Brilliant Science is...

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...the imagination, creativity, and innovation of Columbia students.
“Research has been a defining aspect for me as a science major here at Columbia. I could not have imagined that I would be flown out to Texas to be acknowledged for the research I have been conducting. It is because of the opportunities I have been offered by Columbia and my professors that my career as a successful scientist is already beginning.”

Amanda Olivo
Biochemistry
Research has been a defining aspect for me as a science major here at Columbia. A year ago I could not have imagined that I would be flown out to Texas to be acknowledged for the research I have been conducting. It is because of the opportunities I have been offered by Columbia that my career as a successful scientist is already beginning to take shape.”

Amanda Olivo
Biochemistry
Join a rich tradition of discovery and innovation that has changed history and human understanding of the world.

In recent years alone, eight of our faculty members have won the Nobel Prize. This includes Martin Chalfie, Professor of Biological Sciences, who shared the 2008 Chemistry Nobel Prize for his work in discovering and developing the green fluorescent protein (GFP), and Professor of Biochemistry and Molecular Biophysics Richard Axel, CC ’67, who shared the 2004 Physiology Nobel Prize for his work in mapping the genes that govern the sense of smell.

Modern genetics, plate tectonics, robotics, the environmental movement, pioneering stem cell research, the discovery of deuterium, the first supercomputer and personal computer, and climate science have all been born out of Columbia Blue.
Top Fellowships

The Rhodes Scholarship, Hertz Fellowship and Gates-Cambridge Scholarship and multiple Fulbright Fellowships, Truman Scholarships, Goldwater Scholarships, Udall Scholarships and National Science Foundation Fellowships have been awarded to recent Columbia science majors.

91% admit rate for M.D./Ph.D. programs in the past three years.

200+ research institutes and centers, including a wide range of world-class laboratories.

$900 Million in sponsored research projects each year.

82 Nobel Prize winners are Columbia alumni, faculty, or former faculty. More Nobel Laureates have graduated from or taught at Columbia than any other university in the Ivy League.

Some students are guaranteed research experiences for 4 years at time of admission.

Columbia has over 1,000 active patents across the full spectrum of research areas.
Columbia is at the center of many of the world’s most exciting scientific leaps. More than a third of Columbia College undergraduates choose science majors. When you include Columbia Engineering majors, half of all our undergraduates are majoring in science or related fields. Most science departments have a 3-to-1 student-to-faculty ratio.

No matter your major or department, at Columbia you join a collaborative science community that emphasizes the interdisciplinary nature of scientific inquiry. So your opportunities for research are never bound by departmental structures and majors.
Areas of Study, Interdisciplinary Research, and Subfields

1. Astronomy and Astrophysics
   Majors
   **Astronomy, Astrophysics**
   Subfields
   active galactic nuclei; galaxies; gamma-ray sources; large scale structure and cosmology; neutron stars and supernovae; planetary science; stars and stellar evolution; surveys

2. Biological Sciences
   Major
   **Biology**
   Subfields
   cell molecular biology; developmental biology; neurobiology; structural biology and molecular biophysics; systems and computational biology

3. Chemistry
   Majors
   **Chemistry, Environmental Chemistry**
   Subfields
   biological chemistry; chemical physics; environmental chemistry; inorganic chemistry; organic chemistry; materials chemistry; physical chemistry; theoretical chemistry

4. Computer Science
   Majors
   **Computer Science, Information Science**
   Subfields
   computational biology; computer security; foundations of computer science; machine learning natural language; processing; network systems; software systems; vision and graphics

5. Earth and Environmental Sciences
   Majors
   **Earth Science, Environmental Science**
   Subfields
   aqueous geochemistry; atmospheric science; biogeochemistry; climate science; ecophysiology; geology; marine geology and geophysics; paleoclimate; paleontology; physical oceanography; seismology and solid earth geophysics; solid earth geochemistry

6. Ecology, Evolution and Environmental Biology (E3B)
   Majors
   **Environmental Biology, Evolutionary Biology of the Human Species**
   Subfields
   animal behavioral biology and ecology; community, landscape and ecosystem ecology; conservation biology; demography and population biology; evolutionary and population genetics; forensic osteology; global change biology; human evolution; paleoanthropology; plant and animal systematics; skeletal biology; related fields including disease ecology and ethnobiology

