

# Mellon College of Science

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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 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.

## 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

## 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. Please see the appropriate sections elsewhere in this catalog for specific descriptions and course requirements.

- Biological Sciences and Psychology Major
- Computational Biology Major
- Computer Science Minor
- Engineering Studies Minor
- Environmental Policy Major
- Health Care Policy and Management Minor
- International Affairs Minor
- Mathematics and Economics Major
- Neuroscience
- Robotics Minor
- Scientific Computing Minor
- Technology and Policy Minor

For a complete list of the minors offered at Carnegie Mellon, please go to <http://coursecatalog.web.cmu.edu/servicesandoptions/undergraduateoptions/>.

## University Self-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 Undergraduate Options at <http://coursecatalog.web.cmu.edu/servicesandoptions/undergraduateoptions/>.

## 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/servicesandoptions/undergraduateoptions/#healthprofessionsprogram>) 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/servicesandoptions/undergraduateoptions/#pre-lawadvisingprogram>) section for details on the Pre-Law Advising Program.

## General Education Requirements

### For Students Entering Prior to the Fall of 2015

#### Technical Breadth Requirements

An MCS education is based on a broad foundation in the sciences: two semesters each of calculus and physics and one semester each of biology, chemistry and computer science. This foundation corresponds to the following courses required for all MCS students.

03-121	Modern Biology	9
09-105	Introduction to Modern Chemistry I	10
15-110	Principles of Computing	10
or 15-112	Fundamentals of Programming and Computer Science	
or 02-201	Programming for Scientists	
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
or 21-124	Calculus II for Biologists and Chemists	
33-111	Physics I for Science Students	12
or 33-121	Physics I for Science Students	
33-112	Physics II for Science Students	9-12
or 33-122	Physics II for Biological Sciences and Chemistry Students	
or 33-142	Physics II for Engineering and Physics Students	

In the first year, students take two semesters of calculus, 21-120 Differential and Integral Calculus and 21-122 Integration and Approximation or 21-124 Calculus II for Biologists and Chemists. They also take three of the remaining five science core courses. The other two science core courses are completed by the end of the junior year. Additional courses in the first year include one course from the intended major; humanities, social sciences or fine arts courses; and Computing @ Carnegie Mellon, a course that introduces students to the computing environment and ethics of computing at Carnegie Mellon.

With this broad science background, a student is prepared to undertake any of the degree programs offered by the college when selecting a major at the end of the first year.

### Sample First Year Schedule

Fall Semester		44-50 units
21-120	Differential and Integral Calculus	10
xx-xxx	Science Core Course	9-12
xx-xxx	Science Core Course	10
76-101	Interpretation and Argument	9
99-101	Computing @ Carnegie Mellon	3
xx-xxx	Optional First-Year Seminar or Discovery-Based Lab	3-6
Spring Semester		46-53 units
21-122	Integration and Approximation	10
or 21-124	Calculus II for Biologists and Chemists	
xx-xxx	Science Core Course	9-12
xx-xxx	Departmental Elective from Intended Major	9-10
xx-xxx	Humanities, Social Sciences, or Fine Arts Course	9
xx-xxx	Optional Free Elective Course or Discovery-Based Lab	6-9
xx-xxx	Optional First-Year Seminar	3

Notes:

1. Departmental electives from the intended major are as follows:

#### Biological Sciences or Chemistry:

09-106 Modern Chemistry II (10 units)

#### Mathematical Sciences

21-127 Concepts of Mathematics (10 units)

#### Physics

33-104 Experimental Physics (9 units)

2. A free elective is any Carnegie Mellon course. However, a maximum of nine units of physical education, military science and/or STUCO courses may be taken as free electives in any MCS degree program. Credit earned for physical education, military science and STUCO courses will not be calculated in a student's QPA.
3. Students who enter with advanced placement credits will follow a similar schedule with modifications for their AP work.

### Humanities, Social Sciences, and Fine Arts Requirements

All candidates for the bachelor's degree must complete a minimum of 72 units offered by the Dietrich College of Humanities and Social Science and/or the College of Fine Arts. These courses for MCS students are to meet the following distribution requirements:

#### A. Designated Writing Course (9 units)

76-101	Interpretation and Argument	9
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#### B. Distributional Course Requirements (27 units)

Complete three courses, one each from Category 1, Category 2, and Category 3. Listed below are examples of courses that meet the requirement for each category. Students wishing to substitute a course that is not listed should meet with their advisor.

