Mellon College of Science

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Location: Doherty Hall 1324
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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 adapt their knowledge to new situations.

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
• Computer Science Minor
• 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).

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 9
42-101 Introduction to Biomedical Engineering 12
42-202 Physiology 9
85-219 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 NANOlegos: 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
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
21-120 Differential and Integral Calculus 12
21-122 Integration and Approximation 10
21-124 Calculus II for Biologists and Chemists 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 10
or 21-242 Matrix Theory 10
21-259 Calculus in Three Dimensions 10
or 21-268 Multidimensional Calculus 10
or 21-269 Vector Analysis 10
21-260 Differential Equations 9
or 21-261 Introduction to Ordinary Differential Equations 9
36-200 Reasoning with Data 9
36-202 Methods for Statistics & Data Science 9
36-217 Probability Theory and Random Processes 9
36-220 Engineering Statistics and Quality Control 9
36-225 Introduction to Probability Theory 9
36-247 Statistics for Lab Sciences 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 or 21-124)
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 or 21-124)
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 Reasoning with Data, or 36-202
4. STEM Elective: any STEM course from the approved list.

Physics
1. Life Sciences: 03-121
2. Physical Sciences: 09-105 or 09-111 Nanolegos: Chemical Building Blocks
4. STEM Elective: will be filled 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 6
76-101 Interpretation and Argument 9

or 76-102 Advanced First Year Writing: Special Topics 9
or 76-106 Writing about Literature, Art and Culture 9
or 76-107 Writing about Data 9
or 76-108 Writing about Public Problems 9
99-101 Computing @ Carnegie Mellon 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.html) 9

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 1
38-430 ENGAGE in Wellness: Looking Forward 1

