## **College of Sciences**

## 2022-23 Annual Report

## Overview

The College of Sciences is home to people and programs in the biological, mathematical and physical sciences at NC State. The 10-year-old college continues to be one of the largest and most research-intensive units at the university, with more than 4,100 students, 415 active research projects and \$43 million in annual research expenditures. The college seeks to provide an inclusive, world-class science education; catalyze scientific research and innovation that improve our world and our collective understanding; and invite everyone into our work as we become a local and global hub for open science. This annual report reflects the priorities in NC State's strategic plan and supported by our leadership.

## **Responsiveness to Universitywide Strategic Goals**

## 1. Empower students for a lifetime of success and impact.

Our Academic Affairs office continues to hold events to support students, which this year included a College Connections event at Wolfpack Welcome Week, at which first-year and sophomore students were invited to network with each other, student organizations, staff and faculty; and an Academic Affairs Open House, which helped introduce students to our staff.

Faculty in the college continue to play leading roles in Wicked Problems, Wolfpack Solutions, an interdisciplinary course experience for all incoming students that helps them prepare to make the most of their college careers. The summer 2022 course addressed the future of food.

A new study abroad program launched in summer 2023 after COVID-related delays. The course investigates the effects of environmental and evolutionary change on our planet using millions of years of geological, biological, paleontological, societal, and cultural evidence visible throughout Italy.

## 2. Ensure preeminence in research, scholarship, innovation and collaboration.

Faculty hiring continues to be a top priority. To that end, 16 new tenured, tenure-track and professional faculty arrived on campus in 2022-23, and 19 more plan to start in 2023-24. Overall, Sciences faculty authored or co-authored more than 1,100 journal publications from January 2022 to June 2023, including in top-tier journals such as *Science*, *Nature* and *Cell*, according to estimates from the NC State University Libraries.

A major infrastructure project began in summer 2023 when work commenced on the Integrative Sciences Building. The building, which will sit on the former Harrelson Hall site and is scheduled to open in 2026, will be the core facility for the new Integrative Sciences Initiative and home to the burgeoning Chemistry of Life training and research program. Another positive facilities development was the funding of the first two phases of renovations to Dabney Hall. Many faculty and staff displaced by the construction in Dabney will move to nearby Broughton Hall, where swing space will be created.

The college's information technology unit continued to make efforts to improve research infrastructure. Activities included maintaining a partnership with NC State Libraries' Research Facilitation Service and funding and facilitating improvements to the Office of Information Technology's High-Performance Computing services.

## 3. Expand and advance our engagement with and service to North Carolina and beyond, defining the standard for a 21st-century land-grant university.

The Science House's programs directly served nearly 15,000 students and 2,000 teachers in 75 counties across the state. Its Rural Equipment Loan program supplied resources to perform hands-on STEM investigations to 123 teachers serving more than 7,000 students.

The NC Science Olympiad, which is part of the Science House, led 17 elementary tournaments and 12 middle and high school tournaments across the state. A total of 640 teams participated, up 16% from last year. Activities culminated with the NC Science Olympiad State Tournament on the NC State campus. The program has a new director, Lisa Giacomelli, who was an Olympiad coach for nine years prior to joining NC State. Another Science House Program, Catalyst, provided students with a trip to NASA's facilities in Houston to engage with adults with disabilities thriving in STEM careers.

The college's academic departments were also active in outreach. The Department of Physics hosted the U.S. Association for Young Physicists Tournament in collaboration with the Science House and Cary Academy. The Department of Biological Sciences coordinated Brain Night, a national-award-winning neuroscience public engagement event, at the NC Museum of Natural Sciences that drew over 280 attendees. The Chemistry Graduate Student Association hosted a National Chemistry Week event in downtown Raleigh that showed off the wonders of chemistry to more than 360 attendees. Mathematician

Lorena Bociu collaborated with the Science House to hold a Girls in Applied Math, Modeling, and Analysis event to provide high school girls with opportunities to learn about math careers.

## 4. Champion a culture of equity, diversity, inclusion, belonging and well-being in all we do.

The 2022-23 academic year posed many challenges for the NC State community, most notably in terms of student mental health. An important part of the college's response was hiring a shared embedded counselor and running events to promote mental health and well-being. Our Academic Affairs team engaged with the university's Mental Health Task Force and will be part of several implementation teams charged with carrying out recommendations that arose from it. In the spring, the college held its second Diversity, Equity and Inclusion Leadership Summit, which brought together dozens of participants from around the college to discuss issues including mental health.

Sciences staff continue to lead NC State's Women in Science and Engineering (WISE) program, which brings together first- and second-year female students and upper-class mentors in Lee Hall. WISE has grown significantly and had 370 students during the 2022-2023 academic year.

