' candidacy for the University System of Georgia Regents' Scholarship of Teaching and Learning Award. Dr. Andrews is nationally recognized STEM education researcher whose innovative and well-funded research program has transformed undergraduate STEM classrooms at the University of Georgia. As a dedicated and experienced educator with a research focus on supporting the effective use of evidence-based strategies in the STEM classroom, she is an outstanding candidate for the Regents' SoTL award.

Dr. Andrews has led undergraduates to become independent learners and to develop an ability to "think like a scientist" since 2013. Her research explores how to engage non-majors in large, introductory biology courses by re-designing these courses to make the material more meaningful through real-life examples. Her notable teaching philosophy highlights the importance of small-group dialogue, which provides a place for students to engage with challenging material while developing a deeper conceptual understanding.

Dr. Andrews also is keenly aware of potential achievement gaps in higher education. To make classroom materials accessible to all students, she uses open educational resources that limit financial burdens while also promoting small-group dialogues that give all students an opportunity to engage with the subject. Through innovative course design and the use of open educational resources, Dr. Andrews has revamped multiple undergraduate STEM courses to create an interactive learning environment and foster critical scientific thought.

Since 2015, Dr. Andrews has received three National Science Foundation grants to promote active learning in large undergraduate STEM courses. While she has collected data from STEM courses across the United States, Dr. Andrews also has focused on her own courses and documented significant learning gains in her students' comprehension. Of her numerous invited presentations, Dr. Andrews has presented on active learning strategies for beginning and experienced faculty and how to be an effective educator in large STEM classes. Dr. Andrews' contributions to the field of scholarship of teaching and learning are practical, yet highly influential, informing her own teaching strategies and those of local and national STEM instructors.

Dr. Andrews is committed to the success of her students and to the success of STEM undergraduates nationally. Her exceptional STEM education research and her effectiveness as a STEM educator make her a leader in the SoTL field. I believe that Dr. Andrews exemplifies the

far-reaching impact that the Regents' Scholarship of Teaching and Learning Award seeks to recognize.

Sincerely,

A handwritten signature in blue ink, appearing to read "Libby Morris", with a stylized, cursive script.

Libby V. Morris

Interim Senior Vice President for Academic Affairs and Provost

TEACHING PHILOSOPHY AND IMPACT ON STUDENT LEARNING

My teaching philosophy is grounded in my overarching goals for students. In each of my courses, I aim to help students develop deep conceptual understanding of core ideas in biology, hone the ability to think like a scientist, grow as independent learners, and appreciate the relevance of biological research to their lives. I focus on scientific practices in all of my courses, including introductory courses for non-majors. A few key principles guide my teaching as I support students to achieve these goals.

The first principle guiding my teaching is that students develop deep conceptual understanding in science by engaging in challenging cognitive work during class (Freeman *et al.*

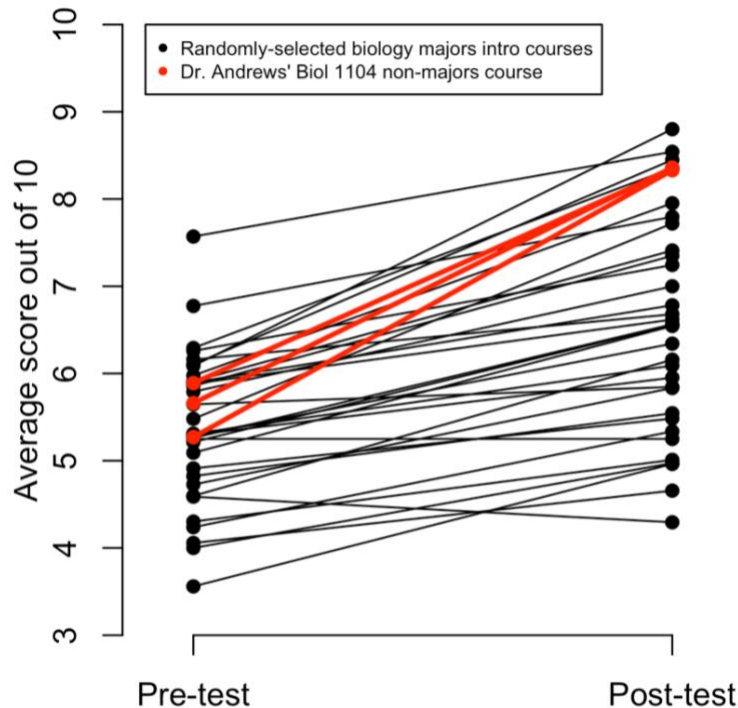


Figure 1. Student learning gains in my course at UGA (red lines) and 33 other introductory biology courses (black lines). Pre- and post-test are the average score achieved by students in a course on the research-based Conceptual Inventory of Natural Selection (Anderson & Bishop 2002). The slope of the line connecting these points represents the magnitude of learning gains. Steeper lines represent greater gains. The average normalized gain in the 33 courses is **0.26** (black lines; Andrews *et al.* 2011), whereas the average normalized gains in my course range from **0.60 – 0.65** (red lines).

2014). This can be called “active learning.” I teach large undergraduate biology classes focused on evolution, including introductory and upper-division courses. My course size ranges from 100 to 250 students, and I engage students in active learning in each and every class period. My scholarship of teaching and learning (SoTL) has been crucial to continually improving my teaching in these “industrial-sized” courses. My students spend significant time in each class working on problems and tasks in small groups. I design this work specifically to challenge their thinking. For example, I have created and refined a set of tasks to help students overcome common misconceptions about natural selection and build scientifically-accurate ideas (e.g., Andrews *et al.* 2011). These tasks elicit student thinking through individual writing and then guide them to reconsider their thinking through small-group and whole-class discussion. I have assessed student learning of natural selection and found these tasks to be highly effective (Kalinowski *et al.* 2013) as shown in Figure 1. Regularly assessing student learning helps me continually refine my teaching.

A second key principle that guides my teaching is that building scientific thinking skills is a key goal of undergraduate instruction for all students in biology courses. Biology content increases by leaps and bounds each year, and we cannot reasonably teach students all of the accumulated biological knowledge. Instead, a large convening of experts proposed renewed focus on scientific thinking practices (AAAS 2011). Utilizing elements of a flipped classroom model, students in my courses learn basic concepts outside of class by reading and take weekly reading quizzes that hold them accountable for pre-class work. Class time is then available for students to develop deep understanding of concepts by engaging in scientific practices. For example, in my upper-division evolution course, students read scientific papers before class and take quizzes about the basic research questions and design. In-class they work collaboratively on problem-sets that ask them to draw figures to predict the results of experiments, interpret data, and evaluate the conclusions drawn by researchers. I refine these problem sets each semester as I gain richer understanding of where student struggle and the types of scaffolded questions that help them develop accurate understandings. Learning to think like a scientist allows students to continue to learn biology as the field advances after they leave my course, whether or not they opt for a career in research.

A third principle that guides my teaching is that effectively engaging students in active-learning instruction in large courses requires carefully designed structure, particularly for group work. Dialoguing with peers particularly improves student learning (Chi & Wiley 2014), so I assign students to groups of 4-5 students, with whom they work throughout the semester. I draw on research regarding effective use of groups. Specifically, Knight *et al.* (2013) demonstrated that student groups engage in richer discussions if they are explicitly prompted to share their reasoning each time the instructor asks them to talk with their group. Therefore, I rely on carefully crafted prompts to encourage rich student discussions, such as “Discuss your answers and focus on the reasons for your answers. Talk about why the wrong answers are wrong and why the right answers are right.”

