MARINE SCIENCE AND LIMNOLOGY (MSL)

MSL F111L  MSL F111X Laboratory
0 Credit
**Co-requisites:** MSL F111X.
*Lecture + Lab + Other: 0 + 0 + 0

MSL F111X  The Oceans
(n, a)
4 Credits
Offered Fall, Spring and Summer
Study of the oceans from the broad perspective offered by combining insights from biology, physics, chemistry and geology. Topics include the evolution of the oceans and marine life, forces acting on water and the resulting currents and waves, and relationships between the physics and chemistry of water bodies and their biological productivity. Societal questions related to fisheries management, global climate change and pollution will be discussed.
**Prerequisites:** Placement in WRTG F111X; placement in MATH F105.
**Co-requisites:** MSL F111L.
**Attributes:** UAF GER Natural Science Req
*Lecture + Lab + Other: 3 + 3 + 0

MSL F211  Introduction to Marine Science I
3 Credits
Offered Fall
This is the first part of a two semester sequence in Marine Science: MSL F211, MSL F212, MSL F213L (Lab). This course introduces students to the geology, chemistry and physics of the ocean as well as related topics in the cryosphere and climate. Students will gain a basic understanding of the interconnections between the ocean and atmosphere, and the oceans and the solid earth (the continents and sea floor).
**Prerequisites:** MATH F151X (may be taken concurrently).
*Lecture + Lab + Other: 3 + 0 + 0

MSL F212  Introduction to Marine Science II
3 Credits
Offered Spring
This course explores the diversity of marine life, from microbes to mammals, and the interactions of marine organisms with each other and with their environment. Topics include primary productivity, marine food webs, physiological adaptations, and ecology of marine habitats from coastal to deep-sea systems. Students will also be introduced to current topics in marine and fisheries research.
**Prerequisites:** MSL F211.
*Lecture + Lab + Other: 3 + 0 + 0

MSL F213L  Marine Science Laboratory
1 Credit
Offered Spring
Introductory laboratory course designed to accompany MSL F211-F212 series. Laboratory activities will provide students with hands-on experience to cement topics covered in lectures (MSL F211-F212). Activities include exploration of physical and chemical properties of seawater; geologic and biological classification and introduction to tools for oceanographic data visualization.
**Prerequisites:** MSL F212 (may be taken concurrently).
*Lecture + Lab + Other: 0 + 3 + 0

MSL F215  Marine Geological Drama and Undersea Catastrophes
3 Credits
Offered Fall Even-numbered Years
Case studies of geological events that disrupt the ocean environment serve as an introduction to geological oceanography and its connections to other aspects of ocean and Earth history.
**Prerequisites:** MSL F111X; or MSL F211.
*Lecture + Lab + Other: 3 + 0 + 0

MSL F220  Scientific Diving
2 Credits
Offered Spring
Introduction to cold water diving and SCUBA techniques used in the research community. Includes familiarization with Alaska subtidal flora and fauna. Opportunity to work underwater and assist with diving projects conducted by MSL F421 students at the Kasitsna Bay Marine Lab during spring break. Completion of this course will allow students to be eligible to join the UAF (AAUS) dive program and to dive on the UAF-sanctioned diving projects and have reciprocity to dive with other universities and other government agencies. Through this course, students also can be certified with a Research Diver Specialty (PADI) and a Dry Suit Specialty (PADI). CPR, First Aid (Red Cross), and Emergency Oxygen Administration (DAN) are offered through this course. Special Conditions: Must have current SCUBA physical approved.
**Prerequisites:** Basic biology/ecology courses, SCUBA (open water) certification.
*Lecture + Lab + Other: 1 + 1 + 8

MSL F317  Introduction to Marine Mammal Biology
3 Credits
Offered Spring
The course will introduce students to the biology and diversity of cetaceans, pinnipeds, sirenians, and other marine mammals. Topics will include evolution, ecology, reproduction, and behavior of marine mammals, their special adaptations, such as diving, osmo- and thermoregulation, and will explore some current conservation and management issues. The course will be structured in a lecture format.
**Prerequisites:** BIOL F116X or MSL F212.
*Lecture + Lab + Other: 3 + 0 + 0

