INTRODUCTION

The College of Computer, Mathematical, and Natural Sciences (CMNS) at the University of Maryland (UMD) aims to provide outstanding leadership in research, education, and outreach programs in the sciences across the state, nation, and world.

The college includes 10 academic departments and six research institutes and centers that report directly to the dean of the college:

**Academic Departments**

- Astronomy
- Atmospheric and Oceanic Science
- Biology
- Cell Biology and Molecular Genetics
- Chemistry and Biochemistry
- Computer Science
- Entomology
- Geology
- Mathematics
- Physics

**Research Centers and Institutes**

- Center for Scientific Computation and Mathematical Modeling
- Earth System Science Interdisciplinary Center
- Institute for Advanced Computer Studies
- Institute for Physical Science and Technology
- Institute for Research in Electronics and Applied Physics
- National Socio-Environmental Synthesis Center

As the largest college at UMD, CMNS boasts the highest numbers of undergraduates (22 percent of the total), doctoral students (29 percent of the total), and faculty members (26 percent of the total). In addition, the college’s research funding totals more than $150 million per year.

Our educational programs prepare students for a lifetime of accomplishment and contributions to society in a world that is undergoing rapid change and becoming increasingly complex. The college provides mentoring and research training that prepares undergraduate and graduate students to become the next generation of scientific leaders.

Our research programs expand the frontiers of knowledge in the computer, mathematical, and natural sciences with faculty members that include two Nobel laureates, 19 members of the National Academies of Sciences and Engineering, and 15 fellows of the American Academy of Arts and Sciences.

The college also has many successful partnerships, outreach programs, and mechanisms for engaging external constituents.

This 2017-2021 strategic plan overview outlines strategic initiatives and goals for the college in six categories:

- Undergraduate Education
- Graduate Education
- Research & Scholarship
- Personnel
- External Relations
- Communications
More than 6,000 undergraduates pursuing more than 20 academic majors, specializations, and academic minors call CMNS home. We enroll outstanding undergraduates with a passion for learning and the potential to become creative leaders in their chosen fields. We offer academically rigorous curricula that keep pace with 21st century advances in knowledge in our disciplines. We do this by employing effective pedagogical strategies to foster deeper learning through high-quality teaching and student engagement. We provide outstanding advising and mentoring to support students in achieving their academic and career goals. We foster experiential learning through faculty-mentored research and assist students in connecting to a diverse array of internship, service-learning, and education experiences locally and globally.

Goals

- Foster innovative academic programs and curricula
- Support student success through academic advising and mentoring
- Emphasize research, innovation, and experiential learning
- Enhance focus on career-readiness activities throughout the undergraduate experience

Through its 18 graduate programs, CMNS faculty members mentor more than 1,500 graduate students. Graduate students are educated and trained through cutting-edge research for a broad range of career opportunities in science, technology, and mathematics fields and beyond. Increasingly, graduate students are mentored by multiple faculty members to prepare students for future opportunities that lie at the convergence of disciplines. In fact, three of our graduate programs cross over units and colleges/schools.

Graduate students play a central role in our college. They make valuable contributions to the research output of our university, and at the same time—as teaching assistants—play a vital role in mentoring undergraduate students. As mentees, they facilitate research cooperation and partnerships with federal agencies, other universities, and international partners. Current and former graduate students serve as ambassadors to industry and other universities, and thus directly influence our standing and reputation. As mentors and teaching assistants, graduate students are the face of the university in many active-learning sections, recitations, laboratories, and undergraduate teaching experiences.

We aim to further strengthen our graduate programs. We will identify and recruit an excellent and diverse graduate student body by maintaining and advertising the scientific strength of our faculty, the breadth and flexibility of our programs, the supportive and diverse community of our units, and the success of our alumni. We are committed to working with the Graduate School, graduate program directors, and units to enhance fellowship and mentorship opportunities so that our graduate students experience success in a broad range of professional careers.

Goals

- Foster inclusive excellence
- Support mentoring, fellowship opportunities, and professional development
- Enhance the graduate student experience
RESEARCH AND SCHOLARSHIP

CMNS research and scholarship efforts focus on discovering new science and technology that will benefit the State of Maryland, our nation, and our world. The college’s research enterprise consists of nearly 1,000 research, tenured, and tenure-track faculty members; 1,500 graduate students; and many of our 6,000 undergraduate students. The overarching aim of CMNS research and scholarship is excellence and impact.

