

Mellon College of Science

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www.cmu.edu/mcs (<http://www.cmu.edu/mcs/>)

The Mellon College of Science (MCS) has provided the undergraduate training for many of today's leading scientists. We have earned national recognition for our integration of undergraduate education and research from such organizations as the National Science Foundation, the Howard Hughes Medical Institute, and the Beckman Foundation. MCS students gain a broad education in science, mathematics, and the liberal arts while using state-of-the-art computational approaches in their courses, laboratories, and research activities. Our faculty members are committed to teaching as well as to a wide range of scientific research. This combined emphasis on education and research brings special benefits to students, including increased awareness of current scientific developments that are incorporated in classroom instruction, and, most importantly, opportunities to participate with faculty, graduate students, and other research scientists in a variety of research projects.

In the context of rigorous training in each field, the MCS curriculum emphasizes problem-solving, communication, and analytical skills, and it teaches our students the value of hard work and discipline. Our students go on to highly successful careers in a broad range of fields like astrophysics, biotechnology, computer science, business management, environmental science, health care policy, investment banking, marketing analysis, medicine, patent law, and pharmaceuticals. Our alumni credit their education in science for preparing them for a lifetime of learning and achievement; their employers attest to their ability to succeed and to continue learning in an ever-changing world.

The MCS Departments of Biological Sciences, Chemistry, Mathematical Sciences, and Physics each outline their degree programs and courses in the departmental sections. Students select their major in the spring of the first year so that the sophomore year begins with a focus within a department. Most of the courses required within a major are scheduled in the sophomore and junior years, leaving much of the senior year and part of the junior year open for electives. This provides the opportunity to participate in undergraduate research, explore interdisciplinary studies, study abroad, pursue additional majors or minors in other fields, or take other specialty courses oriented toward immediate job placement upon graduation or entry into graduate studies.

Science education in the 21st Century demands educational experiences that are much broader than the traditional preparation of a scholar in a chosen field of science. We want our MCS graduates to be **scholars** who are deeply trained in their discipline(s), and also **professionals** adept at communicating to broad audiences, accustomed to working in diverse, multidisciplinary teams, and keenly aware of the global context of their work. We want them to be **citizens** who are actively involved and globally engaged, and to grow as **persons** with a sense of wellness and balance.

With these ambitions in mind, we have set forth fifteen (15) outcomes that all MCS undergraduate students should complete in their time at Carnegie Mellon. Upon graduation, MCS students should be able to:

1. Apply foundational and advanced mathematical and scientific knowledge in a chosen field of study appropriately and fluently to solve complex problems, to integrate concepts across disciplines, and to adapt their knowledge to new situations.
2. Critically assess their current state of knowledge and expertise and acquire new knowledge in pursuit of both specific scientific goals and new intellectual interests broadly throughout their lifetime.
3. Communicate effectively via oral, visual, and written formats with an understanding of the perspectives and expectations of diverse audiences, including those within their chosen discipline, outside that discipline (but within STEM), and non-scientists.
4. Participate effectively in multidisciplinary research and/or other teams pursuing a shared vision while optimizing team outcomes.
5. Use the appropriate tools and required media literacy to acquire, assess, and analyze data and information from diverse sources.
6. Recognize and explain the importance of at least one current research topic in a STEM field outside of their major.
7. Recognize and explain the similarities and differences in analyzing/approaching problems, including in technical and non-technical fields other than their major.
8. Demonstrate knowledge of the arts, humanities, and social sciences.
9. Recognize the interplay of science, society, public policy, business, and economics.
10. Identify global examples of the reciprocal relationships among science, technology, political forces, societal contexts, and environmental issues.
11. Describe multiple similarities and differences between one's own culture and that of others.
12. Engage in recursive, reflective processes to assess their own levels of physical, emotional, and social wellness and then to choose activities that promote these aspects of wellness.
13. Engage in recursive, reflective processes to balance multiple endeavors by setting priorities and managing time in academic, meta-curricular, and personal dimensions.
14. Recognize ethical issues and appreciate the complexities of interrelationships among them, and the use of information in ethical and legal manners.
15. Articulate how one's own developing skills in science and technology can be increasingly used in constructive community service or engagement that recognizes the potential impact on local and global issues, including environmental impact and sustainability.

Tailoring Your Education

The Mellon College of Science offers students tremendous opportunity for tailoring their education to meet individual professional objectives. Whether you target your degree to a particular field in your discipline via departmental options and concentrations, add a secondary major, minor, or degree to your primary degree program, participate in honors programs, or pursue a master's degree along with your bachelor's degree, MCS has much to offer you. Many of these opportunities are outlined below.

Departmental Concentrations

Each department in MCS offers degrees and programs that allow students to explore particular fields within a science discipline. These are outlined below — see the departmental sections for further details.

Biological Sciences

- Biochemistry
- Biophysics

- Cell Biology
- Computational Biology
- Developmental Biology
- Genetics
- Molecular Biology
- Neuroscience

Chemistry

- Biochemistry
- Biological Chemistry
- Colloids, Polymers, and Surfaces
- Computational Chemistry
- Environmental Chemistry
- Management
- Material Chemistry
- Polymer Science

Mathematical Sciences

- Computational and Applied Mathematics
- Computational Finance
- Discrete Mathematics and Logic
- Mathematics
- Operations Research
- Statistics

Physics

- Applied Physics
- Astrophysics
- Biological Physics
- Chemical Physics
- Computational Physics
- Quantum Physics

Minors, Double Majors, and Double Degrees

As an MCS student, you can pursue additional majors and minors to complement your primary degree, not only within the science college, but also through the other colleges at Carnegie Mellon. Carnegie Mellon offers many exciting interdisciplinary majors and minors, some of which are listed below. In addition, every college and most departments have designed minors or second majors in their discipline so that you can gain expertise in their fields as well.

