MCS Interdisciplinary Courses

About Course Numbers:

Each Carnegie Mellon course number begins with a two-digit prefix that designates the department offering the course (i.e., 76-xxx courses are offered by the Department of English). Although each department maintains its own course numbering practices, typically, the first digit after the prefix indicates the class level: xx-1xx courses are freshmen-level, xx-2xx courses are sophomore level, etc. Depending on the department, xx-6xx courses may be either undergraduate senior-level or graduate-level, and xx-7xx courses and higher are graduate-level. Consult the Schedule of Classes (https://enr-apps.as.cmu.edu/open/SOC/SOCServlet/) each semester for course offerings and for any necessary pre-requisites or co-requisites.

38-100 CATALYST - MCS First-Year Seminar
Spring: 3 units
The CATALYST seminar will equip transfer students to MCS, as well as those students who did not successfully complete the EUREKA seminar, with foundational knowledge, skills and perspectives that will support their development as emerging scientists and scholars. During the seminar, students will be presented with opportunities and experiences designed to help them frame how the MCS curriculum aspires to shape their evolving identities in the areas of scholar, person, professional and citizen, while also engendering a sense of excitement about science and scientific inquiry. The seminar will offer information and strategies that are employed both by successful students and by successful scientists in optimizing their approach to work and life, with a key focus on areas such as cognitive learning skills, research, teamwork, goal setting, time management, community engagement, ethics, resources and assessment. Additionally, the seminar will introduce students to the learning outcomes and requirements associated with the MCS core curriculum, with a particular emphasis on the self-directed ENGAGE courses and the role of the MyCORE e-portfolio system in documenting and framing student growth and development.

38-101 EUREKA!: Discovery and Its Impact
Fall: 6 units
The MCS first-year seminar “EUREKA: Discovery and Its Impact” will equip new students with foundational knowledge, skills and perspectives that will support their development as emerging scientists. During the seminar, students will be presented with opportunities and experiences designed to help them frame how the MCS curriculum aspires to shape their evolving identities in the areas of scholar, person, professional and citizen, while also engendering a sense of excitement about science and scientific inquiry. The seminar will offer information and strategies that are employed both by successful students and by successful scientists in optimizing their approach to work and life, with a key focus on areas such as cognitive learning skills, research, teamwork, goal setting, time management, innovation, community engagement, ethics, resources and assessment. Additionally, the seminar will introduce first-year students to the learning outcomes and requirements associated with the MCS core curriculum, with a particular emphasis on the self-directed ENGAGE courses and the role of the e-portfolio system in documenting and framing student growth and development.

38-110 ENGAGE in Service
Fall and Spring: 1 unit
ENGAGE in Service is a 1-unit course (9 hours of work, minimum requirement for a passing grade) designed to promote MCS students’ direct engagement with community development and service learning. To fulfill this requirement, students must engage in a minimum of 9 hours of work devoted to a non-profit organization or organizations of their choice, 3 of which must have a direct benefit to the local Pittsburgh community. Students may complete the requirements anytime during their undergraduate years, but must register for the class during the semester that they intend to complete it, no later than their penultimate semester. Coursework includes documentation of service via completion of a form for each eligible activity that includes a time log, a description of the activity, the name and contact information for their supervisor and the supervisor’s signature. In addition, during the last semester of the project/course students will prepare a 1-2 page reflective paper on the lessons learned from their immersion in the organization(s) and its (their) work. No pay or other compensation can be received, and in special cases, students may petition for a waiver if they have completed another service-learning course at Carnegie Mellon.

38-119 Grand Challenge Freshman Seminar: Feeding the World, Feeding Ourselves
Intermittent: 9 units
Food in the twenty-first century is ripe with paradox: fewer people than ever work as farmers or ranchers, but the quantity and global variety of foods available to consumers continues to expand; public health officials around the world are raising alarms about diseases linked to the over-consumption of fats and sugars, even as hundreds of millions of people do not know where their next meal is coming from; organic agriculture is booming, while agribusiness giants like Monsanto continue to expand. Producing food consumes more land and water resources than any other human activity. The individual and collective decisions people make about food shape individual and community health, social justice, and sustainability. If we are to make sound decisions about how to feed the world and feed ourselves, we need to understand the highly creative and contentious ways that people produce and consume food. In this class we will address the following central questions in order to unravel some paradoxes, and help us make informed choices, about foods we consume: (1) What are the origins of agriculture, and why does it matter for the future of food? (2) How do cultural, ecological, economic, and technological contexts shape food acquisition, preparation, and consumption? (3) What are the causes of hunger: can we feed 8 billion people healthy food and not trash the planet? And (4) what roles have science and technology played in shaping industrial food, and in shaping the world around us?