Groups not only provide the opportunity for students to articulate their reasoning to each other, they also help me hold students accountable for working during class. After small-group discussion, I randomly select one or more groups to share their thinking with the class. This is another place where I use very specific language. Random call can increase anxiety among

students (e.g., Cooper *et al.* 2018), so I only call on groups after they have had a chance to talk to each other and I ask them to “share what their group was thinking.” This invites groups to share their confusions, as well as their reasoning. It also spreads ownership for the ideas across the group so the student

Five key principles guiding my teaching practice:

1. Students develop deep conceptual understanding in science by engaging in challenging cognitive work in class.
2. Building scientific thinking skills is a key goal of undergraduate instruction.
3. Effectively engaging students in active-learning instruction in large courses requires carefully-designed course and lesson structure.
4. STEM disciplines benefit from diversity and it is my responsibility as an instructor to minimize gaps in achievement and classroom experience between those well-represented in STEM fields and those underrepresented in STEM fields.
5. Students work harder if they see the relevance of the content to their own lives.

speaking does not feel like their ideas are on display to be judged.

Lastly, learning student names in even my largest classes is an important way I create a welcoming climate in which students feel comfortable sharing newly-formed ideas and asking questions (Cooper *et al.* 2017). Many students in science courses take only large courses until late in their undergraduate careers, and large courses can often feel impersonal. Therefore, students in my courses create name tents that they use in class each day. I use these to call them by name during class, as well as photo rosters to learn as many names as possible. Though the task of learning hundreds of names is daunting each semester, I am regularly reminded of its value because student evaluations inevitably reveal that some students felt like my course was the first one in which a professor seemed to care about them as an individual.

A fourth principle that guides my teaching is the importance of equity and inclusion in STEM. STEM courses often create achievement gaps between majority students and students from historically underrepresented groups, including racial and ethnic minorities and financially underprivileged students. With this in mind, I aim to make instructional choices that minimize achievement gaps. One important strategy for promoting inclusion is transparency in teaching because it makes unwritten rules and expectations clear to all students (e.g., Eddy & Hogan, 2014). Transparency involves making explicit to students how the course will operate, what is expected of them, and what they can expect from the instructor. For example, I provide specific learning objectives for each lesson and assessments are based on these objectives. I also create opportunities for students to learn to study for my exams, which require more than memorization. For example, I created a set of resources to introduce students to new studying techniques and to encourage self-reflection about their learning habits. Furthermore, I use open-access education materials to minimize the financial burden on students. I have built a collection of articles, videos, and podcasts to give students free access to content in my courses. Finally, randomly calling on groups is an important strategy to achieve equitable representation of voices in the classroom. Research has revealed concerning patterns of inequity in undergraduate biology courses. Since male students volunteer to answer questions in large classes much more often than do female students, over the course of the semester, students form the impression that the most successful students in the class are male (Eddy *et al.* 2014; Grunspan *et al.* 2016). Though this impression is not supported by student performance data, it may influence the degree to which female students feel they belong in STEM, ultimately negatively influencing their persistence. Therefore, I randomly select groups to share their thinking during whole-class discussions, rather than asking for volunteers. Students remain in the same groups throughout the semester, which helps students who may experience undue anxiety in social situations, such as LGBTQIA students who may feel they have to “come out” to their group (Cooper & Brownell 2016).

The fifth principle that guides my teaching is that students are more motivated to learn and take on challenging tasks when they see the relevance of the work to their lives (Glynn *et al.* 2007). Therefore, I engage students in course material by embedding it in a context that is relevant to their lives. For example, I designed my non-majors biology course so that all content is covered within the context of important contemporary biology problems, such as antibiotic resistance and ocean acidification. I also engage students in projects that allow them to choose a topic they want to explore further. Students in that course also create short video public service announcements to bring attention to ways that human behaviors negatively affect biodiversity. I find that students take ownership of scientific ideas and the value of these ideas when they are charged with communicating science to others.

IMPACT OF SCHOLARSHIP OF TEACHING & LEARNING ON THE DISCIPLINE

My teaching philosophy is both grounded in research on teaching and learning and contributes to my own scholarship. I began engaging in SoTL by studying student thinking and learning about evolution in my classroom and other classrooms. I continue this work so that I can consistently improve as an educator, and to contribute to our collective knowledge about teaching evolution. The scope of my SoTL also goes beyond my own classroom to study college STEM faculty and how they can best be supported to effectively implement evidence-based teaching. This work has earned me a national reputation as a discipline-based education researcher studying teaching knowledge and systemic change in undergraduate STEM. This work also allows me to play a leadership role in promoting and supporting SoTL and evidence-based teaching at UGA.

As a result of my education research, I have had the opportunity to take leadership roles in national efforts. I served as a Senior Advisor for the Bill & Melinda Gates Foundation to make recommendations of initiatives the Foundation could undertake to support the adoption and sustained use of evidence-based teaching in college classrooms across the country. I also held a leadership role at a working meeting hosted by the American Association for the Advancement of Science (AAAS). I wrote a review of the state of evidence-based reform in undergraduate life sciences education that will be part of a widely distributed report from AAAS in spring 2019. Additionally, I am on the Steering Committee for the Society for the Advancement of Biology Education Research (SABER), which supports research about undergraduate biology education nationally and internationally. Additional evidence of the impact of my education research on the discipline is reflected in invitations to give plenary talks at education research conferences and at universities. I have given plenary talks at the annual meeting of SABER and an NSF-funded meeting called Transforming Research in Undergraduate STEM Education. In 2019, I will give invited plenary talks at a Gordon Conference focused on Undergraduate Biology Education in the US and at a meeting about scientific literacy in Evolution in Portugal. I have given research seminars about my scholarship at six universities around the country in recent years.

My scholarship of teaching and learning investigates: (1) undergraduate evolution education, (2) teaching knowledge for active-learning instruction in large courses, and (3) systemic change in undergraduate STEM education. Below I describe the theoretical and empirical bases for my research and the unique contributions my research had made to teaching and learning in higher education and at UGA.

Undergraduate evolution education

Evolution is a unifying and explanatory theory for all of biology and is therefore a core concept in undergraduate biology education (AAAS 2011). However, it is also challenging to learn (e.g., Price & Perez 2016). Students often have intuitive ideas that are not aligned with a scientifically-accurate understanding of evolution (Coley & Tanner 2012). Additionally, understanding evolution requires knowledge of abstract concepts that are hard for people of all ages, such as randomness. As a result of these challenges, undergraduates often retain inaccurate ideas about evolutionary concepts even after carefully planned lessons. **Addressing this problem requires research to understand how students think about specific topics in evolution, including what difficulties they face as they learn.** My scholarship in this area investigates student thinking. I also work to make SoTL more accessible to faculty.