Some students choose to gain this expertise by following a double degree program. This results in two distinct bachelor's degrees. Please see the section on Undergraduate Academic Regulations for a more formal definition of these "Multiple Degree" programs.

Interdisciplinary Majors and Minors

Here is a sampling of just a few of the interdisciplinary minors and majors offered at Carnegie Mellon (not all are in MCS). Please see the appropriate sections elsewhere in this catalog for specific descriptions and course requirements.

- Biological Sciences and Psychology Major
- Engineering Studies Minor
- Environmental and Sustainability Studies Additional Major or Minor
- Environmental Policy Major
- Health Care Policy and Management Minor
- International Affairs Minor
- Mathematics and Economics Major
- Neuroscience Major and Minor
- Operations Research Minor
- Robotics Minor
- Scientific Computing Minor
- Technology and Policy Minor

For a complete list of the minors offered at Carnegie Mellon, please go to Undergraduate Options (<http://coursecatalog.web.cmu.edu/aboutcmu/undergraduateoptions/#minorstext>).

University Student-Defined Majors

With a well-thought proposal, you may be able to pursue a major you have designed to meet your particular interests and goals. Please see the catalog section on Student-Defined Majors (<http://coursecatalog.web.cmu.edu/aboutcmu/undergraduateoptions/#studentdefinedmajortext>). MCS students wishing to pursue a student-defined major should contact the MCS Senior Associate Dean for Student Success and Strategic Initiatives (<https://www.cmu.edu/mcs/undergrad/advising/>).

General Education Requirements

Students pursuing any MCS bachelor's degree will fulfill the 15 Core Education outcomes (p. 1) through their primary MCS major and by completing the following technical and nontechnical breadth requirements prior to graduation. Please see MCS Course Planning Guide (<https://www.cmu.edu/mcs/undergrad/course-planning.html>) for the recommended timeline to complete these requirements.

Technical Breadth Requirements

As a 21st Century practicing scientist or mathematician, our graduates will work with others from a variety of technical backgrounds. Therefore, all of our students will be broadly trained within the technical fields of science and math. Students will fulfill this training by completing four (4) technical courses in the Science, Technology, Engineering, and/or Mathematics (STEM) fields at Carnegie Mellon University.

A student must take at least 9 units, outside of their primary major department, from each of four categories listed below. These may include prerequisite courses or courses required by their major department but must be outside their home department. AP/IB/Cambridge credit may NOT be used to fulfill these requirements. At least three of these courses must be taken in their first year. The categories are:

A. Life Sciences

(Refer to your specific department for how this category should be fulfilled. Some courses have prerequisites that can be satisfied by AP, IB, Cambridge A Level Exams. Please check the prerequisites requirements as necessary.)

LIFE SCIENCES

02-250	Introduction to Computational Biology	12
02-261	Quantitative Cell and Molecular Biology Laboratory	9
03-117	Frontiers, Analysis, and Discovery in Biological Sciences	6
03-121	Modern Biology	9
03-151	Honors Modern Biology	10
03-124	Modern Biology Laboratory	9
03-125	Evolution	9
03-132	Basic Science to Modern Medicine	9
03-133	Neurobiology of Disease	9
03-135	Structure and Function of the Human Body	9
03-161	Molecules to Mind	9
03-231	Honors Biochemistry	9
or 03-232	Biochemistry I	
42-101	Introduction to Biomedical Engineering	12
42-202	Physiology	9
85-170	Foundations of Brain and Behavior	9

B. Physical Sciences

(Refer to your specific department for how this category should be fulfilled. Some courses have prerequisites that can be satisfied by AP, IB, Cambridge A Level Exams. Please check the prerequisites requirements as necessary.)

PHYSICAL SCIENCES

09-105	Introduction to Modern Chemistry I	10
09-106	Modern Chemistry II	10
09-107	Honors Chemistry: Fundamentals, Concepts and Applications	10
09-111	Chemical Building Blocks	9
09-214	Physical Chemistry	9
09-217	Organic Chemistry I	9
09-219	Modern Organic Chemistry	10
09-221	Laboratory I: Introduction to Chemical Analysis	12

09-225	Climate Change: Chemistry, Physics and Planetary Science	9
09-348	Inorganic Chemistry	10
33-121	Physics I for Science Students	12
33-122	Physics II for Biological Sciences & Chemistry Students	9
33-141	Physics I for Engineering Students	12
33-142	Physics II for Engineering and Physics Students	12
33-151	Matter and Interactions I	12
33-152	Matter and Interactions II	12
33-211	Physics III: Modern Essentials	10
33-224	Stars, Galaxies and the Universe	9
33-225	Quantum Physics and Structure of Matter	9

C. Mathematics, Statistics, and Computer Science

(Refer to your specific department for how this category should be fulfilled. Some courses have prerequisites that can be satisfied by AP, IB, Cambridge A Level Exams. Please check the prerequisites requirements as necessary.)

