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# Application Summary

## Competition Details

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| **Competition Title:** | 2020 Innovation and Excellence in Laboratory Instruction Award |
| **Category:** | Institutional Awards - CTL |
| **Award Cycle:** | 2020 |
| **Submission Deadline:** | 03/02/2020 at 11:59 PM |

## Application Information

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| **Submitted By:** | David Garton |
| **Appplication ID:** | 4310 |
| **Application Title:** | Colin Harrison |
| **Date Submitted:** | 02/28/2020 at 6:23 AM |

## Personal Details

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| **Applicant First Name:** | David |
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**Primary School or Department**
School of Biological Sciences

| | |
|---|---|
| **Primary Appointment Title:** | Senior Lecturer |

## Application Details

**Proposal Title**
Colin Harrison

**School of Biological Sciences**
Atlanta, Georgia 30332-0230 USA
Email: todd.streelman@biology.gatech.edu

28 February 2020

Dear Dr. Weinsheimer:

The School of Biological Sciences Faculty Teaching Awards committee nominates Dr. Colin Harrison, Academic Professional in the School of Biological Sciences, for the Innovation and Excellence in Laboratory Teaching Award.

Dr. Harrison was hired in 2016 as the Director of Introductory Biology Labs, responsible for course design, implementation, TA supervision, and curriculum innovation in the four lab courses that comprise the introductory biology sequence at Georgia Tech: BIOL 1510, 1511, 1520, and 1521. His role annually influences 30 teaching assistants and over 750 undergraduates as they train for careers in life sciences and biology-related engineering. He designs and innovates in these courses with the intent to train our graduates to think as scientists.

**Dr. Harrison enhances student learning by helping students deepen their understanding of fundamental concepts by having students participate in the processes of investigation, analysis, and reflection.** The fundamental concept in core area D lab sciences is practice of the scientific method, so that students are actively engaged in the process of science rather than learning second hand about what researchers have found. In Dr. Harrison's courses, students have moved far beyond the traditional lab practices of appreciation of science, where students repeat experiments or actions to achieve known results. Instead, his students "do" science by posing their own educated guess about a biological question and then testing their hypothesis by conducting an experiment, analyzing the data, and presenting their results. By the introduction of relevant techniques and model systems into the BIOL 1510 and 1520 labs, Dr. Harrison provides students with current approaches to basic lab science, laying a foundation for their future exposure to science in their courses, careers, and as civic decision-makers.

**Dr. Harrison is deeply invested in having his students participate in Serve-Learn-Sustain and citizen science, providing opportunities for students to think about, discuss, and/or investigate/solve real-world problems.** The course-based undergraduate research experienced by students in the honors/majors labs BIOL 1511 and BIOL 1521 get students off campus and into the community, engaging with community partners and also with community members who stop to talk with student researchers in their local parks. Dr. Harrison recognized that first year college student scientists often lack the expertise to take full control over their research questions, so he's put some guidance and parameters in place to channel the student interest and creativity toward productive scientific questions in the framework of the needs of a community partner: the Atlanta Botanical Gardens and Piedmont Park are two organizations he and his students partner with on a regular basis.

While the idea of constraints of student research may sound like a step in the wrong direction, it is actually a move forward to help students focus on questions and ideas that will have impact. This, too, mimics the true process of science, where background information and expertise plays a role in defining research questions and technical expertise steers the scope of the research and indicates when a collaboration is required. **To engage students in collaborative problem solving, Dr. Harrison has students working with community partners and also with peers on teams of 4-8 students.** Course TAs work in teams of two with Dr. Harrison to lead class and guide student research questions into areas that will yield the most success.

**A key contribution to a positive student learning experience at Georgia Tech is Dr. Harrison's awareness that students are developing their identity as citizens and independent adults while engaging in their education at Georgia Tech.** He is therefore conducting research on science identity in BIOL 1510 and 1520. Another valuable contribution he is working on in collaboration with his lab director counterpart at Emory is a way to assess the intangibles of learning about scientific methodology in a course-based research experience, for eventual implementation in BIOL 1511 and 1521. These evidence-based practices improve the student experience and the quality of education in the sciences at Georgia Tech.

Dr. Harrison has co-authored with Dr. Chrissy Spencer to present of his service-learning and citizen-science initiatives in a presentation at the Association of Biology Laboratory Educators. He participates annually in the Society for the Advancement of Biology Education Research, and he is currently collaborating with Dr. Megan Cole at Emory University on a biology education research project. His work supports student learning about science, the scientific process, and developing science identity. I am please to nominate Dr. Colin Harrison for the Innovation and Excellence in Laboratory Teaching Award.

Sincerely,

Dr. Todd Streelman
Chair, School of Biological Sciences

NOMINATION OF DR. COLIN HARRISON FOR CENTER FOR TEACHING AND LEARNING INNOVATION AND EXCELLENCE IN LABORATORY INSTRUCTION AWARD

March 2, 2020

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**Summary of Instructional Role and Overall Goals**

As Director of the Introductory Biology Labs I am responsible for course design, implementation, innovation, and TA training/supervising for four courses for the Biology Department here at Georgia Tech. Over the course of an academic term I work with over 750 students across all majors as well as overseeing over 40 graduate and undergraduate teaching assistants.