38-127 DC Grand Challenge First-Year Seminar: Environmental Justice
Fall and Spring: 9 units
Wondering what the “Green New Deal” proposal is about? Does it seem like you have to choose between protecting people and protecting the planet? How does environmentalism connect to struggles over social justice and human rights? This first-year interdisciplinary seminar is an introduction to the Grand Challenge: Environmental Justice. In Giovanna de Chiro's words, the environmental justice movement is working “toward building diverse, dynamic, and powerful coalitions to address the world's most pressing social and environmental crises global poverty and global climate change by organizing across scales and seeking a global vision for healthy, resilient, and sustainable communities.” In this seminar, we’ll study the history and science behind two interconnected challenges for environmental justice: global climate change and fine-particle air pollution. Both types of pollution start with combustion of fossil fuels. Particulate air pollution kills roughly 7 million globally each year; these air pollution deaths happen close to the source, with unequal levels of exposure and risk for people according to class and race. Climate change, mostly from carbon dioxide and methane emissions, is spreading globally and lasts well beyond our lifetimes, yet its effects are again disproportionally based on class and race. In this course, we'll explore the science, history, ethics, and public perception of these problems, with implications for Pittsburgh and the planet, and for the near- and long-term future.

38-132 DC Grand Challenge First-Year Seminar: Health in Unhealthy Times: Preventing, Ma
Intermittent: 9 units
We live in times when health is a major global concern, whether we worry about the increase in Covid-19 cases, await our immunization, strive to understand the disproportionate impact of the disease on BIPOC populations, or debate mitigation measures to mention ongoing concerns with common chronic illnesses such as diabetes, cancer, autoimmune disease, depression, anxiety, etc. Health, or lack thereof, has always been a critical part of the human experience, and it is fundamentally impacted by different human experiences. This seminar will introduce students to the scientific aspects of health, its political and social determinants, ethical constraints, historical roots, as well as to the cultural and communicative skills required to dialogue about health, make decisions, and engage empathetically with others in their health stories. We will read and discuss a broad variety of materials from medical science articles to social psychological experimental reports and personal or literary narratives about health. The course is divided into three components: health and preventative behaviors, managing chronic health challenges, and coping with disruptive health experiences. We believe these components can represent a broad array of interest and engage students on a personal level.
38-220 ENGAGE in the Arts
Fall and Spring: 2 units
ENGAGE in the Arts is part of Mellon College of Science's Core Curriculum. This 2-unit full-semester course will broaden students' knowledge of the fine arts, extend their global and cultural awareness, and facilitate the further development of their self-identification. Coursework requires that students attend 8 distinct arts events, 2 of which must engage with a culture different from one's personal cultural background. In choosing events, students should be imbued with an attitude of openness to new ideas and a willingness to try something new. The course requires students to share, reflect, and document their participation in a variety of arts events by engaging with classmates and instructors through MyCORE, where they can upload coursework and find postings for events. Coursework can be completed at any time during students' undergraduate years, but they must register for the class during the semester that they intend to complete it, no later than their penultimate semester.

38-230 ENGAGE in Wellness: Looking Inward
Spring: 1 unit
ENGAGE in Wellness: Looking Inward is a 1-unit mini-course that MCS students will enroll in the spring of the sophomore year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this first course, taken in the first mini of the sophomore year, students will select one of three areas on which to focus: intellectual, emotional or physical health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness in this area, develop short-term goals for the next year and a statement of a longer-term goal in this area, identify possible resources and then choose activities that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students' elect to pursue in fulfillment of their wellness plan. THIS COURSE IS FOR SOPHOMORES ONLY.

38-301 PROPEL
Spring: 6 units
PROPEL: Preparation, Readiness, and Optimization for Professional Excellence in Life - is a 6-unit seminar course that MCS students will enroll in the spring of their junior year. The course will leverage students' deepening disciplinary perspective in service of the development of competencies, skills and perspectives that are necessary to achieve professional excellence in today's society. The course will use traditional career development activities, such as interviewing, resume writing and networking, as a starting point for students to begin the process of reflecting on, and preparing for, their impending transitions into professional life. From there, the course will seek to expand students' conceptualization of the scientific workplace by exploring the interplay of science, innovation, public policy, entrepreneurship and business in professional settings today. The seminar will also equip students with significant insight into the ways in which global policy, societal and political forces, environmental issues and ethical considerations shape and influence the activity and research of working scientists. The course will offer additional experiences for students to refine their multidisciplinary teamwork and communication skills via small group projects focusing on the aforementioned course themes. Finally, “PROPEL” will include a formal academic advising component to ensure that all students are well positioned to complete the MCS core requirements and departmental requirements in the following year. THIS COURSE IS FOR MCS JUNIORS ONLY.

