College of SCIENCE

College of Science Strategic Plan Update

April 2023

ACCELERATE SCIENCE

Table of Contents

MESSAGE FROM THE DEAN

Science is essential. It satisfies the need to comprehend the world around us. It inspires creativity and opens our eyes to new understandings. Scientific discoveries drive the innovations of the future — often in unexpected ways. In today's increasingly complex world, the solutions to big problems will be brought to life only through a steadfast commitment to advancing human knowledge.

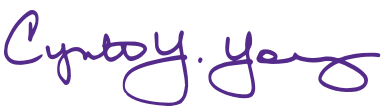
Science is at the heart of everything we do at Clemson. To realize this responsibility, Clemson University established the College of Science. As founding dean, I focused my first five years and our College's initial strategic priorities on building our operational infrastructure, expanding our teams with diverse and high performing top talent, fostering faculty excellence, cultivating a culture of research preeminence, enhancing student success and navigating a global pandemic. During this time, we challenged the status quo and took deliberate steps that would prepare us to accelerate our efforts. That work was completed thanks to the innovation, dedication, and teamwork of the outstanding leaders among our faculty, staff and students. We have emerged as a prominent force for excellence at Clemson University, and we are poised to be even better.

The transition from the College of Science's original strategic plan, ScienceForward, to this plan, Accelerate Science, marks our turn from building a strong framework to accelerating our impact into the future. It represents the growth from what I refer to as Science 1.0 to Science 2.0.

Accelerate Science reflects and guides not only our commitment to discovery, learning and engagement but also to the exponential power of integrating these three. By bringing these three pillars together and emphasizing their interconnectedness, we are elevating our university, better preparing our students, and improving our nation and world.

With Accelerate Science, we're continuing these commitments while also developing an increased focus on external engagement — with our alumni and with industry and community partners — to raise the impact of our work and expand our students' opportunities. And by incorporating inclusive excellence as a core value, we are ensuring it permeates our work, guaranteeing that everyone can benefit from the bright future ahead.

With Accelerate Science, we are delivering on our original vision to be a world-class college of science and paving the way for a remarkable future. Our success accelerates the success of Clemson University.



Cynthia Y. Young
Founding Dean

WHAT'S NEW IN THIS UPDATE

Liliana N. Gehring, DrPH, MBA
Chief Strategy and Engagement Officer, College of Science

This strategic plan update builds on the achievements of the College's faculty, staff and students since we launched our first College of Science strategic plan, ScienceForward (SciForward), in 2018. It continues to set the course for meeting our 2026 goals and aligns with Clemson Elevate, the university's new strategic plan. The next effort to evaluate and update our strategic plan will begin in 2025 with the implementation of a new institutional revenue-based budget (RBB) model.

We have made minor but important wording changes to our mission and vision statements:

- We strengthened our mission statement by highlighting the "integration" of discovery, learning, and engagement as foundational to what we do in the College of Science, recognizing that our work helps "elevate Clemson's local relevance and global impact."
- We refined our vision statement, being deliberate about becoming a "world-class college of science," recognizing the preparation of future "leading" scientists and articulating our role in fostering a "scientifically informed society."

While our key leadership principles remain the same, we have refined our core values by adding "inclusive excellence" and incorporating respect under integrity. This change recognizes our growth and maturity as a college over the past five years, as we have built a culture of teamwork where everyone can thrive. As a core value, inclusive excellence should permeate all we do. When the SciForward strategic plan was developed in 2018, the college did not yet have an inclusive excellence strategic plan (IEP). The IEP was introduced in 2019 in alignment with SciForward but with its own set of objectives and metrics. With this revised approach, we will integrate the college's IEP more clearly and deliberately as part of our initiatives and metrics.

We have aligned our three strategic goals with our key pillars of discovery, learning and engagement.

It's time for this shift not because the work of focusing internally is done — we will continually refine what we do within our teams — but because the progress we have made gives us the ability and capacity to turn our attention elsewhere. Our former Goal 3 focused on improving our workplace quality of life and challenging the status quo, and we have done so over the past five years, implementing many improvements in our processes, systems and tools. We have been and continue to be drivers of change and valued partners in many initiatives that are helping introduce efficiencies and increased productivity at Clemson.

We have updated our objectives and outlined strategies to meet each of our three goals with a deliberate focus on building our external collaborations and partnerships to accelerate science at Clemson. We have revisited and refined our key metrics to monitor our progress through 2026 and will publish our progress in annual reports to hold us accountable for delivering on our strategic plan.

1

Goal 1 was relabeled "Discovery," retaining the focus on faculty excellence and research. This goal was articulated as "Increase national and global impact through excellence in scientific discovery."