7. Mathematics
   Majors
   **Mathematics, Applied Mathematics**
   Subfields
   algebraic geometry; geometric analysis; mathematical finance; mathematical physics; number theory; partial differential equations; probability; representation theory; string theory; topology

8. Physics
   Major
   **Physics**
   Subfields
   astrophysics; atomic, molecular, and optical physics; biophysics; condensed matter physics; cosmology; high energy nuclear physics; high energy particle physics

9. Psychology
   Major
   **Psychology**
   Subfields
   behavioral neuroscience; cognition; cognitive neuroscience; decision-making; motivation; neurobiology; social psychology; social cognitive neuroscience; social relations; visual perception

10. Statistics
    Major
    **Statistics**
    Subfields
    actuarial science; data mining; disease epidemic and etiology analyses; financial mathematics; neural coding; political data analysis; social network analysis; statistical genetics; statistical theory

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Interdisciplinary Majors

**Biochemistry**

**Biophysics**

**Chemical Physics**

**Computer Science-Mathematics**

**Mathematics-Statistics**

**Neuroscience and Behavior**
“What is most impressive to me about research at Columbia is that it is so dynamic and so cutting edge in every field. If it’s talked about by leading researchers, someone is working on it. Do I get to hear about and some of the big issues in supersymmetry, and non-proliferation, but I have many friends who are doing so many interesting things in other fields from differential geometry to gene therapy.”

STEPHEN CHAN
Physics
to me about research at Columbia. Not only do I get to hear about and discuss with faculty some of the big issues in physics like dark matter, supersymmetry, and non-proliferation, but I have many friends who are doing so many interesting things in other fields from differential geometry to gene therapy.
A computer models the first star—the generator for elements that created planets and, eventually, life. Columbia’s Astrophysics Laboratory helped track a key chemical reaction after the Big Bang that allowed stars to emerge from clouds. It’s a significant contribution to cosmologists pursuing universal truths.

Astronomy and Astrophysics

New research simplifies equation to determine how stars originated

Biological Sciences

Chemical biologist examines “undruggable” proteins to help find new cures for disease

Chemistry

The synthetic compounds Associate Professor of Chemistry Scott Snyder has developed can prevent ultraviolet sun damage and modulate neurodegenerative disease among other benefits.

Chemistry professor investigates ways nanoscience can increase solar cell efficiency

Computer Science

Computer scientist uses modeling to demonstrate complex movement through animation
As a Columbia scientist you are surrounded by trailblazing ideas on a daily basis in every field. Here are just a few of the breakthroughs by Columbia professors and researchers that made the headlines recently.

Earth and Environmental Sciences

Columbia geologists discover that Antarctica ice sheets refreeze and impact glacial movements

Statistics

Professor uses statistical analysis to examine voting patterns and reconstruct climate history

Psychology

Study finds that using Internet search engines changes the way our memory works

Ecology, Evolution and Environmental Biology

Neuroscientist studies songbirds to learn how new languages are acquired

Physics

Columbia physicists at CERN assist in finding the elusive Higgs boson, seen as key to the universe

Statistics Professor Andrew Gelman finds infinite possibilities in numbers, allowing him to decode the climate history hidden in tree rings as well as unpack the American political divide in his book, Red State, Blue State, Rich State, Poor State: Why Americans Vote the Way They Do.
Nobel Laureates with Open Office Hours

At Columbia, you work with many of the best and the brightest scientific minds in the world.

Being part of this community means learning, collaborating, co-authoring papers, and often forming lasting friendships with today’s and tomorrow’s greatest scientists.

