

## 2. Executive Summary

We are now in the “Century of Biology”, where seven out of the top ten of the “Best Jobs in 2021” are in the biosciences - as well as more than half of the top fifty jobs. Increasing the STEM workforce is a national initiative that encompasses the call to increase enrollment and success of underrepresented students pursuing STEM majors. North Carolina was reported to have the best business climate in the nation and is among the top locations for Biomanufacturing in the world. The Department of Biological Sciences is positioning itself as a leader in the preparation of skilled graduates to join this rapidly expanding industry by broadening its course offerings and providing our students with real-world learning opportunities and hands-on training in biomanufacturing. In addition, the department will continue to provide a pipeline for students to join and excel in the pharmaceutical industries, healthcare workforce, and environmental and ecological careers. Considering these facts, it is perhaps not surprising that Pre-Biology and Biology comprise the largest undergraduate major in CLAS, as well as one of the top 3 majors at UNC Charlotte.

The Department of Biological Sciences seeks to address the problem of intergenerational poverty and social mobility within the Charlotte region and the nation by increasing outreach to economically challenged and Title 1 schools. Providing students with early access to engaging STEM activities has been shown to increase interest in STEM majors and careers among students who are underrepresented in STEM. Moreover, providing underrepresented students with the skills necessary to compete in a highly technical job market promotes equity and social justice within the STEM field. Underrepresented students leave STEM majors at a higher rate than their peers. Further, the attrition rate of underrepresented students is higher in STEM than any other major (Riegle-Crumb et al., 2019). Students cite poor teaching (96%) as the primary reason they leave STEM majors (Seymour & Hunter, 2019).

For all of these reasons, effective teaching and training of diverse UNC Charlotte undergraduates in the Biological Sciences has never been more important than it is now. The Department of Biological Sciences has established itself as a regional and national leader in innovative teaching and training for biology majors at UNC Charlotte. The exemplary teaching practices implemented in the department are further evidenced by the data showing a steady increase in the retention of Black and Hispanic transfer students in the biology major, with retention nearly doubling since 2008. We aim to continue this trend in the future, and propose to further develop our initiatives as an R1 Area of Excellence by:

1. Developing and offering more student-centered and research-based courses, mentoring opportunities, and original research opportunities for undergraduate students.
2. Hiring a professional advisor and lab coordinator in the department to allow our faculty to dedicate additional time to developing novel courses, offering the research-based courses described above, and increasing our educational research activity.
3. Creating a pipeline of instructional and research opportunities for cohorts of students who are historically underrepresented in STEM (women, racial/ethnic minorities, first-generation college students, transfer students).
4. Increasing the number of educational grants and high-impact publications to continue to grow our programs and our regional and national profile as leaders and innovators in STEM education.

### 3. Evidence of Strength and Excellence

Faculty in the Department of Biological Sciences have innovated the scholarship of scientific teaching and undergraduate research, and lead UNC Charlotte, regional, and national initiatives to increase student belonging, equity, and success. An example of our national leadership in undergraduate teaching and research is evidenced by our success in the Student Experience Project (SEP), a national multi-university collaborative. Bates and Furr-Rogers presented their findings on social connectedness and belonging at the SEP Winter Convening, being highlighted as having the highest gains in measures of student belonging and social connectedness across all participating campuses, which include many R2 peer institutions in urban areas. Our teaching methods serve as a model for the other institutions, and can be replicated across disciplines here at UNC Charlotte and across the country. To that end, we have designed programs that can be scaled from the university level to regional and national, with experts at all levels. For example, the UNC Charlotte Transforming STEM Teaching and Learning Academy is co-lead by Bates, with multiple cross-campus faculty participants. We also have faculty leaders in the UNC System Digital Learning Initiative, including course collection developers and technology adopters (Somayaji, Harris, Furr-Rogers). Our HHMI Science Education Alliance SEA-PHAGES Faculty are trained to bring innovative course-based research to our campus (Bates, Bullock, Pass, Wisner). Many faculty have attended the National Academies Summer Institute on Scientific Teaching (Bates, Bullock, Chi, Pass, Schneider, Warner, Wisner), with Warner being named the National Academies Education Mentor in the Life Sciences. We have brought our expertise from the national and regional levels to various leadership roles at UNC Charlotte, including the Active Learning Academy, Teachers Observing Peers program, and the LEADS program.