MATH, STATS, and CS

02-120	Programming for Scientists	12
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
21-127	Concepts of Mathematics	12
21-128	Mathematical Concepts and Proofs	12
21-228	Discrete Mathematics	9
21-241	Matrices and Linear Transformations	10
or 21-240	Matrix Algebra with Applications	
or 21-242	Matrix Theory	
21-259	Calculus in Three Dimensions	10
or 21-268	Multidimensional Calculus	
or 21-269	Vector Analysis	
21-260	Differential Equations	9
or 21-261	Introduction to Ordinary Differential Equations	
36-200	Reasoning with Data	9
36-202	Methods for Statistics & Data Science	9
36-220	Engineering Statistics and Quality Control	9
36-225	Introduction to Probability Theory	9
36-309	Experimental Design for Behavioral & Social Sciences	9
15-110	Principles of Computing	10
15-112	Fundamentals of Programming and Computer Science	12
15-122	Principles of Imperative Computation	12
15-150	Principles of Functional Programming	12
15-251	Great Ideas in Theoretical Computer Science	12

D. STEM Course

- All of the above courses
- Any introductory engineering course from CIT
- A STEM course approved by an MCS advisor

Technical Breadth-Departmental Requirements

Some of the majors in MCS require certain courses from the technical breadth requirement that are necessary for either prerequisite knowledge in the major or scientific breadth. For each of the four majors in MCS the Technical Breadth Requirement is completed as follows. If these requirements are met by AP/IB/Cambridge A Level Exams, students can choose any course from the categories to fulfill the Technical Breadth Requirement.

Biological Sciences

1. Life Sciences: any courses in this category **except** for the 03-XXX courses
2. Physical Sciences: 09-105, 09-106, 33-121 and 33-122
3. Math/CS/Stats: 21-120 and 21-122
4. STEM Elective: will be filled by courses above or any STEM course from the approved list.

Chemistry

1. Life Sciences: 03-121 or 03-231 or 03-232
2. Physical Sciences: 33-121 and 33-122
3. Math/CS/Stats: 21-120 and 21-122
4. STEM Elective: will be filled by courses above or any STEM course from the approved list.

Mathematical Sciences

1. Life Sciences: any courses in this category
2. Physical Sciences: any course in this category
3. Math/CS/Stats: any course in this category **except** for the 21-XXX courses, 36-200, or 36-202
4. STEM Elective: any STEM course from the approved list.

Physics

1. Life Sciences: 03-121
2. Physical Sciences: 09-105
3. Math/CS/Stats: 21-120, 21-122, 21-259
4. STEM Elective: will be fulfilled by courses above or any STEM course from the approved list.

Nontechnical Breadth Requirements

MCS aspires for all of our undergraduates to leave our campus with a strong sense of personal integrity, social responsibility, ethics, working with diverse others, global engagement, and personal health and well-being. The following nontechnical breadth requirements will require students to develop a personalized plan for their course selection and meta-curricular participation to maximize their CMU experience. Our graduates will be well trained to be life-long and life-wide learners that will lead the scientific community and the world at large.

All candidates for MCS bachelor's degrees must complete the following nontechnical breadth requirements:

A. First Year Courses:

The following three courses must be taken in the first year:

38-101	EUREKA!: Discovery and Its Impact	6
or 38-100	CATALYST - MCS First-Year Seminar	
76-101	Interpretation and Argument <small>A total of nine units must be completed in order to fulfill this requirement</small>	9
or 76-102	Advanced First Year Writing: Special Topics	
or 76-106	Writing about Literature, Art and Culture	
or 76-107	Writing about Data	
or 76-108	Writing about Public Problems	
99-101	Core@CMU	3

B. Science and Society Course:

This requirement must be completed no later than the penultimate semester. Any student who finds an appropriate Carnegie Mellon course not on the pre-approved elective list below that might fulfill this requirement should contact their home department's Director of Undergraduate Studies to review the course description to determine if it can be substituted. In addition, transfer courses will also be considered for this category. However, this course requirement *cannot* be satisfied with AP/IB/Cambridge exam credit.

- Option 1: Take 38-304 Reading and Writing Science
- Option 2: Take one of the pre-approved (<https://www.cmu.edu/mcs/science-society/electives.html>)electives (<https://www.cmu.edu/mcs/science-society/electives.html>)

Note: QBS students should plan to enroll in 38-301 PROPEL in spring of junior year to fulfill this requirement.

C. ENGAGE Courses:

The ENGAGE courses are self-directed learning opportunities (using the MyCORE online platform) designed to enhance students' engagement with wellness, the arts and community service. Please see the course description for information on when these courses should be taken:

ENGAGE COURSES

38-110	ENGAGE in Service	1
38-220	ENGAGE in the Arts	2
38-230	ENGAGE in Wellness: Looking Inward	1
38-330	ENGAGE in Wellness: Looking Outward	var.
or 38-402	MCS Leadership Development Seminar	

38-430 ENGAGE in Wellness: Looking Forward var.
 or 38-402 MCS Leadership Development Seminar
 Option 1: 38-402 may be substituted for BOTH 38-330 AND
 38-430. -OR- Option 2: 38-402 may fulfill the Science and
 Society requirement.

D. Cultural/Global Understanding Course:

Cultural or global understanding course(s) may be taken at any time. Nine (9) or more units from the following group of courses will fulfill this requirement. Any student who finds an appropriate Carnegie Mellon course not on the list below that might fulfill this requirement should contact their home department's Director of Undergraduate Studies to review the course description to determine if it can be substituted. Cultural and global understanding courses that are taken while studying abroad can be used to fulfill this category. In addition, transfer courses will also be considered for this category. However, this course requirement *cannot* be satisfied with AP/IB/Cambridge exam credit.