Here are some of the passionate faculty who could help you realize your own potential for discovery and innovation.
Neuropsychiatrist Eric Kandel, who was a recipient of the 2000 Nobel Prize in Physiology or Medicine for his research on the physiological basis of memory storage in neurons, is the subject of the documentary “In Search of Memory.” He mentors undergraduates in his Columbia College of Physicians and Surgeons lab every summer.
Brian Greene
Professor of Mathematics and Physics
Department of Physics
Co-Director of Columbia’s Institute for Strings, Cosmology, and Astroparticle Physics

Undergraduate Courses & Research
Frontiers of Science
Intro to Quantum Mechanics

Professor Brian Greene is recognized for a number of groundbreaking discoveries in his field of superstring theory. He teaches several undergraduate courses and mentors students. His books include The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory, which was adapted for a Peabody Award-winning television special on PBS. He is one of the founders of New York’s World Science Festival.

Shahid Naeem
Professor of Ecology
Chair of the Department of Ecology, Evolution and Environmental Biology
Director of Science at The Earth Institute’s Center for Environmental Research and Conservation

Undergraduate Courses & Research
Environmental Biology I
Climate and Biodiversity
Directed Research

Professor Naeem studies the ecological and environmental consequences of biodiversity loss, which he calls the single most significant problem in contemporary ecology. He co-chaired the 2005 Millennium Ecosystem Assessment Biodiversity Synthesis Report, a project created to set a scientific basis for sustainable development. He and his team, which includes undergraduates, pioneer ways of understanding how ecosystems are affected by the loss of species. Their motto is “Ecology with no apology.”

Virginia Cornish
Helena Rubenstein Professor of Chemistry
Department of Chemistry

Undergraduate Courses & Research
Frontiers of Science
Chemical Biology

Virginia Cornish, CC ’91, Professor of Chemistry and an alumna of Columbia College and its Chemistry Department, works closely with students as an undergraduate biochemistry major advisor and in teaching a wide array of classes. She also mentors students in her laboratory, where her group’s award-winning research brings together modern methods in synthetic chemistry and DNA technology to expand the synthetic capabilities of living cells.
Darcy B. Kelley  
*Harold Weintraub Professor of Biological Sciences*  
*Chair of Frontiers of Science*

**Undergraduate Courses & Research**  
Frontiers of Science  
Developmental and Systems Neurobiology  
Independent research and mentor in the Summer Undergraduate Research Fellowship program

In 2002, 20 scientists were chosen to receive $1 million each as the first Howard Hughes Medical Institute (HHMI) Professors. Their charge was to innovate undergraduate science education. Professor Darcy Kelley used her grant to work with other faculty members to help create Frontiers of Science, which expanded Columbia’s Core Curriculum with an interdisciplinary course that introduces students to the types of questions scientists ask and the sort of research they are pursuing. Dr. Kelley’s own research uses the South African clawed frog, Xenopus laevis, to study the neurobiology, genetics and evolution of social communication and to analyze sexual differentiation.

Ruben Gonzalez, Jr.  
*Associate Professor*  
*Department of Chemistry*

**Undergraduate Courses & Research**  
General Chemistry  
Biophysical Chemistry

Professor Gonzalez helped pioneer the first single-molecule fluorescence investigations of the ribosome, the RNA-based biomolecular machine responsible for protein synthesis in all living cells. His undergraduates are now working with him on award-winning research focusing on the biophysical chemistry and biochemistry of the ribosome and nature’s other RNA-based biomolecular machines. Studying these machines will lead to a deeper understanding of the mechanisms underlying gene expression and the deregulation of gene expression that is associated with numerous human genetic diseases, including cancer and viral infections.

Elena Aprile  
*Professor*  
*Department of Physics*

**Undergraduate Courses & Research**  
Intermediate Laboratory Work  
Advanced Laboratory Work

Professor Aprile leads the XENON Dark Matter Experiment designed to search for the invisible matter that makes up nearly a quarter of the universe. The experiment, built largely at Columbia’s Nevis Laboratories before installation at an underground lab in Italy, uses hundreds of kilograms of liquid xenon as target and detector for Weakly Interacting Massive Particles (WIMPs), the theoretically favored candidate for dark matter. The XENON Collaboration currently includes multiple universities in the US, Europe, China and Israel.
“Being a science student at Columbia means that you are a full member of a major research institution. All of our faculty mentor undergraduates in their labs, and because of the large number of science faculty, every student has an opportunity to do research the day you arrive on to graduation.”

