

Overview

The College of Sciences is home to people and programs in the biological, mathematical and physical sciences at NC State. The nine-year-old college continues to be one of the largest and most research-intensive units at the university, with more than 4,100 students, 390 active research projects and \$40 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 the people of North Carolina, the nation and the world into our work as we become a local and global hub for open science.

The college's vision, as outlined in its recently enacted strategic plan, is to urgently expand equity, public participation and discovery in science, so that anyone can contribute solutions to the world's greatest challenges for a sustainable, data-driven and just future. This annual report reflects the priorities laid out in NC State's strategic plan and supported by the college's leadership.

Responsiveness to Universitywide Strategic Goals**1. Empower students for a lifetime of success and impact.**

Dozens of students showcased work that addressed grand challenges in health, the environment and other areas in November 2021 at the first College of Sciences Research Symposium. The event brought together graduate students and postdoctoral researchers to share interdisciplinary research. The college plans to make the symposium an annual event.

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 2021 session focused on global change, which included explorations of ancient life, mass extinction, modern ecologies and climate justice.

To further promote the success of transfer students, the college continued development of a course that is designed to facilitate career readiness and a successful transition into college and the NC State community. Students are challenged to think and address eight competencies including

critical thinking/problem solving, oral/written communication and digital technology. Following online delivery in 2020, the course was offered in person for the first time in 2021.

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

Faculty hiring continues to be a top priority. To that end, 15 new tenured, tenure-track and professional faculty arrived on campus in 2021-22, and 11 more plan to start in 2022-23.

Sciences is playing a leading role in the new Integrative Sciences Initiative (ISI), which launched in Spring 2022 with the goal of developing teaching and research across campus with the Integrative Sciences Building at the core. The building, which will sit on the former Harrelson Hall site on North Campus, will also be home to the burgeoning Chemistry of Life training and research program. Construction of the building is scheduled to begin in 2023, with the opening slated for 2026. This building will be managed by the university and our college will be the primary occupant. Chemistry of Life Director Joshua Pierce has also been named director of the ISI.

Another welcome facilities development was the state legislative approval of \$60 million to renovate chemistry facilities in Dabney Hall. A design firm has been selected for the project, which will work with the building committee and stakeholders to plan the renovation.

A major research milestone was achieved when researchers led by Cathrine Hoyos in the Department of Biological Sciences were awarded \$17 million from the National Institutes of Health to explore a potential link between environmental contaminants and liver cancer. The grant was the largest in the history of the college.

The college also continues to play leading roles in new NC State academies, which are strategically-focused university-level interdisciplinary units. Several Sciences faculty are key players in the Genetics and Genomics Academy and the Data Science Academy.

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 State Climate Office formally launched the Carolinas Collaborative on Climate, Health and Equity in September 2022. The collaborative is one of 11 regional centers in the United States that relocated after being housed at the University of South Carolina for 19 years. The five-year, \$5.4

million project is in collaboration with NC State's North Carolina Institute for Climate Studies, the Environmental Protection Agency and other partners.

The Science House's programs continue to reach communities across North Carolina. Overall, its student programs directly served 11,250 students and reached over 50,000 students. The NC Science Olympiad, which is part of the Science House, ran 19 elementary school tournaments and 12 middle and high school tournaments across the state. Activities culminated with the NC Science Olympiad State Tournament, which returned to the NC State campus for the first time since 2019; over 1,200 middle and high school students participated.

Joann Blumenfeld, the leader of the Science House's Catalyst Program, which creates opportunities in STEM for high school students with disabilities, was recognized by Time magazine as one of its Innovative Teachers of the Year. Earlier in the year, N.C. First Lady Kristin Cooper and Secretary of Commerce Machel Sanders came to campus to meet with Catalyst students.

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

Nurturing a diverse, equitable and inclusive culture that values all experiences and perspectives and breaks down barriers to equity and equality of opportunity is a focus of the college's new strategic plan. Advancing Equity is one of the plan's four priorities.

