

# MARINE SCIENCE (MSC)

---

**MSC 101. Survey of Oceanography. 3 Credit Hours.**

Introduction to the oceans and their significance to mankind, encompassing geological, physical, chemical, and biological processes; man's role in and on the sea, including fisheries, pollution, and ocean management. Not for major or minor.

NOT FOR ANY MSC STUDENT MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MSC 104. Molecules of Life. 3 Credit Hours.**

Molecules of Life explores the modern science of biological molecules, which occurs at the intersection of chemistry, biology, and medicine. We examine the major molecular components of the cell--proteins, nucleic acids, lipids, etc.--and illustrate the role of chemical principles in understanding their structure and function. Not for major or minor.

NOT FOR ANY MSC STUDENT MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 105. Shark Behavioral Ecology & Conservation Semester. 3 Credit Hours.**

SUMMER SCHOLARS PROGRAM ONLY. In this course, students will learn core concepts in shark behavioral ecology and key aspects of shark biology needed for the holistic understanding and study of shark behavioral ecology and conservation. NOT FOR MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**MSC 106. Marine Mammal Biology and Conservation. 3 Credit Hours.**

SUMMER SCHOLARS PROGRAM ONLY. The purpose of this class is to provide an introductory overview of basic biological concepts relevant to marine mammal taxonomy, physiology, natural history, behavior, and threats/conservation. This class will be dynamic, involving lectures, discussions, review of primary literature, career guidance, guest lectures, videos/movies, and field trips. NOT FOR MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**MSC 107. Life in the Sea. 3 Credit Hours.**

Lectures provide an introduction to the plants and animals of the sea, including plankton, nekton and the benthos, with anthropogenic impacts. Not for major or minors.

NOT FOR ANY MSC STUDENT MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 108. Environmental Oceanography. 3 Credit Hours.**

This course will focus on environmental issues facing the oceans today, including global climate destabilization, the impact of population growth on coastal environments, marine pollution, and the state of marine fisheries. An active learning approach will be adopted, with emphasis on case studies and critical analysis. Marine environmental issues will be presented in self-contained analytical exercises. Basic math needed to quantify environmental issues will be introduced. Information and questions on sustainability will be integrated throughout the course and students will be asked to think critically about these pressing concerns. Not for major or minor.

NOT FOR ANY MSC STUDENT MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 111. Introduction to Marine Science. 3 Credit Hours.**

Geological, physical, chemical and biological processes of the world's oceans. The role of the oceans in global dynamics and man's role in and on the sea, including fisheries, pollution and ocean management. Enrollment limited to Marine Science/Marine Affairs majors and minors. Lecture and discussion, 3 hours. Field trips.

Requisite: Marine Science Major or Minor.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 112. Introduction to Marine Science Lab. 1 Credit Hour.**

Laboratory and field exercises to accompany Marine Science.  
Pre/Corequisite: MSC 111. And Marine Science Major or Minor.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 115. Tropical Marine Biology. 3 Credit Hours.**

A field and lecture study of selected marine environments around South Florida, with emphasis on the interaction between organisms and the geological, physical, and chemical environment. Summer Scholars Program Only.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**MSC 116. Marine Conservation. 3 Credit Hours.**

SUMMER SCHOLARS PROGRAM ONLY. The purpose of this class is to introduce students to a wide range of conservation topics regarding marine environments around the world, with an emphasis on marine mammals. This class will cover current natural and anthropogenic threats to a variety of marine organisms and the current conservation and management efforts to mitigate these threats. Students will also develop their written, visual, and oral communication skills to inspire others to contribute to protecting the health of our oceans. NOT FOR MAJOR OR MINOR.

NOT FOR ANY MSC STUDENT MAJOR OR MINOR.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**MSC 121. Ocean Currents. 3 Credit Hours.**

Ocean Currents will be a comprehensive, multi-disciplinary course on the history, geography, socio-economics, and physics of ocean currents. The importance of ocean currents to socioeconomic, weather, climate, transport of fish larvae and pollutants, distribution of plankton and fish, military operations, and shipping will be illustrated using many examples. The history of ocean current observations, detailed maps of ocean circulation and its variability, and the evolution of instruments, and theories from ancient to modern times will be detailed. The discovery and the most important observations of the major ocean currents will be discussed. There will be also lectures on modern ocean circulation theory. NON-MSC MAJORS ONLY  
For non- MSC majors.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 172. Special Topics in Marine Science. 2-6 Credit Hours.**

Content varies by semester and is indicated in parentheses following course number and title in class schedule.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 180. Seminar in Marine Science. 1 Credit Hour.**

Seminar in current research as conducted by Marine Science faculty and graduate students. This course is intended as an introduction for first year students to contemporary research topics.

