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Course Outline for BIOL 5

MARINE BIOLOGY

Effective: Fall 2009

I. CATALOG DESCRIPTION:
BIOL 5 — MARINE BIOLOGY — 4.00 units

Ocean as a habitat, the organisms that inhabit marine waters, their ecology, adaptations and evolution, and the role of the ocean in the ecology of the biosphere.

3.00 Units Lecture 1.00 Units Lab

Grading Methods:
Letter or P/NP

Discipline:

	MIN
Lecture Hours:	54.00
Lab Hours:	54.00
Total Hours:	108.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Demonstrate knowledge of basic principles of geological, physical and chemical oceanography that are necessary for understanding the biology and ecology of marine organisms in their environment, including:
   1. Describe ocean geography (e.g. locations of oceans, continents, major seas, island chains, mid ocean ridge system, trenches, and other important features of the ocean floor)
   2. Identify the major chemical constituents of seawater (e.g. major ions, dissolved gases and nutrients for plant growth)
   3. Describe major surface currents and explain the main forces that drive the currents
   4. Describe factors affecting the density of seawater and explain the importance of density stratification in the ocean
   5. Explain thermohaline circulation and the importance of the great ocean conveyor
   6. Describe light penetration and absorption in the ocean

B. Explain structure, function, and evolutionary history of important taxa and functional groups of marine organisms and describe their roles in marine communities and ecosystems;
C. Define and describe photosynthesis and explain the physical, chemical and biological factors that affect phytoplankton growth and production in the ocean;
D. Explain patterns of phytoplankton biomass and production in the ocean; explain latitudinal variations in phytoplankton biomass and production; explain seasonal variations in phytoplankton biomass and production in temperate latitudes (i.e. spring bloom);
E. Describe the structure of planktonic food webs and explain factors that affect organic matter export from the surface zone in equatorial upwelling regions, coastal upwelling regions, "high nutrient, low chlorophyll" regions, and the centers of gyres;
F. Describe the ocean's role in the global carbon cycle and possible effects of potential human interventions like ocean fertilization or pumping carbon dioxide into deep ocean waters;
G. Identify biotic and abiotic factors that affect fisheries; demonstrate familiarity with exploited fish species and describe human impacts on fish populations;
H. Describe ocean-atmosphere interactions in the development and progression of an ENSO (El Niño-Southern Oscillation) event; explain the effects of ENSO on marine ecosystems;
I. Describe kelp structure, function, ecology, and kelp forest ecosystems;
J. Identify abiotic and biotic features of muddy bottom, deep-sea environments; describe how diversity, abundance and community composition in deep-sea benthic invertebrate communities differs from that of near-shore, shallow subtidal benthic communities; describe feeding strategies that deep-sea organisms use to exploit low and pulsed food availability;
K. Identify abiotic and biotic features of hydrothermal vent environments and explain the link with sea floor spreading; demonstrate knowledge of chemosynthesis and explain the role of chemosynthetic organisms in vent environments; compare vent food webs and communities to typical muddy bottom, deep-sea food webs and communities; Define "vent-like" ecosystems (e.g. dead whales, hydrocarbon seeps) and compare them with vent ecosystems and muddy bottom, deep-sea ecosystems;
L. Describe tides and waves; describe important abiotic and biotic factors that structure communities in rocky intertidal environments; identify common species of plants and animals in rocky intertidal communities in California;
M. Explain general estuarine circulation and the effects of tides; explain the importance of estuaries as nursery grounds for invertebrates and fish; explain how larvae of estuarine organisms use estuarine and tidal circulation (i.e. "ride the tides"); explain how organisms respond to salinity changes (osmoconfomers vs osmoregulators); discuss geologic history, oceanography and ecology of San Francisco Bay; discuss the issues related to exotic species introductions using San Francisco Bay as an exemplar;
N. Describe reef-building corals (structure, function, ecology) and coral reef ecosystems; explain Darwin's theory of coral reef

development; describe exploitation of coral reef ecosystems by humans;
O. Describe effects of human activities on different marine ecosystems.