The overall goal of my efforts with the labs is to make a lasting impression on the students about what science is and can be and how they as citizens and scientists can interact with the scientific world around them. Biology affects every aspect of human life and society on the planet and our students will interact with it in some form or another in their lives. The innovations that I have introduced into the labs have enhanced the labs' ability to prepare students for the very real ways they will encounter biology in the world and their careers.

Research into effective biology lab instruction shows that inquiry based labs and course based undergraduate research experiences that connect students to real science are the most effective ways to enhance biology laboratory education[1,2]. Below, I demonstrate ways in which my efforts have achieved the goals mentioned above through innovation in lab course curriculum, course learning goals, education research, Serve Learn Sustain outreach, and teaching assistant development.

**Course Summary Biology 1510 and 1520 Lab**

Biology 1510 and Biology 1520 are our intro sequence of labs designed for non-majors. In these courses students design their own experiments over the course of five different modules covering five different aspects of Biology. All of these labs are inquiry based, meaning the students are not simply following a set of directions but engaging in the scientific process by developing their own methods within the constraints of the course.

Our learning objectives for both courses are as follows:

- Student should learn to design, perform, and analyze the data from their own experiments in a collaborative format
- Students will gain experience in scientific communication by creating and evaluating written lab reports
- Students will learn how to effectively work in a collaborative science environment

To assess the progress of these learning goals, students write lab reports after each of the modules in a scaffolded approach, where as we move forward in the semester each lab report adds another aspect of writing a scientific paper. In this manner we do not overwhelm students with too much information but allow them to grow into the scientific writing process. Teaching assistants and myself regularly note how students' writing improves over the course of the semester, especially given this is many of these students first experience with scientific writing.

**Biology 1510 and 1520 Innovations**

The majority of our Biology 1510 and 1520 students are non-majors students who are taking biology to fill a Georgia Tech or med school requirement. Their motivations often vary for being in the course but the goals for all students are the same. Because this will often be many of these students only experience with biology, it is crucial that we make a positive impression and show ways in which biology and experimental design can impact their everyday lives. Thus, the innovations that I have introduced into the intro bio labs allow the course structure to further align with the learning goals and inquiry nature of the courses, as well as connect the experiments to real world job applications. To achieve these ends I have taken on the challenge of updating our

current lab manuals as well as introducing three new experiments that move our labs closer to more modern biologic techniques.

While the previous lab manuals did a good job of explaining the background science for each experiment, they did not impress upon the students why the experiment and study was important, nor how this type of experiment could relate to real world problems. To address this issue, I have updated the lab manuals for both Biology 1510 and Biology 1520 to connect each separate experiment to a real world career in science. For each experiment students are given a scenario based around each job and asked to test various aspects of each scenario.
In Bio 1510 the careers and real world applications they explore are:

1. Epidemiologist working for the CDC studying mortality rates in the US and UK
2. Entomologist/ecologist working for the USDA studying the behavior of bean beetles, an agricultural pest
3. Nutritionist/food scientist studying carbohydrate digestion and nutritional supplements
4. Evolutionary biologist studying the evolution of multicellularity
5. Biotech researcher studying muscle degeneration disorders

In Bio 1520 the careers and real world applications they explore are:

1. Epidemiologist working for the CDC studying childhood obesity in the US
2. Hospital clinician studying antibiotic resistance
3. Horticulturist studying plant growth responses for local farms
4. Behavioral scientist trying to develop traps for food pests
5. Botanist working for the arboretum studying transpiration rates for various plants

By allowing students to explore these different topics and professions, students will gain an understanding of what types of work biologists do. They will also be able to better connect their experiments to real world applications and potentially find a link to something they care about for their own future careers.

The three new experiments I helped design provide a good example of not only further innovation in these courses, but how this principle of connecting experiments to real world examples applies in practice. The first new experiment, carried out in Biology 1510, involves studying the amylase enzyme and its function in digesting starch. In this lab students take on the role of a nutritionist working for a company that develops supplements. They are tasked with studying the rates of amylase under various conditions. One of the conditions they can study is a dietary supplement that is supposed to block the intake of carbohydrates by decreasing amylase activity. This leads to a discussion about how the nutritional supplement industry is not regulated by the FDA as the supplements are not very effective at inhibiting amylase activity and the claims made about blocking carb are dubious at best. Students do find there are other ways to inhibit amylase activity but these may not be relevant to affecting human health. This is all relevant and useful information that our students can take forward in their lives even if they go into a field not directly related to biology.

The second experiment, also in Biology 1510, has students working as biotech researchers using a common model genetic system to study human degenerative muscle disorders (myopathies). Students utilize the RNAi system, a tool for knocking out gene expression in *Caenorhabditis elegans* (roundworms), to study how muscles function and develop. Students have access to four different RNAi vectors, each corresponding to a gene that plays some role in muscle development. Students research these genes and then make hypothesis about what effect they will have on the *C. elegans*. In the course of this research students will use BLAST searches, a computational tool that allows for the comparison of genes and their products across species. This allows them to see how the effects of these genes in *C. Elegans* can relate to their human counterparts and potential human conditions. This lab introduces them to a modern technique that is used frequently in molecular biology and genetics labs, as well as some computational biology skills. It

gives them freedom in exploring a topic and designing an experiment, allowing this lab to better correspond to the learning objectives of the course. By connecting the work to human conditions we can better connect the science to issues they may encounter in the world beyond the laboratory.