The varied contributions of our faculty and students to teaching and research excellence is evident in the numerous awards and recognitions we have received. Our Department was awarded the Provost's Award for Excellence in Teaching in 2018 in recognition of our collective high-quality teaching and collaborative efforts to improve student learning and outcomes. Selected examples of recent individual awards include: UNC Charlotte Award for Teaching Excellence (Bates), Integration of Undergraduate Teaching and Research Award (Marriott, Dreau), Bank of America Award for Teaching Excellence (Schneider), UNC Board of Governors Award for Excellence in Teaching (Schneider), CLAS Award for Outstanding Teaching by a Full-Time Lecturer (Bates), Outstanding Faculty Award from Multicultural Academic Services (Dreau), and the UNC Charlotte Valoria B. Burch Award for Curriculum Innovation in Alternative Education (Pass).

Our faculty and doctoral students are highly successful in obtaining internal and external educational grant funding, with partnerships within the department and across colleges. Several of our grants promote equity and inclusion for underrepresented students and enable successful transfer of students from regional community colleges to UNC Charlotte. The total funding for these recent projects is ~\$7,000,000. In 2020, Furr-Rogers and Bates were awarded a CTL Scholarship of Teaching and Learning (SOTL) grant with collaborators across three colleges, and three faculty members (Bates, Furr-Rogers & Wisner) received Scholarship of Assessment Grants. Reitzel received a VWR Foundation Award to expand educational programs at a local science museum. In 2018, Wells and Pass were recipients of a CTL SOTL grant, and Furr-Rogers was awarded a Faculty Adoption Grant from NC LIVE's Open Education North Carolina. Schnieder and Stearns were awarded a NSF SPARC4 grant to promote the transfer of STEM students from local community colleges to UNC Charlotte. Richardson and Bullock were

awarded a grant from the NSF REU Program: Biology and Biotechnology, to promote mentored research experiences for URM students (2014-2018). Richardson has also been awarded a NIH Bridges to Baccalaureate grant that enables URM and financially disadvantaged STEM transfer students to perform mentored research and increase student success (2018-2024). Chi was awarded a NSF EAGER: MAKER award entitled “Making Prosthetics for Kids - Socially Relevant Making to Catalyze Diversity and Engagement in STEM Learning” (2017-2021).

Our faculty present about inclusive excellence, scientific teaching, and educational research at local, regional, national, and international conferences. While our outstanding teaching, innovative ideas, and student successes are consistently highlighted in these presentations, they are also featured in many media publications. Our pedagogical successes and grants have been covered in local and national news, and faculty have shared their expertise in international television shows, podcasts, and radio segments. Many presentations and publications are co-authored with undergraduate students. Selected publications include: *American Biology Teacher* (Wells); *Urban Education* (Pass), *J Microbiol Biol Educ* (Chi); and open-access platforms like Quantitative Undergraduate Biology Education and Synthesis (Wisner). Selected book chapters include topics such as active learning across disciplines (Bates), strengthening STEM identities in Black students (Pass), and applying principles of social justice in the classroom (Pass).

Our department has a strong and successful undergraduate research program. Beginning in our teaching labs, students design and conduct a research project. Student research is encouraged at every level, with innovative course-based research experiences added to our curriculum and planned for future semesters. The SEA-PHAGES program is part of a national network and is designed to bring research experiences to students who may not be eligible for traditional research programs. Research opportunities also include individualized research and internships. Finally, the Honors in Biological Sciences is a highly sought-after and modeled program that enrolls outstanding biology students, pairing them with faculty mentors to develop original research projects. 90% of our current Honors students are female, ethnic minorities, or transfer students. The success of the Honors program is shown by the many awards received by students, number of presentations made at national and international meetings (5-10/yr) and the number of peer-reviewed student publications. (2-4/yr).

Our department is heavily involved in service learning and community outreach. Students volunteer and intern for local and regional organizations like Charlotte Stormwater Services, Carolina Waterfowl Rescue, the NC Research Campus, Wake Forest Primate Center, and Discovery Place. Selected outreach includes partnering with the Center for STEM Education to co-facilitate AP Biology Teachers Workshop, and developing Biotechnology workshops for K-12 teachers and summer camps for underrepresented middle and high school students.