We are transitioning from five discovery pillars to seven "discovery areas of focus" centered around human health, biodiversity and sustainability, data and information science, energy, advanced materials, quantum technologies, and astrophysical and space science. We combined genomics and precision medicine with health innovation into human health and added three areas of focus: sustainable environments, energy, and quantum technologies. Each area of focus has been defined and will help guide our continued investments.

2

Goal 2 was relabeled "Learning," retaining the focus on undergraduate and graduate education. K-12 outreach, previously identified under the "learning" goal, was moved to "engagement." The revised learning goal was articulated as "Enhance science learning experiences that elevate lives and livelihoods."

3

Goal 3 was replaced by "Engagement" as we embed inclusive excellence in everything we do. This goal was articulated as "Amplify engagement with science to build a better future." This goal guides us to intentionally turn attention outwards, developing partnerships and collaborations with external audiences that will elevate science and the College of Science.

COLLEGE OF SCIENCE STRATEGIC FRAMEWORK

OUR MISSION

We elevate Clemson's local relevance and global impact through excellence in scientific discovery integrated with learning and engagement.

OUR VISION

We will be a world-class college of science that tackles tomorrow's scientific challenges, prepares the next generation of leading scientists, and fosters a scientifically informed society.

OUR CORE VALUES

Our core values and leadership principles will guide our actions and behaviors for delivering on our mission and vision. Diverse viewpoints are the foundation for both academic excellence and research innovation.

Integrity

We demonstrate honesty, reliability and trustworthiness, being accountable for what we say and do. We treat each other with respect and adhere to the highest ethical standards.

Curiosity

We ask bold questions and are not afraid to fail. We drive innovation that positively transforms research, scholarship, teaching and administration.

Inclusive Excellence

We foster a culture that values diversity and challenges the status quo. We create an environment in which staff, faculty and students from diverse backgrounds bring their authentic selves to campus to achieve our highest potential.

KEY LEADERSHIP PRINCIPLES

- Adaptability, Accountability, Communication, Collaboration, Excellence, Evidence and Inclusiveness.

Accelerate Science Goals, Objectives and Strategies

- DISCOVERY
- LEARNING
- ENGAGEMENT

DISCOVERY

GOAL: Increase national and global impact through excellence in scientific discovery.

OBJECTIVE 1: Build a stronger, more diverse community of scholars with global recognition

KEY STRATEGIES

- Establish and expand research clusters anchored by "National Academy of Sciences (NAS)-level" faculty and endowed chairs.
- Continue to target tenure-line hires on scholars who strengthen discovery focus areas.
- Implement best practices to maximize the diversity of our community of scholars.
- Promote faculty excellence nationally and proactively nominate faculty for national honors (fellows).
- Prepare top experts for roles of national public influence.

OBJECTIVE 2: Expand and modernize research space

KEY STRATEGIES

- Expand the innovation campus in Greenwood with a focus on precision medicine.
- Align Science's footprint in the Advanced Materials Innovation Complex with strategic priorities.
- Establish a health focus precinct with a new Science building adjacent to the Life Sciences Building.
- Renovate Martin Hall, Long Hall, Jordan Hall, Hunter Laboratory, and Kinard Laboratory to house modern research space aligned with strategic priorities.

OBJECTIVE 3: Strengthen research infrastructure

KEY STRATEGIES

- Increase programs to support faculty pursuing externally funded research (e.g., equipment, seed grants).
- Increase shared equipment infrastructure and enhance core facilities.
- Expand technical and administrative support for proposal development, submission and implementation.

DISCOVERY KEY METRICS

- Number of Ph.D. students per tenure/tenure-track (T/TT) faculty (Fall)
- Number of postdocs per T/TT (Fall)
- T/TT headcount (Fall)
- Underrepresented minority (URM) T/TT headcount (Fall)
- Annual number of active faculty with prestigious awards
- Annual research proposals ($K) per T/TT
- Annual externally funded research expenditures ($K) per T/TT
- Annual percent of faculty with externally funded research grants
- Citations per capita, per 5 years
- Peer-reviewed research papers per capita, per 4 years

LEARNING

GOAL: Enhance science learning experiences that elevate lives and livelihoods.

OBJECTIVE 1: Increase signature high-impact student experiences

KEY STRATEGIES

- Expand student research opportunities (e.g., Creative Inquiry, Research Experiences for Undergraduates, funded research programs).
- Increase the breadth and depth of strategic industry partnerships to provide student internships and strengthen career opportunities.
- Expand student entrepreneurship opportunities (e.g., Catalyst competition).
- Expand the number of faculty-directed programs (study-abroad, research-abroad, internship-abroad) and Science Without Borders.