MSL F330  The Dynamic Alaskan Coastline
3 Credits
Offered Fall
Mountains, rivers, glaciers, fjords, estuaries, deltas, tidal zones, sediments, nutrients, elements, habitats, fish. This class will provide an interdisciplinary perspective on the dynamic Alaskan coastal landscape from Glacier Bay to the Arctic. We will delve into the driving geological, geochemical, and oceanographic processes occurring along Alaska’s coast and linkages to various marine ecosystems. Students will learn the fundamental physical and geochemical processes in the coastal zone using various locations in Alaska as examples. Field trip required.
**Prerequisites:** Junior standing; MSL F111X or GEOS F101X; CHEM F105X; PHYS F123X or PHYS F211X.
*Lecture + Lab + Other: 3 + 0 + 0
MSL F412   Early Life Histories of Marine Invertebrates
3 Credits
Offered Fall Odd-numbered Years
This course will explore the diversity of reproductive strategies and larval forms in marine invertebrates, and consider selective pressures governing the evolution of these forms. Topics include: larval ecology and evolution, environmental constraints on early life histories, reproductive biology, population dynamics, sources of larval mortality, dispersal and recruitment. Graduate standing or instructor permission and invertebrate zoology recommended.
Prerequisites: MSL F212 and upper-division standing.
Lecture + Lab + Other: 3 + 0 + 0

MSL F419   Concepts in Physical Oceanography
3 Credits
Offered Fall Even-numbered Years
This course establishes the physical concepts that account for fluid motion of the oceans on our rotating earth. This course will include the role of the Coriolis force, ocean stratification, wind driven and thermohaline circulation, tides and the major ocean gyres and why they are present. The physical forces that influence biological production will be presented. These foundation concepts will be part of a well-rounded undergraduate program in marine science or establish the foundation for graduate students.
Prerequisites: MATH F251X or PHYS F211X.
Lecture + Lab + Other: 3 + 0 + 0

MSL F421   Field Course in Subtidal Studies
2 Credits
Offered Spring
Students will propose a hypothesis and experimentally test it during a one-week field trip to the Kasitsna Bay Lab. Prior to field trip, students will develop a proposal, dive plan and materials list in relation to their project. Undergraduates will present their findings in an oral presentation to the class while graduate students will present theirs in a public seminar and produce a conference-ready poster. Special Conditions: Must have a current SCUBA physical approved.
Prerequisites: MSL F220, basic biology/ecology courses, SCUBA (open water) certification.
Stacked with MSL F623.
Lecture + Lab + Other: 1 + 1 + 8

MSL F431   Polar Marine Science
3 Credits
Offered Fall Odd-numbered Years
Physical, biological, chemical and geological oceanography of the polar oceans with emphasis on comparing and contrasting the Arctic and Antarctic.
Prerequisites: MSL F211; MSL F212.
Stacked with MSL F621.
Lecture + Lab + Other: 3 + 0 + 0

MSL F449   Biological Oceanography
3 Credits
Offered Fall
Survey of biological processes emphasizing organic matter synthesis and transfer including topics essential to a basic understanding of contemporary biological oceanography. Primary and secondary production, standing stocks, distribution, and structure and dynamics of phytoplankton and zooplankton populations. The transfer of organic matter to higher trophic levels and food webs. Nutrient cycling, especially but not exclusively nitrogen, phosphorus and silicon, microbiological processes relevant to nutrient cycling. Heterotrophic production, benthic communities, coastal ecosystems, the influence of organisms on the composition of seawater, particularly with reference to oxygen and carbon dioxide regimes. Aspects of regional oceanography.
Prerequisites: Upper Division standing in a Science major; MSL F212 for undergraduate students.
Lecture + Lab + Other: 3 + 0 + 0

MSL F450   Marine Biology and Ecology Field Course
4 Credits
Offered Summer Odd-numbered Years
Advanced understanding of marine organisms in an ecological and evolutionary context through field and laboratory work at the Kasitsna Bay Marine Lab (Kachemak Bay). Includes collection of marine macroalgae, invertebrates and plankton and relating their anatomical organization to habitat, lifestyle and ecology. Emphasis will be on familiarization with Alaska’s nearshore flora and fauna, the ecological function of organisms and ecosystem dynamics. Students will employ different field sampling techniques and experimental designs in various habitats found around the Kasitsna Bay Marine Lab, e.g. rocky intertidal, open water, mudflats, seagrass beds, and salt marshes. Graduate students will perform a research project related to the course subject matter.
Prerequisites: One year of biology.
Recommended: Basic courses in ecology and invertebrate zoology.
Stacked with MSL F651.
Lecture + Lab + Other: 3 + 6 + 0