The college held its third Diversity in STEM Symposium in February 2022. The free event, which drew nearly 500 registrants, featured sessions on DEI topics as well as a keynote talk by N.C. A&T State University biologist Joseph L. Graves. The event was once again sponsored by BASF. Later that spring, the college held its first Diversity, Equity and Inclusion Leadership Retreat, which brought together more than 50 participants from around the college. The college also broadened the audience for participation in the GLBT+ in STEM workshop series, extending it to faculty and staff.

Sciences staff continue to lead NC State's Women in Science and Engineering program, which brings together first- and second-year female students and upper-class mentors in Lee Hall. The program has grown from 56 students in 2003 to about 380 students in 2021-22.

In the Science House, the Kyran Anderson and Imhotep Academies continued to reach underserved elementary- and middle-school students. Nearly 80% of these programs' participants were African-American, Latino or Native American students and 55% of the participants were girls.

5. Improve university effectiveness through transformative technologies, cutting-edge processes and actionable data.

The college has been preparing for the transition to the new university budget model and is embarking on a revised version of its own budget allocation model taking into account any changes in funding as well as how the college's student-hour production is reflected in its continuing budget. The college's Office of Finance and Business Management has also created a sophisticated budget planning and management tool that has been shared with other colleges..

The college is also partnering with the NC State Libraries to serve as a pilot for the university's new Research Facilitation Service. The service provides a single point of contact for research computing and data questions, strengthens communication among the many research service providers around campus, supports the continuous assessment of researcher needs, and offers advice on tools. The college's information technology unit has been involved in developing the service and will play a future role in providing service advising.

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

The college also continues to be a leader in the Chancellor's Faculty Excellence Program cluster hiring initiative. As of Summer 2022, Sciences is home to 15 of these cluster hires, the second-most of any college at NC State. New hires in the past year were Ryan Chiechi and Qing Gu in the Carbon Electronics cluster.

The Department of Statistics continued to provide high-quality statistical support and engagement with on- and off-campus researchers throughout the year. Through the Statistical Consulting and Statistical Practice courses, graduate students mentored by faculty provided statistical advice and support for more than 50 projects across campus. Statistics also had five students supported by the Graduate Industrial Traineeship Program with industrial partners, including SAS.

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

Programs in the college continue to perform well in national and international rankings. In the latest rankings of graduate schools in science by *U.S. News and World Report*, NC State's statistics program moved up five spots to 11th in the nation, while applied mathematics, which made the list for the first time, ranked 21st. The mathematics, chemistry, physics and earth sciences graduate programs ranked 53rd, 62nd, 68th and 70th, respectively. Mathematics and chemistry ranked in the top 30 percent of programs surveyed, while physics ranked in the top 40 percent. Biological sciences ranked 93rd overall, in the top third of programs surveyed.

Another program recognized for its excellence was the Master of Science in Financial Mathematics program, which ranked sixth in the 2022 Risk.net annual list of the top 25 quantitative financial master's programs globally. The program also received recognition in the 2022 QuantNet ranking of the best financial engineering programs, ranking 13th nationally.

Areas of Impact in 2021-22

1. Changes in service environment

The college made major changes to its Research Office to elevate service. These changes included creating and hiring a new assistant director of research administration to coordinate post-award activity. The college also hired a new pre award specialist to help manage our increasing proposal submission workload. The college now has four full-time proposal processors.

Another change was to move oversight of the seven accounting technicians from the academic departments to the Research Office to streamline post-award service, more equitably distribute workload, enhance flexibility and improve staff training. This additional staff support will improve both pre- and post-award services for faculty.

2. Initiatives

In February 2022, the college launched its first strategic plan and culture charter, which were designed to support leadership toward building a stronger and more collective future for the college. The planning process identified opportunities for the college to create unique value and greater equality of opportunity for its various internal and external stakeholders.

The plan identified four priorities: Deepen Scientific Foundations, Elevate Support Infrastructure, Advance Equity and Open Up Science. These priorities were developed to mesh well with the university's new strategic planning priorities.

Eric Dorfman, director of the North Carolina Museum of Natural Sciences, was the speaker at the college's annual State of the Sciences event. The college has a longstanding and expanding partnership with the museum, which is the largest institution of its kind in the Southeast. The event is supported through the generosity of mathematics alumnus Joe Bridger.