OBJECTIVE 2: Enhance student success while mitigating achievement gaps

KEY STRATEGIES

- Improve student success in gateway courses.
- Expand IDEA (inclusion, diversity, equity and accessibility) programs that promote the Clemson Experience and amplify academic success.
- Challenge the status quo of curriculum and pedagogy and apply novel best practices in undergraduate learning.
- Leverage the power of analytics to prioritize investment in key strategies for improving student learning, success and persistence for all students (e.g., first-generation, Pell-eligible, minorities, transfers, majors, in-state/out-of-state).

OBJECTIVE 3: Expand and strengthen graduate and pre-professional programs

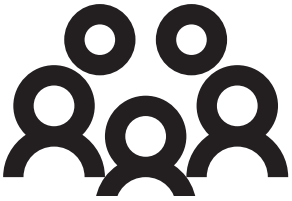
KEY STRATEGIES

- Improve recruitment and retention efforts for graduate and pre-professional programs.
- Explore relevant new professional certificate and MS programs in a variety of modalities.
- Facilitate access to and expand pre-professional programs.

LEARNING KEY METRICS

- Annual percent of graduates reporting jobs or further education
- Annual Ph.D. graduates
- 6-yr doctoral graduation rate
- 6-yr undergraduate graduation rate, Non-Pell vs Pell-eligible gap
- Annual percent of unique students completing ≥ 1 experiential learning event (Non-Pell vs Pell-eligible gap)
- Annual percent student success rate in gateway courses (Non-Pell vs Pell-eligible gap)
- Annual percent underrepresented minority (URM) undergraduate population
- Undergraduate students per professional adviser (Fall and Spring)
- Student credit hours (SCH) per instructional faculty (Fall and Spring)

ENGAGEMENT



GOAL: Amplify engagement with science to build a better future

OBJECTIVE 1: Expand the K-12 South Carolina science pipeline across all 46 counties

KEY STRATEGIES

- Strengthen the content knowledge of current and future K-12 science and math teachers.
- Enhance professional development of current K-12 science and math teachers.
- Broaden engagement with elementary, middle and high school students.

OBJECTIVE 2: Foster a great public appreciation and understanding of science

KEY STRATEGIES

- Translate and disseminate science news and information to broader audiences.
- Expand and enhance science engagement through outreach programs.

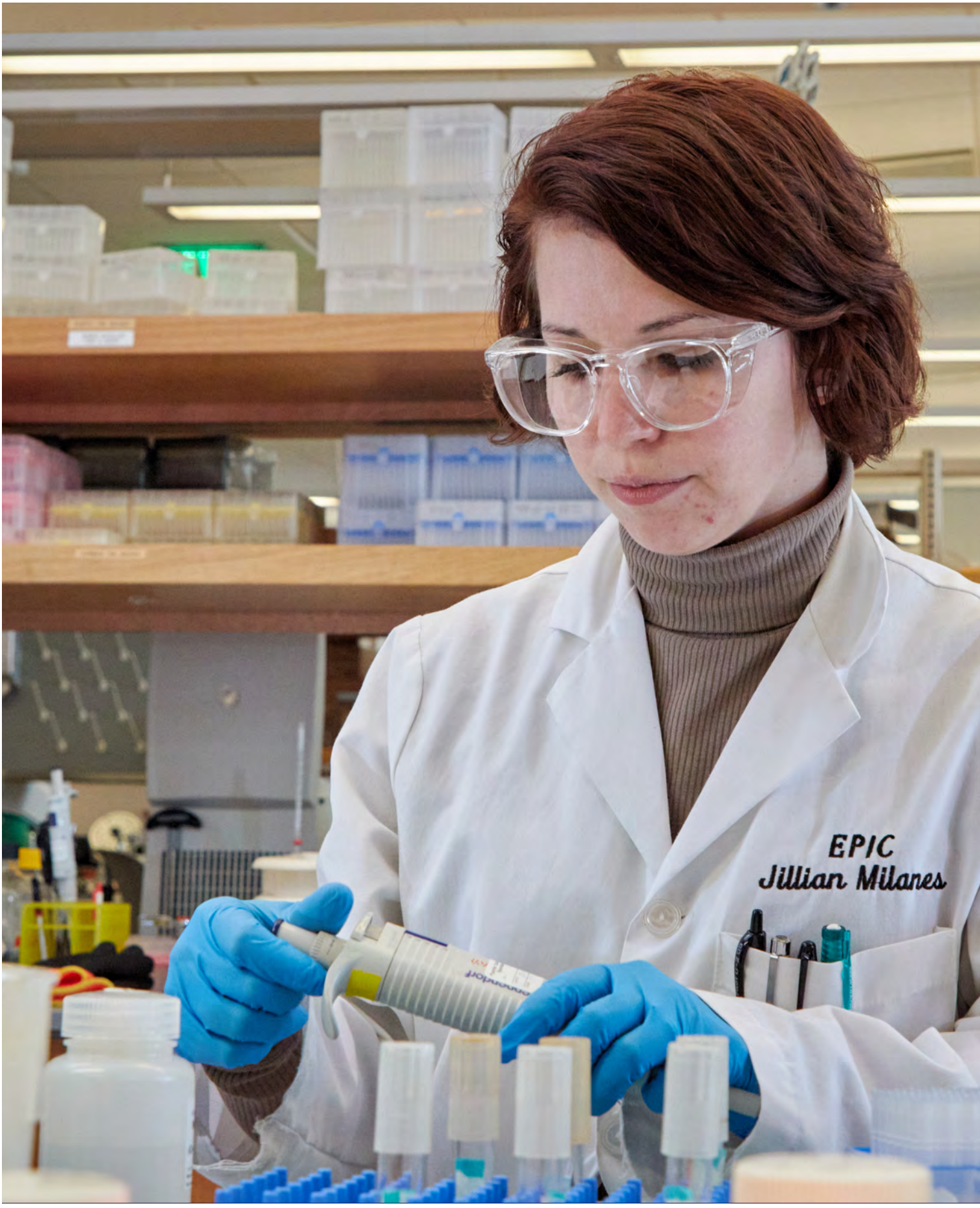
OBJECTIVE 3: Increase outreach and engagement by partnering with industry, alumni and communities