MSL F456   Kelp Forest Ecology
4 Credits
Offered Summer Even-numbered Years
Introduction to knowledge, hypotheses and disputes regarding components of nearshore tidal communities and the ecological interactions that influence their structure and dynamics. Includes primary published literature in marine subtidal ecology, and local Alaska subtidal flora and fauna. Work underwater conducting ecological research. Includes formulating questions, collecting and analyzing ecological data, report writing and feedback.
Prerequisites: UAF Science Diver certification.
Stacked with MSL F656.
Lecture + Lab + Other: 28 + 35 + 0

MSL F457   Field Techniques in Ocean Acidification Research
3 Credits
Offered Summer Even-numbered Years
An introduction to the design and fabrication of experimental ocean acidification systems and oceanographic pH sensors for the study of ocean acidification. This course will require extra fees to cover laboratory activities, room and board. Students are responsible for the travel to and from Kasitsna Bay Laboratory, near Seldovia, Alaska.
Prerequisites: MSL F211 and MSL F212.
Lecture + Lab + Other: 2 + 4 + 3
M.S. F461  Chemical Oceanography  
3 Credits  
Offered Spring  
An integrated study of the chemical, biological, geological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined.  
Prerequisites: Upper-division standing, CHEM F106X, BIOL F116X.  
Stacked with CHEM F660; MSL F660.  
Lecture + Lab + Other: 3 + 0 + 0

M.S. F463  Chemical Coastal Processes  
3 Credits  
Offered Spring Even-numbered Years  
A study of chemical processes in the coastal ocean. This course will examine chemical interactions at different boundaries, and explore physical and biological controls on the chemistry of coastal environments. Some of the topics to be covered include: The role of suspended particles; coastal acidification, photochemical processes; controls on coastal productivity; future challenges in coastal management. This course is intended for students with a background in general chemistry and marine science.  
Prerequisites: Upper-division standing; CHEM F105X; CHEM F106X; MSL F111X or MSL F211, MSL F212, MSL F213L series.  
Stacked with MSL F663.  
Lecture + Lab + Other: 3 + 0 + 0

M.S. F481  The Oceans and Global Change  
3 Credits  
Offered Fall  
Explores how human activities are affecting Earth's oceans. Topics include climate change, sea-level rise, coastal erosion, declining sea ice, shifting ecosystems, ocean acidification, pollution and various mitigation proposals. The course will investigate the causes and effects of these changes and consider the challenges and opportunities that arise from them.  
Prerequisites: Upper division standing or MSL F212.  
Stacked with MSL F681.  
Lecture + Lab + Other: 3 + 0 + 0

M.S. F499  Senior Thesis  
3 Credits  
Under the supervision and mentorship of a fisheries and ocean sciences faculty member, students will complete a self-designed project that is the capstone of a student's exemplary academic performance. The student will complete a senior thesis based on field and/or laboratory data collected during a field course or work that was completed with the faculty mentor within the context of the existing literature relevant to the study topic. Students are required to present their study results as an oral or poster presentation at a UAF seminar or symposium, or at a state or national scientific conference. In addition, students are encouraged to work with their mentor to submit their thesis for publication in a peer-reviewed scientific journal.  
Prerequisites: Permission of a fisheries and ocean sciences faculty mentor.  
Lecture + Lab + Other: 0 + 0 + 9

M.S. F601  Professional Development  
1 Credit  
Offered Spring Odd-numbered Years  
Improve ability to make oral and poster presentations and to write resumes and cover letters. Includes lectures, discussions, and four individual projects. Students are encouraged to use their thesis/dissertation material for the posters and oral presentations. Feedback on all projects will be given by both instructor and students.  
Recommended: Graduate status.  
Lecture + Lab + Other: 1 + 0 + 0

M.S. F602  Proposal Writing  
1 Credit  
Offered Fall  
Familiarize students with the proposal writing process. Writing proposals is a common requirement during graduate school and will be continuing during the career as a scientist and researcher. This class aims to cover some common rules about good proposal writing. Students will be required to write a proposal and to give feedback to 1-2 proposals of classmates. Course may be repeated for credit.  
Recommended: Graduate status.  
Lecture + Lab + Other: 1 + 0 + 0