The third experiment in Biology 1520 incorporates *Drosophila melanogaster* (fruit flies), one of the most commonly used model organisms for laboratory study. Students are tasked with studying fruit fly sensory systems while trying to help design a better food trap for common household pests. Students choose from multiple different scents that have the potential to attract or repel the flies due to their olfactory senses. Not only do we provide several scents for the students, but students are able to bring items from home which further increases students' connection to the lab. Additionally, there are several *Drosophila* olfactory mutants that can be incorporated into the lab, further enhancing the scientific utility and impact of this lab. *Drosophila* behavior tests are an extremely important way to study the effects of gene knock outs before studying their effects in higher organisms and in disease outcomes in humans. This lab also demonstrates ways in which different companies may utilize biology in a manner students may not initially anticipate.

Overall these changes have the potential to impact our students in significant ways. The connection to the careers shows students how these types of experiments are beneficial to various professions and how they can apply their biology knowledge in other contexts related to their lives. *C. elegans* and *Drosophila* are two of the most used model organisms in multiple different fields of biology. By introducing students to several techniques utilized in research labs, we help students gain skills that will be useful when applying for and working in jobs in research labs both here on campus and elsewhere. Additionally, by incorporating modern techniques we do a better job of demonstrating real-world science in an educational setting and thus helping students better understand the scientific process and connect this to real world issues.

**Education Research in Biology 1510 and 1520**

In addition to the innovations listed above, I am currently conducting research into how biology labs can influence students' science identities (IRB: H18267). Having a strong science identity is one of the most important factors for retention in science, long term learning, and trusting in science[3]. This effect is especially pronounced in the retention of underrepresented groups[4]. Because this is a non-majors course and this may be many of these students' only opportunity to take a biology course, the development of a strong science identity is important for their future interactions with health and biology.

My research is working to understand if making scientific experiments in lab directly related to real world issues and career paths can positively influence science identity. My hypothesis is that the more students can relate to the science in the course the more we will be able to enhance their science identity over the course of the lab. I am currently in the process of collecting the last semester of data in this research project. Early cursory analysis of the data shows some very positive results due to the innovations listed above.

**Course Summary Biology 1511 Lab**

Biology 1511 lab is the first lab in the intro sequence for Biology majors. Biology 1511 lab is a Course Based Undergraduate Research Experience (CURE) that is affiliated with Georgia Tech's Serve Learn Sustain (SLS) initiative. In this course students work on a semester long project in association with the Atlanta Botanical Gardens to help explore the microbiomes of orchids. In this lab students have the opportunity to visit the site and develop their own research question based around the microbiome project. Our learning objectives for this course are:

- Interpret and summarize primary biological literature.

- Work with a Community Partner to create testable scientific hypotheses regarding real world scientific issues.

- Work in groups to design experiments and gather data to test their hypothesis.

- Apply qualitative and quantitative methods including basic statistics and visualizations to their data to evaluate their hypotheses.

- Communicate their research findings in both written and short presentation formats.

- Acquire basic biological laboratory and ecological sampling techniques.

To assess these learning goals students write research proposals, short reflections, annotated bibliographies, and a final lab report that is scaffolded, with different parts of the lab report being written throughout the semester. Finally, our students present their findings to the Atlanta Botanical Gardens, our SLS affiliated partner.

**Biology 1511 Innovation**

Over the course of late 2018 and early 2019 I developed a new Course-Based Undergraduate Research Experience (CURE) in this Serve Learn Sustain (SLS) affiliated course. Working with Dr. Emily Coffey, the Vice President of Conservation and Research at the Atlanta Botanical Gardens (ABG), we designed this project to have students study the differences in microbiome communities in the soil around wild *Platanthera integrilabia* (white fringeless orchid) and those grown in the greenhouse at the Botanical Gardens. *P. integrilabia* is an endangered species of orchid that is native to this area of Georgia. The Gardens are involved in micropropigating this species in the lab and then ultimately replanting them in the wild. However, the success rates for these plants once they are back in the wild are extremely low (20-40% success rate) and achieving higher success rates is vital in further conservation efforts for this and other endangered orchid species.

In an attempt to understand one variable that could be influencing success rates, our students carry out this semester long CURE. They go through the process of creating a background proposal, extracting DNA from soil samples, amplifying the gene of interest using PCR, and finally analyzing sequencing data to do comparisons of wild and greenhouse soil. Students then get to present their research findings at the ABG in front of experts in the field of conservation research. Students have shown an extremely positive response to this project and truly value the chance to do real research and utilize the expertise from the ABG. This project and partnership will continue in the future with our students looking at other species of orchids in addition to *P. integrilabia*.

**Course Summary Biology 1521 Lab**

Biology 1521 is the second lab in the intro sequence for biology majors. Like Biology 1511, Biology 1521 is a CURE and SLS affiliated course. In this lab students build on the ideas presented in the first course in the sequence and look at a project studying ecotoxicology in Piedmont Park. Students utilize two model organisms *Brachionus calyciflorus* (Rotifers) and *Brassica rapa* (Wisconsin Fast Plants) to study the toxicology of different environmental exposures that may occur at Piedmont Park. Our learning objectives for this course are the same as those in 1511:

- Interpret and summarize primary biological literature.

- Work with a Community Partner to create testable scientific hypotheses regarding real world scientific issues.

- Work in groups to design experiments and gather data to test their hypothesis.

- Apply qualitative and quantitative methods including basic statistics and visualizations to their data to evaluate their hypotheses.

- Communicate their research findings in both written and short presentation formats.