Studying student thinking about evolution

Though undergraduate biology courses cover many evolutionary topics, most scholarship has focused on just a few (Ziadie & Andrews 2018). Thus, for many topics, we have little or no research about how students learn. One such topic is genetic drift, an important mechanism of evolution that is fundamentally different from natural selection. In collaboration with colleagues, I conducted an in-depth study to explore biology undergraduates' misconceptions about genetic drift (Andrews *et al.* 2012). This work identified five overarching categories of 16 distinct

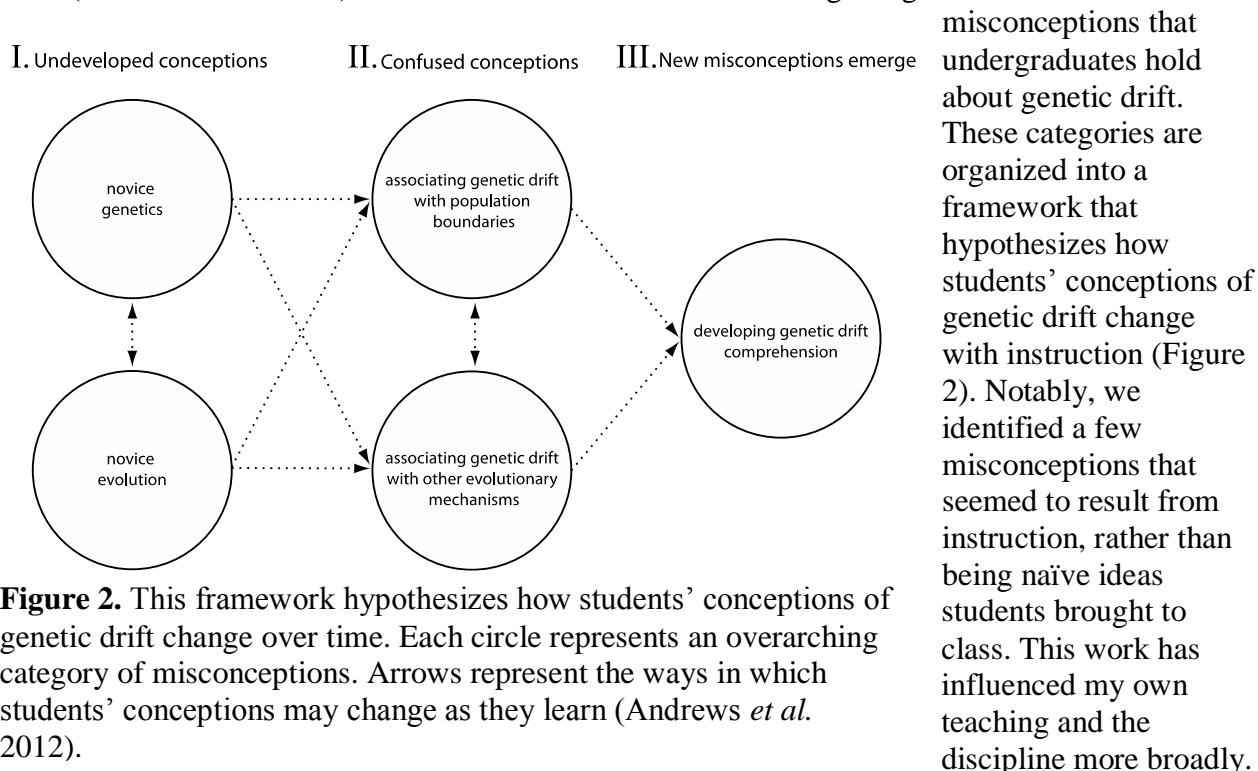


Figure 2. This framework hypothesizes how students' conceptions of genetic drift change over time. Each circle represents an overarching category of misconceptions. Arrows represent the ways in which students' conceptions may change as they learn (Andrews *et al.* 2012).

I design my own lessons on genetic drift with constant attention to the misconceptions that students may possess. My detailed understanding of the nuance of student thinking about this topic also helps me to more readily make sense of student thinking during class, which helps me better facilitate active-learning lessons on the topic. This work was recognized as an important contribution to the discipline through its inclusion in the annual "Highlights of 2012" edition of the leading journal in undergraduate biology education research, *CBE-Life Sciences Education*. This research also formed the basis for the work described next.

I worked with a research team to develop and validate a test to assess student knowledge about genetic drift. This test is a concept inventory, which is a research-based test in which the wrong answers are common misconceptions held by students. Students tend to perform much worse on concept inventories than on instructor-generated exams because concept inventories probe deep conceptual understanding. This makes them important tools for assessing teaching effectiveness and other SoTL. My work identifying students' misconceptions about genetic drift was crucial to the development of the concept inventory, which is called the Genetic Drift Inventory (GeDI; Price *et al.* 2014). We tested early versions of the GeDI with hundreds of undergraduates from different institution types around the country and iteratively revised it to ensure that it produced reliable and valid results. The GeDI is publically-available for use by any instructor or researcher. I use this instrument in my upper-division Evolutionary Biology course

(GENE 3000) each semester as a pre- and post-test to assess student learning about genetic drift. These data have helped me continually refine my lessons on this important topic. This research also has broader impacts on the discipline for both student learning and research. The GeDI is used by undergraduate biology programs to assess student learning outcomes across courses, including in my own department. It has also been used to assess the effectiveness of research-based lessons to teach natural selection (e.g., Price *et al.* 2016).

Making evolution education research more accessible to faculty

My most recent work in the area of evolution education was a systematic review of all peer-reviewed papers related to undergraduate evolution education, which I conducted in collaboration with a graduate student mentee, Michelle Ziadie. This work had two important goals, each with a different audience. First, we aimed to create a comprehensive “map” of the current state of the field for the evolution education research community. We identified areas where abundant scholarship exists and areas with little or no scholarship exists. We collected all relevant peer-reviewed work (n = 316 papers) and systematically categorized each paper as addressing one of 22 topics in evolutionary biology. We also determined if it focused on student thinking, assessment of student knowledge, or instructional strategies. Furthermore, we classified each paper as empirical, descriptive, author’s perspective, or review. Our work was first comprehensive review of research in the area (Ziadie & Andrews 2018).

We discovered many topics in evolution for which there is little or no research to help instructors better understand student thinking, assessment, or instructional strategies. We also collected syllabi from 32 upper-division evolution courses around the country and compared the topics commonly taught to the topics for which we have a literature base to inform that instruction. Many topics taught in nearly all courses have been the subject of little or no SoTL, including macroevolution, speciation, and population genetics. Therefore, we were able to make recommendations about the areas in need of most immediate investigation of student thinking, assessment, and instructional strategies. Our work also revealed that the majority of papers (77%) about instructional strategies for topics in evolution lacked any empirical investigation of student outcomes. Thus, another outcome of our work was a call for greater engagement in SoTL to rigorously assess the learning that results from instructional strategies that are described in peer-reviewed papers.

Our second goal for this work was to make the peer-reviewed papers that we analyzed more accessible to faculty who could use them to inform their own instruction. This is an important goal because many biology faculty do not engage in SoTL, nor are they likely to invest much time reading journals that publish this work. Yet their teaching would be well-informed by drawing on existing knowledge generated through research. Therefore, we created a searchable file that contains all 316 papers we identified and analyzed. The file categorizes each paper based on its focus (e.g., student thinking, assessment, instructional strategy), type of work (e.g., descriptive, empirical, author’s perspective, review), evolution topic, journal, and year. This searchable file allows an instructor to quickly identify papers relevant to their teaching. For example, an instructor searching for papers about instructional strategies for teaching tree thinking skills to undergraduates would find 12 papers, five of which have collected empirical evidence of effectiveness. We are further promoting this resource to college biology faculty in an article that will be published in *The American Biology Teacher*. The paper, entitled “*Don’t reinvent the wheel: Capitalizing on what others already know about teaching topics in evolution*,” is accepted for publication in February 2019.