KEY STRATEGIES

- Expand strategic industry partnerships that support research, workforce development and science outreach.
- Build and implement a strategic alumni engagement plan and portfolio.
- Increase engagement with key community partners.

ENGAGEMENT KEY METRICS

- Annual number of South Carolina K-12 students participating in SCIENCE academic and outreach programs
- Annual number of South Carolina K-12 teachers participating in SCIENCE teacher professional development programs
- Annual number of South Carolina K-12 teachers participating in SCIENCE degree programs
- Annual number of public participants in SCIENCE outreach programs
- Annual number of industry partners engaged with SCIENCE
- Annual SCIENCE Alumni Engagement Index


EPIC
Jillian Milanes

Discovery Focus Areas

- HUMAN HEALTH
- BIODIVERSITY AND SUSTAINABILITY
- DATA AND INFORMATION SCIENCE
- ENERGY
- ADVANCED MATERIALS
- QUANTUM TECHNOLOGIES
- ASTROPHYSICAL AND SPACE SCIENCE

DISCOVERY FOCUS AREAS

Through the power of discovery, the College of Science will contribute to the elevation of scientific understanding and the impact of Clemson University and improve the wellbeing of our state and the people of the nation and world.

The College of Science will pursue research in the following primary areas of focus, deploying our individual and collective strengths to drive innovation and advancement in human health, biodiversity and sustainability, data and information science, energy, advanced materials, quantum technologies, and astrophysical and space science.

We seek to discover new knowledge and develop innovative approaches to help address key scientific and societal challenges, from harnessing the power of data and improving human health to understanding the nature of the cosmos.

These primary research areas of focus leverage existing and emerging strengths in the College of Science and are instrumental in helping us establish priorities and identify opportunities.

We are committed to furthering Clemson's goal of doubling research by 2035 by strategically investing in both these research priorities and in new and developing areas.