3. Instructional program advances

In the Department of Physics, introductory undergraduate teaching labs were completely revamped to incorporate techniques developed in the physics education community. The transformation included materials to improve inclusion and equity in STEM. Introductory physics can have a significant impact on students' trajectories and scientific self-efficacy.

In the Department of Marine, Earth and Atmospheric Sciences, the Climate Change and Society (CCS) Master's Program and Climate Adaptation Certificate continue to evolve. The number of students continues to grow and is likely to set a program record this coming year.

4. Research

Between July 1, 2021, and June 30, 2022, Sciences faculty received 391 awards totaling \$50 million in funded projects, the most since the inception of the college. The college is now the university's second-leading F&A revenue generator, trailing only the College of Engineering. Awards to our researchers from the National Institutes of Health grew from \$11.1 million in 2020-21 to \$20.7 million in 2021-22. Among our research highlights:

Biological Sciences: Reade Roberts and others looked at the African cichlid *Metriaclima mbenjii* to see how sex differences emerge in species with more than one set of sex-determining chromosomes. The work could provide insights into how sex-linked traits develop more generally.

Chemistry: Graduate student Kaylie Kirkwood led research that used pine needle samples to trace the presence and concentrations of over 70 different types of per- and polyfluoroalkyl

substances (PFAS) in six N.C. counties from 1961 to the present. The researchers hope the work will lead others to use passive sampling to monitor PFAS spatial and temporal distribution.

MEAS: Post-doctoral research assistant Paula Marques Figueiredo received attention for her work on the first documented surface rupture earthquake in the eastern U.S. The quake occurred in 2020 in Sparta, N.C., and propagated to the surface along a preexisting structure in the shallow bedrock, which had not been previously identified as an active fault.

Mathematics: A simplified mathematical model of carbon dioxide (CO₂) concentrations and temperature developed by Mohammad Farazmand and others found a “lag time” between human intervention and an actual decrease in CO₂ levels. This lag time has ramifications for intervention strategies meant to avoid climate tipping points and potentially catastrophic temperature increases.

Physics: A unique new instrument, coupled with a powerful telescope and a little help from nature, gave Rongmon Bordoloi and colleagues the ability to peer into galactic nurseries at the heart of the young universe. Through this method the researchers were able to determine not only the size of two Damped Lyman- α systems, but also that they both contained host galaxies.

Statistics: Ana-Maria Staicu and Jonathan Stallrich won the 2021 Statistics in Physical and Engineering Sciences Award for their work to develop a prosthesis controller that is more directly tied to known biomechanical movement models requiring data from a sparse set of EMG sensors.

State Climate Office: The office is developing a heat vulnerability analysis and tool for the Southeast funded by NOAA's Climate Program Office. This tool will incorporate physical and social science data to help the National Weather Service monitor and better communicate extreme heat.

5. Extension

The State Climate Office installed its 44th ECONet climate monitoring station, which is located at Jockey's Ridge State Park in Nags Head. ECONet provides partners like the National Weather Service and the NC Department of Emergency Management with critical weather observations.

The Science House's Rural and Equipment Loan program supplied technologies to perform STEM investigations to 211 schools serving 10,980 students. Overall, 180 NC state undergraduate and graduate students and 1,235 volunteers from the community and other partner organizations

volunteered in Science House programs. In Fall 2022, the Science House will move to the Cherry Building on Dorothea Dix campus to support the College of Engineering's need for more space on Centennial Campus while providing a promising new home for Science House programs and staff.

6. Faculty

Faculty in the college received many prestigious awards this year. Six faculty members were recognized at the 2022 Celebration of Faculty Excellence, an annual event that honors faculty who won top state, national and international awards. Several more faculty were honored with university teaching and research awards; two were named University Faculty Scholars; and two were named Goodnight Early Career Innovators. Among our faculty award highlights:

Biological Sciences: Caiti Heil, Maximizing Investigators' Research Award, National Institutes of Health; Jane Hoppin, Gov. James E. Holshouser Jr. Award for Excellence in Public Service, UNC System; Christina Zakas, Maximizing Investigators' Research Award; National Institutes of Health

Chemistry: Erin Baker, Biemann Medal, American Society for Mass Spectrometry; Jeremiah Feducia, Outstanding Advising Award, National Academic Advising Association; Vincent Lindsay, Maximizing Investigators' Research Award, National Institutes of Health; Maria Oliver-Hoyo, Fellow, American Chemical Society; Laura Sremaniak, Fellow, American Chemical Society