V. CONTENT:
A. The geography of the oceans and geology of the sea floor
1. Overview of ocean facts and geography
2. Profile of the ocean bottom and ocean depth zones
3. Review of plate tectonics
B. The chemistry of seawater
1. Properties of water
2. Inorganic chemistry of seawater
3. Salinity and measurements
4. Carbon in seawater
5. Concept of limiting nutrient
6. Nutrients for plant growth
C. Ocean circulation
1. Winds patterns, Coriolis effect and surface currents
2. Gyres
3. Boundary currents
4. Vertical temperature, salinity and density structure of the ocean (stratification)
5. Thermohaline circulation and deep water formation
D. Introductory survey of animal phyla
1. List of all phyla (traditional groupings and phylogenetic groupings)
2. Porifera
3. Cnidaria
4. Ctenophora
5. Annelida
6. Mollusca
7. Arthropoda (primarily Crustacea)
8. Echinodermata
9. Chordata
E. Bacteria and phytoplankton
1. Planktonic bacteria; cyanobacteria
2. Phytoplankton diversity and size categories
3. Diatoms
4. Dinoflagellates
5. Chlorophyll and measurement of phytoplankton productivity
6. Light in the ocean and the relationship between photosynthesis and light intensity
7. Factors that affect phytoplankton growth and production
F. Zooplankton
1. Zooplankton diversity and size categories
2. Microzooplankton -- protists
3. Copepods and other planktonic crustaceans
4. Holoplankton and meroplankton
5. Features shared by planktonic organisms
6. Planktonic predators
7. How to avoid predation in the plankton
G. Nekton
1. Invertebrate examples
2. Jawless fish -- Class Agnatha
3. Cartilaginous fish – Class Chondrichthyes
4. Bony fish – Class Osteichthyes
5. Coloration
6. Migration
H. Open ocean ecosystems
1. Structure of planktonic food webs
2. "Traditional food chain"
3. Microbial loop
4. Seasonal patterns in phytoplankton production -- spring bloom of phytoplankton
5. Equatorial upwelling
6. Gyre
7. Polar latitudes
8. High nutrient, low chlorophyll areas and the iron hypothesis
9. Ocean's role in the global carbon cycle and impacts of human activities
I. Coastal ocean ecosystems
1. Coastal upwelling
2. Phytoplankton production in upwelling areas
3. Upwelling food webs and fish production
4. Fisheries biology
5. ENSO
6. Kelp forests
J. Marine mammals
1. Carnivora -- polar bears, otters, pinnipeds
2. Sirenia -- manatees, dugongs, Stellar's sea cow
3. Cetaceans
4. Mysticetes -- baleen whales
5. Odontocetes -- toothed whales
K. Deep sea ecosystems
1. General features of the deep-sea environment
2. Patterns of invertebrate diversity, abundance and community composition
3. Feeding strategies in the deep sea: roving scavengers and deposit feeders
4. Adaptations of deep sea organisms
5. Hydrothermal vent ecosystems
6. "Vent-like" ecosystems: dead whales, hydrocarbon seeps, brine pools and seeps
L. Intertidal ecosystems
1. Waves and tides
2. Abiotic and biotic factors that structure intertidal communities
3. Intertidal communities of California (lecture, invertebrate survey lab and field trips)
M. Estuarine ecosystems

1. General estuarine circulation
2. Tidal circulation
3. Survey of estuarine habitats
4. Importance of estuaries as nursery areas
5. Larval dispersal and estuarine inverterbrates
6. Salinity changes and estuarine animals
7. Focus on San Francisco Bay
8. Introductions of exotic species
9. Human impacts

N. Coral reef ecosystems
1. Structure, function and ecology of reef-building corals
2. Zooxanthellae and symbiosis
3. Coral reef types
4. Coral reef formation and Darwin's hypothesis
5. Reef zones
6. Reef destruction
7. Impacts of humans

O. Laboratory:
1. Microscope and Cell Structure
2. Metric System
3. Properties of Seawater
4. Phytoplankton and Zooplankton
5. Effect of Pollution on Plankton
6. Marine Algae/Plants
7. Photosynthetic Pigments
8. Taxonomic Classification of Invertebrates
9. Molluscs
10. Arthropods
11. Molluscs
12. Fishes
13. Field investigation(s) of marine and estuarine habitats

VI. METHODS OF INSTRUCTION:
A. **Lecture** -
B. **Discussion** -
C. **Lab** -
D. **Guest Lecturers** -
E. **Projects** -
F. **Audio-visual Activity** -
G. **Field Trips** -

VII. TYPICAL ASSIGNMENTS:
A. Design and conduct experiment on psooble abiotic factors that affect plankton growth B. Use compound microscopes to study plankton C. Dissect and study marine animals D. Read chapter, answer end-of chapter questions, and define and describe importance of key terms

VIII. EVALUATION:
A. **Methods**

1. Exams/Tests
2. Quizzes
3. Papers
4. Projects
5. Lab Activities
6. Other:
    a. Methods:
        1. Quizzes, midterms, and final exam
        2. Laboratory write-ups
        3. Student project
        4. Term paper

B. **Frequency**

1. Frequency:
    a. Occasional quizzes, 2-3 midterms, 1 final exam per semester
    b. Laboratory write-ups weekly
    c. Student project once a semester
    d. Term paper once a semester

IX. TYPICAL TEXTS:
1. Castro, Peter and Michael Huber *Marine Biology.* 7th ed., McGraw-Hill Companies, Inc, 2008.

X. OTHER MATERIALS REQUIRED OF STUDENTS:
A. Laboratory manual or custom package