HUMAN HEALTH

BIODIVERSITY AND SUSTAINABILITY

DATA AND INFORMATION SCIENCE

ENERGY

ADVANCED MATERIALS

QUANTUM TECHNOLOGIES

ASTROPHYSICAL AND SPACE SCIENCE

HUMAN HEALTH

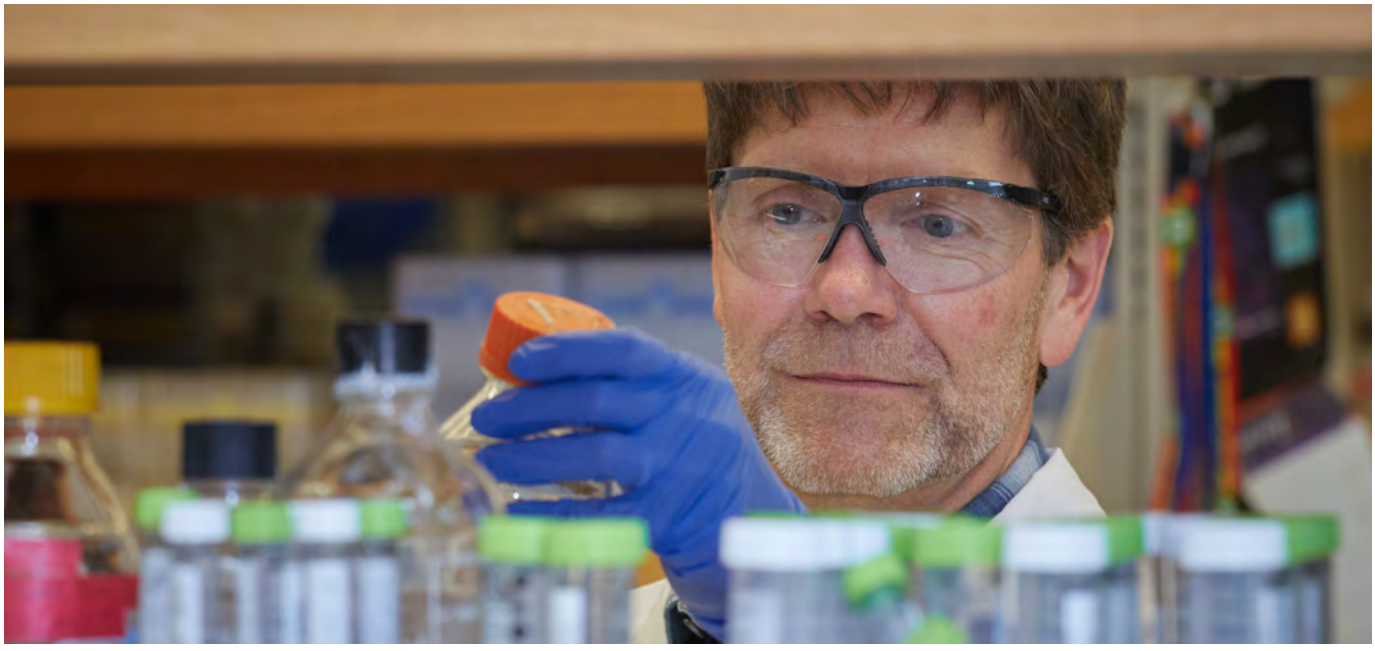
Future advances and improvements in human health will involve precision medicine, which aims to tailor disease treatment and prevention to each patient's genetic makeup, environment and lifestyle.

Further development of precision medicine tools and processes will require population-scale genome-wide sequencing of DNA and RNA and quantification of individual epigenomes, proteomes, metabolomes and microbiomes and environmental exposures, enabling prediction of disease- and health-related phenotypes. Understanding organismal biological complexity in terms of the structure, biophysical and biochemical properties, and functions and interactions among macromolecules will advance human health.

Researchers will enable the prevention and treatment of diseases by discovering molecular targets for the design, synthesis and development of new pharmaceuticals.

This multidisciplinary research area is at the interface of genomics, biological, biochemical and biophysical sciences, population and evolutionary genetics, structural chemistry, bioinformatics, and advanced computing and statistical/ data science.

The human health discovery focus area leverages existing infrastructure — such as the Palmetto cluster supercomputer, the Clemson University Center for Human Genetics and the Eukaryotic Pathogens Innovation Center — and encourages collaboration among departments and with external partners like Prisma Health and the Greenwood Genetic Center.



DISCOVERY FOCUS AREAS

BIODIVERSITY & SUSTAINABILITY

Humans are part of a natural world that sustains our existence by meeting fundamental needs, providing resources and serving as inspiration for products ranging from medicines to novel materials. This natural world faces threats on several fronts, from climate change and pandemic disease to the impacts of resource extraction.

We lack basic knowledge about most of the living things with which we share the planet, limiting our ability to effectively confront these threats and their local and global effects. Improving our understanding of the complex diversity of life is critical to sustaining it and discovering its novel applications.

The foci of this multidisciplinary pillar include climate change, environmental genomics, phenotype prediction, integrative biology, ecological interactions, adaptation and evolution, bioinspired design, the water-food-energy nexus, bioproduct security, precision agriculture, conservation and sustainable building design. It draws from expertise across College of Science units and collaborations with the College of Engineering, Computing and Applied Sciences and the College of Agriculture, Forestry and Life Sciences.

Clemson researchers focusing in this area leverage diverse infrastructure including the Clemson University Bioinformatics and Genomics Facility, Palmetto cluster, electron microscopy and light imaging facilities, and the Bob and Betsy Campbell Museum of Natural History.

DATA & INFORMATION SCIENCE

Today's science is characterized by the collection of massive and unprecedented amounts of data. These data are collected at various temporal and spatial scales, and the collections present major challenges for storing, securing, representing, visualizing, modeling and analyzing.

New decision tools are needed to transform growing datasets into useful information that will advance scientific knowledge. We need innovation in many areas of mathematical sciences to support faster, more accurate and more powerful analyses of these datasets to facilitate useful predictions for real world problems.

These advancing methods will contribute to multiple domains, including astrophysics, biology, chemistry, engineering, genomics, materials science, mathematical and statistical science, and space science, helping to advance fundamental science across disciplines.

The development of these tools requires a multidisciplinary effort between experts in statistical modeling and computation, machine learning, artificial intelligence, blockchain technologies, cybersecurity, quantum computing, cryptography, data mining, coding theory, applied topology, operations research, modeling and data analytics, decision-making, game theory, modeling risk and uncertainty quantification, among others.