38-302 Science and Society
Spring: 4 units
The course is not designed to be a deep dive into any one topic, but rather seeks to equip students with insights into the scientific workplace by exploring the interplay between science and society, which might include areas such as public policy, political forces, business, technology, environmental issues, and economics. Additionally, the course will offer opportunities for students to develop and refine their multidisciplinary teamwork and communication skills via team projects focusing on the aforementioned course themes.

38-303 Professional Development and Life Skills
Spring: 2 units
This course will leverage students' deepening disciplinary perspective in service of the development of competencies, skills and perspectives that are necessary to achieve professional excellence in today's society. The course will use traditional career development activities, such as interviewing, resume writing and networking, as a starting point for students to begin the process of reflecting on, and preparing for their impending transitions into professional life.

38-304 Reading and Writing Science
Spring: 6 units
This course is designed to hone the student's ability to read scientific writing and to communicate about scientific topics to audiences with different levels of interest and expertise in science. This course introduces students to frameworks for identifying the linguistic features of scientific argumentation in research papers across a range of scientific disciplines to improve their reading and writing of scientific content. The course also examines how scientific information changes when it is reported in the popular media and the effects these changes have on non-experts' understanding of science. Students will use these changes as a model for writing about scientific research to non-expert audiences. Finally, this course gives students the opportunity to practice science communication by creating oral presentations for their peers. The curriculum in this course is drawn from rhetoric: a discipline focused on the analysis and production of language, arrangement, and argument strategically designed to persuade an audience.

38-330 ENGAGE in Wellness: Looking Outward
Fall: 1 unit
ENGAGE in Wellness: Looking Outward is a 1-unit mini-course that MCS students will enroll in the fall of the junior year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this second course, taken in the first mini of the junior year, students will select one of three areas on which to focus: spiritual, environmental and institutional or community health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness, participate in wellness activities on campus or develop short-term goals and longer-term goal in this area, identify possible resources that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students' elect to pursue in fulfillment of their wellness plan. THIS COURSE IS FOR JUNIORS ONLY.
38-411 The Science and Mathematics of Art
Intermittent: 6 units
This interdisciplinary course will provide a view of the application of mathematical and scientific knowledge in the creation, analysis, conservation, restoration, and preservation of art work. The course will combine science and art history lectures with field work to Museums and Art Galleries. Students from diverse science and mathematics backgrounds will be exposed to the methods, demands, and aims of other technical and non-technical disciplines. They will be challenged to consider and communicate how their own discipline relates to and enables the development of art and to identify synergetic relationships between different areas of human endeavor. Students will collaboratively design and carry out final projects which combine research and creative work; these projects will be designed such that they can be used in local Museums for public outreach. A series of researchers and artists who work at the boundary between science and art will give guest lectures.
Prerequisites: 03-115 or 03-124 or 03-343 or 09-122 or 09-221 or 33-104 or 21-270 or 21-292 or 21-369 or 33-100 or 21-257

38-430 ENGAGE in Wellness: Looking Forward
Fall: 1 unit
ENGAGE in Wellness: Looking Forward is a 1-unit mini-course that MCS students will enroll in the fall of the senior year, designed to give students a holistic understanding of their own personal wellness. The course is structured around the concept of a Wellness Wheel, a model for personal wellness that is used to describe the various areas that students should reflect upon when describing, and ultimately improving, their overall wellness. The MCS Wellness Wheel has nine components: intellectual, physical, emotional, spiritual, environmental, institutional or community, financial, social, and occupational health. During this third course, taken in the first mini of the senior year, students will select one of three areas on which to focus: financial, social and occupational health. They will be asked to engage in a recursive, reflective process to assess their own level of wellness, participate in wellness activities on campus or develop short-term goals and longer-term goal in this area, and identify possible resources that promote this aspect of wellness. Students should expect to devote 9-14 hours to the development and articulation of their plan in order to earn a passing grade. These hours are tied to completion of the requested assessments and not to the activities students’ elect to pursue in fulfillment of their wellness plan. THIS COURSE IS FOR SENIORS ONLY.