Pre/Corequisite: MSC 111.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Offered by Announcement Only.

**MSC 190. Studies in Marine Science. 1-5 Credit Hours.**

For transfer courses taken at other institutions that have no direct equivalents at UM

**Components:** LEC.

**Grading:** GRD.

**MSC 191. Studies in Marine Policy. 1-5 Credit Hours.**

For transfer courses taken at other institutions that have no direct equivalents at UM.

**Components:** LEC.

**Grading:** GRD.

**MSC 203. Foundations of Computational Marine Science. 4 Credit Hours.**

The course provides a basic introduction to Computational Marine Science. The course will use Python as a programming language and will illustrate its use in problem solving and exploratory data analysis in the Marine Sciences. Programming topics covered include the language syntax and construct, variables, flow control, functions, software design and object-oriented programming.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 204. Environmental Statistics. 3 Credit Hours.**

This introductory course provides an overview of parametric and nonparametric statistics with an emphasis on applications in the analysis of environmental data. (Not open to students with credit in BIL311 or equivalent).

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 215. Chemical Oceanography. 3 Credit Hours.**

An introduction to the chemistry of the oceans. Descriptive chemical oceanography of the components of ocean waters (metals, gases, organic compounds and nutrients). Biogeochemical cycles in oceanic systems.

Prerequisite: MSC 111 and (CHM 112 or CHM 121).

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 216. Chemical Oceanography Laboratory. 1 Credit Hour.**

Chemical and physical methods in chemical oceanography. Analytical and instrumental techniques used to determine density, salinity, chlorinity, dissolved oxygen, nutrients and components of the carbonate system. Corequisite: MSC 215.

Pre/Corequisite: MSC 215 and Prerequisite: CHM 113.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 217. Physical and Chemical Processes in Coastal Ecosystems. 3 Credit Hours.**

This course is primarily intended for students enrolled in the Marine Affairs program to serve as an introduction to the role of physical and chemical processes in estuarine and coastal ecosystems in the context of the management of estuarine and coastal waters. Students will provide reviews of case studies in preparation for future management decisions that will require knowledge of coastal physical and chemical processes.

Prerequisite: CHM 110 and MSC 111.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 218. Biological Oceanography. 3 Credit Hours.**

This course will examine energy flow in marine ecosystems, the biogeochemical cycles that control them, the wide variety of types of communities and ecosystems in different parts of the ocean, and the changes they have undergone over geological timescales.

Prerequisite: MSC 111.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 220. Climate and Global Change. 3 Credit Hours.**

The Earth's climate system and the role of natural and anthropogenic processes in shaping climate change.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 250. Sustainable Economics Goes to the Movies. 3 Credit Hours.**

MSC 250 is an interdisciplinary lower-division general education course that uses the motion picture as a cultural context for illustrating sustainability and economics concepts. Stories, particularly those of human interest and emotion, can enrich discussions of economics and sustainability. Many films portray economics and sustainability as a set of problems to be inherited by future generations. Learners are more likely to recall course content when presented as a narrative than when couched in abstract models.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 300. Water Resources: History, Management, and Policy. 3 Credit Hours.**

An overview of the issues and problems surrounding the management of aquatic resources in the broadest sense including water quality of natural waters, drinking water, water pollution, water quantity and supply issues, watershed management, wetland protection, and coastal management.

We will explore the available strategies to wisely manage the various aquatic resources, policy options and their socio-economic aspects, legal frameworks, and institutional arrangements.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 301. Introduction to Physical Oceanography. 3 Credit Hours.**

Application of the laws of physics to the study of the properties and circulation of the world's oceans and atmosphere.

Prerequisite: MSC 111. And MTH 162. Or MTH 172.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 302. Introduction to Physical Oceanography Lab. 1 Credit Hour.**

Laboratory exercises and field work on basic fluid mechanics applicable to the ocean. These include buoyant convection and double diffusion, methods for measuring flows, gravity wave experiments in the lab and field, diffusion studies and rotating tank investigations as an analog for planetary flows.