CULTURAL/GLOBAL UNDERSTANDING

57-173	Survey of Western Music History	9
57-306	World Music	9
70-100	Global Business	9
70-342	Managing Across Cultures	9
76-221	Books You Should Have Read By Now	9
76-239	Introduction to Film Studies	9
76-241	Introduction to Gender Studies	9
76-386	Language & Culture	9
79-112	Introduction to Asian American History	9
79-145	Genocide and Weapons of Mass Destruction	9
79-160	Introduction to the History of Science	9
79-170	Introduction to Science, Technology, and Society	9
79-175	Moneyball Nation: Data in American Life	9
79-189	Democracy and History: Thinking Beyond the Self	9
79-201	Introduction to Anthropology	9
79-202	Flesh and Spirit: Early Modern Europe, 1400-1750	9
79-203	The Other Europe: The Habsburgs, Communism, & Central/Eastern Europe, 1740-1990	9
79-205	20th Century Europe	9
79-206	Crime and Punishment in Early Modern Europe	9
79-208	Witchcraft and Witch-Hunting	9
79-211	Modern Southeast Asia: Colonialism, Capitalism, and Cultural Exchange	9
79-220	Screening Mexico: Mexican Cinema, 1898 to Present	9
79-223	Mexico: From the Aztec Empire to the Drug War	9
79-227	Modern Africa: The Slave Trade to the End of Apartheid	9
79-229	The Origins of the Palestinian-Israeli Conflict, 1880-1948	9
79-230	The Arab-Israeli Conflict and Peace Process Through 1948 to Present	9
79-232	Arabian Peninsula Environmental History	9
79-234	Technology and Society	9
79-237	Comparative Slavery	9
79-240	U.S. History and Culture	9
79-242	African American History: Reconstruction to the Present	9
79-245	Capitalism and Individualism in American Culture	9
79-257	Germany and the Second World War	9
79-261	The Last Emperors: Chinese History and Society, 1600-1900	9
79-262	Modern China: From the Birth of Mao ... to Now	9
79-264	Tibet and China: History and Propaganda	9
79-265	Russian History: Game of Thrones	9
79-266	Russian History and Revolutionary Socialism	9
79-267	The Soviet Union in World War II: Military, Political, and Social History	9
79-268	World War I: The Twentieth Century's First Catastrophe	9
79-275	Introduction to Global Studies	9
79-278	How (Not) to Change the World	9
79-280	Coffee and Capitalism	9

79-281	Introduction to Religion	9
79-283	Anthropology of Energy	9
79-343	Education, Democracy, and the Arts	9
79-345	Roots of Rock & Roll	9
79-346	U.S. Political Films and Satire	9
79-350	Early Christianity	9
79-377	Food, Culture, and Power: A History of Eating	9
80-100	Introduction to Philosophy	9
80-101	Dangerous Ideas in Science and Society	9
80-130	Introduction to Ethics	9
80-180	Introduction to Linguistics	9
80-246	Moral Psychology	9
80-250	Ancient Philosophy	9
80-251	Modern Philosophy	9
80-252	Kant	9
80-253	Continental Philosophy	9
80-254	The History of Analytic Philosophy and Its Influence	9
80-255	Pragmatism: Scientific Approach to Philosophy	9
80-271	Mind and Body: The Objective and the Subjective	9
80-276	Philosophy of Religion	9
82-xxx	Any course from Languages, Cultures, and Applied Linguistics [†]	Var.
84-226	International Relations	9
84-275	Comparative Politics	9
84-306	Latin American Politics	9
84-319	Civil-Military Relations	9
84-322	Nonviolent Conflict and Revolution	9
84-323	War and Peace in the Contemporary Middle East	9
84-324	The Future of Democracy	9
84-325	Contemporary American Foreign Policy	9
84-328	Military Strategy and Doctrine	9
84-362	Diplomacy and Statecraft	9
84-365	The Politics of Fake News and Misinformation	9
84-370	Nuclear Security & Arms Control	9
84-372	Space and National Security	9
84-373	International Law	9
84-380	US Grand Strategy	9
84-387	Remote Systems and the Cyber Domain in Conflict	9
84-389	Terrorism and Insurgency	9
84-390	Social Media, Technology, and Conflict	9
84-405	The Future of Warfare	9
85-350	Research Methods in Social Psychology	9
88-221	Markets, Democracy, and Public Policy	9
88-234	Negotiation: International Focus	9

***Please note the units on the following course options. You may mix and match these courses together to meet the 9-unit minimum.**

57-209	The Beatles	6
79-238	Modern African American Film: History and Resistance	6
79-319	India Through Film	6
79-355	Fake News: "Truth" in the History of American Journalism	6
79-375	Science & Religion	6
82-xxx	Any course from Languages, Cultures, and Applied Linguistics	Var.
99-3xx	Any of the Country Today courses	3

[†] Please note the category requirement is for 9+ units. Depending on the selected course you may need to take 1 or more courses together.

E. Nontechnical Elective Courses

To fulfill this requirement, students must complete a minimum of four (4) nontechnical courses totaling at least 36 units in the College of Fine Arts, the Tepper School of Business, and/or the Dietrich College for Humanities and Social Sciences. A maximum of 18 units of these units may be fulfilled via AP/IB/Cambridge exam credit. Up to 36 units of these nontechnical

elective units may be filled by transfer credit (with prior approval through the MCS transfer credit process).

Notes:

1. Courses counted toward the Cultural/Global Understanding requirement and the First-Year Writing requirement **do not** count toward this requirement.
2. Check our web site for courses from DC, CFA, and Tepper that may NOT be used (<http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/deletions.html>) to satisfy this requirement because they are too technical in nature, plus a list of courses in other colleges (including SCS, CIT, and Heinz College) that do satisfy (<http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/additions.html>) this requirement.
3. Mix and match nontechnical courses with less than 9 units either from an approved college (as specified above) or the additions list (<https://www.cmu.edu/mcs/undergrad/advising/hss-finearts/additions.html>) as long as the combined total is at least 36 units.