- Acquire basic biological laboratory and ecological sampling techniques.

To assess these learning goals students write research proposals, short reflections, annotated bibliographies, and a final lab report that is scaffolded with different parts of the lab report being written throughout the semester. Finally, our students present their findings to the Piedmont Park Conservancy, our SLS affiliated partner. By the end of this semester our students are more capable and confident in these learning objectives than they were in Biology 1511.

**Biology 1521 Innovation**

Over the course of my first two years at Georgia Tech we developed this CURE for Biology 1521 to help expand upon the ideas students are first exposed to in Biology 1511 lab. While 1511 lab does a good job of introducing students to how to ask a research question and formulate a hypothesis, the potential questions they can look at are constrained by the technical nature of the project. We have developed Biology 1521 lab to allow the students more freedom in how they conduct their projects and what their specific question is. Students pick one of two model systems (Fast Plants or rotifers) and decide what variable they want to study. Students then measure the toxicology of various chemicals and pollutants that affect Piedmont Park through experimental techniques that they research themselves. This freedom and flexibility give students an even greater sense of agency over their projects.

This project also allows students to repeat their experiments multiple times throughout the course of the semester while making incremental changes to obtain better results. This iteration is a critical part of the scientific process and can help students to increase their understanding and ownership of a project[6]. We also challenge students to relate their research back to larger ecological issues of the park, as well as how urban ecosystems function in cities like Atlanta. By adding levels of iteration and larger scale scientific connections we build upon the students' foundations of the understanding of science.

**Education Research in Biology 1511 and 1521**

One of the downsides of research based labs is being able to quickly and efficiently evaluate students for the learning outcomes in courses. While lab reports, presentations, and other types of writing can be enlightening in assessing student learning gains, they are time consuming and sometimes can miss the finer details. To help with the assessment of learning outcomes related to experimental design, Dr. Megan Cole (Emory University) and I have developed a card sorting task for students that would allow us to identify whether or not they are developing expert-like thinking in their biology labs (IRB: H19330). We are currently in the process of assessing the card sorting task and early results show promise for differentiating between novice-like thinking and expert-like thinking in our students.

**Serve Learn Sustain in 1511 and 1521**

Both Biology 1511 and 1521 are Serve Learn Sustain (SLS) affiliated courses that leverage partnerships in the community to help benefit student learning, while providing valuable assistance to our community partners. Our partnerships with the Atlanta Botanical Garden and Piedmont Park Conservancy have been extremely beneficial in this regard as both parties have derived significant value from the partnerships. Maintaining these partnerships is a constant balance of making sure that student learning is prioritized while simultaneously providing a useful benefit to our community partners. We feel we have achieved an appropriate balance in this regard. I have also attended several SLS workshops and hope to continue to be involved with the SLS program moving forward.

Having students gain experience by going out in the community has been valuable on multiple levels. One of the biggest benefits is observing science's impact on the community around us. The perception of science as something done in a lab with no engagement with non-scientists in the community is prevalent and this effort can help students realize how vital science is to the communities it serves. Students also get access to experts from our community partners in areas that they may not have been exposed to previously. This helps provide keen scientific insights, but also examples of the types of roles scientists can have in the community. The students get to see their work put into practice as well, as the data that we provide for our community partners helps them make changes in practices to better improve their projects. The research we performed on orchid microbiomes is currently being analyzed further by ABG scientists to see if there are ways in which we can incorporate the students' findings into practice when planting the orchids in the wild. This is just one example of how this partnership is positive for our community partners.

**CIOS/Student Feedback**

Student feedback on CIOS surveys was generally positive for all labs and many of the student comments highlighted how the structure of the course helped them succeed. Several students, across all labs, commented on how scaffolding the writing assignments helped them organize information without being overwhelmed. Students also commented on how they enjoyed being able to ask their own questions and go through the scientific process. Students who participated in the SLS courses had incredibly positive things to say about the interaction with our SLS partners. Provided below are some sample student comments that highlight these opinions:

"The best thing [about this course] was the way the course taught students how to write a lab report. We started with just data crunching. Then an abstract. Then an abstract and methods. Then an abstract, methods, and results. Etc. Etc. Then we practiced writing full lab reports. It was a great way to allow students to practice their lab report writing skills since many of us didn't know how to going into this course"

"This was a great first introductory lab. I was able to learn how to effectively break down a complex scientific article. I liked how we were given the freedom to come up with our own hypothesis and collect our own data."

"Conducting our own research topic made us take pride/ownership of our work."

"The real-life connections and partnership with the Atlanta Botanical Garden makes the course really engaging and interesting. The step by step process is extremely helpful in learning every aspect of the research process."

**Teaching Assistant Training**

Not only have changes been made to the student facing side of the labs, but I have made several important changes to the way teaching assistants are trained in weekly TA prep sessions. To make sure that the in lab innovations have a positive effect it is important for the TAs to have a strong background in ways to navigate an inquiry based lab. In addition to their CETL training, TAs that teach in my labs get extra pedagogical information on how best to incorporate scientifically studied methods into their teaching style.

TAs also receive more in depth diversity and equity training through exposure to activities dealing with a variety of topics, ranging from issues of what resources students have available to unconscious bias. This is especially important in settings where students are going to be doing extensive group work as this type of structure can lead to some students being excluded from the full experience. By being exposed to this information TAs should be better prepared to ensure that everyone is learning in the labs no matter their background with science or biology.