MEAS: Anantha Aiyyer, Editorial Board, *Geophysical Research Letters*

Mathematics: Dávid Papp, Sanjay and Panna Mehrotra Research Excellence Award, Health Applications Society of INFORMS

Physics: Harald Ade, Highly Cited Researcher, Web of Science Group; Laura Clarke, Board of Governors Award for Excellence in Teaching, NC State; Karen Daniels, Fellow, American Association for the Advancement of Science; Sebastian König, CAREER Award, National Science Foundation; Dali Sun, CAREER Award, National Science Foundation

Statistics: Subhashis Ghoshal, Elected President, International Indian Statistical Association; Emily Griffith, American Statistical Association Section (ASA) on Statistical Consulting Outstanding Mentor Award and North Carolina ASA Chapter's Chapter Service Award

7. Students

The college's student population in Fall 2021 was 4,120, including 3,107 undergraduates and 1,013 graduate students. The first-year class had a weighted high school grade point average of 4.36.

Caleb Keaveney, a meteorology and applied mathematics double major, was named a 2022 Astronaut Scholar, one of the nation's most prestigious honors for STEM students. Keaveney was also a 2022-23 recipient of the NC Space Grant's Undergraduate Research Scholarship and a 2022-23 recipient of the Goldwater Scholarship. The Chemistry Graduate Student Association was honored with the Chancellor's Creating Community Award for Outstanding Student Organization.

8. Fundraising

The college logged another excellent fundraising year. Through May 31, 2022, gifts and new commitments totaled \$4.6 million. The college raised \$71,203,356 during the Think and Do the Extraordinary Campaign that ended on Dec. 31, 2021, nearly 120% of our initial \$60 million goal.

This year's fundraising highlights included two endowment commitments totaling \$500,000 to support microbiology students and a \$600,000 estate gift to support the Department of Biological Sciences. The college also exceeded its \$100,000 fundraising goal for the new Diversity Program Endowment. At the 2022 Day of Giving event, the college received 835 gifts — its most ever.

For faculty, Cathrine Hoyo in the Department of Biological Sciences was named a Goodnight Innovation Distinguished Chair and Subhashis Ghoshal in the Department of Statistics was named a Goodnight Distinguished Professor in Statistics. The professorships were made possible by gifts from longtime NC State supporters Jim and Ann Goodnight.

9. Administration

There were some changes to the college's Leadership Team during the past year. Tina Morrison was named the new assistant dean of advancement and Alun Lloyd was named interim associate dean for academic affairs. Jamila Simpson was named the college's first assistant dean for inclusive excellence, expanding her work on diversity initiatives to all students, faculty, staff and postdoctoral scholars. Simpson was recognized by Gov. Roy Cooper in February 2022 as one of North Carolina's African American STEM leaders.

In the academic departments, Gavin Williams was named head of the Department of Chemistry. Williams had been serving as interim department head.

10. Recommendations and concerns for the future

Among our upcoming challenges will be dealing with the Engineering Expansion, which will eventually add 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, particularly for the biological sciences and chemistry. Major renovations and/or at least one additional new building are required to maintain growth and development of core research activities.

Faculty attrition continues to be a challenge — for example, we have lost more Chancellor's Faculty Excellence Program hires than we have gained over the past few years — and several of our departments remain understaffed compared to our peers. Hiring is greatly limited by available and quality space and the lack of resources for competitive startup packages. There is also an urgent need for greater IT support, including data security and resiliency, research computing, web services and technical solutions development.

Another longstanding issue is graduate student stipends, which remain among the lowest of our peers. To help address this, we have aggressively grown our National Institutes of Health T32 training grant programs, which helps us stay competitive because the grants come with higher stipends. Maintaining Provost's Office support for those programs is essential to keep them going.

Finally, COVID-19 remains a challenge, as faculty and staff navigate changes in their work environment and concerns about their own health and the health of those around them.

Looking ahead, we recommend that the university establish an Academy of Environment and Climate to target and gain critical funding, attention and engagement in this area of strength. 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.