My interest in studying evolution education stems from my own teaching and my passion for the subject area, but I also have broader goals aimed at improving undergraduate STEM education for all students. The next sections describe my SoTL aimed at these broader goals.

Teaching knowledge for active-learning instruction in large courses

While active-learning instruction *can* be highly effective at improving student outcomes (e.g., Freeman *et al.* 2014), the results instructors achieve vary substantially. For example, some of my research of student learning of natural selection indicated that even among faculty adopting active-learning, the results achieved often fell short of the great potential of these strategies to improve student outcomes (Andrews *et al.* 2011). Additionally, accumulating evidence indicates that instructors commonly implement active-learning strategies differently than intended by developers, changing or omitting parts that are crucial to student learning (e.g., Dancy *et al.* 2016). The knowledge instructors use influences how they implement teaching strategies, and active-learning instruction requires different knowledge than lecturing (e.g., Park *et al.* 2011).

Critically, an instructor's knowledge of teaching and learning—not just content knowledge—affects student outcomes (e.g., Hill *et al.* 2005). However, the existing empirical base for what teaching knowledge faculty need—beyond content knowledge—is slim. **Thus, there is a critical need to determine the knowledge college STEM instructors need to plan and implement active learning, especially in challenging contexts like large courses.** In order to assist instructors in effectively using active learning, and thereby improve outcomes for students, we must first determine the knowledge instructors need to succeed. My research about teaching knowledge aims to address this need.

Drawing on prior research studying K12 instructors, I used a lesson analysis approach to elicit and study teaching knowledge for active-learning instruction. This work was funded by a National Science Foundation grant from the Improving Undergraduate STEM Education program. We developed a lesson-analysis survey, in which research participants watch short videos of real active-learning lessons in large college biology courses and critically analyze the lessons by responding in writing to prompts. The prompts ask them what was effective and why it was effective. They also ask what could be improved in the lesson, why it needs to be improved, and how it could be improved. After iteratively refining the videos and writing prompts using pilot data, we launched a national study to better understand teaching knowledge for active-learning instruction.

Developing a framework for pedagogical knowledge for active learning in large classes

We first used this research approach to fill gaps in existing theory about knowledge bases for teaching. The vast majority of prior research on teaching knowledge in STEM has studied K12 teachers and focused on topic-specific knowledge of teaching and learning. Another important knowledge base for teaching is pedagogical knowledge (PK), which is generalizable knowledge of teaching and learning. Instructors can use similar PK across all the topics they teach. PK has been much less extensively studied and therefore was not well defined. **Yet a major difference between a traditional lecture and active-learning instruction is the pedagogy so this may be an important knowledge base for instructors using active learning.** Therefore, my research team sought to generate a framework that defined components of PK active learning instruction.

We recruited 77 college biology instructors who taught large courses (50+ students) and who self-identified as active-learning instructors to complete the lesson-analysis survey. We used qualitative analyses aligned with grounded theory to identify distinct components of PK and to richly describe how instructors used this knowledge as they critically analyzed active-learning lessons. The framework resulting from this study consists of seven components of PK and how participants connected these components (Figure 3).

There are important outcomes from this work. Participants displayed knowledge of how people learn, practical knowledge of teaching strategies and behaviors, and knowledge related to classroom management. Their deep knowledge of pedagogy suggests that active-learning instruction requires much more than content knowledge built through training in the discipline, yet may college STEM instructors have little or no training in teaching. This framework provides a theoretical basis for my future research and that of other instructors studying teaching knowledge and the development of college teachers. Importantly, this framework provides finer resolution of what constitutes PK than any prior work at the college or K12 level. Lastly, this framework has the potential to be a resource to instructors and those responsible for teaching professional development because it can serve as a taxonomy of potentially important knowledge for instructors learning to use active learning. I share this framework with UGA colleagues who want to start teaching using active-learning instruction, but are wary about wading through the extensive body of education research. This framework provides concrete components of instruction on which they can focus as they consider how to design their own teaching.

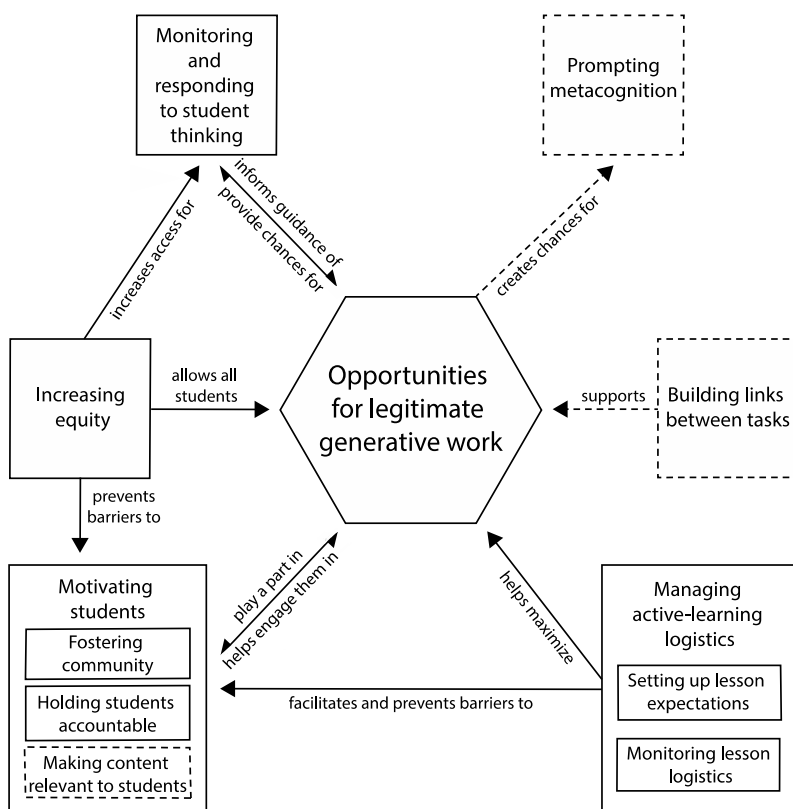


Figure 3. Framework of pedagogical knowledge for active-learning instruction in large undergraduate STEM course. This framework displays the collective ideas of 77 participants as they analyzed the effectiveness of active-learning lessons. There are seven components, some of which have subcomponents. Arrows indicate relationships among components that participants described. Auerbach & Andrews (2018) provide extensive descriptions of each component and variation seen across participants.

Identifying knowledge differences between expert and novice active-learning instructors

My research team's next goal was to better understand what teaching knowledge distinguished highly effective (i.e., expert) and novice active-learning instructors (Auerbach *et al.* 2108). Expert-novice comparisons have a rich history in cognitive science. Examining the performance of novices and experts within a specific domain allows for inferences about knowledge that is important in the domain (Ericsson 2000). We examined how experts and novices differed in what they noticed as they analyzed active-learning lessons. We also examined how experts and novices differed in their ability to use reasoning to support their evaluations of suggestions for improving active-learning lessons. We collected data using the lesson-analysis survey and analyzed participants' responses using qualitative content analysis and generalized linear models. Experts had extensive experience and demonstrated effectiveness using active-learning instruction in large undergraduate biology courses and novices had one to four years of experience and lacked evidence of effectiveness.