In the Science House, the Kyran Anderson and Imhotep Academies continued to reach underserved elementary- and middle-school students; more than 230 students participated throughout the year. Eighty percent of these programs' participants were African-American, Latino or Native American students, 52% were girls, and 70% received need-based financial support to participate.

In spring 2023, the college won the Chancellor's Creating Community Award for the Outstanding College/Unit for its work recruiting, retaining and promoting individuals of underrepresented populations. 5. Improve university effectiveness through transformative technologies, cutting-edge processes and actionable data.

In partnership with leadership and the college's Office of Finance and Business Management, our Human Resources office took significant steps to attract and retain college staff by conducting equity analyses across many different areas. From January 2022 to June 1, 2023, the college provided over \$1.6 million in salary adjustments for various reasons through 262 actions. Our retention rates have now recovered from the "great resignation" experienced during the pandemic. In 2021-22, the college's Office of Finance and Business Management created a new budget planning and management tool. In the most recent fiscal year, the tool was implemented by all Dean's Office units and piloted by two academic departments. The office hopes to further refine the tool for wider implementation in the college in future years. In the college Research Office, an exciting change was the development and implementation of a SmartSheet project management tool for all pre-award activities and some post-award activities. The office worked with the SmartSheet team on campus to build and implement a software system that will help the college manage its increasing proposal submission workload.

# 6. Lead in developing innovative partnerships, entrepreneurial thinking and applied problem-solving.

The college is a key player in the Chancellor's Faculty Excellence Program cluster hiring initiative. As of Summer 2023, Sciences is home to 16 of these hires, the second-most of any college at NC State.

The Department of Statistics continued to provide high-quality statistical support and engagement with on- and off-campus researchers throughout the year. And through the Comparative Medical Institute, the college and its faculty continue to promote research translation and commercialization through Catalyst and similar programs. The Departments of Chemistry and Physics, in particular, continue to be highly engaged in research commercialization and the creation of spin-off companies.

## 7. Elevate the national and global reputation and visibility of NC State.

Programs in the college continue to perform well in national rankings. In the latest rankings of graduate schools in science by *U.S. News and World Report,* our statistics program ranked 11th in the nation, while applied mathematics ranked 18th. College programs also fared well in the National Science Foundation's most recent Higher Education Research and Development Survey. Among the highlights: 2nd in mathematics and statistics; 36th in geosciences, atmospheric sciences and ocean sciences; 38th in chemistry; 40th in biological and biomedical sciences; and 54th in physics.

The Department of Statistics has produced more doctoral graduates than any other statistics program in the nation over the last two decades. According to figures from the American Statistical Association, the department awarded 350 doctorate degrees between 2003-2021 — nearly 100 more than the institution with the second highest number of doctoral statistics graduates.

College faculty and staff also provide scientific guidance to national leaders. Kathie Dello, director of the State Climate Office, was invited to represent North Carolina at the White House Forum on Community and Campus-Scale Climate Solutions in March. She was also invited to testify on the Weather Act Reauthorization to the Environment Subcommittee of the House Committee on Space, Science, and Technology in June. Our faculty are also regularly sought-after to serve on highly prestigious National Academy of Sciences Committees, including one on the health effects of PFAS and another on new approach methodologies for chemical testing and risk assessment.

Our Superfund Center, the Center for Environmental and Health Effects of PFAS, co-hosted the National Institute for Environmental Health Sciences Superfund Meeting in December 2022. This meeting was twice as large as previous annual meetings and attracted more than 500 attendees.

## Areas of Impact in 2022-23

## 1. Changes in service environment

The college experienced a major leadership change during 2022-23 when Dean Chris McGahan retired. Senior Associate Dean for Administration John Blondin was named interim dean. In May, Provost Warwick Arden announced that Lewis Owen would become the next permanent dean, effective August 1, 2023. Owen had been head of the Department of Marine, Earth and Atmospheric Sciences since 2019 and previously spent a decade as a department head at the University of Cincinnati.

In July 2022, the college Research Office was restructured to improve and elevate service, and this past year the office refined that structure to keep up with growing research activity. The new alignment allows for redundancy and cross-position collaboration, which proved advantageous as the office and three academic departments in the college experienced numerous critical vacancies.

### 2. Initiatives

A major outreach event occurred in April when the college brought back State of the Sciences to James B. Hunt Jr. Library for the first time since 2018. About 750 people attended.

The Academic Affairs office instituted a new event to recognize excellence in teaching and advising within the college. In addition to announcing college-level teaching awards, this event recognized all individuals who were nominated for university-level awards in teaching and advising.

The college has also enhanced its Excellence Symposium, to be held in September 2023, to feature its newest faculty members, innovations in teaching, and engagement opportunities.

## 3. Instructional program advances

In the Department of Physics, introductory undergraduate teaching labs were completely revamped in 2021-22 and 2022-23 was the first year they were fully utilized. By transforming the labs to boost students' sense of belonging and introduce connections between science and sociopolitical issues, the new labs are improving equity and inclusion in this important STEM area.