#### Category 1: Cognition, Choice and Behavior

80-100	Introduction to Philosophy	9
80-130	Introduction to Ethics	9
80-150	Nature of Reason	9
80-180	Nature of Language	9
80-208	Critical Thinking	9

80-220	Philosophy of Science	9	79-225	West African History in Film	9
80-221	Philosophy of Social Science	9	79-229	Origins of the Arab-Israeli Conflict, 1880-1948	9
80-230	Ethical Theory	9	79-230	Arab-Israeli Conflict and Peace Process since 1948	9
80-241	Ethical Judgments in Professional Life	9	79-235	Caribbean Cultures	9
80-270	Philosophy of Mind	9	79-240	Development of American Culture	9
80-271	Philosophy and Psychology	9	79-241	African American History: Africa to the Civil War-American History I	9
80-312	Philosophy of Mathematics	9	79-242	African American History: Reconstruction to the Present-American History II	9
85-102	Introduction to Psychology	9	79-255	Irish History	6
85-211	Cognitive Psychology	9	79-261	The Last Emperors: Chinese History and Society, 1600-1900	9
85-221	Principles of Child Development	9	79-265	Russian History: From the First to the Last Tsar	9
85-241	Social Psychology	9	79-297	Dilemmas and Controversies in Anthropology	9
85-251	Personality	9	79-307	Religion and Politics in the Middle East	9
85-261	Abnormal Psychology	9	79-310	Modern U. S. Business History: 1870 to the Present	9
85-390	Human Memory	9	79-345	Roots of Rock & Roll	9
88-120	Reason, Passion and Cognition	9	79-350	Early Christianity	9
<b>Category 2: Economic, Political and Social Institutions</b>					
19-101	Introduction to Engineering and Public Policy	12	80-100	Introduction to Philosophy	9
36-303	Sampling, Survey and Society	9	80-250	Ancient Philosophy	9
70-332	Business, Society and Ethics	9	80-251	Modern Philosophy	9
70-420	Entrepreneurship for Scientists	9	80-253	Continental Philosophy	9
73-100	Principles of Economics	9	80-254	Analytic Philosophy	9
79-203	Social and Political Change in 20th Century Central and Eastern Europe	9	80-255	Pragmatism	9
79-205	20th/21st Century Europe	9	80-261	Empiricism and Rationalism	9
79-221	Development and Democracy in Latin America	9	80-276	Philosophy of Religion	9
79-245	Capitalism and Individualism in American Culture	9	82-xxx	Any Course Offered by Modern Languages	
79-246	Industrial America	9	<b>C. Elective Course Requirements (36 units)</b>		
79-252	Exploring the American Century: United States History After 1945	9	Complete non-technical courses totaling 36 units from DC, CFA, and Tepper. These can include language courses and music courses, for instance. In this category, you have the freedom to design how you want to structure your remaining general education requirements. For example, you can use these electives to build a depth sequence of 2-4 courses in a particular area or you can take courses from different areas or some combination of each.		
79-316	Photography, the First 100 Years, 1839-1939	9	<b>NOTE**</b> Check our web site for courses from DC, CFA, and Tepper that may NOT be used ( <a href="http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/deletions.html">http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/deletions.html</a> ) to satisfy these requirements because they are too technical in nature, plus a list of courses in other colleges (including SCS, CIT, Tepper, and Heinz College) that do satisfy these requirements( <a href="http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/additions.html">http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/additions.html</a> ).		
79-330	Medicine and Society	9	<b>For Students Entering in the Fall of 2015 and Beyond</b>		
79-331	Body Politics: Women and Health in America	9	Carnegie Mellon's Mellon College of Science (MCS) has a distinguished record of educating leaders in science and technology. Science education in the 21 <sup>st</sup> 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 <b>scholars</b> who are deeply trained in their discipline(s), and also <b>professionals</b> 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 <b>citizens</b> who are actively involved and globally engaged, and to grow as <b>persons</b> with a sense of wellness and balance.		
79-340	Juvenile Delinquency and Juvenile Justice	9	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:		
79-341	The Cold War in Documents and Film	9	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.		
79-374	American Environmental History: Critical Issues	9	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.		
79-377	Food, Culture, and Power: A History of Eating	9	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.		
80-135	Introduction to Political Philosophy	9	4. Participate effectively in multidisciplinary research and/or other teams pursuing a shared vision while optimizing team outcomes.		
80-136	Social Structure, Public Policy & Ethics	9			
80-226	Revolutions in Science	9			
80-245	Medical Ethics	9			
80-276	Philosophy of Religion	9			
80-341	Computers, Society and Ethics	9			
80-344	Management, Environment, and Ethics	9			
84-104	Decision Processes in American Political Institutions	9			
84-275	Comparative Politics	9			
84-310	International Political Economy and Organizations	9			
84-320	Domestic Politics and International Affairs	9			
84-321	Autocrats and Democrats	9			
84-322	Nonviolent Conflict and Revolution	9			
99-238	Materials, Energy and Environment	9			
79-268	World War I: The Twentieth Century's First Catastrophe	9			
<b>Category 3: Cultural Analysis</b>					
57-173	Survey of Western Music History	9			
57-209	The Beatles	9			
76-227	Comedy	9			
70-342	Managing Across Cultures	9			
76-232	Introduction to African American Literature	9			
76-239	Introduction to Film Studies	9			
76-241	Introduction to Gender Studies	9			
79-104	Global Histories	9			
79-202	Flesh and Spirit: Early Modern Europe, 1400-1750	9			
79-205	20th/21st Century Europe	9			
79-207	Development of European Culture	9			
79-221	Development and Democracy in Latin America	9			