Prerequisite: MSC 301 or ATM 405. Or Co-requisite: MSC 301 or ATM 405.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 311. Economics and Politics of the Environment. 3 Credit Hours.**

The objective of the class is to discuss the main economic and political concepts associated with environmental policy in the US and elsewhere. In particular, the class focuses on how economic thinking, methods, and data relate to conservation, environmental, and natural resource policy and management problems. The class will draw on marine, terrestrial, climate, weather, and other inter-dependent domains to illustrate similarities and differences from an economic and political perspective.

Prerequisites: ECO 211, MSC 111, MSC 112, and Sophomore Standing.

**Components:** LEC.

**Grading:** GRD.

**MSC 313. Coastal Law. 3 Credit Hours.**

Basic doctrines and public policy related to the use and regulation of the United States coastal zone and seabed.

Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 314. Ocean Law. 3 Credit Hours.**

The principles of international ocean law regarding ocean management; ocean delimitation and issues of environmental ocean regulation within international legal framework.

Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 316. Global Primary Production. 3 Credit Hours.**

Photosynthesis supports the vast majority of life on planet earth. This course reviews the magnitude and the processes that shape primary production in terrestrial, oceanic, and freshwater habitats. It includes the fate of primary production in the earth's biomes, and the role of terrestrial and aquatic productivity in regulating, and responding to, variable climate.

Prerequisite: BIL 160.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 317. Earth's Biogeochemistry. 3 Credit Hours.**

Outstanding features of planet Earth, including its vast oceans, climate and atmosphere, are strongly impacted by life. Scientists investigate these impacts, such as ocean acidification, variable atmospheric CO<sub>2</sub> concentrations, coastal anoxia, and permafrost melting, through their biogeochemical dynamics. The first part of the course covers the relevant microbial and chemical reactions that occur in the atmosphere, on land, in freshwaters and in the oceans. The second part links this mechanistic understanding to a large-scale, synthetic view of global biogeochemical cycles. These are considered in the context of global change.

Prerequisite: CHM 112 or CHM 121.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 321. Scientific Computing in Marine and Atmospheric Sciences. 3 Credit Hours.**

This course will present practical computational approaches to solve problems commonly encountered in marine and atmospheric science. These include interpolation, solution of linear systems, least-square fitting, numerical differencing and integration of ODEs, statistical simulations, time-series analysis and principle component analysis. Python will be used as a programming language for homework and projects.

Prerequisite: MTH 210 And MSC 203 or CSC 120.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 325. Biological Oceanographic Techniques. 3 Credit Hours.**

Field sampling for plankton biomass and productivity; benthic biomass, and of selected physical parameters. Applications of molecular techniques and remote sensing to oceanographic problems.

Prerequisite: MBE 230.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 339. Marine and Coastal Protected Area Theory and Practice. 3 Credit Hours.**

This course shall present the study and analysis of marine and coastal protected areas (MPAs) in an interdisciplinary manner, consisting of a review of the various theoretical aspects of MPAs (ecology, economics, and socio-cultural dimensions), an evaluation of governance approaches, and a review of management and planning outcomes. The expectation is that students will learn about this now mature and increasingly important conservation tool, critically examining its benefits, costs, and present and future challenges.

Prerequisite: ECO 211.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 340. Ocean Policy. 3 Credit Hours.**

Analysis of ocean policy issues in US fisheries, marine conservation and marine protected areas, marine pollution, coastal management and regulation of offshore oil and gas activities.

Prerequisite: MSC 111 and MSC 313 Or MSC 314 and Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 341. Sunken Ships and Submerged Sites: An Introduction to Underwater Archaeology. 3 Credit Hours.**

The course serves to provide an overview of underwater archaeology, covering general concepts, methods, field techniques, time periods and their associated unique sites and discoveries, as well as an introduction to professional application in preservation, management, and how popular media plays a role in public education and outreach. Note: There is no SCUBA diving component to this class.

Requisite: MSC 111 AND Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 342. Decision Making and the Environment. 3 Credit Hours.**

A basic, critical appreciation of interdisciplinary decision theory as applied to natural resources management. Specific goals include comprehension of: decision making under uncertainty, evolutionary social science, managing common pool resources, and behavioral economics.

Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 345. Economics of Natural Resources and the Environment. 3 Credit Hours.**

A comprehensive overview of the economics of national, international, and global environmental problems. A unifying theme throughout is sustainable development defined as "maximizing the net benefits of economic development while maintaining the services and quality of natural resources over time". We will use economic reasoning to examine causes and consequences of environmental and resource problems, and measures for dealing with them.

Prerequisite: ECO 211.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 346. Climate Science and Policy. 3 Credit Hours.**

The scientific evidence for, and the projected consequences of, climate change. The political and geo-engineering responses to the problem.

Prerequisite: MSC 111. Or ATM 103. Or ECS 111. And Requisite: Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 347. Polar Science and Policy. 3 Credit Hours.**

The course will address the physical, chemical, and biological properties of the polar oceans, atmosphere, and coastal regions. The interactions between ocean, ice, atmosphere, and land will be discussed in detail, not only in terms of local relationships, with cross-disciplinary linkages, but also with emphasis on the influence the Polar Regions exert on the global climate, biogeochemical cycles, ecosystems and local human populations.

Prerequisite: MSC 111 and MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 348. Sea Level Rise. 3 Credit Hours.**

Sea-level rise (SLR) is one of the most serious and challenging consequences of climate change. The long-term impacts on coasts and coastal cities are potentially catastrophic and Miami has been ranked the number one city at risk worldwide. This course will cover the physics and geophysics of global and regional SLR, including how and why sea level changed in the past and how it is predicted to change in the future, as well as the impacts of SLR and how coastal communities might adapt to these challenges.

Prerequisites: MSC 111, and MTH 108 or higher.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 351. Climate, Oceanography, and Biogeography of the Galapagos. 3 Credit Hours.**

This course and its companion describe the climate, oceanography of the Galapagos Islands, and explore the ways the physical environment has influenced biodiversity on the islands. This field intensive course sequence is part of the Galapagos semester abroad program.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 352. Biophysical Dynamics in the Ocean: Biogeography and Evolution of the Galapagos. 3 Credit Hours.**

Course expands aspects of bio-physical description of the Galapagos in comparison with other systems. Emphasis on identification of flow regimes in various settings based on winds and buoyancy forcing and characterization of the resulting biological niches. Analysis focuses on scales and components of the resulting biogeography. Biological aspects covered include bioenergetics and reproduction in relation to their role in evolution. This field intensive course sequence is part of the Galapagos semester abroad program.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 355. Limnology. 3 Credit Hours.**

This course is an introduction to the physical, chemical, and biological properties of freshwater ecosystems. It is intended as an upper level course for juniors and seniors. It emphasizes the ecological process of lakes, rivers, and to less extent, streams. The role of watershed processes is considered in the context of management of rivers and estuaries. Case studies integrate the scientific understanding of freshwater ecosystem function with management decisions. Applied aspects of freshwater systems are included.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 364. Life in Moving Fluids. 3 Credit Hours.**

The physical characteristics of air and water are described in relation to various flow phenomena that play a part in life functions. Adaptations of form and function reflect the very different properties of the media (air and water) of terrestrial and aquatic life. Energy conversion and transfer limit form and function and enable a wide variety of survival strategies.

Prerequisite: MBE 230 Or BIL 360.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 371. Readings in Marine Science. 1-3 Credit Hours.**

Library research with faculty supervision. Bibliography to be submitted in preparation for laboratory and/or field research project. No more than 6 credits in total from MSC371, MSC411, and MSC412 can be counted towards any of the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Permission of Instructor.

**Components:** DIS.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 372. Special Topics in Marine Science. 1-6 Credit Hours.**

Content varies by semester and is indicated in parentheses following course number and title in class schedule.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 373. Writing the GRFP and Graduate School Applications. 1 Credit Hour.**

Writing the GRFP (graduate research fellow proposal) and Graduate School Applications is a practical course for undergraduate students interested in applying to graduate school next year or in the future. We will review NSF guidelines for the GRFP and both discuss and implement the steps for this proposal and graduate school applications. Basic tips on writing will be covered. Students will write a two page research statement and three page personal statement for the GRFP and then will modify these statements to use in graduate school applications. Students will be involved in reading and providing constructive criticisms to their fellow classmates. (No more than 3 credits in total from MSC370-level courses can be counted towards the MSC major or minor requirements).