**Intro Biology Labs in the Future**

While all of these innovations have had a strong positive effect on student engagement in science, more can be done. In Biology 1510 and 1520 the research into science identity will hopefully yield some important insights into student thoughts and attitudes as it relates to the process of science. We will continue to innovate by connecting these labs to real-world problems and examples. Ultimately, because of the success of the Biology 1511 and 1521 labs, I hope to incorporate SLS and CURE initiatives into 1510 and 1520 lab so that all intro biology students can get an authentic research experience regardless of major[7]. I am currently in the process of exploring ways in which to expand the scope of our more popular and scientifically beneficial labs so that they have a stronger research component to them. One potential idea involves expanding our RNAi studies so that we can look at how genetic changes can affect muscle structure and function on the molecular level. Another possibility would be partnering with a nationwide CURE like HHMI's Science Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science (SEA-PHAGES) program to incorporate aspects of these experiments into our non-majors courses.

As was stated in the intro summary, my goal is to ensure that every student who participates in one of the intro bio courses receives as many tools as possible to be an engaged citizen scientist in their interactions with society. I believe that the changes that have been made to the intro lab curriculum have helped support these goals and students who have completed the course have a greater understanding for the way biology impacts their lives directly.

**References**


1. Hanauer DI, Graham MJ, Hatfull GF. A Measure of College Student Persistence in the Sciences (PITS). CBE Life Sci Education. Winter 2016;15(4).
2. Gormally C, Brickman P, Hallar B, Armstrong N. Effects of Inquiry-based Learning on Students' Science Literacy Skills and Confidence. International Journal for Scholarship of Teaching and Learning. Vol 3:No 2.
3. Trujillo G and Tanner KD. Considering the Role of Affect in Learning:Monitoring Students' Self-Efficacy, Sense of Belonging, and Science Identity. CBE Life Sci Education. Spring 2014;13(6)
4. Estrada M, Burnett M, Campbell AG, Campbell PB, Denetclaw WF, Gutiérrez CG, Hurtado S, John GH, Matsui J, McGee R, Okpodu CM, Robinson TJ, Summers MF, Werner-Washburne M, Zavala M. Improving Underrepresented Minority Student Persistence in STEM. CBE Life Sci Education. 2016 fall;15(3)

5. Seidel SB, Tanner KD. “What if students revolt?”—Considering Student Resistance: Origins, Options, and Opportunities for Investigation. CBE Life Sci Educ. 2013 Winter; 12(4)
6. Auchincloss LC, Laursen SL, Branchaw JL, Eagan K, Graham M, Hanauer DI, Lawrie G, McLinn CM, Pelaez N, Rowland S, Towns M, Trautmann NM, Varma-Nelson P, Weston TJ, Dolan EL. Assessment of course-based undergraduate research experiences: a meeting report. CBE Life Sci Educ. 2014 Spring;13(1)
7. Ballen CJ, Blum JE, Brownell S, Hebert S, Hewlett J, Klein JR, McDonald EA, Monti DL, Nold SC, Slemmons KE, Soneral PAG, Cotner S. A Call to Develop Course-Based Undergraduate Research Experiences (CUREs) for Nonmajors Courses. CBE Life Sci Educ. 2017 Summer;16(2)

**School of Biological Sciences**
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PHONE 404 894 3700
FAX 404 894 0519

28 February 2020

Dear Teaching Awards Selection Committee,

I am delighted to nominate my colleague, Dr. Colin Harrison, Academic Professional in the School of Biological Sciences (SoBS), for the Innovation and Excellence in Laboratory Instruction Award. I have had the pleasure of working with him as a co-instructor and undergraduate committee member, and I believe in his potential to truly innovate in our undergraduate lab curriculum.

Dr. Harrison and I have been allies since we started 3 years ago in pushing for the learning objectives of our courses to better align with the activities and assessments of student learning. In particular, he has additional challenges in that the laboratory sections function semi-independently of the lecture components. This means that the content and general learning objectives of the course are often fixed, yet the laboratory objectives are free to design. Through a slow-and-steady approach, Dr. Harrison has better aligned the current labs with the course objectives, while refining the lab objectives to create a more cohesive approach to true scientific inquiry. Additionally, Dr. Harrison is not afraid to keep what works, and change elements that do not—even in the bigger aspects of courses. He has continued working, semester-long partnerships with Atlanta area community partners (a tough feat, as leadership turn-over is common), while tweaking experiments to better meet the changing needs of partners. For example, in his partnership with Atlanta Botanical Gardens (ABG), his students in BIOL1511 have meaningfully contributed to the orchid microbiome work that the garden is doing by integrating their research aims into the student's work. I am pleased to say that the work he has students have meaningfully impacted ABG's work, and the students, in much more than a superficial way.

In the same vein, Dr. Harrison is trying out new labs which are aimed at pointed failures of the past curriculum in order to improve. In particular, he has worked to revise the laboratory manuals to promote relevancy of experiments and diversity of scientists working in these fields. This helps to provide meaningful context, particularly for the non-majors in our large, required courses.

Luckily, Dr. Harrison is also engaged in research in the Scholarship of Teaching and Learning (SoTL). This means that I don't have to take his word for it that improvements happened as a result of these changes; he will be able to show me the data! I really appreciate approaches which look to systematically assess the outcomes of curricular change, and his Science Identities project plays right into demonstrating whether the laboratory activities spark lifelong learning and trust in science, in addition to retaining more of our students.