The following requirements apply to all MCS bachelor's degrees:

1. Students must complete a minimum of 360 units.
2. The four courses required for the Technical Breadth category can be completed at Carnegie Mellon or via transfer credit.
3. AP/IB/Cambridge exam credit cannot be used to fulfill the Science and Society Requirement. Transfer courses will also be considered for this category.
4. AP/IB/Cambridge exam credit cannot be used to fulfill the Cultural/Global Requirement. Cultural and global understanding courses that are taken while studying abroad can be used to satisfy this requirement. In addition, transfer courses will also be considered for this category.
5. For the Nontechnical Electives requirement, students must complete a minimum of four courses totaling at least 36 units with a maximum of 18 units from AP/IB/Cambridge exam credit. In addition, transfer courses will also be considered for this category.

Double Counting Restrictions

Double counting occurs when a student attempts to use one course to meet more than one major, college, or university degree requirement. Any student attempting to double count a course should only do so in close consultation with all relevant academic advisor(s) and/or the Assistant Dean for Educational Initiatives to ensure that all degree requirements are appropriately met.

Generally speaking, students are permitted to double count courses from the MCS Core Education requirements towards their primary major, additional major, or additional minor requirements. However, the following information describes limitations to double counting policies within the MCS Core Education requirements themselves.

The goals of the MCS core technical breadth requirements are different from the goals of the non-technical breadth requirements. Therefore, students are not permitted to double count courses across the following categories/courses:

1. Technical Breadth Requirements (students must take 4 courses total, 1 each from the life sciences, physical sciences, and math, statistics and computer science).
2. Non-Technical Breadth Requirements (including the first-year seminar, first-year writing requirement, ENGAGE courses, third year seminar, cultural/global understanding requirement, and non-technical breadth requirements).

Furthermore, students are not permitted to double count courses across the following list of non-technical core requirements.

1. First-Year Writing Requirement
2. Global/Cultural Understanding Requirement
3. Science and Society Requirement
4. Non-Technical Breadth Requirements (36 units total)

Honors Degree Programs in MCS

Several of the departments in MCS offer students an opportunity to participate in a departmental honors degree program. Some of these programs result in a master's degree along with the bachelor's degree (see next section on accelerated master's programs). These programs are listed below; see the department's section of the catalog for more details.

- Honors Program in Research Biology
- Departmental Honors in Chemistry

- Honors B.S./M.S. Program in Chemistry
- Honors B.S./M.S. Program in Mathematical Sciences

Accelerated Master's Programs

Carnegie Mellon offers some accelerated master's programs for motivated students, whereby students complete both the bachelor's and the master's degree in four or five years. Some programs are in the student's home department in MCS as part of an honors program, while others are offered through one of our graduate schools at Carnegie Mellon. Below is a listing of the programs currently available to MCS students; please see the appropriate sections of the catalog for more details.

- Honors B.S./M.S. Program in Chemistry
- Honors B.S./M.S. Program in Mathematical Sciences
- Accelerated Master's Program in the Heinz College

Study Abroad

There are many programs for studying abroad, usually during your junior year. Please see the catalog section on Undergraduate Options for more details, and talk with the Office of International Education to get information and advice specifically for you.

Pre-Professional Programs

Many students in the Mellon College of Science decide to pursue professional training such as medical school or law school after completing their undergraduate work. Carnegie Mellon offers strong advising services to support these students. Through these programs, students get help with everything from course selection to identification of important experiential opportunities to the application process itself.

Health Professions Program

Faculty Contact: Jason D'Antonio

Please see the Undergraduate Options (<http://coursecatalog.web.cmu.edu/aboutcmu/undergraduateoptions/#healthproftext>) section for details on the Health Professions Program.

Pre-Law Advising Program

Faculty Contact: Joseph Devine

Please see the Undergraduate Options (<http://coursecatalog.web.cmu.edu/aboutcmu/undergraduateoptions/#prelawtext>) section for details on the Pre-Law Advising Program.

Intercollege Programs

Bachelor of Science and Arts Degree Program (BSA)

Students in the Bachelor of Science and Arts Degree Program (<http://coursecatalog.web.cmu.edu/servicesandoptions/intercollegeprograms/bxaintercollege.html>) are jointly admitted to MCS and the College of Fine Arts (CFA). This is a degree program for students who are naturally gifted in both the arts and the sciences, and allows for the combining of talents in these areas.

Additional Major in Environmental and Sustainability Studies

The Dietrich College of Humanities & Social Sciences and the Mellon College of Science have joined together to establish the interdisciplinary Program in Environmental & Sustainability Studies offering a Minor or an Additional Major. Please see the Intercollege section (<http://coursecatalog.web.cmu.edu/intercollegeprograms/#environmentalsustainabilitystudiescontainer>) of the catalog for requirements of these programs.

Applying Your Education Through Research

An important feature of education in MCS is the opportunity for undergraduate research experience. This experience may be arranged as a course taken for credit or occasionally as a part-time job. Our website (<https://www.cmu.edu/mcs/>) offers a range of useful information including links to faculty research areas, links to undergraduate research programs at other institutions, and ideas on how to get involved. Because of the strong research base of MCS, undergraduate research positions offer an exciting

opportunity to apply your theoretical training to participate in the discovery of new knowledge.

Students can earn MCS Research Honors for significant research accomplishments; see the policy outlined below for the requirements.

Mellon College of Science Research Honors

Undergraduates in the Mellon College of Science will be awarded MCS College Honors at the completion of their degree if they have met one of these requirements:

1. Successfully completed the Honors BS/MS program in the Department of Chemistry or Department of Mathematical Sciences.
2. Successfully completed the departmental honors program in the Department of Biological Sciences or the Department of Chemistry.
3. Earned a cumulative grade point average of ≥ 3.20 (by the end of their seventh semester or by the time of graduation) and carried out significant research. Typically, this would consist of an academic project carried out for at least two semesters. However, a single project that spans a summer and a semester or that the research mentor deems to be significant and sustained, even if the student worked for pay rather than credit, will be allowed. In addition, some form of public dissemination of this research, which has been approved by the MCS Senior Associate Dean for Student Success and Strategic Initiatives, such as a peer reviewed publication, research thesis, or presentation at an external scientific meeting is required. The Meeting of the Minds by itself is not sufficient and participation in a pre-approved judged competition (eg. Sigma Xi, Math Department competition, or Psychology department competition) is necessary.