We discovered that experts exhibited four components of teaching knowledge significantly more often than did novices: holding students accountable, planning for topic-specific difficulties, monitoring and responding to student thinking, and creating opportunities for generative work (Auerbach *et al.* 2018). Experts exhibited knowledge about holding students accountable for working during class 5.8 times more often than did novices. We also discovered that experts supported their evaluations of and suggestions for improving instruction with detailed reasoning significantly more often than did novices. Specifically, experts provided evaluations with reasoning 2.9 times more often than did novices. They provided suggestions with reasoning 3.8 times more often than did novices. Together these indicate that experts displayed more sophisticated analyses of active-learning lessons.

This research has important practical implications for teaching professional development because it indicates knowledge that is important for active-learning instruction in large classes. I am using this work to inform teaching development here at the University of Georgia and also in a new national program we are proposing to the National Science Foundation.

In addition, what we learned also allowed me to create immediate resources for instructors. One gap in available resources is videos of active-learning instruction. The opportunity to observe another teacher can persuade a teacher to try a new strategy (e.g., Gaudin & Chalias 2015) and facilitate the development of critical knowledge. Yet many college instructors rarely observe other instructors (e.g., Andrews & Lemons 2015). Videos are another way to access real classrooms. Therefore, my team created seven video clips that provide an uninterrupted look at real active-learning lesson in large undergraduate biology courses. These videos show a range of active-learning practices and a range of effectiveness. This variety makes them perfect for teaching professional development. They are used as tasks to prompt faculty to critically analyze instruction.

The impact of these videos is far-reaching. These videos have been viewed over 1000 times. This almost certainly underestimates their impact because they are frequently shown to rooms of faculty in teaching professional development. For example, they are used by the Summer Institutes for Scientific Teaching, which occur around the country within science departments. In addition, the Center for Teaching and Learning at UGA uses these videos in their work to support faculty teaching. In addition to the videos we created, I curated a collection of other videos as resources to college STEM faculty and organized them in a web collection

(Figure 4). This collection is called *REALISE: Repository for Envisioning Active-Learning Instruction in STEM Education* (<https://seercenter.uga.edu/realisevideos/>).

I am building on my existing research in this area by investigating the knowledge used by active-learning instructors as the plan, implement, and reflect on their own instruction. This builds on prior work by eliciting how instructors actually use teaching knowledge in their own teaching. Preliminary work was funded by the Owen's Institute of Behavioral Research at the University of Georgia. Furthermore, I currently have a pending National Science Foundation CAREER grant to fund investigations of the relationships between teaching knowledge, instructional practice, and student learning gains in introductory biology courses around the country, and to study how teaching knowledge develops in new active-learning instructors.

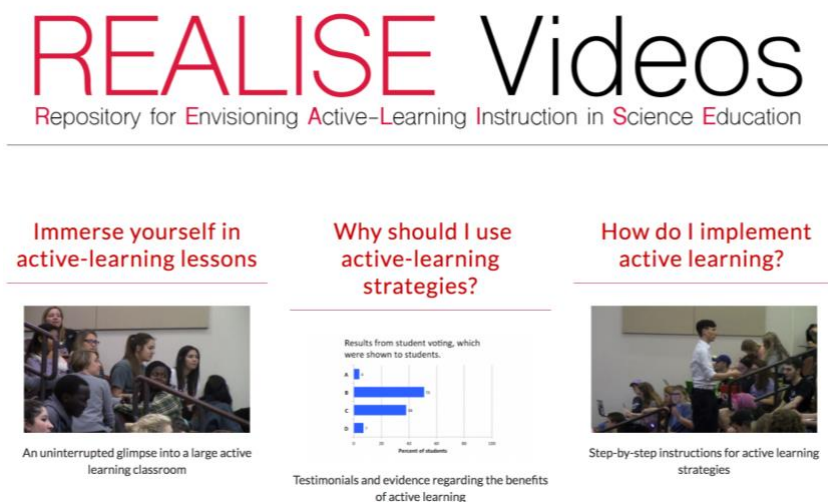


Figure 4. Screenshot of the front page of REALISE Videos. The videos we created allow instructors to immerse themselves in active-learning lessons. The site is also populated with carefully curated videos created by other groups to support active-learning instruction in undergraduate STEM.

Systemic change in undergraduate STEM education

Another key area of my scholarship that is aimed at improving undergraduate STEM education focuses on the system in which undergraduate teaching occurs. Despite many high-profile calls for faculty to adopt evidence-based teaching strategies, most STEM faculty continue to teach primarily by lecturing (e.g., Stains *et al.* 2018). Researchers and policy makers now recognize that to change what happens in undergraduate classrooms, we have to change the system in which faculty are trained, hired, supported, and rewarded. In other words, we have to achieve systemic change, which includes change at all levels of the institution. For example, an in-depth study that I conducted of a few life sciences departments at one research university indicated that departments vary considerably in the degree to which faculty talk to each other about teaching, and the degree to which they view the department as valuing time spent on undergraduate teaching (Andrews *et al.* 2016). These differences are at least partly due to leadership and the priority placed on teaching training and rigorous evaluation of teaching.

My work in this area was recently funded by a \$2.9 million grant from the National Science Foundation. This grant funds a major 5-year effort at the University of Georgia, called DeLTA, to reform undergraduate STEM education. It supports instructors through long-term professional development for evidence-based teaching. It also gathers department heads to collaboratively reconsider how departmental practices, policies, and values can be re-imagined to better support, evaluate, incentivize, and reward evidence-based teaching. Furthermore, the project will work at the level of the institution to contribute to efforts to re-evaluate and reform

university incentive structures. As a co-PI on this grant, my role is to study how thinking and actions relevant to STEM education change among faculty, departments, and the administration. This research will yield new insights into how to transform teaching and learning in institutions of higher education, including the University of Georgia.

REFERENCES

- AAAS (2011). Vision and change in undergraduate biology education: A call to action. Washington, DC.
- Anderson, D. L., Fisher, K. M., & Norman, G. J. (2002). Development and evaluation of the conceptual inventory of natural selection. *Journal of Research in Science Teaching*, 39(10), 952-978.
- Andrews, T.C.**, Conaway, E.P., Zhao, J., Dolan, E.L. (2016). Colleagues as change agents for undergraduate teaching. *CBE-Life Sciences Education*, 15(2), 1-17.
- Andrews, T.C.**, Lemons, P.P. (2015) It's personal: Biology instructors prioritize personal evidence over empirical evidence in teaching decisions. *CBE-Life Sciences Education*, 14(1):1-18.
- Andrews, T.M.**, Kalinowski, S.T., Leonard, M.J. (2011). 'Are Humans Evolving?' A classroom discussion to change students' misconceptions about natural selection. *Evolution: Education and Outreach*, 4(3), 456-466.
- Andrews, T.M.**, Leonard, M.J., Colgrove, C.A., Kalinowski, S.T. (2011). Active learning not associated with student learning in a random sample of college biology courses. *CBE-Life Sciences Education*, 10(4), 394-405.
- Auerbach, A.J.J., **Andrews, T.C.** (2018). Pedagogical knowledge for active-learning instruction in large undergraduate biology courses: A large-scale qualitative investigation of instructor thinking. *International Journal of STEM Education*, 5:19.
- Auerbach, A.J.J., Higgins, M., Brickman, P., **Andrews, T.C.** (2018). Teacher knowledge for active-learning instruction: Expert-novice approach reveals differences. *CBE-Life Sciences Education*, 17(1), ar12.
- Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist*, 49(4), 219-243.
- Coley, J. D., & Tanner, K. D. (2012). Common origins of diverse misconceptions: cognitive principles and the development of biology thinking. *CBE—Life Sciences Education*, 11(3), 209-215.
- Cooper, K. M., & Brownell, S. E. (2016). Coming out in class: Challenges and benefits of active learning in a biology classroom for LGBTQIA students. *CBE—Life Sciences Education*, 15(3), ar37.
- Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *International Journal of STEM Education*, 5(1), 23.
- Cooper, K. M., Haney, B., Krieg, A., & Brownell, S. E. (2017). What's in a name? The importance of students perceiving that an instructor knows their names in a high-enrollment biology classroom. *CBE—Life Sciences Education*, 16(1), ar8.
- Dancy, M., Henderson, C., & Turpen, C. (2016). How faculty learn about and implement research-based instructional strategies: The case of peer instruction. *Physical Review Physics Education Research*, 12(1), 010110.