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

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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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>57-173</td>
<td>Survey of Western Music History</td>
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<tr>
<td>57-209</td>
<td>The Beatles</td>
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<tr>
<td>57-306</td>
<td>World Music</td>
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<tr>
<td>70-100</td>
<td>Global Business</td>
</tr>
<tr>
<td>70-342</td>
<td>Managing Across Cultures</td>
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<td>76-217</td>
<td>Literature &amp; Culture of the 20th and 21st Century</td>
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<tr>
<td>76-221</td>
<td>Books You Should Have Read By Now</td>
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<td>76-232</td>
<td>Introduction to Black Literature</td>
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<td>76-239</td>
<td>Introduction to Film Studies</td>
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<td>76-241</td>
<td>Introduction to Gender Studies</td>
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<td>76-287</td>
<td>Sex &amp; Texts</td>
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<td>76-366</td>
<td>Language &amp; Culture</td>
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<tr>
<td>79-145</td>
<td>Genocide and Weapons of Mass Destruction</td>
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<tr>
<td>79-160</td>
<td>Introduction to the History of Science</td>
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<td>79-170</td>
<td>Introduction to Science, Technology, and Society</td>
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<td>79-175</td>
<td>Moneyball Nation: Data in American Life</td>
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<tr>
<td>79-189</td>
<td>Democracy and History: Thinking Beyond the Self</td>
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<tr>
<td>79-201</td>
<td>Introduction to Anthropology</td>
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<tr>
<td>79-202</td>
<td>Flesh and Spirit: Early Modern Europe, 1400-1750</td>
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<td>79-203</td>
<td>The Other Europe: The Habsburgs, Communism, &amp; Central/Eastern Europe, 1740-1990</td>
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<td>79-205</td>
<td>20th Century Europe</td>
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<tr>
<td>79-208</td>
<td>Witchcraft and Witch-Hunting</td>
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<tr>
<td>79-211</td>
<td>Modern Southeast Asia: Colonialism, Capitalism, and Cultural Exchange</td>
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<td>79-216</td>
<td>Genghis Khan and the Mongol Empire</td>
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<td>79-220</td>
<td>Screening Mexico: Mexican Cinema, 1898 to Present</td>
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<td>79-222</td>
<td>China and the Second World War</td>
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<td>79-223</td>
<td>Mexico: From the Aztec Empire to the Drug War</td>
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<tr>
<td>79-227</td>
<td>Modern Africa: The Slave Trade to the End of Apartheid</td>
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<tr>
<td>79-229</td>
<td>The Origins of the Palestinian-Israeli Conflict, 1880-1948</td>
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<td>79-230</td>
<td>The Arab-Israeli Conflict and Peace Process since 1948</td>
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<td>79-232</td>
<td>Arabian Peninsula Environmental History</td>
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<tr>
<td>79-234</td>
<td>Technology and Society</td>
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<td>79-238</td>
<td>Modern African American Film: History and Resistance</td>
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<td>79-240</td>
<td>Development of American Culture</td>
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<td>79-241</td>
<td>African American History: Africa to the Civil War</td>
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<td>79-242</td>
<td>African American History: Reconstruction to the Present</td>
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<td>79-244</td>
<td>Women in American History</td>
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<td>79-245</td>
<td>Capitalism and Individualism in American Culture</td>
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<td>79-257</td>
<td>Germany and the Second World War</td>
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<tr>
<td>79-261</td>
<td>The Last Emperors: Chinese History and Society, 1600-1900</td>
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<td>79-262</td>
<td>Modern China: From the Birth of Mao … to Now</td>
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<td>79-263</td>
<td>Mao and the Chinese Cultural Revolution</td>
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<td>79-264</td>
<td>Tibet and China: History and Propaganda</td>
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<tr>
<td>79-265</td>
<td>Russian History: Game of Thrones</td>
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<td>79-266</td>
<td>Russian History and Revolutionary Socialism</td>
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<tr>
<td>79-267</td>
<td>The Soviet Union in World War II: Military, Political, and Social History</td>
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<td>79-268</td>
<td>World War I: The Twentieth Century's First Catastrophe</td>
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<tr>
<td>79-275</td>
<td>Introduction to Global Studies</td>
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<tr>
<td>79-278</td>
<td>How (Not) to Change the World</td>
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<td>79-280</td>
<td>Coffee and Capitalism</td>
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<td>79-281</td>
<td>Introduction to Religion</td>
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<td>79-283</td>
<td>Hungry World: Food and Famine in Global Perspective</td>
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<td>79-319</td>
<td>India Through Film</td>
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<td>79-343</td>
<td>Education, Democracy, and Civil Rights</td>
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<td>79-345</td>
<td>Roots of Rock &amp; Roll</td>
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<td>79-350</td>
<td>Early Christianity</td>
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<td>79-375</td>
<td>Science &amp; Religion</td>
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<td>79-377</td>
<td>Food, Culture, and Power: A History of Eating</td>
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<td>80-100</td>
<td>Introduction to Philosophy</td>
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<td>80-101</td>
<td>Dangerous Ideas in Science and Society</td>
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<td>80-130</td>
<td>Introduction to Ethics</td>
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<td>80-250</td>
<td>Ancient Philosophy</td>
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<td>80-251</td>
<td>Modern Philosophy</td>
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<td>80-252</td>
<td>Kant</td>
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<td>80-253</td>
<td>Continental Philosophy</td>
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<td>80-254</td>
<td>Analytic Philosophy</td>
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<td>80-255</td>
<td>Pragmatism: Making Ideas Work</td>
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<td>80-276</td>
<td>Philosophy of Religion</td>
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<td>82-238</td>
<td>Topics in Chinese Culture</td>
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<td>82-290</td>
<td>Transformative Learning through Cross-Cultural Analysis</td>
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<tr>
<td>82-xxx</td>
<td>Any course from Modern Languages</td>
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<tr>
<td>84-226</td>
<td>International Relations</td>
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<td>84-275</td>
<td>Comparative Politics</td>
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<td>84-306</td>
<td>Latin American Politics</td>
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<td>84-319</td>
<td>Civil-Military Relations</td>
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<td>Nonviolent Conflict and Revolution</td>
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<td>War and Peace in the Contemporary Middle East</td>
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<td>Diplomacy and Statecraft</td>
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<td>84-365</td>
<td>The Politics of Fake News and Misinformation</td>
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<td>84-370</td>
<td>Nuclear Security &amp; Arms Control</td>
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<td>84-372</td>
<td>Space and National Security</td>
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<td>84-373</td>
<td>Emerging Technologies and International Law</td>
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<td>84-374</td>
<td>Technology, Weapons, and International Conflict</td>
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<td>84-380</td>
<td>US Grand Strategy</td>
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<td>84-387</td>
<td>Remote Systems and the Cyber Domain in Conflict</td>
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<td>84-389</td>
<td>Terrorism and Insurgency</td>
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<td>84-390</td>
<td>Social Media, Technology, and Conflict</td>
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<td>84-405</td>
<td>The Future of Warfare</td>
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<td>85-350</td>
<td>Psychology of Prejudice</td>
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<td>85-352</td>
<td>Evolutionary Psychology</td>
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<tr>
<td>88-221</td>
<td>Markets, Democracy, and Public Policy</td>
</tr>
<tr>
<td>99-xxx</td>
<td>Any of the Country Today courses</td>
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</tbody>
</table>

### E. Nontechncial Elective Courses

To fulfill this requirement, students must complete a minimum of four (4) nontechncial 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 nontechncial elective units may be filled by transfer credit (with prior approval through the MCS transfer credit process). Courses counted toward the Cultural/Global Understanding requirement and the First-Year Writing requirement do not count toward this requirement.

**Note:** Check our web site for courses from DC, CFA, and Tepper that may NOT be used (http://www.cm.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.cm.edu/mcs/undergrad/advising/hss-finearts/additions.html) this requirement.