Requisite: Junior or Senior Standing.

**Components:** DIS.

**Grading:** SUS.

**Typically Offered:** Fall.

**MSC 380. Field Studies in Marine and Aquatic Science. 1-4 Credit Hours.**

Field course to selected marine, estuarine and/or aquatic sites in the United States and abroad. Travel fee may be required.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MSC 390. Advanced Studies in Marine Science. 1-5 Credit Hours.**

For transfer courses taken at other institutions that have no direct equivalents at UM.

**Components:** LEC.

**Grading:** GRD.

**MSC 391. Advanced Studies in Marine Policy. 1-5 Credit Hours.**

For transfer courses taken at other institutions that have no direct equivalents at UM.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MSC 401. Ocean Dynamics. 3 Credit Hours.**

This course provides an introduction to the mathematical description of fluid flows in the ocean. Topics covered include a review of vector calculus, conservation equations, the Euler and Navier-Stokes equations, flow kinematics, Eulerian and Lagrangian descriptions of fluid flows, vorticity dynamics, rotation effects including the Coriolis force and geostrophy, wind forcing, an introduction to turbulence, surface gravity waves, stratification and internal waves.

Prerequisite: MTH 162 and PHY 202 or PHY 221 or equivalent and Pre/Corequisite: MSC 301 and MTH 211 or MTH 310.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 402. Ocean Acidification. 3 Credit Hours.**

Ocean Acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO<sub>2</sub>) from the atmosphere. In this course students will learn about its impacts on important biogeochemical and biological processes.

Prerequisites: MSC 215 and MSC 216 and Pre or Corequisite: MSC 218.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 405. Observing the Ocean. 3 Credit Hours.**

This course provides an introduction to measurement systems and data analysis techniques that are commonly used by oceanographers. Sensors and data types to be discussed include shipboard observations (CTD [conductivity-temperature-depth], ADCP [acoustic Doppler current profiler] and others), moored instrumentation, gliders, submerged floats, surface drifters, and satellite measurements. The use of most types of instrumentation that are discussed will be demonstrated in a laboratory setting and/or at sea. (Several one-day instructional cruises on the R/V Walton Smith are anticipated during the semesters that this course is offered. Students enrolled in this course are expected to participate on one of those cruises.) Basic oceanographic data analysis is also discussed, including use of computational tools to access archived oceanographic data sets.

Prerequisite: MSC 204 and MSC 215 or Pre/Corequisite: MSC 301.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 411. Research in Marine Science. 1-3 Credit Hours.**

Individual, independent research projects with faculty supervision. A formal written report is required. (No more than 6 credits in total from MSC371, MSC411, and MSC412 can be counted towards the Rosenstiel School major or minor requirements with no more than 3 credits from each course).

Requisite: Junior or Senior Standing.

**Components:** THI.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.

**MSC 412. Undergraduate Thesis in Marine Science. 1 Credit Hour.**

Students will write a formal thesis summarizing the results of independent research carried out under faculty supervision. (No more than 6 credits in total from MSC371, MSC411, and MSC412 can be counted towards any of the Rosenstiel School major or minor requirements with no more than 3 credits from each course.)

MSC 411 And Senior Standing.

**Components:** THI.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MSC 417. Marine Biota and Biogeochemical Cycles. 3 Credit Hours.**

The distribution of dissolved particulate materials in the sea is not uniform in time or space. Variability in these reflects the diverse biological sources, transformations, and sinks of chemical constituents in the sea. This course focuses on the role of marine organisms in marine biogeochemical cycling, with particular emphasis on the marine carbon and the nutrients. We visualize and query the ocean system using publicly available global ocean data sets and the application Ocean Data View. The material is presented as a capstone bringing together the physical, chemical and biological dynamics of the ocean as a single system.

Prerequisite: MSC 215.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 418. Climate Law. 3 Credit Hours.**

Climate Law evaluates the interactions between climate and the law, with an emphasis on existing laws and the gaps in current legislation related to the climate environment. The course will analyze court cases, domestic and foreign laws, treaties, and international conventions. In addition, the course will examine how climate manipulation requires an international model for the future.