To further elevate our commitment to the scholarship of scientific teaching and undergraduate research at the national level, resources would be used to develop and offer more original research and course-based research opportunities. We would like to create a pipeline of instructional and research opportunities for cohorts of underrepresented students (transfer students, women, racial/ethnic minorities - underrepresented in STEM). We can recruit from student organizations such as Black Students in Science, Society for Advancement of Chicanos/Hispanics and Native Americans in Science, and Minority Association of Pre-Medical Students. The addition of a professional advisor and lab coordinator in the department would allow our faculty to dedicate their time to developing new courses, offering the research-based courses described above, and significantly increasing our educational research activity and publications.

#### 4. Alignment with Regional and National Priorities

The co-leads share UNC Charlotte's commitment to addressing the needs of the greater Charlotte region. The Department supports the University mission in providing hands-on learning opportunities to students that will "enhance students' personal and professional growth." The courses we offer, clubs we mentor, and our involvement in community outreach all provide experiential learning that promotes diverse and equitable learning environments. Warner is the faculty director of the LEADs program which is heavily focused on providing access to all students, and especially underrepresented groups, for experiential learning. This program offers a certificate in leadership, innovation, technology, and diversity, with course-based internships at community locations such as Discovery Place, Mecklenburg County Park and Recreation, and Heineman Robicsek Medical Outreach. Along those lines, our Department has a strong record of initiating and supporting STEM education in the greater Charlotte community. Bates and Pass serve on the university committee that plans the Science Expo, the signature event of the North Carolina Science Festival. This is a large-scale event where faculty communicate their research to the public. In addition, Pass has created STEM outreach opportunities to regional Title 1 schools.

Equity and inclusivity in STEM education are national priorities. We have each committed to university initiatives on promoting these pressing matters in our classes and within our department. Lopez-Duarte and Pass are currently co-chairs of the newly formed Diversity, Equity and Inclusion committee. Parrow is the CLAS representative in the university-wide Student Equity Audit working group. Evidence shows that we have generated an infrastructure to make learning accessible and we are disseminating this knowledge across campus and to institutions across the country. Some specific involvements include Bates' as co-lead of the Transforming STEM Academy, an initiative that promotes evidence-based teaching practices on campus. Pass, Bates and Furr-Rogers serve as mentors in the Student Experience Project. As mentors, they provide resources and support to faculty participants in equitable teaching practices that promote a sense of belonging and social connectedness among all students.

Our investment in underrepresented students has already impacted our students; for example, 90% of our current Honors students are female, ethnic minorities, or transfer students. Our plans to develop and implement mentoring and research opportunities for students who are historically underrepresented in STEM, aligns with the NIH Minority Health and Health Disparities Strategic Plan by providing a diverse group of students with the skills necessary to transition into the biomedical workforce. Furthermore, The Institute of Education Sciences (IES) funds research that contributes to improved education outcomes for all learners, and particularly for those whose education prospects are hindered by inadequate education services and conditions associated with poverty, race/ethnicity, limited English proficiency, disability, and family circumstance. Our current research in the areas of curricula, instructional practices, and assessment aligns with the IES funding interests.

We have built a strong foundation for underrepresented groups and plan to use our highly successful and sought-after model of the Honors in the Biological Sciences program to expand our repertoire of opportunities with the support of this commission. As established leaders in our field, we will continue to align our priorities with the needs of the University, region, and nation. Our location, unique skill set, and commitment to equity in STEM education positions the Department of Biological Sciences to greatly expand our current recognition as innovators in scientific teaching and research for undergraduate students.

