# Marine Science and Limnology (MSL)

**MSL F111X**  
The Oceans  
(n, a)  
4 Credits  

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 or higher; placement in DEVF 105 or higher; or permission of instructor.  
**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, F212, F213 (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 or concurrent enrollment  
**Lecture + Lab + Other:** 0 + 3 + 0  

**MSL F215**  
Marine Geological Drama and Undersea Catastrophes  
3 Credits  

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; or permission of instructor.  
**Lecture + Lab + Other:** 3 + 0 + 0  

**MSL F216**  
The Oceans and Global Change  
3 Credits  
Offered Fall Odd-numbered Years  
Explores how global environmental changes are affecting Earth’s oceans. Topics include climate change and ocean warming, sea level rise, coastal erosion, declining sea ice, changes in ocean circulation and ecosystems, oceanic uptake of carbon dioxide, ocean acidification, ocean pollution, dead zones and climate engineering. The course will investigate the causes, effects and implications of changes in the oceans.  
**Prerequisites:** MSL F111X or MSL F211 or ATM F101X or ENVI F101 or GEOG F111X.  
**Lecture + Lab + Other:** 3 + 0 + 0  

**MSL F218**  
Astrobiology: Planets, Oceans and Life  
3 Credits  
Offered Spring  

Study of life in the universe from a transdisciplinary perspective, bringing together insights from physics, astronomy, geology, chemistry and biology. Topics include the evolution of the universe, planets, oceans and life. Past and present oceans found in the Solar System provide case studies from which to examine the potential for life on and off Earth. Societal questions related to the origins of life, global climate change and the possibility of extraterrestrial life will be discussed.  
**Prerequisites:** WRTG F111X; BIOL F103X or CHEM F103X or GEOS F101X or PHYS F102X; or permission of instructor.  
**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 F305**  
Invertebrate Zoology  
(n)  
4 Credits  
Offered Spring Even-numbered Years  
Classification, structure, function, evolution and life histories of invertebrate animals.  
**Prerequisites:** BIOL F115X; BIOL F116X.  
**Crosslisted with** FISH F305; BIOL F305.  
**Lecture + Lab + Other:** 3 + 3 + 0
**MSL F317**  Introduction to Marine Mammal Biology  
3 Credits  
Offered Spring Even-numbered Years  
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 or instructor permission.  
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 F103X or PHYS F211X.  
Lecture + Lab + Other: 3 + 0 + 0

**MSL F403**  Estuaries Oceanography  
3 Credits  
Offered Fall  
Advanced class for Marine Science minors, offering an overview of the oceanography of estuaries. The class involves lectures, reading assignments, reviewing and criticizing scientific literature.  
Prerequisites: MSL F212, STAT F200X or permission of instructor.  
Lecture + Lab + Other: 3 + 0 + 0

**MSL F411**  Current Topics in Oceanographic Research  
3 Credits  
Study of research problems from biology, chemistry, geology and physics. Topics include sea floor hydrothermal vents and their indigenous communities, manganese nodules, tsunami prediction, radioisotopes in the sea, Bering Sea productivity and the role of the ocean in global warming due to fossil fuel carbon dioxide.  
Prerequisites: Four semesters of natural sciences at F100-level or above or permission of instructor.  
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 or permission of instructor.  
Stacked with MSL F623.  
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 higher) or PHYS F211X (or higher); or instructor permission.  
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  
(a)  
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; or permission of instructor.  
Stacked with MSL F621.  
Lecture + Lab + Other: 3 + 0 + 0

**MSL F435**  Acoustical Oceanography  
3 Credits  
Principles and applications of underwater sound in solving oceanographic problems related to chemistry, physics, geology and biology, including hydroacoustical methods, acoustical phenomena, bioacoustics and fisheries acoustics, environmental noise and signal processing.  
Prerequisites: College physics and calculus.  
Lecture + Lab + Other: 3 + 0 + 0