- Use the appropriate tools and required media literacy to acquire, assess, and analyze data and information from diverse sources.
- Recognize and explain the importance of at least one current research topic in a STEM field outside of their major.
- Recognize and explain the similarities and differences in analyzing/ approaching problems, including in technical and non-technical fields other than their major.
- Demonstrate knowledge of the arts, humanities, and social sciences.
- Recognize the interplay of science, society, public policy, business, and economics.
- Identify global examples of the reciprocal relationships among science, technology, political forces, societal contexts, and environmental issues.
- Describe multiple similarities and differences between one's own culture and that of others.
- 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.
- Engage in recursive, reflective processes to balance multiple endeavors by setting priorities and managing time in academic, meta-curricular, and personal dimensions.
- Recognize ethical issues and appreciate the complexities of interrelationships among them, and the use of information in ethical and legal manners.
- 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.

Students pursuing any MCS bachelor's degree will fulfill these outcomes through their primary MCS major and by completing the following technical and nontechnical breadth requirements prior to graduation.

### Technical Breadth Requirements

As a 21<sup>st</sup> 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 4 categories listed below. These may include pre-requisite 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 3 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 pre-requisites that can be satisfied by AP, IB, Cambridge A Level Exams. Please check the prerequisites requirements as necessary.)

##### LIFE SCIENCES

02-223	Personalized Medicine: Understanding Your Own Genome	9
02-261	Quantitative Cell and Molecular Biology Laboratory	9
03-115	Phage Genomics Research	6
03-116	Phage Genomics Research	6
03-121	Modern Biology	9
03-124	Modern Biology Laboratory	9
03-125	Evolution	9
03-127	How Biological Experiments Work - A Project Course	9
03-161	Molecules to Mind	9
03-231	Biochemistry I	9
or 03-232	Biochemistry I	
03-250	Introduction to Computational Biology	12
42-101	Introduction to Biomedical Engineering	12
42-202	Physiology	9
85-219	Biological Foundations of Behavior	9

#### B. Physical Sciences

(Refer to your specific department for how this category should be fulfilled. Some courses have pre-requisites 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
09-214	Physical Chemistry	9
09-217	Organic Chemistry I	9
09-219	Modern Organic Chemistry	10
09-221	Laboratory I: Introduction to Chemical Analysis	12
09-348	Inorganic Chemistry	10
33-121	Physics I for Science Students	12
33-122	Physics II for Biological Sciences and 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 pre-requisites that can be satisfied by AP, IB, Cambridge A Level Exams. Please check the prerequisites requirements as necessary.)