In short: Dr. Harrison is a colleague who is striving to steer a set of large introductory courses toward inquiry-based learning through more engaging experiments aligned with course goals.

Sincerely,

Emily G. Weigel, PhD

Academic Professional (Teaching Faculty and Advisor)
Georgia Tech School of Biological Sciences

Dear Innovation and Excellence in Laboratory Awards Committee:

I am writing this letter in full support of Dr. Colin Harrison for Innovation and Excellence in Laboratory Instruction Award. I had the opportunity to get to know Dr. Harrison in 2019 when he reached out to me regarding potential collaboration with the Atlanta Botanical Garden. I was very keen to develop a partnership with Dr. Harrison and his students. It was during these initial interactions I was first aware of the deep interest in the students and their learning that Dr. Harrison posed. He is truly an exceptional instructor who is truly concerned about the learning experiences of his students. He is always looking for innovative and novel ways to reach the students while providing meaningful learning experiences and academic excellence in the laboratory setting.

I highly admire Dr. Harrisons teaching style and abilities. He provides a learning environment where students can thrive and are able to take the full advantage of his impressive background in innovative research and education. Teachers deliver instruction and students learn. However, to encounter a teacher that has the 'gift' of teaching, that ability to light up the classroom with inspiration, that is rare. Dr. Harrison is one of those rare teachers who truly inspire.

I have seen the energy and motivation Dr. Harrison brings to his classroom and know that he constantly works to improve his teaching skills. The culture of learning established within his classrooms sets clearly-defined expectations for all students, providing each student a chance to succeed while pushing students to greatness.

Considering Dr. Harrisons performance at Georgia Institute of Technology teaching, conducting research, and providing service, I strongly support his nomination. My judgment is based on Dr. Harrisons excellence as an instructor, curriculum designer, and innovative laboratory development.

Yours sincerely,

Emily Coffey, Ph.D.
Vice President of Conservation and
Research Atlanta Botanical Garden

Georgia Institute of
Technology Adjunct
Professor – Biology

Emory University
Adjunct Professor – Department of Environmental Sciences

To Whom It May Concern:

I would like to enthusiastically express my support for the nomination of Dr. Harrison in Innovation and Excellence in Laboratory Instruction. During my time at Tech, Dr. Harrison facilitated my participation in the laboratory courses for BIOS 1510 and BIOS 1521. Dr. Harrison's structure of these courses provided insight to the scientific method and basic biological principles that I have been beneficial in my higher-level biology courses since. Additionally, as a biology lab TA for the 1510 course this year, Dr. Harrison provided in-depth collaboration and thought-provoking discussion during our TA prep meetings. These beneficial problem-solving and brainstorming sessions served as an exceptional environment for growth as both a student and an instructor. Dr. Harrison is an enthusiastic instructor and supportive mentor to all students and is deserving of this award.

My first laboratory course at Georgia Tech (BIOS 1510) was my first introduction to biology in college and influenced my decision to switch into the major afterwards. Through lab, my skills in both technical and teamwork increased through the facilitation of the laboratory structure. Each two weeks were dedicated to inquiry-based learning, where students were able to adapt hypotheses and experimental methods to cater to specific questions they had about the area of study (e.g. genetics, evolution, etc.). This allowed me to see science as a conduit to asking thoughtful questions and being able to successfully determine correlations from data collected thereafter.

As a biology lab TA during the Fall semester of 2019, I saw the flipped effects of the inquiry-based approach that had monumental impact on me. Through the experiences in the lab space, students certainly grew in their understanding of basic biological principles and the scientific method. Students were also prompted to build upon each layer of a lab report, starting with basics such an abstract and methods, until eventually they included more thorough sections on discussion and results. This approach allowed students to build confidence and expertise in the scientific method. Having a solid foundation in this helped me gain leverage in laboratory courses of all sciences and my lab space as an undergraduate researcher.

Dr. Harrison served as the key player in this by providing us with bountiful resources, whether it be as a teaching assistant or student, to learn important laboratory technical and problem-solving skills. This collaborative environment supported my growth as a mentor and truly made for an enjoyable experience.

In the spring semester, I took a laboratory course, BIOS 1521 (Honors Organismal Biology) that was different in structure with a semester long project versus a series of smaller experiments. This allowed students to gain feedback throughout the entirety of the semester on one specific goal they were working towards. I appreciated this because it allowed my lab team to continually build and improve on proposing and executing a full-blown project in conjunction with Piedmont Park. Dr. Harrison caters these lab spaces to the students directly with the distinction between an honors and unmodified lab course. Both experiences were valuable and shaped my experiences in experimental learning. Each semester, Dr. Harrison collects data at the beginning and end of these courses to further refine them showing his support and dedication to student learning.

Dr. Harrison was a very active instructor to students, coming to the presentations and giving constructive feedback on areas of improvement. He cares about student success and is always friendly and approachable if there are ever any concerns or questions. Dr. Harrison knows how to handle complex situations whether that was in my capacity as a teaching assistant or a student, such as student struggles or hydrogen peroxide spills. Through troubleshooting and student input, he works to brainstorm new experiments that

will excite and engage student learning. This kind of personalized and inquiry-based learning allowed my lab groups and the ones that I taught to work towards a common goal and enjoying their time doing so.