University researchers and industry partners will utilize computing resources such as the Palmetto cluster and machines with a high number of graphics processing units (GPUs) to support this complex work.

DISCOVERY FOCUS AREAS

ENERGY

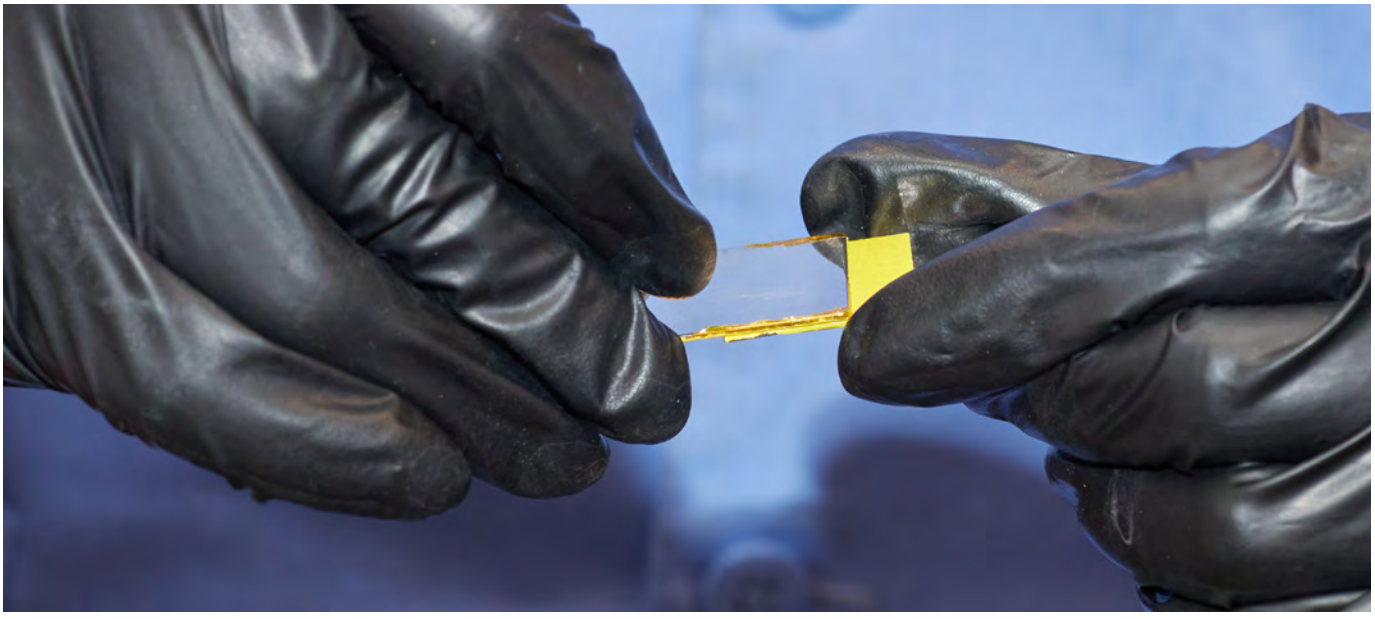
Modern society is powered by abundant, reliable, affordable energy; however, 80% of that energy is produced from fossil fuels — a major driver of air pollution and climate change. To maximize the potential of renewable energy sources, realize the promise of nuclear fusion and expand the use of nuclear fission, there are numerous technical challenges that must be addressed.

Focused research will lead to the development of cheaper, denser and more reliable forms of energy storage that can revolutionize transportation; novel micro-energy harvesting through tribo- and thermo-electricity; reliable materials for fusion reactors; safer strategies for dealing with nuclear waste; creation of smart energy grids; and more efficient photovoltaic materials.

The preparation, development and operation of new energy-dense fuels and devices to convert various forms of available energy (solar, wind, water, nuclear) into more usable forms and to store energy for future use (batteries, fuel cells) will fundamentally alter the way energy is generated and used, supporting a safer, healthier and more functional society.

The College of Science includes scientists working at the forefront of these challenges as well as collaborations with researchers from automotive engineering, environmental science, electrical engineering, chemical engineering and material science.

These scholars — utilizing infrastructure such as the Clemson Nanomaterials Institute and its forthcoming battery fabrication and testing lab and the electron microscopy and light imaging facilities — are building partnerships with industry to bring these solutions to market.



ADVANCED MATERIALS

Advanced materials are essential for every aspect of modern society, enabling development in areas such as computing, energy storage and production, and health care. Deepening our understanding of design, synthesis and characterization of advanced materials will power the technological developments of the future that will improve lives and livelihoods in as-yet-inconceivable ways.