**MSL F440**  Oceanography for Fisheries  
3 Credits  
Offered Fall Even-numbered Years  
Students examine how understanding the oceanographic processes that determine the distribution, recruitment, and abundance of marine vertebrates and invertebrates from global to local scales and from evolutionary time scales to daily scales supports the sustainable management of marine fisheries resources.  
Prerequisites: CHEM F105X, PHYS F103X, FISH F288, STAT F200X.  
Recommended: FISH F425.  
Cross-listed with FISH F440.  
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; As Demand Warrants
Advanced understanding of marine organisms in an ecological and evolutionary context through field and laboratory work at the Kasitsna Bay Marine Lab. Includes collection of marine macroalgae, invertebrates and plankton and relating their anatomical organization to habitat, lifestyle and ecology. Emphasis on familiarization with Alaska’s nearshore flora and fauna, the ecological function of organisms and ecosystem dynamics. Includes employing 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.
Prerequisites: One year of biology and permission of instructor.
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; As Demand Warrants
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 F463 Chemical Coastal Processes
3 Credits
Offered Spring; As Demand Warrants
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; or permission of instructor.
Stacked with MSL F663.
Lecture + Lab + Other: 3 + 0 + 0

MSL F464 Ecological and Evolutionary Genomics
2 Credits
Offered Spring
Uses free, open-source bioinformatics software to teach concepts in the field of ecology and evolution while providing a basic background in computing and programming. Covers methods in genomics, metagenomics and transcriptomics using example datasets derived from the marine environment. Prepares students for other quantitative graduate-level courses.
Prerequisites: BIOL F260, BIOL F360, BIOL F433, BIOL F466, BIOL F481, BIOL F487; or permission of instructor.
Lecture + Lab + Other: 1 + 3 + 0

MSL F467 Introduction to Marine Macroalgae (n)
3 Credits
Offered As Demand Warrants
Introduction to marine macroalgae. Algal structure, function and ecology, basic knowledge of the major phyla, key and press algae, and local Alaska flora. Includes a four to five day field trip to Kasitsna Bay Marine Laboratory.
Prerequisites: Upper-division standing in a natural science for undergraduates or graduate standing.
Stacked with MSL F667.
Lecture + Lab + Other: 2 + 3 + 0

MSL F492 Seminar
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0

MSL F498 Research
1-6 Credits
Lecture + Lab + Other: 1-6 + 0 + 0
MSL 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

MSL F601  Professional Development
1 Credit
Offered Fall
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

MSL F602  Proposal Writing
1 Credit
Offered Fall; As Demand Warrants
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

MSL F604  Modern Applied Statistics for Fisheries
4 Credits
Offered 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 or permission of instructor.

Cross-listed with FISH F604.

Lecture + Lab + Other: 3 + 3 + 0

MSL 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 or permission of instructor.

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
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
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 or permission of instructor.

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 Spring Odd-numbered Years  
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 F103X or PHYS F211X; science or engineering degree; or permission of instructor.  
Lecture + Lab + Other: 3 + 3 + 0

MSL F621  Polar Marine Science (a)  
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 F431.  
Lecture + Lab + Other: 3 + 0 + 0

MSL F622  Tides--Their Nature and Impact  
3 Credits  
Offered Spring Even-numbered Years  
This course will provide students in marine sciences with in-depth knowledge of tides and the role of tides in the physical, biological, chemical and geological processes in the oceans. We will investigate the importance of tides for the coastal regions of the Bering Sea and North Pacific. We will also cover associated aspects such as tidal currents and their role in transport of sediments, zooplankton and fish larvae, harnessing the tidal power for the generation of electricity, and impact of tides on climate.  
Prerequisites: MSL F620; MATH F252X; baccalaureate degree in physics, engineering, mathematics or equivalent.  
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 F421.  
Lecture + Lab + Other: 1 + 1 + 8

MSL F624  Oceanic-Atmospheric Gravity Waves  
3 Credits  
Offered Spring; As Demand Warrants  
Introduction to the dynamics of surface and internal gravity waves in non-rotating and rotating fluids including, derivation/solutions of the wave equation, approximations to the governing equations, particle motions and wave energetics, dispersion relationships, phase and group velocities, normal mode and WKB theory, reflection, refraction, critical layer absorption, wave instabilities.  
Prerequisites: MSL F620; MATH F302; or permission of instructor.  
Cross-listed with ATM F624.  
Lecture + Lab + Other: 3 + 0 + 0

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 F626  Continental Shelf Dynamics  
3 Credits  
Offered As Demand Warrants  
Geophysical fluid dynamic fundamentals appropriate to continental shelf circulation. Steady and time-dependent wind and buoyancy-forced flows in the presence of stratification and bathymetry.  
Prerequisites: MSL F620; MATH F421.  
Lecture + Lab + Other: 3 + 0 + 0