## 5. Supporting Documents

**Table 1. Contributors**

<b>Contributor</b>	<b>Title</b>	<b>Contribution and expertise of individual</b>
<b>Tonya C. Bates, M.S.</b>	Senior Lecturer; post Undergraduate Coordinator	<u>PKAL STEM Leadership trained; STEM education; Transforming STEM Faculty Fellow; evidence-based teaching; educational grants.</u> Courses taught include Principles of Biology I and II, Current topics in Biology, Microbiology, and SEA-PHAGES Bioinformatics.
Sharon Bullock, Ph.D.	Senior Lecturer; Biotechnology Minor Program Coordinator	<u>Biotechnology Coordinator; evidence-based teaching; educational grants; Minority Association of Pre-Medical Students Advisor.</u> Courses taught include Cell Biology, Histology, and SEA-PHAGES.
Tuan Cao, Ph.D.	Lecturer	<u>Participant; evidence-based teaching; Biology Club advisor.</u> Courses taught include General Biology, Evolution, Field Entomology, and Biology of Insects.
Richard Chi, Ph.D.	Assistant Professor	<u>Participant; evidence-based teaching; grants.</u> Courses taught include Cell Biology.
Didier Dreau, Ph.D	Professor; Undergraduate Honors Coordinator	<u>Biology Honors Program Coordinator.</u> Courses taught include Cell Physiology and Animal Physiology.
Farzana Ferdous, Ph.D.	Faculty Fellow	<u>Participant; science communication.</u> Courses taught include Principles of Biology lab, Human Anatomy, and Human Anatomy lab.
Kristen Funk, Ph.D.	Assistant Professor	<u>Participant; undergraduate research.</u>
<b>Samantha Furr-Rogers, Ph.D., MPH</b>	Lecturer	<u>Leadership; STEM education; evidence-based teaching; undergraduate research; Tri-Beta advisor; educational grants; science communication.</u> Courses taught include Principles of Biology, Human Anatomy and Physiology, General Biology, and Epidemics and Plagues.

Melanie Harris, M.S.	Senior Lecturer; Undergraduate Program Coordinator.	<u>Undergraduate Program Coordinator; evidence-based teaching.</u> Courses taught include Microbiology and General Biology.
M. Brittany Johnson, Ph.D.	Research Assistant Professor	<u>Participant; undergraduate research.</u> Courses taught include Microbiology and Research Ethics.
Aaron Kampe, M.S.	Lecturer	<u>Participant; Field Ecology Club advisor.</u> Courses taught include Ecology, Field Botany, General Biology, and Field Ecology.
Paola Lopez-Duarte, Ph.D.	Assistant Professor	<u>Participant; undergraduate research; Diversity, Equity, &amp; Inclusion Co-Chair.</u> Courses taught include Marine Ecology, Hypothesis Testing, and Invertebrate Biology.
Ian Marriott, Ph.D.	Professor; Vice Chair for Research	<u>Participant; undergraduate research.</u> Courses taught include Immunology and Advanced Immunology..
Matthew Parrow, Ph.D.	Associate Professor; Academic Vice Chair	<u>Associate Chair of DBS; evidence-based teaching.</u> Courses taught include Eukaryotic Microbiology for STEM underrepresented student pipeline, and Cell Biology.
<b>Michelle B. Pass, Ph.D.</b>	Senior Lecturer	<u>Leadership; STEM Education Research; educational grants; Undergraduate Laboratory Coordinator; Black Students in Science Advisor; Diversity, Equity &amp; Inclusion Co-Chair.</u> Courses taught include SEA-PHAGES.
Adam Reitzel, Ph.D.	Professor; Graduate Program Coordinator	<u>Leadership; Graduate Program Director; educational grants; LEADS program; AGEP-NC.</u> Courses taught include Evolution and Developmental Biology.
Christine Richardson, Ph.D.	Professor; Interim Department Chair	<u>Chair; oversight of program; educational grants.</u> Courses taught include Molecular Biology and Cell Biology.
Stan Schneider, Ph.D.	Professor	<u>Participant; educational grants.</u> Courses taught include Animal Behavior, General Zoology, and Parasitology.

Shankari Somayaji, Ph.D.	Lecturer	<u>Participant; evidence-based teaching.</u> Courses taught include Principles of Biology and Human Anatomy and Physiology.
Todd Steck, Ph.D.	Associate Professor	<u>Participant, Faculty Ombudsman.</u> Courses taught include Genetics and Bacterial Genetics.
Junya Tomida, Ph.D.	Assistant Professor	<u>Participant; undergraduate research.</u> Courses taught include Animal Physiology and Genome Stability and Human Disease.
Jennifer Warner, Ph.D.	Teaching Professor	<u>LEADS Coordinator; educational grants; experiential learning.</u> Courses taught include Microbiology and Senior Seminar.
Carrie Wells, Ph.D.	Lecturer	<u>Participant; educational grants.</u> Courses taught include Ecology, Conservation Biology, and Scientific Writing.
Ellen Wisner, Ph.D.	Lecturer	<u>Participant; educational grants; evidence-based teaching; active learning.</u> Courses taught include Ecology, Biology of Birds, SEA-PHAGES Bioinformatics, and General Biology.
Shan Yan, Ph.D.	Professor	<u>Participant; evidence-based teaching.</u> Courses taught include Developmental Biology and Cell Biology.