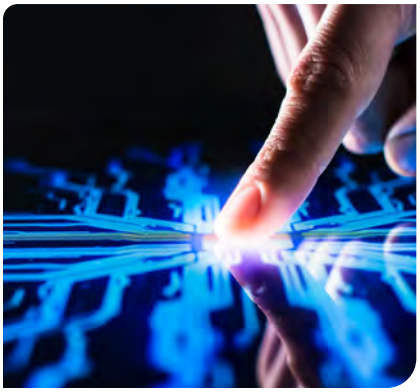
Research in this field encompasses a wide variety of materials with different compositions and properties that vary over a range of length, time and energy scales. Examples include nanomaterials, optical materials and optoelectronic structures, bio and bio-inspired materials, polymeric and lightweight materials, resilient materials, energy applications, ceramic matrix composites, and materials with properties to support emerging quantum technologies.

We seek to understand the fundamental properties of matter using analytical descriptions, numerical modeling, computational mathematics, artificial intelligence, machine learning and experimental observations.

This multidisciplinary work relies on scholarship from the fields of chemistry, physics, automotive engineering, bioengineering, electrical engineering, chemical engineering, material science and mechanical engineering.

This research builds on the historically strong record of Clemson University in the synthesis, characterization, applications and theory of advanced materials and leverages the existing infrastructure of electron microscopy, light imaging and Palmetto cluster core facilities and institutes and facilities housed at the Advanced Materials Research Laboratory and Duke Energy Innovation Center and the soon-to-be-completed Advanced Materials Innovation Complex.

DISCOVERY FOCUS AREAS



QUANTUM TECHNOLOGIES

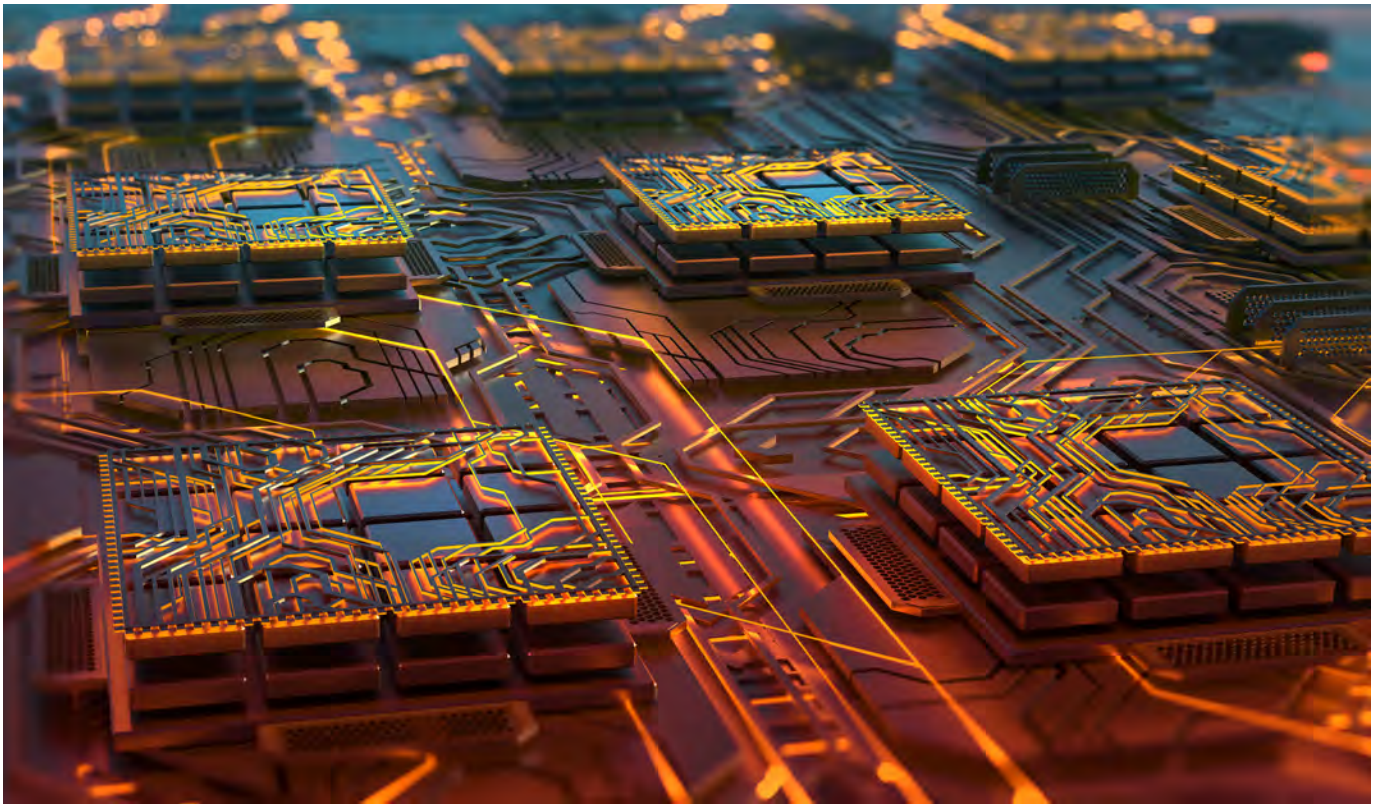
Through the 20th century, quantum science and technology (QST) has fueled technology development such as lasers, magnetic resonance imaging, semiconductors and charge-coupled devices.