MSL F627  Statistical Computing with R  
2 Credits  
Offered Fall, As Demand Warrants  
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 or equivalent, STAT F401 or equivalent, and proficiency with Excel; or permission of instructor.  
Cross-listed with FISH F627.  
Lecture + Lab + Other: 1 + 3 + 0

MSL F628  Sea Ice Ecology (a)  
1 Credit  
Offered As Demand Warrants  
Provides students with an introduction into the physics, chemistry and biology of Arctic and Antarctic sea ice. Topics will include seasonality of sea ice extent, ice microstructure, diversity and activity of biological communities and impacts of climate change on the ice biota.  
Recommended: MSL F650.  
Lecture + Lab + Other: 1 + 0 + 0

MSL F650 
MSL F629  Methods of Numerical Simulation in Geophysical Fluid Dynamics  
4 Credits  
Offered Fall Odd-numbered Years  
Fundamentals of computer simulation, including time and spatial differencing and stability theory applied to partial differential equations describing dynamic processes in the ocean and atmosphere. Numerical approximation schemes for geophysical fluid dynamics will be analyzed through equations of motion, continuity and transport. Special consideration given to description of frictional processes in turbulent flow and transport/diffusion phenomena. Includes laboratory practice.  
Prerequisites: MATH F310; MATH F421; MATH F422 or equivalent; baccalaureate degree in physics, engineering, mathematics or equivalent; experience with FORTRAN.  
Lecture + Lab + Other: 3 + 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. Paleoceanography. Upper-division standing are invited to contact the instructor.  
Prerequisites: Graduate standing or permission of instructor.  
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 or equivalent; FISH F627 (Statistical Computing with R) or familiarity with R, general ecology, graduate standing in fisheries or permission of instructor.  
Cross-listed with FISH F631.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F632  Oceanographic Data Analysis and Visualization  
3 Credits  
Offered Alternate Springs  
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; or permission of the instructor.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F633  Integrative Oceanography  
3 Credits  
Offered Fall Odd-numbered Years  
This course explores the interactions between physical, chemical and biological processes in the ocean. A wide range of spatial scales will be considered, ranging from the large ocean gyres down to the physiochemical scales on which individual bacteria, phytoplankton and zooplankton function. The course covers case studies that provide examples of the processes, connections and feedbacks that control the biological, chemical and physical variability throughout the oceans. Students will improve their interdisciplinary understanding of oceanography and learn how to apply these concepts in their own research.  
Prerequisites: Graduate standing; MSL F620 or MSL F630 or MSL F650 or MSL F660.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F637  Veterinary Bacteriology and Mycology  
3 Credits  
Offered Spring  
This course will discuss bacterial structure, differences between bacterial families, and fungi and 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; or permission of instructor.  
Cross-listed with BIOL F632; DVM F637.  
Lecture + Lab + Other: 3 + 0 + 0  

MSL F638  Veterinary Parasitology  
2 Credits  
Offered Spring  
Biology of helminth, arthropod and protozoan pathogens of animals with emphasis on common infectious diseases encountered in veterinary practice will be discussed. In addition, the course will discuss treatment and management options for parasitic infections of domestic animals.  
Prerequisites: Permission of instructor.  
Cross-listed with DVM F638; BIOL F634.  
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: Permission of instructor.  
Cross-listed with BIOL F639; DVM F639.  
Lecture + Lab + Other: 2 + 0 + 0
### MSL F640  Fisheries Oceanography
4 Credits
Offered Fall Odd-numbered Years
Oceanography of marine processes affecting commercially important fisheries (finfish and shellfish) and species that affect them. Interactions between fisheries resources and physical, biological, geological and chemical oceanography, as well as climatological and meteorological conditions. Topics include recruitment, transport, natural mortality, predator-prey relationships, competition, distribution and abundance. El Nino/La Nina, regime shifts, and climate change. Emphasis on early life history of fishes. Examples from fisheries and ecosystems worldwide are used.

**Prerequisites:** MSL F620; MSL F650; or permission of instructor.

**Recommended:** FISH F400.

*Lecture + Lab + Other:* 4 + 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; or permission of instructor.

*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 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.