- Eddy, S. L., & Hogan, K. A. (2014). Getting under the hood: how and for whom does increasing course structure work?. *CBE—Life Sciences Education*, 13(3), 453-468.
- Eddy, S. L., Brownell, S. E., & Wenderoth, M. P. (2014). Gender gaps in achievement and participation in multiple introductory biology classrooms. *CBE—Life Sciences Education*, 13(3), 478-492.
- Ericsson, K. A. (2000). Expertise in interpreting: An expert-performance perspective. *Interpreting*, 5(2), 187-220.
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410-8415.
- Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review*, 16, 41-67.
- Glynn, S. M., Taasobshirazi, G., & Brickman, P. (2007). Nonscience majors learning science: A theoretical model of motivation. *Journal of Research in Science Teaching*, 44(8), 1088-1107.
- Grunspan, D. Z., Eddy, S. L., Brownell, S. E., Wiggins, B. L., Crowe, A. J., & Goodreau, S. M. (2016). Males under-estimate academic performance of their female peers in undergraduate biology classrooms. *PloS one*, 11(2), e0148405.
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42(2), 371-406.
- Kalinowski, S.T., Leonard, M.J., **Andrews, T.M.**, Litt, A.R. (2013). Six classroom exercises to teach natural selection to undergraduate biology students. *CBE-Life Sciences Education*, 12(3), 483-793.
- Knight, J. K., Wise, S. B., & Southard, K. M. (2013). Understanding clicker discussions: student reasoning and the impact of instructional cues. *CBE—Life Sciences Education*, 12(4), 645-654.
- Park, S., Jang, J. Y., Chen, Y. C., & Jung, J. (2011). Is pedagogical content knowledge (PCK) necessary for reformed science teaching?: Evidence from an empirical study. *Research in Science Education*, 41(2), 245-260.
- Price, R. M., & Perez, K. E. (2016). Beyond the adaptationist legacy: updating our teaching to include a diversity of evolutionary mechanisms. *The American Biology Teacher*, 78(2), 101-108.
- Price, R. M., Pope, D. S., Abraham, J. K., Maruca, S., & Meir, E. (2016). Observing populations and testing predictions about genetic drift in a computer simulation improves college students' conceptual understanding. *Evolution: Education and Outreach*, 9(1), 8.
- Price, R.M., **Andrews, T.C.**, McElhinny, T.L., Mead, L.S., Abraham, J.K., et al. (2014). The Genetic Drift Inventory: a tool for measuring what advanced undergraduates have mastered about genetic drift. *CBE-Life Sciences Education*, 13(1), 65-75.
- Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., ... & Levis-Fitzgerald, M. (2018). Anatomy of STEM teaching in North American universities. *Science*, 359(6383), 1468-1470.
- Ziadie, M.A., **Andrews, T.C.** (2018). Moving evolution education forward: A systematic analysis of literature to identify gaps in collective knowledge for teaching. *CBE-Life Sciences Education* 17(1), ar11.

CONDENSED CURRICULUM VITAE FOR TESSA C. ANDREWS

(formerly Tessa M. Andrews)

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Email: tandrews@uga.edu

EDUCATION

Ph.D. Biological Sciences (2012)	Montana State University, Bozeman, MT
Certificate of College Teaching (2012)	Montana State University, Bozeman, MT
B.S. Psychology (2006)	Montana State University, Bozeman, MT

PROFESSIONAL APPOINTMENTS

Assistant Professor, Department of Genetics, University of Georgia (UGA), 2013-present
Biology Teacher-Scholar Postdoctoral Associate, UGA, 2012-2013

SELECTED PEER-REVIEWED EDUCATION RESEARCH PUBLICATIONS (out of 17)

1. Ziadie, M.A., **Andrews, T.C.** (Accepted Sept 18) Don't reinvent the wheel: Capitalizing on what others already know about teaching topics in evolution. *American Biology Teacher*.
2. Auerbach, A.J.J., **Andrews, T.C.** (2018) Pedagogical knowledge for active-learning instruction in large undergraduate biology courses: A large-scale qualitative investigation of instructor thinking. *International Journal of STEM Education*, 5:19. doi:10.1186/s40594-018-0112-9
3. Ziadie, M.A., **Andrews, T.C.** (2018) Moving evolution education forward: A systematic analysis of literature to identify gaps in collective knowledge for teaching. *CBE-Life Sciences Education* 17(1), ar11. doi:10.1187/cbe.17-08-0190
4. Auerbach, A.J.J., Higgins, M., Brickman, P., **Andrews, T.C.** (2018) Teacher knowledge for active-learning instruction: Expert-novice approach reveals differences. *CBE-Life Sciences Education*, 17(1), ar12. doi:10.1187/cbe.17-07-014
5. **Andrews, T.C.**, Conaway, E.P., Zhao, J., Dolan, E.L. (2016) Colleagues as change agents for undergraduate teaching. *CBE-Life Sciences Education*, 15(2), 1-17. doi:10.1187/cbe15-08-0170. **Featured** by *Genetics* Issue Highlights July 2016, 203 (3).
6. **Andrews, T.C.**, Lemons, P.P. (2015) It's personal: Biology instructors prioritize personal evidence over empirical evidence in teaching decisions. *CBE-Life Sciences Education*, 14(1):1-18. doi: 10.1187/cbe.14-05-0084.
7. Price, R.M., **Andrews, T.C.**, McElhinny, T.L., Mead, L.S., Abraham, J.K., Thanukos, A., Perez, K.E. (2014) The Genetic Drift Inventory: a tool for measuring what advanced undergraduates have mastered about genetic drift. *CBE-Life Sciences Education*, 13(1), 65-75. doi: 10.1187/cbe.13-08-0159
8. Kalinowski, S.T., Leonard, M.J., **Andrews, T.M.**, Litt, A.R. (2013) Six classroom exercises to teach natural selection to undergraduate biology students. *CBE-Life Sciences Education*, 12(3), 483-793. doi:10.1187/cbe-12-06-0070