Prerequisite: MSC 220 and Requisite: Junior or Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**MSC 419. Microbial Geochemistry of the Ocean. 3 Credit Hours.**

An overview of how microbes respond to and modify the chemistry of the ocean, focusing on the geochemical consequences and signatures of microbial activity in the ocean. Microbes form the base of the food chain and are responsible for essential chemical transformations that control important processes on Earth, including the production of atmospheric oxygen, and the consumption of carbon dioxide and transformation to organic carbon which fuels the rest of life in the ocean. This course will build a quantitative framework for understanding the chemical inputs and outputs of microbial metabolism, and the role these microbial processes play in controlling chemical fluxes in the ocean. This will address how biological origins, metabolic reworking, and physical phase influence the distribution and fluxes of organic matter in the marine carbon cycle on both short and long timescales.

Prerequisite: MSC 111 and MSC 215 and BIL 150 or BIL 160.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MSC 420. Political Ecology of the Galapagos. 3 Credit Hours.**

This field course in the Galapagos National Park offers a rare chance to examine the human interactions in this highly politicized landscape of conservation. Students practice the political ecology approach for doing ethnographic field work and explore how it can lead to wiser resource management. Part of UGalapagos semester.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 421. Terrestrial Biology and Adaptations of the Galapagos.. 3 Credit Hours.**

This course will examine the terrestrial plant and animal life of Isabela Island, discuss the biology and how it adapted to life on Isabela. Through field and laboratory exercises we will explore the power of organisms' DNA in shaping life into unique forms like those famously present in today's Galapagos. Part of UGalapagos semester.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 422. Marine Ecology of the Galapagos. 3 Credit Hours.**

This course focuses on marine ecosystems of the Galapagos, emphasizing near-shore environments. Topics will include how the unique location and oceanography of the Galapagos have shaped the species composition of resident and migrant marine animals. The role of genetic drift, local habitat characteristics and natural selection on marine ecosystems will be examined. This is a field intensive course with time spent in intertidal, near-shore and off-shore island environments. Part of UGalapagos semester.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 423. Marine Conservation Biology and Fisheries of the Galapagos. 3 Credit Hours.**

The Galápagos are located in a uniquely productive area of the sea, which has allowed the development of rich and unique marine biota. The first week of the course will carry the students through the dynamic, climatic, and oceanographic circumstances that determine the unique character of the Galapagos. The second week will cover scientific evaluation of the threats to the marine biodiversity of the Galapagos, focusing on sharks, penguins, sea turtles and other at-risk species and habitats. Part of UGalapagos semester.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MSC 424. Origin and Geology of the Galapagos Islands.. 3 Credit Hours.**

This course will explore the origin and geology of volcanic oceanic islands, using the Galapagos Islands as a natural laboratory. Though all share a common origin in plate tectonic theory, each island presents a host of environments that originate in the processes of volcanic action, erosion and hydrology. Individual islands therefore develop distinctive ecosystems within which organisms interact and evolve. The emphasis of this course will be to lay out the underlying geological processes that have led to the formation of the islands and to their present state, and then to explore the ways the physical environment has influenced adaptation and biodiversity. Part of UGalapagos semester.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MSC 425. Galapagos Community-Based Research and Service. 2 Credit Hours.**

Individual, civic engagement activities identified in consultation with the people, national park and local government of Puerto Villamil, Isla Isabela, as part of the marine science semester program in the Galapagos Islands. Student research and service is faculty supervised and concluded by submission of a formal written report. This course may not be counted towards the MSC elective requirement for majors or minors.

**Components:** PRA.

**Grading:** CNC.

**Typically Offered:** Fall & Spring.

**MSC 427. Field experience in the Galapagos. 2 Credit Hours.**

Three week Summer I field course explores the flora, fauna, geology, and society of the Galapagos Islands.

Prerequisite: MSC 111 or ECS 111 or Permission of Instructor.

**Components:** PRA.

**Grading:** GRD.

**Typically Offered:** Summer.

**MSC 460. Spatial Applications in Marine Science. 3 Credit Hours.**

The concepts and marine applications of Geographic Information Systems. Every class period will entail short class lectures and hands on computer based GIS exercise on marine science related issues. Students will learn how to use ArcGIS Desktop or Arc Pro.

Prerequisite: MSC 111 and MSC 112 and Requisite: Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.