In the Department of Marine, Earth and Atmospheric Sciences, the Climate Change and Society (CCS) Master's Program and Climate Adaptation Certificate is setting records for applications and enrolled students. A new CCS program funded by the U.S. Department of State involves exchanges between faculty and students from NC State and women's universities in Pakistan, as well as a seminar series. The program aims to develop the next generation of women environmentalists in Pakistan.

#### 4. Research

During 2022-23 Sciences faculty received 416 awards totaling \$56.1 million in funded projects, the most since the inception of the college. In 2021-22, the college was the university's second-leading F&A revenue generator and was on target to remain so in 2022-23. Among our research highlights:

Biological Sciences: In a paper detailing findings from NC State's GenX Exposure Study, Jane Hoppin and others found that elevated levels of per- and polyfluoroalkyl substances (PFAS) were associated with higher total cholesterol and non-HDL cholesterol in participants' blood. They also found that the legacy PFAS chemicals PFOS and PFNA were most strongly associated with elevated cholesterol compared to the other chemicals, and that effects were more pronounced in older people. The research adds to the evidence linking PFAS exposure and adverse health outcomes. Similarly, Scott Belcher and colleagues identified PFAS levels in pets and livestock, making national headlines.

<u>Chemistry</u>: Thomas Theis and other researchers received a \$2.25 million interdisciplinary grant from the Department of Energy to fund a project that proposes quantum spin technology to image biochemical pathways in the rhizosphere with unprecedented chemical detail and sensitivity. The proposed technology will reduce penetration depth limitations in molecular imaging, allowing the researchers to observe molecular turnover and metabolism directly in soil.

<u>MEAS</u>: Stacy Zhang and others were awarded a \$1.22 million grant by the National Science Foundation and the Paul G. Allen Family Foundation to test science-informed restoration and advance biodiversity conservation in coastal North Carolina and Virginia. The goal is to amplify evidence-based approaches in conservation to preserve coastal biodiversity and enable people to use the most cost-effective and climate-resilient strategies in restoration.

<u>Mathematics</u>: Mohammad Farazmand and other researchers identified and addressed a flaw in a commonly used pandemic model that can cause the model to severely underestimate disease spread. By modifying parts of an existing model, the researchers substantially improved its accuracy when compared to real world data on the spread of the COVID-19 Omicron variant.

<u>Physics</u>: The Department of Defense (DOD) awarded Dali Sun and colleagues a \$7.5 million grant to study quantum spin effects in chiral matter as part of the DOD's Multidisciplinary University Research Initiative Program. The work could lead to new strategies to leverage quantum information technologies at ambient temperatures, making them more energy-efficient and cost-effective.

<u>Statistics</u>: Jeff Thorne and others created a simple statistical test that shows that contrary to current practice, the "gaps" within DNA protein and sequence alignments commonly used in evolutionary biology can provide important information about nucleotide and amino acid substitutions over time. The finding could be particularly relevant to those studying distantly related species.

<u>State Climate Office</u>: The office received \$700,000 from the North Carolina Office of Recovery and Resiliency to understand the state's flood risk in a changing climate. Among other outcomes, the project will prepare statewide projections of future precipitation extremes using the newest downscaled climate model data, which should help communities prepare.

## 5. Extension

The Science House moved from Centennial Campus to the Cherry Building on Dorthea Dix campus in January 2023. The Cherry Building creates an opportunity for The Science House to expand its outreach programs and provide more accessible space and parking. The State Climate Office continued to build and maintain custom tools for North Carolina state agencies, including a refreshed Air Quality Portal for the Department of Environmental Quality. During the Canadian wildfires of 2023, the office saw web traffic increase over 22,000% from a typical week.

## 6. Faculty

Faculty in the college received many prestigious awards this year. Five faculty members were recognized at NC State's 2023 Celebration of Faculty Excellence, which honors winners of top state, national and international awards. Several more faculty were honored with college and university awards; two were named University Faculty Scholars; two were named Provost's Faculty Fellows; and two were named Goodnight Early Career Innovators. Among our faculty award highlights:

<u>Biological Sciences</u>: Miles Engell, Provost's Award for Excellence in Teaching, NC State; Erica Kosal, Carrie McLean Award for Advising Administrators, NC State; Ann Ross, Jackson Rigney International Service Award, NC State

<u>Chemistry</u>: Daniel Comins, Senior Fellow, International Society of Heterocyclic Chemistry; Maria Gallardo-Williams, Libraries Faculty Award, NC State; David Muddiman, Donald F. Hunt Distinguished Contribution in Proteomics Award, *Journal of Proteome Research*; Maria Oliver-Hoyo, Award for Achievement in Research for the Teaching and Learning of Chemistry, American Chemical Society; Joshua Pierce, Chancellor's Innovation Fund Award, NC State; Caroline Proulx, Early Career Lectureship Award, American Peptide Society; Thomas Theis, Friedrich Wilhelm Bessel Research Award, Alexander von Humboldt Foundation