9. **Andrews, T.M.**, Price, R.M., Mead, L.S., McElhinny, T.L., Thanukos, A., Perez, K.E., Herreid, C.F., Terry, D.R., Lemons, P.P. (2012) Biology undergraduate's misconceptions about genetic drift. *CBE-Life Sciences Education*, 11(3), 248-259. doi:10.1187/cbe.11-12-0107. **Featured** in selective "Highlights of 2012" issue of *CBE-Life Sciences Education*
10. Kalinowski, S.T., **Andrews, T.M.**, Leonard, M.J., Snodgrass, M. (2012) Are Africans, Europeans, and Asians different "races"? A guided inquiry laboratory investigation for introducing students to variation among DNA sequences. *CBE-Life Sciences Education*, 11(2), 142-151. doi:10.1187/cbe.11-09-0087
11. **Andrews, T.M.**, Leonard, M.J., Colgrove, C.A., Kalinowski, S.T. (2011) Active learning not associated with student learning in a random sample of college biology courses. *CBE-Life Sciences Education*, 10(4), 394-405. doi:10.1187/cbe.11-07-0061.
12. **Andrews, T.M.**, Kalinowski, S.T., Leonard, M.J. (2011) 'Are Humans Evolving?' A classroom discussion to change students' misconceptions about natural selection. *Evolution: Education and Outreach*, 4(3), 456-466. doi:10.1007/s12052-011-0343-4

GRANTS FOR EDUCATION RESEARCH AND PRACTICE

Active (Total = \$2,880,951)

- Lemons, P.P (PI), **Andrews, T.C. (Co-PI)**, Brickman, M., Covert, S.F., Dolan, E. L. (2018-2023) National Science Foundation: Improving Undergraduate STEM Education (IUSE). *Transforming STEM Education at a Research I University through Multi-Level Action Teams*. \$2,876,793.
- Andrews, T.C. (PI)**, Reinholz D. (PI) (2018-2020) National Science Foundation IUSE. *Collaborative Research: Connecting Emerging STEM-DBER Change Researchers: Working meetings to enhance research capacity for systemic change in undergraduate STEM education*. \$4,158 to UGA & \$45,740 to SDSU.

Completed (Total = \$286,715)

- Andrews, T.C. (PI)**, Brickman P. (Co-PI), Lemons, P. (Co-PI) (2015-2018). National Science Foundation IUSE. *Promoting active learning in large undergraduate STEM courses: Identifying critical knowledge used by effective instructors*. \$249,887
- Andrews, T.C. (PI)**. (2017-2018) UGA Owens Institute for Behavioral Research Faculty Seed Grant. *Investigating knowledge for active-learning instruction in large college biology classes*. \$8,409 (11/17-5/18).
- Andrews, T.C. (PI)**. (2015-2016) University of Georgia STEM Initiative Small Grants. *Building instructor knowledge for evidence-based teaching in large science classes*.
- Andrews, T.C. (PI)**. (2014) University of Georgia Provost's Faculty Sum. Research Grant. Research on expert active learning instruction in undergraduate science education. PI, \$5000 (Sum. 2014).
- Andrews, T.M. (PI)**. (2011) National Evolutionary Synthesis Center Graduate Student Fellowship. *Short and adaptable assessments to facilitate how evolution is taught and learned*. \$15,500

SELECTED EDUCATION RESEARCH PRESENTATIONS

Invited Presentations (out of 10 total)

- Andrews, T. C.** Online with LSE. Journal-club style webinar for national audience. (October 2018) *Teacher knowledge for active-learning instruction: Expert-novice comparison reveals differences*.

- Andrews, T. C.** Middle Tennessee State University, Math & Science Education (February 2018). *Knowledge for active-learning instruction in large undergraduate STEM courses: What knowledge do instructors need to be effective?*
- Andrews, T. C.** Emory University, Population Biology, Ecology, & Evolution. (October 2017). *Learning evolution in undergraduate courses: What do we know and where are the gaps?*
- Andrews, T. C.** Invited plenary talk at Transforming Research in Undergraduate STEM Education (TRUSE). (July 2017) *Unpacking evidence-based instructional practices: What does it take to be effective?*
- Andrews, T. C.** HHMI Collaborators Workshop, Florida International University (September 2016) *Catalyzing teaching reform: Focusing on Faculty.*
- Andrews, T.C.** University of Nebraska-Lincoln School of Biological Sciences (December 2015) *Improving undergraduate biology education: Focusing on the faculty experience.*

Peer-Reviewed Presentations (out of 17 total)

- Education research presented at the annual meeting of the **Society for the Advancement of Biology Education Research (SABER)** in 2011, 2012, 2013, 2015, 2017, & 2018, including a plenary “Hot Topic” talk in 2018.
- Education research presented at the annual meeting of the **National Association for Research in Science Teaching (NARST)** in 2011, 2016, 2018.
- Education research presented at the annual meeting of the **Society for the Study of Evolution** in 2014, 2018 and **NSF and AAAS’s Envisioning the Future of Undergraduate STEM Education (EnFUSE)** Conference in 2016.

SELECTED EDUCATION RESEARCH LEADERSHIP AND SERVICE

- **Representative and Reviewer for Biological Sciences** for AAAS and HHMI meeting: “*Lever for Change: A cross-disciplinary assessment of the state of research-based reform in undergraduate STEM instruction,*” May 2018.
- **Senior Advisor** for Bill & Melinda Gates Foundation Convening “*Overcoming Barriers to Scaled Solution Adoption: Evidence-Based Teaching and Student Success,*” 2017-2018
- **Founding and core member** of the UGA SEER (Scientists Engaged in Education Research)
- **Steering Committee Member**, Society for the Advancement of Biology Education Research, 2017 – present
- **Creator of curated video repository** for active learning in large undergraduate STEM courses, *REALISE: Repository for Envisioning Active-Learning Instruction in Science Education* (<http://seercenter.uga.edu/realisevideos/>)
- **Classroom observation as a research tool, video lessons** for the Center for the Integration of Research, Teaching, and Learning (CIRTL) at UGA, to be disseminated nationally
- Annual **classroom observations as a research tool workshop** for undergraduate researchers in summer NSF-funded REU program at UGA, 2014 – 2018
- **Classroom observations as a research tool workshop** for UGA SEER center, 2017
- **Introduction to qualitative research methods workshop** for UGA CTL, 2017

SELECTED TEACHING-RELATED HONORS

- UGA CTL Lilly Teaching Fellow (2014-2016) and Lilly Mentor (2016-2018)
- UGA Center for Teaching and Learning Fellows for Innovative Teaching program, 2017



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November 15, 2018

Megan L. Mittelstadt, Ph.D.
Director, Center for Teaching and Learning
The University of Georgia
Athens, GA 30602

Dear Dr. Mittelstadt,

I am pleased to offer my support to the nomination of Dr. Tessa Andrews for the Georgia Regents Award for Scholarship of Teaching and Learning. In the past decade, college science teaching has undergone a paradigm shift, and Tessa is at the forefront of the movement to help instructors adjust to teaching in a completely new way. The American Association for the Advancement of Science (AAAS), the National Science Foundation (NSF), and the President's Council on Science have mandated that instructors need to ensure that all students can apply science content to solve complex real-world challenges and to be able to write coherently about how they arrived at their solutions. Tessa Andrews has emerged as a national leader in helping college Science Technology Engineering and Math (STEM) instructors respond to these calls.

During her graduate training in Ecology, Tessa first confronted the problems that students have comprehending the fundamental concept of how organisms evolve. She responded by developing and disseminating several question sets that could help uncover students' confusion. She also created and published a series of engaging classroom exercises that helped students wrestle with their understanding of evolutionary ideas. She arrived at UGA as a post-doctoral fellow and completely transformed UGA's non-major's course, BIOL1104, to use these question sets and responded to student misunderstandings by developing several case studies, complex real-world stories that can help teach science concepts. Tessa is an expert active learning instructor in even the largest enrollment courses. I worked to capture her teaching on video to showcase for other faculty as a "Classroom Model" that is now part of the iBiology national series (<https://www.ibiology.org/scientific-teaching/active-learning/classroom-models.html>).