Still a largely untapped area, QST has significant potential for scientific and societal impact, reinvigorating and revolutionizing advances in computing, sensing and energy storage.

QST is an active area of academic and industrial research and development with the promise to unleash an era of innovation that rivals the Industrial Revolution. Advances in QST provide platforms for novel experiments that will deepen our knowledge of the quantum world.

QST research combines insights from physics, chemistry, math, computer science, electrical engineering and material science to develop novel synthesis, fabrication, control and characterization techniques as well as forefront numerical tools to guide this work.

It benefits from the current research infrastructure at the Advanced Materials Research Laboratory and Duke Energy Innovation Center, including electron microscopy and microfabrication facilities, as well as the Palmetto cluster.



ASTROPHYSICAL & SPACE SCIENCE

Advances in technology have enabled our understanding of the cosmos beyond Earth to expand exponentially; however, fundamental questions about the origin, processes and evolution of our cosmos remain unanswered.

By studying the region of space ranging from the uppermost reaches of Earth's atmosphere to the most distant objects in the cosmos, we seek to understand the nature of supermassive black holes; the origin of the elements, planets, stars and galaxies; and prevailing space weather conditions in Earth's ionosphere-thermosphere system.

This research will address fundamental questions about the origins of the constituents of our universe. Advancing our understanding will lead to improvements in state-of-the-art models that are foundational to space situational awareness and space weather prediction, helping to guard against the potential impacts of space phenomena.

Scholars at Clemson will combine data from computational simulations, laboratory studies, and observations and insights from astronomy, chemistry, computer science, electrical engineering, mathematics, mechanical engineering, physics and space science to help answer humanity's fundamental questions about the cosmos.

National facilities provide the basic infrastructure for this work, augmented by computational and functional support from the Palmetto cluster and Clemson University instrument shop.

ACCELERATE SCIENCE CONTRIBUTORS

The College of Science thanks the below individuals for their contributions in developing and refining the Accelerate Science strategic plan.

DEAN'S OFFICE

Barbara Bass
Jennifer Blyden
Sharetta Bufford
Amy Clarke Burns
Stephen Creager
Liliana Gehring
Adam Hunter
Deborah Jensen
Yuki Kihara
Melody Land
Jennie LaMonte
Renee Lyons
Joanne Marcou
Pete Martin
Julie Tovey
Jo Ellen Van Vliet
Eryka Wallace
Calvin Williams
Harolynn Williams
Debbie Wright
Cynthia Y. Young

DEPARTMENT OF BIOLOGICAL SCIENCES

William Baldwin
Robert Ballard
Richard Blob
Nancy Brown
Barbara Campbell
Saara DeWalt
Ginger Foulk
Christine Minor
Christopher Parkinson
Vincent Richards
Michael Sears
Matthew Turnbull
Peter Van den Hurk
Yanzhang Wei

DEPARTMENT OF CHEMISTRY

Jeffrey Anker
Julia Brumaghim
Leah Casabianca
Brian Dominy
Carlos Garcia
William Pennington
Rakesh Sachdeva
Sourav Saha
Ellen Sharpe
Dennis Taylor
Daniel Whitehead

DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Weiguo Cao
David Clayton
Alex Feltus
Lukasz Kozubowski
Haiying Liang
Beth Schonert
Rajan Sekhon

SCHOOL OF MATHEMATICAL AND STATISTICAL SCIENCES

Ellen Breazel
Andrew Brown
Lynn Callahan
Colin Gallagher
Patrick Gerard
April Haynes
Kevin James
Svetlana Poznanovik
Leo Rebholz
Keri Sather-Wagstaff

DEPARTMENT OF PHYSICS AND ASTRONOMY

Marco Ajello
Sean Brittain
Amanda Ellenburg
Xian Lu
Joan Marler
Jens Oberheide
Amy Pope
Apparao Rao
Hugo Sanabria

CENTER FOR HUMAN GENETICS

Robert Anholt
Trudy Mackay

DIVISION OF MARKETING AND COMMUNICATIONS

Dave Dryden
Joe Gailbraith
Christine Green
Tara Romanella Patrick

STUDENTS

26 student representatives


of This Form Before
Sending Refrigerated
5μM PCA
10μM PCA

College of
SCIENCE

CLEMSON.EDU/SCIENCE