Final approval of nominations for MCS Honors will come from the Dean of MCS and the MCS Senior Associate Dean for Student Success and Strategic Initiatives. Students can apply to their primary departmental advisor using this form on the MCS website: <https://www.cmu.edu/mcs/undergrad/advising/college-research-honors.html>.

Research Centers

The Mellon College of Science is home to a number of innovative research centers. These centers are particularly strong because of the interdisciplinary collaboration of their scientists. This interdisciplinary research brings international prestige to the college. Many students conduct undergraduate research with one of these centers.

The Bruce and Astrid McWilliams Center for Cosmology joins research efforts in astrophysics and particle physics and partners with computer science, statistics, and other disciplines to unravel the mysteries of the universe.

The Center of Atmospheric Particle Study's goal is to be the world leader in science, engineering, and policy covering the full role of fine particulate matter in the atmosphere. Our goal in research is to advance the state of knowledge across this spectrum substantially, to provide both policy-relevant research, and to participate directly and actively in the evolution of environmental policy related to particulate matter.

The Center for Computational Finance's mission is to improve the interaction between academic research and the finance industry.

The Center for Macromolecular Engineering's goals are to enhance the benefits of polymer science to society by developing new methods to prepare advanced polymer materials, train and develop tomorrow's scientists, and transfer technology to industry.

The Center of Nano-enabled Device and Energy Technologies' mission is to work on real-world problems that can be solved potentially with appropriate nano-enabled technologies.

The Center for the Neural Basis of Cognition is a joint program between Carnegie Mellon University and the University of Pittsburgh. It synthesizes the disciplines of basic and clinical neuroscience, cognitive psychology, and computer science, combining neurobiological, behavioral, computational, and brain imaging methods.

The Center for Nonlinear Analysis was established in 1991. A special focus for applications emphasizes new and innovative methods to study contemporary issues in materials science. The center has created a vigorous environment for collaboration among mathematical and allied scientists.

The Center for Nucleic Acids Science and Technology is a community of Carnegie Mellon scientists and engineers unified by interests in the chemistry, biology, and physics of DNA, RNA, and PNA (peptide nucleic acid).

The Institute for Green Science has been established as a research, education, and development center in which a holistic approach to sustainability science is being developed. The focus of the institute is in

three areas: renewable energy technologies, chemical feedstocks, and benign alternatives to polluting technologies.

The Pittsburgh Supercomputing Center provides information on advanced scientific computing for engineering and research.

Academic Standards

MCS Dean's List

Each semester MCS recognizes those students with outstanding academic records by naming them to the Dean's List. The criteria for such recognition are as follows:

Dean's List

The student must earn a quality point average of at least 3.50 while completing a minimum of 36 factorable units and earning no incomplete grades.

Dean's List with High Honors

The student must earn a quality point average of at least 3.75 while completing a minimum of 36 factorable units and earning no incomplete grades.

Academic Actions

In order to maintain good academic standing, students from the Mellon College of Science must attain at least minimum quality point averages for each semester (as well as cumulatively), and also make and maintain adequate progress toward completing their degree requirements. "Adequate progress towards graduation" generally means that students are successfully completing an average of 45 units per semester so that at the end of eight semesters they will have accumulated the minimum of 360 units required for graduation, have a cumulative QPA of at least 2.00, and completed all college General Education and primary major course requirements.

Specifically, MCS students will make satisfactory academic progress if they meet the following criteria:

- The semester GPA is ≥ 2.00 .
- The cumulative QPA is ≥ 2.00 .
- A student maintains full-time status (≥ 36 units) after the 10th day of classes in a semester.
- Completing $\geq 80\%$ of attempted units in a semester (calculated using total units carried when grades are entered). Grades of N, W, or R grade do not count as completed units.

When a student fails to meet minimum performance criteria, it normally results in an "academic action." Depending on the circumstances, one of the following actions is taken: Academic Warning, Continued Academic Warning, Suspension, or Drop. These academic actions are recommended by the college's departments based on the guidelines described below. However, the sequence of the academic actions is not automatic in all cases.

Academic actions are not meant to be punitive and are put into place to support student success. These actions are designed to notify students of specific academic requirements, outline goals for completion, and identify avenues of support to help students succeed. Students on academic action (except drop) will be asked to identify a plan of action to use resources to improve their academic performance. Resources can include the Student Academic Success Center, CaPS, UHS, and/or regular meetings with advisors, among others.

Warning

The action of Warning will be taken if in any semester a student fails to make satisfactory academic progress as defined above.

The term of Warning is one semester as a full-time student. Students on academic probation may not overload above 54 units in the semester of Warning.

A student is occasionally continued on Warning who has had one semester on Warning and is not yet in good academic standing (as defined above) but whose record indicates that the standards are likely to be met at the end of the next semester of study.

Suspension

A student who does not meet minimum standards at the end of one semester of Warning will be suspended. The minimum period of suspension

is one academic year (two semesters). At the end of that period a student may return to school on final academic Warning by:

- Receiving permission in writing from the MCS Senior Associate Dean for Student Success and Strategic Initiatives.
- Completing a Return from Leave form from Enrollment Services (<https://www.cmu.edu/hub/registrar/leaves-and-returns/>).
- Providing transcripts and clearance forms if the student has been in a degree program at another college or university, even though academic credit earned will not transfer to Carnegie Mellon unless prior approval has been granted by the MCS Senior Associate Dean for Student Success and Strategic Initiatives.