JAMES J. VALENTINI
Dean of Columbia College and Vice President for Undergraduate Education
Professor of Chemistry
November 21, 2011
Columbia means a major research institution. All of our faculty members mentor undergraduates in their labs, and because of the large number of science faculty, every student has an opportunity to do research. You can begin and continue right
Research from Day One

From the smallest molecules to the farthest reaches of the universe, Columbia scientists are at the vanguard of discovery. **Search, build, study, and seek out what’s next.**

<table>
<thead>
<tr>
<th>Research from Day One</th>
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<tbody>
<tr>
<td><strong>Search for the Higgs boson at the Large Hadron Collider near Geneva.</strong></td>
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<tr>
<td><strong>Build perfect crystalline materials using a nanopencil.</strong></td>
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<tr>
<td><strong>Study the leading cause of hereditary blindness worldwide by modeling anatomical and behavioral damage in the retina.</strong></td>
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<tr>
<td><strong>Investigate how mutations in HELLS genes are involved in leukemia.</strong></td>
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<tr>
<td><strong>Explore how cultural psychology overlaps with economics as it applies to individual group membership.</strong></td>
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<tr>
<td><strong>Research primate social behavior in Kenya.</strong></td>
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<tr>
<td><strong>Research the thermoelectric and magnetothermoelectric transport properties of graphene.</strong></td>
</tr>
<tr>
<td><strong>Map the movement of glaciers at Lamont-Doherty Earth Observatory.</strong></td>
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<tr>
<td><strong>Study social communication and language development in Zebra and Blackheart Finches.</strong></td>
</tr>
<tr>
<td><strong>Investigate the ecological and environmental consequences of biodiversity loss.</strong></td>
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<tr>
<td><strong>Study marine sediments to reconstruct past changes in climate.</strong></td>
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<tr>
<td><strong>Discover new ways to predict and monitor Alzheimer’s disease in the brain.</strong></td>
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<tr>
<td><strong>Help create mathematical models of visual processes taking place within the brain.</strong></td>
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<tr>
<td><strong>Research renewable energy resources through The Earth Institute.</strong></td>
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<tr>
<td><strong>Measure the electrical conductivity of single DNA molecules.</strong></td>
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<tr>
<td><strong>Seek the origin of the universe by observing the cosmic microwave background from the Big Bang.</strong></td>
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“My research interests include low-temperature physics in semiconductors like Gallium Arsenide. I am also interested in nanotechnology, which incorporates new materials like carbon nanotubes, graphene, and quantum dots. In working for Professor Aron Pinczuk, my favorite part of the research is taking data. To do so, we use a powerful laser, liquid nitrogen, and liquid helium.”

**Mentor**

Professor of Physics and Professor of Applied Physics

Aron Pinczuk, whose primary research is in nanostructures, an area that has revolutionized the technologies of contemporary microelectronics and optoelectronics.
“I’m studying the climate history of the last ice age using deep-sea sediments off Vancouver Island. My project focuses on the Missoula Floods” — a cycle of catastrophic flooding that helped carve the landscape of the Northwest.

**Mentor**

Professor of Earth and Environmental Sciences Sidney Hemming, who researches geochronology, sedimentary geochemistry, paleoclimate, and continental crust evolution at Columbia’s Lamont-Doherty Earth Observatory.
“Computers convert text to speech and vice versa. They identify voices and dialects, detect deception, recognize human emotions, and more. I’m creating a program that infers emotions from text — not just whether that emotion is positive or negative, but if the actors in the sentence are angry, sad, happy, surprised, disgusted, or afraid. As yet, there are no systems that do this multiple-emotion detection effectively.”

**Mentors**

Professor of Computer Science Julia Hirschberg and Bob Coyne, a member of the Hirschberg research team in the Natural Language Processing (NLP) Group.
“Imagine sitting around a table with twenty classmates who are as talented as you are, but in fields about which you know nothing. Imagine that they were all drawn to that table because they, like you, do not want to be bound to a single discipline. And now, imagine spending four hours a week with them, analyzing Plato’s Republic or the late works of Virginia Woolf to shape and add nuance to your own views. That is the essence of Columbia’s Core Curriculum.”