Dr. Harrison has been a support and one of my favorite professors during my time at Georgia Tech and is a wonderful role model in the School of Biology. His lab shaped my college experience and is the reason I am on the pathway to becoming a physician's assistant. He created an exceptional space for student growth and would be an excellent candidate for this award.

Sincerely,

Kseniya Spikina

School of Biological Sciences

Georgia Institute of Technology

Atlanta, GA 30332-0360

February 20, 2020

I am pleased to write a recommendation for the 2020 Innovation and Excellence in Laboratory Instruction Award in support of Dr. Colin Harrison. I am a first year Biology major in the School of Biology Sciences at Georgia Tech and have had the pleasure of taking laboratory under the instruction of Dr. Harrison during the Fall of 2019 in Honors Introduction to Biology as well as the Spring of 2020 (this semester) in Honors Organismal Biology. I am currently working with him for undergraduate research as well on analyzing the biological knowledge of novices and experts utilizing a card sorting task. Through these experiences, I have observed his passion for laboratory teaching and devotion to making lab enjoyable and valuable for students.

During his time as a laboratory instructor, Dr. Harrison has made several impactful changes to the way the courses are taught at Georgia Tech with the purpose of improving the overall student experience. In the Introduction to Biological Principles laboratory course, he limits project choice to prevent students from feeling too overwhelmed about developing a research idea on their own, but avoids being too restrictive by allowing students to approach their background literature freely in support of their research design. His careful consideration of the mindset and sentiment of the students allows for the successful modification of courses to reflect effective learning strategies.

In my personal experience with this laboratory course last fall, Dr. Harrison gave groups of students the opportunity to directly apply results from their DNA isolation and PCR purification experiments in contributing to the research at the Atlanta Botanical Gardens. Through the analysis of various bacterial species, we were collectively able to discover the cause for their orchids' inability to grow in in-situ environments, contributing to an overall beneficial impact on the community. I do not ever recall in my previous experiences with other labs or projects the opportunity to apply experimental results to a noble cause like we did in this course. Dr. Harrison carefully guided us through the process of project development, often paying individual lab sections special visits and directing questions at us during practice presentations throughout the semester. He knew exactly how to balance constructive criticism and encouragement by questioning our research designs, reinforcing key objectives, and constantly communicating his compliments on our progress. He helped us feel comfortable in the laboratory environment and made himself readily available for any questions we had.

For my current laboratory in Organismal Biology, Dr. Harrison coordinated a more unique approach to his instruction by allowing groups of students to design and implement their own experiments to determine the toxicology of environmental exposures in Piedmont Park. His purpose was to build on the ideas from the introductory course, while also giving students an avenue of free expression to test their own ideas, research questions, and hypotheses. I have personally observed a heightened level of motivation and enthusiasm from the students, as these courses deviate from the traditional laboratory tendency to follow a standardized procedure that leaves no room for student input or modification.

The ability to individually go through the scientific method and design our own experiments allow us to take pride and ownership of our projects. We are also given the opportunity to relate our research results to notable community issues, both physically and ecologically. These aspects of Dr. Harrison's labs have demonstrated the established scientific connections built upon student foundations of scientific understanding, and his courses have evidently helped students succeed and think about science in an innovative light.

I have been given the opportunity to work alongside Dr. Harrison on his current research project on evaluating the learning outcomes of students in his laboratory courses. We analyze how students organize their biological knowledge utilizing a card sorting task and have pooled from students within the lab sections in our current semester's Honors Organismal Biology course. His desire to quantify student learning, measure the development of expert-like thinking, and determine whether they are learning biology in an innovative way affirms his passion within his deepest roots to establish the most effective strategies in laboratory teaching.

Furthermore, Dr. Harrison has a clear vision of a thriving future for biology laboratory design at Georgia Tech. His goals include continuing to innovate and connect labs to real-world problems, giving students access to authentic research opportunities regardless of major, brainstorming ideas to develop a beneficial experience for students, and providing a thorough understanding of the way biology impacts our lives. Dr. Harrison's teaching methods have clearly demonstrated his desire to help students learn important laboratory skills and truly experience what it's like to be a scientist in the field. He emits positive energy with a beaming smile on his face and embodies a constant enthusiasm to teach. There is no doubt that he has influenced countless students' perspectives on science to carry throughout their college careers.

Dr. Harrison has not only contributed to the ongoing development of effective biology laboratory instruction for students, but also has exceeded beyond the expectations of laboratory teaching in the classroom. He has significantly changed the structure of the biology laboratories at our institution and organized them so that the skills the students learn prepare them for real-life applications and perspectives of science. It is with appreciable confidence that I provide my deepest recommendation in support of Dr. Colin Harrison for the 2020 Innovation and Excellence in Laboratory Instruction Award.

Sincerely,

Hannah Shin

Cristian Crisan
School of Biological Sciences
Georgia Institute of Technology

To the selection committee:

My name is Cristian Crisan and I am a PhD student in the School of Biological Sciences at Georgia Tech. I have been a teaching assistant for multiple classes, including introductory biology labs, upper level biology labs and lectures.

I am delighted to write a nomination letter for Dr. Harrison, who has been my teaching assistant supervisor during the Spring 2019, Fall 2019 and current Spring 2020 semesters. Dr. Harrison's passion for teaching is evident and his dedication to creating an environment that stimulates students to learn is inspiring. As a teaching assistant, I feel I learned a lot from his methods and approach in dealing with diverse student situations. Dr. Harrison goes well above and beyond to ensure students are getting the best learning experience. He is very helpful when explaining to his TAs about the expectations of each lab. Aside from being knowledgeable in the subject, Dr. Harrison is also highly skilled at explaining material.