M.S. F604  Modern Applied Statistics for Fisheries  
4 Credits  
Offered Fall Odd-numbered Years  
Covers general statistical approaches to quantitative problems in marine science and fisheries with guidance on how to collect and organize data, how to select appropriate statistical methods and how to communicate results. A variety of advanced statistical methods for analyzing environmental data sets will be illustrated in theory and practice.  
Prerequisites: STAT F200X; STAT F401; proficiency in computing with R.  
Cross-listed with FISH F604.  
Lecture + Lab + Other: 3 + 3 + 0

M.S. F605  Controversies in Marine Science  
1 Credit  
Offered Spring Even-numbered Years  
Introduction to the idea that science is fluid and controversies and disagreements do occur. These disagreements are often published in the primary literature. This course will be a discussion/debate of various controversial topics in marine science.  
Recommended: Graduate status.  
Lecture + Lab + Other: 1 + 0 + 0
MSL F610  Marine Biology
3 Credits
Offered Spring
Biology of the major plant and animal groups in the sea and their roles in pelagic and benthic systems. Physical, chemical and geological features affecting marine organisms and the role of bacteria in the sea. The basic biology and adaptations of selected species of zooplankton and nekton. The benthos-shore biota, shelf and deep-sea organisms: basic biology, trophic roles and adaptations of selected species.
Prerequisites: Degree in biology.
Recommended: Courses in invertebrate zoology, ichthyology, and vertebrate zoology.
Lecture + Lab + Other: 3 + 0 + 0

MSL F612  Early Life Histories of Marine Invertebrates
3 Credits
Offered Fall Odd-numbered Years
This course will explore the diversity of reproductive strategies and larval forms in marine invertebrates, and consider selective pressures governing the evolution of these forms. Topics include: larval ecology and evolution, environmental constraints on early life histories, reproductive biology, population dynamics, sources of larval mortality, dispersal and recruitment. Graduate standing or instructor permission and invertebrate zoology recommended.
Lecture + Lab + Other: 3 + 0 + 0

MSL F613  Veterinary Nutrition and Metabolism
2 Credits
Offered Spring
This course will examine the nutritional needs of major species of veterinary importance. Discussion will revolve around specific nutritional needs as they relate to life-stages and production status of monogastric and ruminant animals. Course topics deal with the classification and function of nutrients, digestive processes (monogastric, ruminant, hind-gut fermenters), evaluation of feedstuffs and feed labels, and principles of disease related to nutritional deficiency as well as nutritional excess.
Prerequisites: Successful completion of first-semester veterinary courses.
Cross-listed with DVM F623.
Lecture + Lab + Other: 2 + 0 + 0

MSL F615  Physiology of Marine Organisms
3 Credits
Offered Fall
A study of the physiological systems of and adaptation to the marine environment, intertidal, pelagic, and deep benthos environment and energy flows will be discussed.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0

MSL F618  Functional Anatomy
8 Credits
Offered Fall
The course will include an introduction to veterinary anatomy in which the basics veterinary anatomy, orientation, nomenclature, locomotion apparatus, circulatory system, digestive, respiratory apparatus, lymphatic organs and nervous system of domestic animals will be explained. A general explanation of the basic anatomical preparation techniques will be presented to improve the manual skills of the students. The course will place the anatomical knowledge in a clinical context.
Prerequisites: Admittance to the professional veterinary program.
Cross-listed with DVM F616.
Lecture + Lab + Other: 5 + 6 + 0

MSL F619  Biology of Marine Mammals
3 Credits
Offered As Demand Warrants
Introduction to a broad range of research and conservation topics associated with marine mammals. Topics include physiological adaptations, phylogeny and evolution, behavior, ecology, population dynamics and conservation.
Prerequisites: Graduate standing; or upper-division ecology and biology courses.
Lecture + Lab + Other: 3 + 0 + 0

MSL F620  Physical Oceanography
4 Credits
Offered Fall
Physical description of the sea, physical properties of seawater, methods and measurements, boundary processes, currents, tides and waves, and regional oceanography.
Prerequisites: MATH F253X; PHYS F123X or PHYS F211X; science or engineering degree.
Lecture + Lab + Other: 3 + 3 + 0