Tessa's teaching materials (published as 6 influential journal articles) have been used by instructors across the nation. However, in Tessa's efforts to help other instructors use her materials, she uncovered a critical issue: Even using the exact same materials, some instructors were able to help students learn more than other instructors. This crucial difference involved a lack of understanding of what an active and engaged classroom should look like and how to plan and execute activities that challenged students.

In response to a need for instructors to conceptualize active instructional methods and train in their use, Tessa wrote and received funding in 2015 from NSF to identify the critical

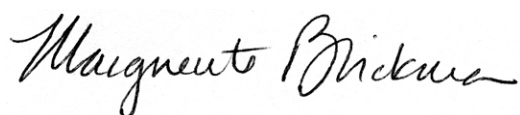
knowledge used by effective instructors. Her findings have been published in five prestigious journal articles including the International Journal of STEM Education, and she has conducted numerous presentations and released media (including video vignettes of instructors (<https://seercenter.uga.edu/realisevideos/>) that have been adopted by the National Academy of Sciences Summer Institutes in Biology Teaching and shown to hundreds of faculty across the country each year.

Tessa has served as a representative and reviewer of a meeting sponsored by AAAS and the Howard Hughes Medical Institute on a critical assessment of the state of research-based reform teaching in undergraduate science classrooms, and she is now acting as a senior advisor to the Bill and Melinda Gates Foundation to make recommendations on initiatives that can assist instructors in these efforts.

Here at the University of Georgia, Tessa has conducted research and published on the positive effects of fellow faculty at encouraging changes in teaching practices. As a founding member of the UGA Scientists Engaged in Education Research Center, she used this knowledge to help garner \$3 million from NSF to conduct a 5-year Institutional Transformation project. This ambitious project will engage over 84 STEM faculty on our campus as well as a dozen department heads and administrators in questioning the assumptions, values, and beliefs about teaching and learning that may be preventing instructors from responding to student learning. Tessa will spearhead the collection and analysis of all data on faculty teaching practices, the shifts that occur in departmental and university procedures, and changes in the reward structure that promotes effective teaching. This project promises to be the most substantial change in the culture of teaching that UGA has experienced in several decades, and Tessa will be instrumental in characterizing the challenges and successes that are generated.

I can think of no other faculty member in our state with the same influence on student learning and success than Tessa Andrews. I am so proud to have her as a colleague, and I feel she epitomizes the qualities that the Regents SoTL award recognizes.

Sincerely,



Dr. Marguerite (Peggy) Brickman

Josiah Meigs Distinguished Teaching Professor in Plant Biology - 2013 Georgia
Regents Scholarship of Teaching and Learning Award Recipient - 2007



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November 28, 2018

Regent's SoTL Award Committee
University System of Georgia

Dear Selection Committee,

I am writing in support of the nomination of Dr. Tessa Andrews for the University System of Georgia SoTL award. Tessa is my colleague in the UGA Scientists Engaged in Education (SEER) Center. Like Tessa, I conduct biology education research. I have observed Tessa's teaching and reviewed her papers and grants. Tessa implements an evidence-based teaching philosophy, and she engages in the systematic investigation of instructional conditions that promote learning. Her students show impressive learning gains from pre- to post-semester, and she is sought after by researchers and policy makers across the country to speak and write about her research. Tessa is a leader at UGA and nationally in teaching and research on teaching and learning. Tessa exemplifies all of the criteria for the SoTL award. I give her my strongest recommendation.

Tessa teaches organismal biology for non-majors and an upper-level course for non-majors using research-based strategies. Tessa gives students repeated opportunities for practice with basic terms, key concepts, and authentic data. These opportunities occur before class through online quizzing and during class using think-pair-share and similar techniques. In class Tessa engages students in collaborative learning and problem solving with scaffolding and feedback. Tessa promotes inclusion and diversity by making her expectations clear, for example, through the use of learning objectives and assessments aligned with learning objectives. Certainly, these are the reasons that Tessa's students experience substantial learning gains from the start of the semester to the end. For example, in organismal biology for non-majors Tessa's students achieve learning gains about the concept of natural selection that are greater than those achieved in 90% of introductory biology courses in a national sample.

Tessa's evidence-based teaching practice is motivated by her own research. She has published six peer-reviewed education research pieces on evolution education over the past seven years. These publications identify students' conceptual difficulties with genetic drift, provide evolution curriculum and evidence for its efficacy, and describe what is known about student thinking about evolution across all subtopics (e.g., speciation and phylogenetics). Tessa's evolution papers have been published in the top journal in biology education research, *CBE-Life Sciences Education*. This strong trajectory of research has made Tessa a national leader in evolution education.

In addition to her work on evolution education, Tessa investigates the knowledge that college instructors need to teach using evidence-based approaches. Tessa recognizes the value of evidence-based instruction, but her research also has shown how difficult it can be for college instructors to effectively implement these methods. The methods require a skill set that is distinct from giving a good presentation. Teachers have to craft inclusive environments that motivate students to discuss. They must create thought-provoking questions and exercises to use in class, and they must respond on the spot to students' questions.

Over the past three years Tessa has conducted research funded by the National Science Foundation to pinpoint the particular categories of knowledge that expert, evidence-based instructors use in the classroom. This work led to two publications in top journals, CBE-Life Sciences Education and the *International Journal of STEM Education*. These publications, which just came out in 2018, have quickly become heavily cited by professional development experts and researchers who aim to support college faculty. For example, colleagues of mine in the nation-wide Automated Analysis of Constructed Response project are drawing upon Tessa's work to frame future work with professional development for college faculty.

Moving forward, Tessa will continue to study teacher knowledge for evidence-based practice. In her most recent endeavor, Tessa is leading research on the National Science Foundation-funded DeLTA project at UGA (<https://news.uga.edu/uga-launches-project-to-transform-stem-education/>). DeLTA aims to stimulate transformative change in undergraduate education across STEM by working at the course, department, and institutional levels. The project will involve nearly 100 STEM UGA faculty over five years. Tessa and her research team will study the thinking and actions of these faculty and the extent to which thinking and actions shift toward new norms, such as designing educational experiences to achieve clear and measurable learning outcomes.

Tessa's strong funding and publication record has created opportunities for her to promote the SoTL at UGA and beyond. At UGA, Tessa is a founding member of the SEER Center. She regularly offers workshops on teaching and educational research and serves as a mentor to numerous undergraduates, graduate students and postdoctoral research fellows. Nationally, Tessa is a steering committee member for the Society for the Advancement of Biology Education Research and served as a Senior Advisor for a project funded by the Bill & Melinda Gates Foundation.

Tessa is a star within the national biology education research community. The University System of Georgia is fortunate to have a teacher-researcher of Tessa's stature. Personally, she is one of my most valued colleagues due to her expertise in the classroom and in research. I call upon her regularly and always learn from her insights. Tessa would be an exemplary representative of the criteria behind the Regent's SoTL Award. I give Tessa my highest recommendation.

Sincerely,



Paula P. Lemons, Ph.D.
Associate Professor