In my experience as a teaching assistant at Georgia Tech, I strongly believe that Dr. Harrison is a unique example of dedication for his desire to improve teaching methods. On multiple occasions, he conducted research surveys during labs with the purpose of creating better-tailored experiences for students. His continuous assessment and willingness to adapt based on feedback from students and teaching assistants is exemplary.

During my first year as a PhD student at Georgia Tech, I was assigned to teach BIOL1510 lab, an introductory biology laboratory course. I found the course to be interesting, but noticed students had difficulty when performing experiments involving the genetic manipulation of *Caenorhabditis elegans* worms. Those technical difficulties interfered with their ability to understand concepts. At that time, Dr. Harrison was not the instructor for the lab. I again became the teaching instructor for the same lab, about 3 years later. In the meantime, Dr. Harrison evaluated that specific problematic experiment and replaced it with one that he designed. I was very pleasantly surprised to discover that

not only was the new experiment more interesting for students, but it allowed them to more easily obtain reproducible results. I strongly believe that the change implemented by Dr. Harrison made the BIOL1510 lab a vastly more beneficial experience for undergraduate students who were able to focus on understanding concepts and designing their experiments.

Throughout my entire time as a teaching assistant with Dr. Harrison, I have been consistently surprised by his drive to show students how science really works. My own biology undergraduate lab experiences have been quite bland. While I learned basic techniques and was exposed to some concepts, I never felt I was doing real science. However, Dr. Harrison creates projects in which students are actively encouraged to think critically and are motivated because their work has the potential to make a real-word impact. During the Fall 2019 semester, I was the teaching assistant for the BIOL1511 Honors lab. Throughout the semester, students were involved in a project in collaboration with the Atlanta Botanical Garden to solve a scientific problem related to the conservation of orchids. Not only did students learn new essential biology techniques such as DNA isolation, polymerase chain reaction and gel electrophoresis, but they were also exposed to bioinformatics data analysis and interpretation. At the end of the semester, students presented their work to the Atlanta Botanical Garden research staff. I thought all students were very proud of their work and most found this unique semester-long research experience a great opportunity.

In conclusion, I would sincerely recommend Dr. Colin Harrison for the Innovation and Excellence in Laboratory Instruction Award. His commitment to students, his attention to detail and determination to improve the teaching environment make him a truly unique instructor. I strongly feel I learned important lessons for my future career. If I will fulfill my career goal to become an instructor myself, I will undoubtedly use Dr. Harrison as an example to emulate. Please do not hesitate to contact me if you have any other questions.

Sincerely,

Cristian Crisan

I am writing to recommend Dr. Colin Harrison for the Innovation and Excellence in Lab Instruction award. I have been a teaching assistant for Dr. Harrison's Biology 1511 and 1521 courses for two semesters. He is very deserving of this opportunity as he has synthesized several semester long projects and introduced students to real world scientific issues.

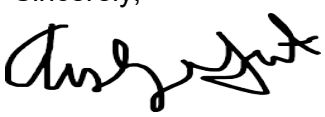
In Dr. Harrison's Biology 1511 and 1521 courses, students establish collaborations with the Atlanta Botanical Garden and Piedmont Park Conservancy. In Biology 1511 students partner with Dr. Emily Coffey at Atlanta Botanical Garden and conduct a research project that studies the difference in microbiomes in greenhouse grown versus wild plants, in hopes of improving plant sustainability. In Biology 1521 students are expected to conduct an ecotoxicology related project. In this particular study students use two model organisms, rotifers and Wisconsin fast plants, to explore the toxicology of environmental exposures that may occur at Piedmont Park. Through these inquiry-based experiments designed by Dr. Harrison students learn to answer complex questions, apply qualitative and quantitative methods, efficiently communicate their findings, and ultimately establish their scientific identity.

At the conclusion of each semester Dr. Harrison has his students present their findings through an oral presentation. After the presentation is completed, the students are asked questions and expected to deliver a strong response. Dr. Harrison challenges his students to think critically which is one of the main characteristics that I value about his teaching. He strives for his students to receive proper training so they can become successful contributors of science.

It is amazing to see the students grow over the course of the semester. During the first week of class the students complete an in class-activity that focuses on what science means to them and how they were first introduced to the field. At the beginning of the semester students are not certain about their future, whether they have plans to attend medical school or graduate school. Some students unsure if biology is the correct field them. By the end of the semester students have a refined idea of what they plan to do after their undergraduate career. I've had a few students meet with Dr. Harrison and I to acquire information on joining a research lab and how to successfully apply to graduate school. The design of Dr. Harrison's course is what fuels their scientific pursuit. Students leave the course feeling motivated and positive about their place in science.

Dr. Harrison has been a wonderful professor to work with. I interact with him on a weekly basis, he is very comfortable to talk to and he gives the best advice. Not only does he converse with me about my teaching experiences, but he also cares to know me on a personal level. I am appreciative of how he advocates for the academic well-being of both undergraduate and graduate students. His advocacy demonstrates his passion for his career. Dr. Harrison is an outstanding candidate for this award and I believe he defines "Innovation and Excellence."

Sincerely,



PhD Student, School of Biological Sciences