MSL F621  Polar Marine Science
3 Credits
Offered Fall Odd-numbered Years
Physical, biological, chemical and geological oceanography of the polar oceans with emphasis on comparing and contrasting the Arctic and Antarctic.
Prerequisites: graduate standing.
Stacked with MSL F421.
Lecture + Lab + Other: 3 + 0 + 0

MSL F623  Field Course in Subtidal Studies
2 Credits
Offered Spring
Students will propose a hypothesis and experimentally test it during a one-week field trip to the Kasitsna Bay Lab. Prior to field trip, students will develop a proposal, dive plan and materials list in relation to their project. Undergraduates will present their findings in an oral presentation to the class while graduate students will present theirs in a public seminar and produce a conference-ready poster. Special Conditions: Must have a current SCUBA physical approved.
Prerequisites: MSL F220; basic biology/ecology courses; SCUBA (open water) certification.
Stacked with MSL F431.
Lecture + Lab + Other: 2 + 1 + 8

MSL F625  Shipboard Techniques
3 Credits
Offered As Demand Warrants
Introduction to modern oceanographic shipboard sampling and analysis techniques.
Lecture + Lab + Other: 2 + 3 + 0

MSL F627  Statistical Computing with R
2 Credits
Offered Fall
Using the free, open-source software R to teach computing, programming, and modeling concepts for the statistical computing of fisheries and biological data. Prepares students for other graduate-level, quantitative fisheries courses and covers exploratory statistical and graphical analyses, as well as computer-intensive methods such as bootstrapping and randomization tests.
Prerequisites: STAT F200X, STAT F401, and proficiency with Excel.
Cross-listed with FISH F627.
Lecture + Lab + Other: 1 + 3 + 0
MSL F630  Geological Oceanography  
3 Credits  
Offered Spring  
Topography and structure of the ocean floor. Theory of plate tectonics.  
Geology of ocean basins, continental slope, shelf and coastal  
environments. Major sediment types and distributions. Sediment  
transport and deposition. Interaction between seawater, rock, and  
sediment. Paleooceanography. Upper-division standing are invited  
to contact the instructor.  
Prerequisites: Graduate standing.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F631  Data Analysis in Community Ecology  
3 Credits  
Offered Spring Odd-numbered Years  
This course will provide an overview of statistical methods that have  
been specifically developed to aid our understanding and interpretation of  
the structure, abundance, and distribution of species and communities in  
relation to resources and the environment.  
Prerequisites: STAT F200X; STAT F401; FISH F627 (Statistical Computing  
with R) or familiarity with R, general ecology, graduate standing in  
fisheries.  
Cross-listed with FISH F631.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F632  Oceanographic Data Analysis and Visualization  
3 Credits  
Offered Spring Even-numbered Years  
This course introduces students to data analysis and visualization  
techniques commonly applied to oceanographic datasets. Students  
will gain a theoretical and practical understanding of propagation of  
errors, linear least squares regression, and time series analyses such as  
correlation, coherence and spectral estimation. The course will also cover  
Empirical Orthogonal Function (EOF) analysis. A significant portion of  
the class will be a project that will give students an opportunity to learn  
a data analysis technique suited to their research. Matlab will be used  
throughout.  
Prerequisites: Graduate standing; MATH F253X; MATH F314.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F637  Veterinary Bacteriology and Mycology  
2 Credits  
Offered Spring  
This course will discuss bacterial structure, differences between bacterial  
and fungal their pathogenesis. The basic principles of  
bacterial and fungal pathogenesis will be presented. Host response to  
bacterial or fungal infection, immunity and the role of vaccines in disease  
prevention will be explained.  
Prerequisites: Successful completion of first-semester veterinary  
courses.  
Cross-listed with BIOL F632; DVM F637.  
Lecture + Lab + Other: 2 + 0 + 0  

MSL F639  Veterinary Virology  
2 Credits  
Offered Spring  
This course will explore current concepts in the field of veterinary virology,  
with an emphasis on the viral structure, viral genetic material and viral  
replication strategies of various animal viruses. In addition, mechanisms  
of viral pathogenesis, prevention and treatment of viral infection will be  
presented.  
Prerequisites: Successful completion of first-semester veterinary  
courses.  
Cross-listed with BIOL F639; DVM F639.  
Lecture + Lab + Other: 2 + 0 + 0  