38-610 Modern Programming for Data Scientists
Fall: 6 units
A hands-on introductory course to the fundamentals of Python programming in data science for students with minimal or no programming experience. Students will learn while working on scientific problems and leveraging scientific datasets. The data science Python ecosystem includes easy-to-use packages for working with data and is the foundation for most deep learning frameworks, which will be used in subsequent courses. Students will develop skills in object-oriented programming in Python3; usage of packages for efficiently working with scientific data; customizing their environment; Anaconda; developing electronic notebooks for reusing and sharing code; reading data specific to the sciences (Biology, Chemistry, Math, or Physics); improving the efficiency of Python code; and visualizing data. At the end of the courses, students will have the skills to design and deploy a python-based data science solution for a small scientific challenge. This course is required for students enrolled in the MS program in Data Analytics for Science.

38-611 Introduction to Large-Scale Computing in Science
Fall: 6 units
This course builds upon the skills acquired in the proceeding mini-semester, Modern Programming for Data Scientists, and introduces students to the techniques necessary for manipulating and analyzing big data encountered in modern scientific computing, and using the large computational platforms involved in those processes. The course will use the Python-friendly Spark framework to massively amplify capabilities introduced in the previous mini. Starting with mining of large and complex scientific datasets, the students will progress to scalable data analytics and eventually very basic machine learning on various large scalable platforms such as supercomputers and clouds. Lower-level concepts such as performance optimization and concurrent programming techniques will also be introduced along the way. Exercises will be motivated by relevant scientific community datasets. This course is required for students enrolled in the MS program in Data Analytics for Science.

38-615 Computational Modeling, Statistical Analysis and Machine Learning in Science
Fall: 12 units
The purpose of this course is to provide a practical introduction to the core concepts and tools of machine learning in a manner easily understood and intuitive to STEM students. The course begins by covering fundamental concepts in ML, data science, and modern statistics such as the bias-variance tradeoff, overfitting, regularization, and generalization, before moving on to more advanced topics in both supervised and unsupervised learning. Students will choose a large dataset from a selection of biology, chemistry, math, or physics datasets hosted by PSC and use this dataset throughout the MS program. The topics of the course are taught with students analyzing the chosen dataset. An intensive knowledge of Python or another computing language is not a pre-requisite since students will be given at first simple scripts that they work with and then expand upon. This course is required for students enrolled in the MS program in Data Analytics for Science.

38-709 Applied Cell and Molecular Biology
Fall: 12 units
This course will examine applications of modern cell and molecular biology, with emphasis on commercial products and processes. The course will include a basic background in the major topics that would be covered in courses on prokaryotic and eukaryotic molecular biology and molecular cell biology. The course is intended for non-specialists who seek an understanding and appreciation of fundamental concepts without the analysis of experimental detail that would support the development of concepts in a course for the specialist. The course will draw on the patent literature as a source of commercial applications of biological discoveries. Examples of the topics that might be included are: diagnostic and therapeutic monoclonal antibodies (e.g., Herceptin), therapeutic proteins (e.g., colony stimulating factors, erythropoietin, hormones), antibiotics, subunit molecular vaccines, amino acid fermentations, enzyme based processes for chemical synthesis, gene therapy, stem cells and regenerative medicine, herbicide tolerant plants, microbial diagnostics (e.g., multilocus sequence typing), transgenic animals, DNA fingerprinting.

38-710 Principles of Biotechnology
Spring: 12 units
This course is intended to provide an introduction to the core areas currently highlighted in the biotechnology industries. The objective is to provide the appropriate background for management level personnel to optimize their decision-making based on knowledgeable background in today’s technologies. The focus will be on weekly modules of similar technologies with an introduction to technology/science behind the topic area and the applications of the technology in today’s industries and markets.

38-801 Evidence Based Teaching in STEM
Fall and Spring: 7 units
Special Permission Only: This course is designed to prepare PhD students from science disciplines to: (1) teach effectively and efficiently as future faculty members; (2) critically read and apply peer-reviewed, STEM-based educational research; and (3) adapt approaches from the Scholarship of Teaching and Learning (SoTL) to formatively assess student learning and iteratively improve teaching and course design. Together, we will explore the research on teaching and student learning, identifying and challenging our assumptions regarding how college students learn best in science disciplines. Participants will leverage this research to develop a diverse toolkit of evidence-based, student-centered strategies for teaching course design that may be applied to face-to-face, blended, or online courses, both within and across STEM disciplines. Prior teaching experience is not required, but students must have completed their first year of PhD study to enroll. This course will not prepare or license participants to teach K-12 students in Pennsylvania or elsewhere.