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 Non-Technical 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/#healthprof) 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/#environmentsustainability) 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 Associate Dean for Undergraduate Affairs, 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 (e.g. 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 Associate Dean for Undergraduate Affairs. Students can apply to their primary departmental advisor using this form on the MCS website: https://www.cm.edu/mc/undergrad/advising/culture-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:

- The semester GPA in the first year is ≥ 1.75.
- The semester GPA beyond the first year is ≥ 2.00.
- The cumulative QPA (excluding the first 2 semesters) is ≥ 2.00.
- A student maintains full-time status (≥ 36 units) after the 10th day of classes in a semester.
- Completing ≥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, academic probation, continued probation, 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. Decisions may be based on unique individual student performance and circumstances, and are not determined purely on the basis of grades and quality point averages.

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

MCS students in their first year who earn a semester GPA between 1.75 and 1.99 will receive a warning of academic action. While this semester GPA is technically acceptable in the first 2 semesters on campus, it is indicative of academic difficulties and would trigger academic probation in subsequent semesters. Students on academic warning may not overload above 54 units in the semester of warning.

Probation

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

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

A student is occasionally continued on probation who has had one semester on probation 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. First-year students are no longer on probation at the end of the second semester if their semester QPA is 1.75 or above.

Suspension

A student who does not meet minimum standards at the end of one semester of probation 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 probation by:
• Receiving permission in writing from the MCS Associate Dean for Undergraduate Affairs.
• 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 Associate Dean for Undergraduate Affairs.

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 some 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 probation. 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 probation 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/thesworldacademic/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, the 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.
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. 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.

Eligible 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 Associate Dean for Undergraduate Affairs 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 should contact the Office of Admission for details about the application process for Carnegie Mellon University.

Students entering MCS or already declared in MCS:
Entering undergraduate students admitted to MCS can choose to pursue any major within MCS. This choice must be 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.

Students who have declared a major in MCS and wish to transfer into another department within MCS must have approval (https://www.cmu.edu/mcs/undergrad/advising/forms/) from the new department (generally through the primary academic advisor (https://www.cmu.edu/mcs/undergrad/advising/)) in the new department and from the MCS Associate Dean for Undergraduate Affairs. Students wishing to transfer into the Mathematical Sciences Department 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 grades of B or better in both courses as well as an overall QPA of 3.5 or higher.

MCS undergraduate students beyond the first year wishing to transfer into another MCS department may do so if they are not on academic probation and if there is room in the department of their choice. If the demand for any department exceeds the space available, then the department will admit students based on a comparative evaluation of
all applicants at the end of each semester, up to the limit of available space.

Students enrolled in another college at Carnegie Mellon:
Undergraduate students admitted to colleges other than MCS and wishing to transfer into an MCS department during their first year should consult with the MCS Associate Dean for Undergraduate Affairs (https://www.cmu.edu/mcs/undergrad/advising/). Students may submit an internal transfer request (https://www.cmu.edu/mcs/undergrad/advising/forms/) no earlier than the first day of their second semester.

Potential transfer students into the departments of Biological Sciences, Chemistry, or Physics must also have credit for 21-120 Differential and Integral Calculus and, depending on major choice, should have completed one of the following courses at Carnegie Mellon: 03-121 Modern Biology, 09-105 Introduction to Modern Chemistry I, or 33-12133-121 Physics I for Science Students. Higher level courses will also be considered by the MCS Associate Dean as alternatives to these courses. Students wishing to transfer into the Mathematical Sciences Department 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 grades of B or better in both courses as well as an overall QPA of 3.5 or higher.

Undergraduate students not in MCS and wishing to transfer into a department in MCS beyond the first semester will be considered for transfer on a space available/academic performance basis. An MCS department may refuse a transfer to a non-MCS student if there are space restrictions and/or if the student’s chance for success is determined to be questionable based on past academic performance.

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. The MCS department head has the right to refuse to accept the student if there are space restrictions and/or if the student’s chance for success in the MCS department is determined to be questionable based on past academic performance.

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. For undergraduate students who enrolled at Carnegie Mellon as freshmen and whose freshman grades cause the cumulative QPA to fall below 2.00, this requirement is modified to be a cumulative QPA of at least 2.00 for all courses taken after the freshman year. Note, however, the cumulative QPA that appears on the student’s final transcript will be calculated based on all grades in all courses taken, including freshman year. 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, Associate Dean for Undergraduate Affairs – Ph.D., JASON D’ANTONIO, Director of Health Professions Program – Ph.D., KENNETH HOVIS, Assistant Dean for Educational Initiatives – Ph.D., MANFRED PAULINI, Associate Dean for Graduate and Faculty Affairs - Ph.D., MICHAEL YOUNG, Associate Dean for Diversity - Ph.D.,

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