MEAS: Chris Osburn, Director of the Blue Economy Innovation Program, NC State

<u>Mathematics</u>: Alina Chertock, Fellow, Society for Industrial and Applied Mathematics; Ilse Ipsen, Olga Taussky-Todd Lecture, International Congress on Industrial and Applied Mathematics; Ralph Smith, Fellow, American Society of Mechanical Engineers

Physics: Harald Ade, Highly Cited Researcher, Clarivate; Jerry Bernholc, Alexander Quarles Holladay Medal for Excellence, NC State; Laura Clarke, Jonathan F. Reichert and Barbara Wolff-Reichert Award for Excellence in Advanced Laboratory Instruction, American Physical Society; Carla Fröhlich, Fellow, American Physical Society; Karen Daniels, Fellow, American Association for the Advancement of Science and Fulbright Scholar Award; Chueng Ji, Outstanding Contribution to KSEA Award, Korean-American Scientists and Engineers Association; Divine Kumah, Oxide Electronics Prize for Excellence in Research, International Workshop on Oxide Electronics; Sharonda LeBlanc, Science Diversity Leadership Award, Chan Zuckerberg Initiative

<u>Statistics</u>: Jacqueline Hughes-Oliver, Fellow, American Association for the Advancement of Science; Charles Smith, Fulbright Scholar Award

## 7. Students

The college's student population in Fall 2022 was 4,138, including 3,135 undergraduates and 1,003 graduate students. The first-year class had a weighted high school grade point average of 4.37. The college has also maintained a roughly 95% first-year retention rate for several years. From 2017-18 to 2021-22, our four-year graduation rate rose from 62% to 74%, and our six-year graduation rate grew from 73% to 87%.

William Anderson in the Department of Mathematics was one of three students worldwide to be awarded the 2022 SIAM Student Paper Prize. Mathematics student Etienne Phillips received a prestigious Goldwater Scholarship. In the Department of Marine, Earth, and Atmospheric Sciences, graduate student Joyce Smith won the National Association of Geoscience Teachers Outstanding Teaching Assistant Award, and graduate student Geneva Gray won the Oak Ridge Institute for Science and Education's Future of Science Graduate Student and Post-Master's Award.

#### 8. Fundraising

The college enjoyed a record-breaking fundraising year. Through June 30, 2023, gifts and new commitments totaled \$13.8 million, the highest annual fundraising total in the college's history.

This year's fundraising highlights included the largest estate gift in the college's history, a \$10 million commitment to support graduate students in physics and mathematics. Other notable gifts include \$50,000 experiential learning endowment for MEAS, two new scholarships (\$250,000 and \$50,000, respectively) supporting physics and chemistry students, a \$250,000 Extraordinary Opportunity Scholarship, and \$375,000 for a statistics graduate fellowship enhancement endowment. The college also raised nearly \$1.5 million on Day of Giving from a record 1,001 gifts.

## 9. Administration

There were some changes to the college's Leadership Team during the past year. Amanda Savas was named assistant dean for finance and business management. In the departments, Kim Sellers of Georgetown University was named the new head of the Department of Statistics, becoming the first black woman to serve as a department head in the college. Following Lewis Owen's appointment as dean, a search began for a new head of the Department of Marine, Earth and Atmospheric Sciences. Gary Lackmann was named interim head.

#### 10. Recommendations and concerns for the future

Among our upcoming challenges will be the Engineering Expansion, which is already adding hundreds of new students each year to many of our undergraduate courses. We will need more space, faculty, staff and teaching assistants to accommodate this increase.

While the Integrative Sciences Building will add much-needed teaching and research space, there remains a critical lack of functional laboratory space. Some of these issues will be eased by the renovation of Dabney Hall, but that process will create complications such as the construction of flex space in Broughton Hall. The college is also running low on space to house live animals. Important animal care infrastructure, particularly the fish facilities, is in a state of critical disrepair.

Faculty attrition continues to be a challenge, and these losses make it difficult to sustain our thriving National Institutes of Health centers and strong environmental health research programs. In addition, our departments remain understaffed compared to our peers. Hiring is limited by stagnant salaries, the lack of quality space, and the lack of resources for competitive startup packages. Another longstanding issue is graduate student stipends, which remain among the lowest of our peers.

Looking ahead, we continue to recommend that the university establish an Academy of Environment and Climate. Creating the academy would help address infrastructure challenges, build faculty, enhance training opportunities, foster collaboration and elevate the prominence of our already strong research and community engagement in the area of environmental and climate health.