##### MATH, STATS, and CS

02-201	Programming for Scientists	10
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
21-124	Calculus II for Biologists and Chemists	10
21-127	Concepts of Mathematics	10
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	9
or 21-268	Multidimensional Calculus	
or 21-269	Vector Analysis	
21-260	Differential Equations	9
or 21-261	Introduction to Ordinary Differential Equations	
36-201	Statistical Reasoning and Practice	9
36-202	Statistical Methods	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 and Social Sciences	9
15-110	Principles of Computing	10
15-112	Fundamentals of Programming and Computer Science	12
15-122	Principles of Imperative Computation	10
15-150	Principles of Functional Programming	10
15-251	Great Theoretical Ideas in 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 and 36-201 and 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 non-technical 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 non-technical breadth requirements:

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

38-101	EUREKA!: Discovery and Its Impact	6
76-101	Interpretation and Argument	9
99-101	Computing @ Carnegie Mellon	3
or 99-102	Computing @ Carnegie Mellon	

#### B. The following course must be taken in the Spring of the junior year:

38-301 MCS Junior Seminar

#### 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 requirement. Any student who finds an appropriate Carnegie Mellon course not on the list below that might fulfill this requirement should contact their academic advisor 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
57-209	The Beatles	9
57-306	World Music	9
70-342	Managing Across Cultures	9
73-331	Political Economy of Inequality and Redistribution	9
76-221	Books You Should Have Read By Now	9
76-227	Comedy	9
76-232	Introduction to African American Literature	9
76-239	Introduction to Film Studies	9
76-241	Introduction to Gender Studies	9
76-386	Language & Culture	9
79-104	Global Histories	9
79-201	Introduction to Anthropology	9
79-202	Flesh and Spirit: Early Modern Europe, 1400-1750	9
79-205	20th/21st Century Europe	9
79-207	Development of European Culture	9
79-221	Development and Democracy in Latin America	9
79-229	Origins of the Arab-Israeli Conflict, 1880-1948	9
79-230	Arab-Israeli Conflict and Peace Process since 1948	9
79-240	Development of American Culture	9
79-241	African American History: Africa to the Civil War	9
79-242	African American History: Reconstruction to the Present	9
79-255	Irish History	6
79-261	The Last Emperors: Chinese History and Society, 1600-1900	9
79-265	Russian History: From the First to the Last Tsar	9
79-266	Russian History: From Communism to Capitalism	9
79-275	Introduction to Global Studies	9
79-297	Dilemmas and Controversies in Anthropology	9
79-307	Religion and Politics in the Middle East	9
79-345	Roots of Rock & Roll	9
79-349	The Holocaust in Historical Perspective	9
79-350	Early Christianity	9
79-357	History of Black American Music	6
79-377	Food, Culture, and Power: A History of Eating	9
80-100	Introduction to Philosophy	9
80-250	Ancient Philosophy	9
80-251	Modern Philosophy	9
80-253	Continental Philosophy	9
80-254	Analytic Philosophy	9
80-255	Pragmatism	9
80-276	Philosophy of Religion	9
82-xxx	Any course from Modern Languages	
99-241	Revolutions of Circularity	9
99-3xx	Any of the Country Today courses	3

#### E. Arts, Humanities, and Social Sciences 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. Courses counted toward the Cultural/Global Understanding requirement, and 76-101, 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.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, Tepper, and Heinz College) that do satisfy (<http://www.cmu.edu/mcs/undergrad/advising/hss-finearts/additions.html>) this requirement.

**For students entering in the Fall of 2015 and beyond, the following requirements apply to all MCS bachelor's degrees:**

1. Students must complete a minimum of 360 units.

- The four courses required for the Technical Breadth category can be completed at Carnegie Mellon or via transfer credit.
- 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.
- For the Arts, Humanities and Social Sciences 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.

## Intercollege Programs

MCS participates in two intercollege programs, the Bachelor of Science and Arts Degree program and the Science and Humanities Scholars program. Enrollment for the Science and Humanities program is by invitation only for incoming first-year students, and by application for current students.