MSL F642  Veterinary Pathology/Biology of Disease I  
5 Credits  
Offered Spring  
This course will discuss basic principles of disease with special  
emphasis on processes likely to be encountered veterinary practice. We  
will discuss these topics organized by underlying disease mechanism.  
The discussions will move from general cell-mediated processes to more  
specific disease mechanisms.  
Prerequisites: Successful completion of first-semester veterinary  
courses.  
Cross-listed with BIOL F640; DVM F640.  
Lecture + Lab + Other: 4 + 3 + 0  

MSL F650  Biological Oceanography  
3 Credits  
Offered Fall  
Survey of biological processes emphasizing organic matter synthesis  
and transfer including topics essential to a basic understanding  
of contemporary biological oceanography. Primary and secondary  
production, standing stocks, distribution, and structure and dynamics  
of phytoplankton and zooplankton populations. The transfer of organic  
material to higher trophic levels and food webs. Nutrient cycling, especially  
but not exclusively nitrogen, phosphorus and silicon, microbiological  
processes relevant to nutrient cycling. Heterotrophic production, benthic  
communities coastal ecosystems, the influence of organisms on the  
composition of seawater, particularly with reference to oxygen and  
carbon dioxide regimes. Aspects of regional oceanography.  
Prerequisites: Upper-division standing in a science major.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F651  Marine Biology and Ecology Field Course (a)  
4 Credits  
Offered Summer Odd-numbered Years  
Advanced understanding of marine organisms in an ecological and  
evolutionary context through field and laboratory work at the Kasitsna  
Bay Marine Lab (Kachemak Bay). Includes collection of marine  
macroalgae, invertebrates and plankton and relating their anatomical  
an organization to habitat, lifestyle and ecology. Emphasis will be on  
familiarization with Alaska’s nearshore flora and fauna, the ecological  
function of organisms and ecosystem dynamics. Students will employ  
different field sampling techniques and experimental designs in various  
habitats found around the Kasitsna Bay Marine Lab, e.g. rocky intertidal,  
open water, mudflats, seagrass beds, and salt marshes. Graduate  
students will perform a research project related to the course subject  
matter.  
Prerequisites: One year of biology; graduate standing.  
Recommended: Basic courses in ecology and invertebrate zoology.  
Stacked with MSL F450.  
Lecture + Lab + Other: 3 + 6 + 0
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Offered</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Lecture + Lab + Other</th>
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</thead>
<tbody>
<tr>
<td>MSL F652</td>
<td>Marine Ecosystems</td>
<td>3</td>
<td>Fall Even-numbered Years</td>
<td>Understanding ecosystems of the sea in the context of evaluating the impact of human activities. Focus on current concepts, trends and perspectives.</td>
<td>BIOL F472; MSL F620; MSL F650.</td>
<td>3 + 0 + 0</td>
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<tr>
<td>MSL F653</td>
<td>Zooplankton Ecology</td>
<td>3</td>
<td>Fall Even-numbered Years</td>
<td>Survey of marine zooplankton including processes and variables which influence their production and dynamics. Emphasis on the northeast Pacific and Arctic Ocean zooplankton communities. Field and lab methods for sampling include fixing, preserving, subsampling, identifying and quantifying zooplankton collections. Laboratory techniques for culture of zooplankton include physiological measurements of bioenergetic parameters. Course is offered outside of Fairbanks by video conference.</td>
<td>MSL F650.</td>
<td>3 + 0 + 0</td>
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<tr>
<td>MSL F654</td>
<td>Benthic Ecology</td>
<td>3</td>
<td>Fall Even-numbered Years</td>
<td>Ecology of marine benthos, from subtidal to hadal zone. Methods of collecting, sorting, narcotizing, preserving and analyzing benthic assemblages, including video analytical techniques from submersibles and ROVs. Hydrothermal vent and cold seep assemblages. Physiology/energetics of benthic organisms, including animal-sediment relationships, feeding, reproduction and growth. Depth, spatial and latitudinal distribution patterns.</td>
<td>Invertebrate zoology course, marine biology course.</td>
<td>3 + 0 + 0</td>
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<tr>
<td>MSL F655</td>
<td>Phytoplankton Ecology, from Form to Function</td>
<td>2</td>
<td>Spring Even-numbered Years</td>
<td>Introduction to the diversity and functioning of aquatic (marine and limnic) phytoplankton taxa in a wide sense. Topics will include various adaptations to the environment (life cycles, physiology). Four lab sessions will intensify the understanding of the covered topics and give students hands-on experience in analyzing phytoplankton samples on algal diversity and activity using modern techniques (fluorescence microscopy, flow cytometry, PAM fluorometry).</td>
<td>Biological oceanography and/or graduate courses in algal ecology and aquatic ecosystems.</td>
<td>1 + 2 + 0</td>
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<td>MSL F656</td>
<td>Kelp Forest Ecology</td>
<td>4</td>
<td>Summer Even-numbered Years</td>
<td>Introduction to knowledge, hypotheses and disputes regarding components of nearshore tidal communities and the ecological interactions that influence their structure and dynamics. Includes primary published literature in marine subtidal ecology, and local Alaska subtidal flora and fauna. Work underwater conducting ecological research. Includes formulating questions, collecting and analyzing ecological data, report writing and feedback.</td>
<td>UAF Science Diver certification.</td>
<td>28 + 35 + 0</td>
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<tr>
<td>MSL F660</td>
<td>Chemical Oceanography</td>
<td>3</td>
<td>Spring</td>
<td>An integrated study of the chemical, biological, geological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined.</td>
<td>Graduate standing.</td>
<td>3 + 0 + 0</td>
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<tr>
<td>MSL F661</td>
<td>Stable Isotope Techniques in Environmental Research</td>
<td>3</td>
<td>Spring</td>
<td>An examination of the use of added or naturally occurring isotope tracers in ecological studies. Demonstration of equipment and modern techniques.</td>
<td>Graduate standing.</td>
<td>3 + 0 + 0</td>
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<tr>
<td>MSL F663</td>
<td>Chemical Coastal Processes</td>
<td>3</td>
<td>Spring Even-numbered Years</td>
<td>A study of chemical processes in the coastal ocean. This course will examine chemical interactions at different boundaries, and explore physical and biological controls on the chemistry of coastal environments. Some of the topics to be covered include: The role of suspended particles; coastal acidification, photochemical processes; controls on coastal productivity; future challenges in coastal management. This course is intended for students with a background in general chemistry and marine science.</td>
<td>Graduate standing.</td>
<td>3 + 0 + 0</td>
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MSL F676  Aquatic Food Web Ecology  
3 Credits  
Offered Fall Even-numbered Years  
This course will examine theoretical and applied aspects of aquatic food web ecology, from the ecological processes that give rise to patterns in aquatic communities to the incorporation of trophic interactions into ecosystem-based management. Lectures and discussion will focus on ecological theory and case studies. Lab exercises will introduce empirical and modeling approaches for studying food web interactions. Proficiency with Excel and basic statistics is preferred.  
Prerequisites: FISH F425.  
Cross-listed with FISH F676.  
Lecture + Lab + Other: 2 + 3 + 0