Achieving this aim requires pursuing high-impact fundamental and applied research while training the next generation of scientific leaders. Outstanding students recruited into highly competitive graduate programs are working with world-class faculty members including two Nobel laureates, 19 members of the National Academies of Sciences and Engineering, and 15 fellows of the American Academy of Arts and Sciences. Collectively, our faculty members translate their thirst for new knowledge into cutting-edge discoveries and innovations in the mathematical, computer, and natural sciences. With CMNS research funding totals of more than $150 million per year from a broad range of sources, our research portfolio plays a vital role in the research and educational mission of the university.

Pillars of our Research Enterprise

- Strong units that individually and collectively create and sustain areas of research excellence and impact, and connect the university to federal research laboratories and other partners
- Nimble units that identify and nucleate new fields and new partnerships
- Effective infrastructure, including shared research resources and support staff, which serves as a foundation for research excellence by enabling breakthrough research and the attraction of top talent

The units in our college have a strong track record of launching and sustaining areas of research excellence, as evidenced by their strong international rankings. The college aims to support existing research excellence in discovery science, which will allow for strategic investment in emerging interdisciplinary areas of research where UMD can play a leading role. These research areas leverage our existing core strengths and involve the expertise of multiple disciplines and units in CMNS, as well as other colleges/schools and external partners.

CMNS’ strategic interdisciplinary research areas include:

AUGMENTED AND VIRTUAL REALITY

Virtual reality immerses people in interactive, 3-D worlds that are incredibly lifelike. Augmented reality overlays digital information onto real-world settings, allowing people to see and use the information that matters most to them. Both technologies will soon reach far beyond gaming into health care, defense, the life sciences, and more. Our researchers are advancing applications that include enhancing medical diagnosis and treatment; providing public safety officials with critical situational awareness data and new tools to process crime scenes; and creating lifelike virtual training tools for surgical residents in trauma centers, government data and language analysts, and high-tech factory workers of the future.

BRAIN AND BEHAVIOR

Biology, computer science, and physics researchers are using innovative techniques to quantitatively assess neural and cognitive mechanisms in animal models and humans. Complemented by faculty members in engineering and the behavioral sciences, our researchers are developing and refining tools, including biomedical devices and imaging systems, to unravel how the brain integrates and processes visual, auditory, and olfactory information. Our researchers are also addressing how the brain changes with age, stores memories, and produces behavior. Their work will contribute to the new Center for Sports Medicine, Health and Human Performance—a signature component of the new Cole Field House. The facility will partly serve as a research center for joint projects between UMD and the University of Maryland, Baltimore, focused on the treatment of nervous system injury and neuroscience.
OVERVIEW OF THE 2017–2021 STRATEGIC PLAN

CYBERSECURITY
Cyber attacks are an ever-increasing threat. Although cybersecurity draws on diverse fields such as policy, economics, and the social sciences, it remains a technical discipline at its core. Our researchers in the Maryland Cybersecurity Center, in partnership with the A. James Clark School of Engineering, are developing robust defenses against the next generation of cyber threats, as well as educating students and professionals in this important area.

DATA SCIENCE
To solve many complex problems in the life sciences and physical sciences, our researchers are harnessing the power of “big data”—a popular term used to describe the massive amount of information that is acquired, stored, searched, shared, analyzed, and visualized. They are tackling the computational challenges associated with this information flood and developing new computational tools to extract the most important pieces of information from huge data sets. With new, sophisticated analytic techniques and efficient algorithms, our researchers are channeling the groundswell of data to discover patterns and unexpected connections in virtually every scientific discipline.

ECOLOGY AND EVOLUTION
Basic and applied research in biology, entomology, and the National Socio-Environmental Synthesis Center, as well as graduate programs in the biological, marine, estuarine, and environmental sciences, combine to address issues impacting the sustainability of our planet. Our faculty members bring expertise in aquatic, terrestrial and agricultural ecology; reproductive and developmental biology; evolutionary genetics and genomics; invasive pest management and biological control; pollinator health; and computational science and modeling to this research area.