Students on suspension can review a list of available resources on the HUB's website (<https://www.cmu.edu/hub/registrar/leaves-and-returns/access.html>). A student who has been academically suspended and who is not employed by the University must absent themselves from campus and is, for the term of the suspension, barred from all activities and affiliations that stem from one's status as an enrolled student. These include registering or enrolling for courses, sitting in on classes, living in residence halls or Greek houses, membership and participation in student activities, and employment in student jobs. (NOTE: Exceptions to the restriction from student jobs for students on academic suspension will in general be granted for summer employment if the position was accepted prior to the decision to suspend.)

Notably, employment within the university in non-student jobs is possible for students on academic suspension, subject to the hiring criteria of the hiring department. However, a student on academic suspension wishing to accept a job on campus must speak with the Associate Dean of the student's college to ensure that the employment will not constitute a violation of the terms of suspension. The Associate Dean will generally allow such employment, in consultation with the Dean of Student Affairs. One employment benefit not available to students on academic suspension who accept a full-time job with the University is the option to take courses through tuition remission. The option to take courses becomes available only after the academic suspension is over.

Students returning from suspension should plan to work with their advisor and Associate Dean for undergraduate affairs at least 30 days prior to the semester they plan to return. Ideally, students will connect with the Associate Dean several weeks before registration for the semester of planned return. In addition to the steps for a smooth return (<https://www.cmu.edu/hub/registrar/leaves-and-returns/>) described on the Registrar's website, MCS students should prepare a short (1000 word maximum) essay describing how they've been preparing for a successful return to CMU.

Upon return, students will be on **Final Academic Warning**. Students in this situation must work closely with all available resources (particularly their academic advisor) to ensure all resources are being properly used to maximize success to avoid progression to academic drop. Students returning on Final Academic Warning may not overload above 54 units in the semester of return.

Drop

This is a permanent severance from the Mellon College of Science. Students are dropped when it seems clear that they will not be able to meet minimum standards. A student who has been suspended and who fails to meet minimum standards after returning to school is dropped.

A student who has been academically dropped and who is not employed by the University must absent themselves from campus and is barred from all activities and affiliations that stem from one's status as an enrolled student. These include registering or enrolling for courses, sitting in on classes, living in residence halls or Greek houses, membership and participation in student activities, and employment in student jobs. (NOTE: Exceptions to the restriction from student jobs for students on academic drop will in general be granted for summer employment if the position was accepted prior to the decision to drop.)

Appeals of Academic Actions

In accordance with the Appeal of Academic Actions Policy (<https://www.cmu.edu/student-affairs/theword/academic/appeal-of-grades-and-academic-actions.html>) outlined in The Word student handbook:

"If a student believes an academic action is inconsistent with the policies of the college, a student should:

1. Submit a formal written appeal to the Associate Dean of the college responsible for the decision, with a copy to the dean, requesting review of the action including all relevant materials to substantiate the inconsistency in policy and to support their concerns. Appeals are due within 10 days of the date the student is notified of the action.

2. The Dean of the college, or the dean's designate, will review the appeal and issue a decision and the basis for it within 30 days.

If, after carrying out the steps of either process described above, the student believes that the matter has not been adequately resolved, or if no decision has been rendered by the appropriate date, the student may appeal at the university level. To appeal at the university level, the student must present copies of all documents and a formal letter of appeal to the provost. Appeals to the Provost office are due within 5 days of a decision from the student's college-level appeal. The Provost or another designated university officer will respond in writing with a final resolution, including the basis for it, within thirty (30) days, or as soon thereafter as practical."

Course Overloads

Overloading is defined as taking more than the equivalent of five full-semester courses in one semester; for MCS students overload means registering for more than 54 units in one semester.

Eligibility to overload is defined as:

1. Student must be in good academic standing (not on any academic action listed above).
2. Student must have a QPA of at least 3.25 in the last completed semester or student must have a current cumulative QPA of at least 3.25.
3. Students new to the college and university (i.e., first-year students and new external transfer students from outside of CMU) may not overload during their first Carnegie Mellon semester.
4. Advisors can, in accordance with these policies, approve overloads up to 61 units. Associate Dean approval is required for overload requests over 61 units. In addition to the other criteria listed above, students must have also successfully completed ≥ 45 units in a previous semester to request to overload > 61 units.

Eligibility to overload based on QPA does not automatically allow the student to register for an overload. Rather, students must petition and discuss the proposed overload with their primary academic advisor. The discussion will include the reason for overload (additional major/minor, trying to graduate early, etc.). If approved, the academic advisor will increase the student's unit maximum for the relevant semester.

The first opportunity to register for a course overload is after registration week for the proposed overload semester. Registration week for the spring semester is usually the third week in November; for the fall semester, it is usually the third week in April. Consult the official university academic calendar for the exact dates.

If as a result of final grades for the current semester a student approved to overload for the next semester falls below the overload eligibility criteria listed above, the academic advisor may withdraw the overload permission. Students thus affected are responsible for resolving this in consultation with their academic advisor.

Students may appeal their advisor's overload request decision to the Senior Associate Dean for Student Success and Strategic Initiatives in writing (email is appropriate for this petition, but a meeting may be requested by the Associate Dean to discuss the appeal).

Transfer into MCS Departments

This section describes the variety of entry points into the Mellon College of Science for students already admitted to a university (Carnegie Mellon or another university). All prospective students not already enrolled should contact the Office of Admission for details about the application process for Carnegie Mellon University.