MSL F677  Scientific Writing Techniques  
3 Credits  
Students learn to write scientifically with skill and clarity by practicing using easy-to-follow writing techniques to write and rewrite a draft manuscript. Topics include writing approaches, storytelling, outlines, style, grammar, punctuation, and editorial review. Most beneficial for graduate students writing theses, but provides excellent writing experience for new students.  
Prerequisites: Graduate Standing.  
Cross-listed with MSL F677.  
Lecture + Lab + Other: 3 + 0 + 0

MSL F681  The Oceans and Global Change  
3 Credits  
Offered Fall  
Explores how human activities are affecting Earth's oceans. Topics include climate change, sea-level rise, coastal erosion, declining sea ice, shifting ecosystems, ocean acidification, pollution and various mitigation proposals. The course will investigate the causes and effects of these changes and consider the challenges and opportunities that arise from them.  
Prerequisites: Upper division standing or MSL F212.  
Stacked with MSL F481.  
Lecture + Lab + Other: 3 + 0 + 0

MSL F692  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692A  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692B  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692C  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692D  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692E  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692F  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F692P  Seminar  
1-6 Credits  
Lecture + Lab + Other: 1-6 + 0 + 0

MSL F698  Non-thesis Research/Project  
1-9 Credits  
Lecture + Lab + Other: 0 + 0 + 0

MSL F699  Thesis  
1-12 Credits  
Lecture + Lab + Other: 0 + 0 + 0