MOLLIE SCHWARTZ, CC ’09
Ph.D. candidate in chemistry, 2008 Goldwater Scholarship winner
Imagine sitting around a table with twenty classmates who are as talented as you are, but in now nothing. Imagine to that table because nt to be bound to a single gine spending four analyzing Plato’s s of Virginia Woolf to your own views. That is s Core Curriculum.”
As a scientist you work to solve some of the most difficult challenges facing humanity today — disease, energy, hunger, poverty, the Earth’s sustainability, global health, economic solvency, freedom and democracy, safety and security. These complex challenges call on your creativity, your analysis, your sense of ethics, your global understanding, the breadth of your knowledge, and the depth of your expertise.

Columbia scientists know how to weigh scientific questions along with human ones. For almost 100 years, the Columbia Core Curriculum has cultivated a critical and creative intellectual capacity to prepare students to lead in the field of science and beyond.
Preparing to Solve Pressing Issues

**The Core Curriculum** is a set of classes you take with your fellow Columbians regardless of major. Core seminars thrive on debate over the most difficult questions of human experience.

**University Writing**

Develop grant proposals, publish research results — successful scientists are compelling communicators. You will read and discuss texts from a number of fields, learn to write critically and persuasively and undertake a collaborative project of your own design.

**Literature Humanities**

Confront issues of the individual versus community — questions at the core of science policy.

**Scientific Questions that Require More than Science**

Some people are suspicious of vaccination yet the public health benefits are many. How can we balance individual and community, and develop vaccines that are acceptable to all?

Scientists can identify genetic markers for more inherited characteristics, including diseases as well as benign conditions like left-handedness. Can we draw a line between acceptable and unacceptable use of this data?

It is possible to develop driverless automobiles that would reduce congestion dramatically. Yet people are likely to be unwilling to put up with the loss of control such a system would require. How can scientists help to usher in advanced technologies while remaining sensitive to society’s occasional resistance to change?

**Engineering and other scientific disciplines** can respond to climate change, but focusing on new innovative solutions may cause people to believe the problem will just be solved by technology. How do we balance short term and long term needs?

**Contemporary Civilization**

The world’s most enduring philosophers will help you think deeply about power, democracy, and responsibility — concepts that drive debates about technology and ethics.

**Art and Music Humanities**

Innovation in science is similar to innovation in other fields. Branching out to study the arts, literature, and philosophy improves your facility with science by giving you the ability to think without restriction.

Some people are suspicious of vaccination yet the public health benefits are many. How can we balance individual and community, and develop vaccines that are acceptable to all?
New York City gives you an unparalleled place to come of age as a scientist. As a major center for research, science, and technology, the city allows Columbia scientists — both students and faculty — to work at their most innovative edge.

Many of the world’s leading science and technology organizations, institutions, and foundations are here. And that means the people behind the game-changing work being done in science are here, too. Our city extends and amplifies options for scientific fieldwork, research, and internships.

The fact that you also live, work, and play in the middle of one of the greatest arts, media, and financial capitals in the world expands and deepens your thinking and experience even further.
1. Columbia University Medical Center
2. World Science Festival
3. Bronx Zoo
4. New York Botanical Garden
5. New York Hall of Science
6. World Health Organization
7. Wall Street
8. Silicon Alley
9. Rose Center for Earth and Space, featuring the Hayden Planetarium
Columbia ...

Where every day we are pushing the conversation of discovery forward.

Where you can pursue emerging fields like disease ecology and conservation medicine as well as fundamental disciplines like chemistry and physics, all at the highest level.

Where your mentors will invite you into the global science community, guiding you, teaching you, and inspiring you.

Where your studies span not only science but other fundamental human questions, making you a better scientist.

Where New York City is an integral part of who you become as a person and a scientist.

Where the future is unfinished and the world is waiting.

Be part of Brilliant Columbia Blue.
Office of Undergraduate Admissions
Columbia University
212 Hamilton Hall, MC 2807
1130 Amsterdam Avenue
New York, NY 10027

For more information about Columbia University, please call our office or visit our website:

212-854-2522
undergrad.admissions.columbia.edu