General Internal Transfer Information:

MCS does not accept undeclared internal transfer students. Students will need to declare which major they intend to pursue upon transfer into MCS at the time of application. The list of prerequisite courses for each department are listed below. *Students will not be considered for transfer on the basis of AP/IB/Cambridge scores alone.* Applicants may use AP/IB/Cambridge credit as prerequisites to the courses listed below prior to applying for transfer but must have completed at least one prerequisite course at CMU.

Applications are accepted on a rolling basis. Students applying for transfer into MCS must have approval from the new department (through the director of undergraduate studies/affairs in the MCS department) and from the MCS Senior Associate Dean for Student Success and Strategic Initiatives. Students can complete the application for transfer (https://www.cmu.edu/mcs/undergrad/advising/forms/mcs_transfer_or_additional_degree.pdf) with the MCS departmental program director. Students will be considered

for transfer on the basis of available space and the student's academic performance in coursework related to their intended MCS major.

Students should complete the prerequisite requirements of their intended department prior to applying for internal transfer:

- Potential transfer students into the **Department of Biological Sciences** must have completed 03-121 Modern Biology or 03-220 Genetics **AND** 09-105 Introduction to Modern Chemistry I with a C grade or better.
- The **Chemistry Department** requires students wishing to transfer to complete and have earned the following grades in one of the following options at CMU:
 - an A in 09-107 or
 - have C grade or better in 09-105 or 107 **AND** a C grade or better in 09-106 (at CMU) or
 - have a C grade or better in 09-217 or 09-219.
- Students wishing to transfer into the **Physics Department** must have earned a C grade or better in one of the following classes completed at CMU: 33-121, 33-151, 33-141, 33-142, 33-152, or 33-211 **AND** have earned a C grade or better in one of the following classes completed at CMU: 21-120, 21-122, or 21-259.
- Students wishing to transfer into the **Department of Mathematical Sciences** must have completed 21-127 Concepts of Mathematics or 21-128 Mathematical Concepts and Proofs **AND** 21-241 Matrices and Linear Transformations or 21-242 Matrix Theory with a B grade or better in both courses as well as an overall QPA of 3.5 or higher.

Students entering MCS or already declared in MCS:

Entering undergraduate students admitted to MCS can choose to pursue any major within MCS. This choice is usually made prior to the first semester of the sophomore year (normally during the second semester of the first year) and does not require approval by any department. While it is possible to remain undeclared beyond the first year, declaring a major offers access to departmental resources, advising, and course reservations.

Students who have declared a major in MCS and wish to transfer into another department within MCS must meet the prerequisites listed above and have approval from the relevant department program director for their intended major (see the internal transfer form (https://www.cmu.edu/mcs/undergrad/advising/forms/mcs_transfer_or_additional_degree.pdf) for details) and from the MCS Senior Associate Dean for Strategic Initiatives and Student Success. Students wishing to transfer into a department in MCS beyond the first semester will be considered for transfer on the basis of available space and the student's academic performance in coursework related to their intended MCS major.

Students enrolled in another college at Carnegie Mellon:

Undergraduate students admitted to colleges other than MCS and wishing to transfer into an MCS department should consult with the relevant department program director for their intended major (see the internal transfer form (https://www.cmu.edu/mcs/undergrad/advising/forms/mcs_transfer_or_additional_degree.pdf) for details) and obtain approval from the MCS Senior Associate Dean for Student Success and Strategic Initiatives.

Students must meet the prerequisites of their intended department (listed above). Students may submit an internal transfer request no earlier than the first day of their second semester.

Undergraduate students not in MCS and wishing to transfer into a department in MCS will be considered for transfer on the basis of available space and the student's academic performance in coursework related to their intended MCS major.

Students wishing to transfer from another university into an MCS department:

A student first applies through the Office of Admission. If the Office of Admission believes the applicant is acceptable, the student's record is sent to the appropriate department for evaluation and a decision on acceptance. Students will be considered for transfer on the basis of available space and the student's academic performance in coursework related to their intended MCS major.

Graduation Requirements

To be eligible to graduate, undergraduate students must complete all course requirements for their program with a cumulative Quality Point Average of at least 2.00 for all courses taken. Some programs may have additional QPA requirements in order to graduate. Students are encouraged to confirm all graduation requirements with their academic advisor.

A minimum of 360 units must be completed. This will include the MCS Core Courses (technical and nontechnical electives) and all departmental course requirements.

Students will be required to meet the residency requirement and to have met all financial obligations to the university before being awarded a degree. The residency requirement is detailed in the Academic Regulations section of the catalog. A student may seek permission to modify graduation requirements by petition to the MCS College Council.

Graduation Honors

There are two types of honors awarded at graduation.

University Honors

University Honors are automatically awarded to students who have earned a cumulative Q.P.A. of 3.5 or better after either seven semesters or by the time they are certified for graduation.

College Research Honors

Please see the section "Mellon College of Science Research Honors (p. 5)" for information on how to qualify for College Research Honors.

Faculty

MAGGIE BRAUN, Senior Associate Dean for Student Success and Strategic Initiatives - Ph.D. ,

JASON D'ANTONIO, Director of Health Professions Program - Ph.D.,

KENNETH HOVIS, Associate Dean for Educational Initiatives - Ph.D.,

MANFRED PAULINI, Associate Dean for Research - Ph.D.,

MICHAEL YOUNG, Associate Dean for Community Engagement - Ph.D.,

Administration

KRYSTALYN KOVACS, Undergraduate Programs Coordinator, HPP

ABIGAIL PINNOW, Undergraduate Programs Administrator, MCS

TARA PRIMIERO, Senior Academic Advisor, MCS