*Lecture + Lab + Other:* 3 + 0 + 0

### MSL F651  Marine Biology and Ecology Field Course (a)
4 Credits
Offered Summer Odd-numbered Years; As Demand Warrants
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; graduate standing; permission of instructor.

**Recommended:** Basic courses in ecology and invertebrate zoology.

*Stacked with* MSL F450.

*Lecture + Lab + Other:* 3 + 6 + 0

### MSL F652  Marine Ecosystems
3 Credits
Offered Fall Even-numbered Years
Understanding ecosystems of the sea in the context of evaluating the impact of human activities. Focus on current concepts, trends and perspectives.

**Prerequisites:** BIOL F472; MSL F620; MSL F650; or permission of instructor.

*Lecture + Lab + Other:* 3 + 0 + 0

### MSL F653  Zooplankton Ecology
3 Credits
Offered Fall As Demand Warrants
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.

**Prerequisites:** MSL F650; or permission of instructor.

*Cross-listed with* FISH F653.

*Lecture + Lab + Other:* 3 + 0 + 0

### MSL F654  Benthic Ecology
3 Credits
Offered Fall Even-numbered Years
Ecology of marine benthos, from subtidal to hadal zone with emphasis on soft-sediment systems, seamounts and chemosynthetic environments. Methods of studying benthic ecosystems. Life strategies of benthic organisms, including animal-sediment relationships, feeding, reproduction and growth. Large scale spatial and temporal patterns in distribution and biodiversity of benthic organisms. Organic matter deposition and cycling in marine sediments.

*Lecture + Lab + Other:* 3 + 0 + 0
MSL F655  Phytoplankton Ecology, from Form to Function
2 Credits
Offered Spring Even-numbered Years
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).
Recommended: Biological oceanography and/or graduate courses in algal ecology and aquatic ecosystems.
Lecture + Lab + Other: 1 + 2 + 0

ML F656  Kelp Forest Ecology
4 Credits
Offered Summer Even-numbered Years; As Demand Warrants
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 F456.
Lecture + Lab + Other: 28 + 35 + 0

ML F660  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: Graduate standing.
Cross-listed with CHEM F660.
Stacked with MSL F461.
Lecture + Lab + Other: 3 + 0 + 0

ML F661  Stable Isotope Techniques in Environmental Research
3 Credits
Offered Spring Even-numbered Years
An examination of the use of added or naturally occurring isotope tracers in ecological studies. Demonstration of equipment and modern techniques.
Prerequisites: MSL F660 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

ML F663  Chemical Coastal Processes
3 Credits
Offered Spring; As Demand Warrants
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: Graduate standing.
Stacked with MSL F463.
Lecture + Lab + Other: 3 + 0 + 0

ML F667  Introduction to Marine Macroalgae
3 Credits
Offered Summer Even-numbered Years; As Demand Warrants
Introduction to marine macroalgae. Includes algal structure, function and ecology, basic knowledge of the major phyla, key and press algae and local Alaska flora. Includes a four to five day field trip to Kasitsna Bay Marine Laboratory.
Prerequisites: Upper-division standing in a natural science for undergraduates or graduate standing.
Stacked with MSL F467.
Lecture + Lab + Other: 2 + 3 + 0

ML F669  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: MSL F650 or MSL F660 or permission of instructor.
Cross-listed with FISH F676.
Lecture + Lab + Other: 2 + 3 + 0

ML F670  Nutrient Dynamics
2 Credits
Offered Fall Odd-numbered Years
The dynamics of nitrogen, phosphorus and silicon cycles of the world oceans and the specific processes which transfer nutrients between ecosystems compartments. Analytical techniques employed in measurement of nutrient transfer rates.
Prerequisites: MSL F650 or MSL F660 or permission of instructor.
Lecture + Lab + Other: 2 + 0 + 0

ML F676  Marine Sustainability Internship
2 Credits
Offered Fall
Internship program in marine ecosystem sustainability to broaden students' interdisciplinary training, develop new research tools, build expertise outside their home discipline, gain exposure to careers, and gain a unique perspective on research problems. Internships are for a minimum of 8 weeks and take place during the summer. In the autumn students report on and meet to discuss their internship experiences.
Prerequisites: MSL F652 or permission of instructor.
Cross-listed with FISH F680 and ANTH F680.
Lecture + Lab + Other: 0 + 0 + 5-16
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