## Bachelor of Science and Arts Degree Program (BSA)

Students in the Bachelor of Science and Arts Degree program 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.

More details can be found at <http://coursecatalog.web.cmu.edu/servicesandoptions/intercollegeprograms/bxaintercollege/>.

## Science and Humanities Scholars Program (SHS)

Students in the Science and Humanities Scholars Program (SHS) are jointly admitted to MCS and the Dietrich College of Humanities and Social Sciences (DC). Participants in this program follow a special general education core, but have the flexibility to choose a primary major in either of the two colleges. More detail can be found at <http://coursecatalog.web.cmu.edu/servicesandoptions/intercollegeprograms/>.

## 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 web site ([www.cmu.edu/mcs/](http://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:

- Successfully completed the Honors BS/MS program in the Department of Chemistry or Department of Mathematical Sciences.
- Successfully completed the departmental honors program in the Department of Biological Sciences or the Department of Chemistry.
- Earned a cumulative grade point average of 3.20 or higher 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 Associate Dean of MCS, 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 preapproved judged competition, such as Sigma Xi, is necessary.

Final approval of nominations for MCS Honors will come from the Dean of MCS and the Associate Dean for Undergraduate Affairs.

## 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 Molecular Biosensor and Imaging Center uses an interdisciplinary approach to develop reagents, microscopes, and imaging tools and applies them to the investigation of fundamental problems in biology and biotechnology.

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

The Computational Biology Department seeks to realize the potential of machine learning for expanding our understanding of complex biological systems. A primary goal of the Center is to develop computational tools that will enable automated creation of detailed, predictive models of biological processes, including automated experiment design and data acquisition.

## Academic Standards

### Academic Actions

#### 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 3.5 while completing a minimum of 36 factorable units and earning no incomplete grades.

### Dean's List 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.

### Probation, Suspension, and Drop

In the first year, quality point averages below 1.75 in either semester invoke an academic action. For all subsequent semesters an academic action will be taken if the semester QPA or the cumulative QPA (excluding the first year) is below 2.00.

The progression below between probation, suspension, and drop is typical.

However, in unusual circumstances, MCS College Council may choose to suspend or drop a student without prior probation.

### Probation

The action of probation will be taken if:

- One semester of the first year is below 1.75 QPA.
- The semester QPA of a student in good standing beyond the first year falls below 2.00. The term of probation is one semester as a full-time student. First-year students are no longer on probation at the end of the second semester if their semester QPA is 1.75 or above.

A student is occasionally continued on probation who has had one semester on probation and is not yet meeting minimum requirements 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 probation will be suspended.

A first-year student will be suspended if the QPA from each semester is below 1.75.

A student in the third or subsequent semester of study will be suspended if the semester factor or the cumulative factor (excluding the first year) is below 2.00 for two consecutive semesters.

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

- Receiving permission in writing from the Associate Dean of MCS.
- Completing a Return from Leave form from Enrollment Services.
- 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 Associate Dean.

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.

### Drop

This is a permanent severance from the Mellon College of Science. Students are dropped when it seems clear that they will never 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 or 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.)

## Transfer into MCS Departments

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.

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. Students may submit an internal transfer request no earlier than mid-term of the spring semester of the first year. Potential transfer students must also have successfully taken 21-120 Differential and Integral Calculus and, depending on major choice, one of the following: 03-121 Modern Biology, 09-105 Introduction to Modern Chemistry I, or 33-111 Physics I for Science Students.

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.

Undergraduate students not in MCS and wishing to transfer into a department in MCS beyond the first year 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.

Procedure for transfer of students 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 2.0 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 2.0, this requirement is modified to be a cumulative QPA of at least 2.0 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 Technical and Nontechnical Core Courses 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 seven semesters.

### College Research Honors

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

## Faculty

WILLIAM ALBA, Director of Science and Humanities Scholars Program – Ph.D.,  
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.,  
CURTIS MEYER, Associate Dean for Faculty and Graduate Affairs – Ph.D.,

## Administration

CHARLOTTE BARTOSH, Interdisciplinary Laboratory Research Technician.  
VERONICA PEET, Senior Academic Advisor.  
TARA PRIMIERO, Administrative Coordinator.  
MAY SIMAAN, Administrative Coordinator.