ENVIRONMENTAL SECURITY
The demands we place on our environment are growing rapidly due to our increasing population, societal needs, and economic development. These demands increase competition for many vital resources—such as water and energy for industry, agriculture, and human consumption—and create geopolitical stress and security issues. Climate change adds additional stresses. Our researchers are collaborating with others across campus to understand the causes of these changes, while improving monitoring and prediction of vulnerabilities that link environmental changes to socioeconomic stresses and security risks. They strive to better assess these vulnerabilities to life, property, and governance at home and abroad on time scales of years to decades.

NANOBIOSCIENCES
The confluence of nanotechnology and the biosciences boasts transformative potential that will directly boost the emerging industry of nanobiotechnology. The nanobiosciences offer the opportunity to invent entirely new classes of biologically active, nanoscale materials that may be used to cure disease and enhance human health through effective targeted drug delivery and real-time, minimally invasive diagnostics. Our researchers offer unique strengths in developing innovative nanobiomaterials and are poised to impact the nanobiosciences through fundamental discoveries in the areas of RNA biology and chemical biology. This research area fosters collaborations among scientists, engineers, and others studying the impact of these emerging technologies in the fields of ethics, economics, public policy, and public health.
OVERVIEW OF THE 2017–2021 STRATEGIC PLAN

Planetary Science and Exploration

Our knowledge of the birth and evolution of planetary systems is changing rapidly. Recent advances in astronomy, planetary exploration, cosmochemistry, and astrobiology are enabling our researchers to answer big questions about the formation of planets, comets, and asteroids; the origins of life; and the habitability of planets orbiting other stars. To answer these questions, our researchers are investigating the properties and evolution of dust, gas, and ices involved in the formation of planetary systems; the interior structures and surface features of planets and moons to understand internal dynamics; the chemical composition of planetary materials; and the existence of water and other chemicals in the atmospheres of planets in other solar systems.

Quantitative Life Sciences

Our understanding of living systems is transforming rapidly, with huge amounts of quantitative information accessible for each cell, each organ, and even each person with today’s emerging biomedical technologies. The challenge now is to transform this data into knowledge. Researchers in biology, chemistry, computer science, mathematics, and physics—in partnership with clinicians and federal laboratories—are creating quantitative approaches and technologies that analyze and model biological systems at multiple scales. Our scientists are building models of how immune cells recognize invaders, measuring how crowds of brain cells work together, and developing personalized approaches to treat diseases such as cancer.

Quantum Science

The race is on to build the first quantum computer, which scientists believe will be able to solve problems that are intractable using current technology. Boosted by industry and government partnerships, we are a world leader in quantum science. In the new Physical Sciences Complex, our researchers investigate a complete range of approaches, including programmable quantum computers, quantum communication networks that cannot be tapped, quantum-limited sensors, and exotic materials with strange and useful properties. The key goal is to harness quantum mechanics to solve next-generation information-processing challenges.

Goals

- Pursue research excellence
- Recruit and enable excellent researchers
- Enhance shared research infrastructure
- Nurture and develop partnerships
- Impact education with research
OVERVIEW OF THE 2017–2021 STRATEGIC PLAN

PERSONNEL

Excellence requires supporting the staff and faculty members who educate our students and strengthen our research and scholarship efforts. We need to continually work hard to enhance morale; increase equity, diversity, and inclusiveness; promote professional development; and develop a culture of cooperative and supportive work ethics throughout the college.

Goal

• Improve equity, diversity, inclusion, and engagement among staff and faculty members

EXTERNAL RELATIONS

The mission of the CMNS Development and Alumni Relations Office is to increase resources for CMNS faculty and staff members, and students. The spirit of the office is one of positive interactions, revenue growth, and mutual benefits for donors and the institution.

Goals

• Increase financial support for faculty members
• Acquire infrastructure endowments to name facilities and programs
• Grow support for graduate and undergraduate education
• Increase diversity initiatives
• Improve annual giving
• Increase corporate support
• Increase engagement and activities of volunteers

COMMUNICATIONS

The mission of the CMNS Communications Office is to promote the high quality of CMNS people, programs, research, and events through a diverse set of channels, including news releases, the college’s alumni magazine, Odyssey, web and print materials, emails, and social media.

Goal

• Effectively communicate the many strengths and successes of CMNS internally, across campus, and externally