Eighth Edition

Marine Biology

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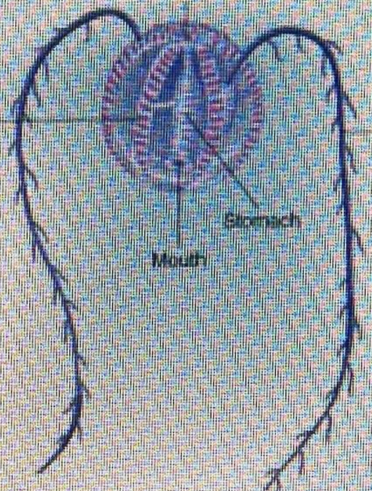
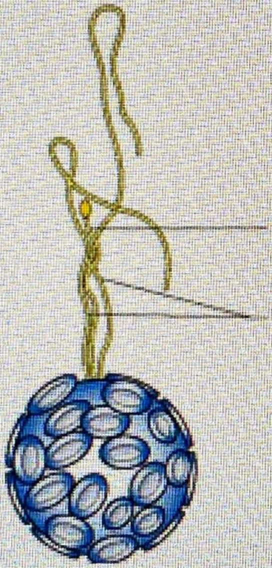
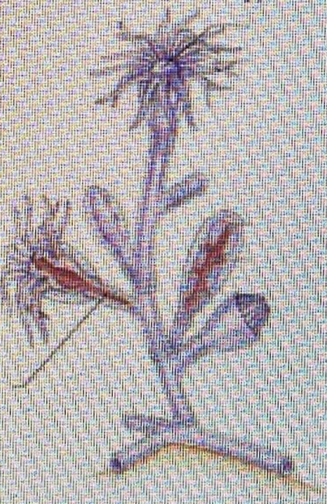
Sea | mester Programs

Introduction to Marine Biology

OCB 1001







Lecture Notes

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Version 3.6

1. Introduction: Science and Marine Biology (Karleskint Chapter 1)

1.1. Class Structure and Evaluation

Introduction to marine biology (OCB 1001) is a 3 credit class accredited through the University of South Florida. It involves a minimum of 45 contact hours that include both lectures and practical activities. This class can generally be divided in four sections.

1. Important biological and ecological concepts
2. Taxonomy of marine organisms
3. Marine ecosystems
4. Human impacts on the marine environment and management

This class is based on the following textbooks:

Karleskint, G., Turner, R. and Small, J.W. 2013. Introduction to Marine Biology, 4th edition. Thomson Brooks/Cole, Belmont CA.

Nybakken, J.W. and Bertness, M.D. 2004. Marine Biology an Ecological Approach, 6th edition. Pearson Benjamin Cummings, San Francisco CA.

Sumich, J.L. and Morrissey, J.F. 2004. Introduction to the Biology of Marine Life, 8th edition. Jones and Bartlett Publishers, Sudbury MA.

How to use these lecture notes:

This booklet is provided so you easily have access to the information that was presented in class. The class is mostly based on the book by Karleskint *et al*, but some information from that book is omitted and information from other books has been added. For each chapter in this booklet, the associated chapters from the reference books are indicated. You are responsible for everything in these lecture notes and presented in class for the exams. These notes are not a detailed explanation of all the organisms and ecosystems we cover in the class, just an outline and study guide. Some pictures are provided, but you are highly encouraged to make full use of the reference books to gain a better understanding of the topics.

Evaluation for the class will be as follows:

4 exams at 15% each	60%
2 short essays at 10% each	20%
1 field identification logbook	15%
1 identification quiz	5%

Exams are non-cumulative and cover 5-6 lectures each. Instructions and expectations for the short essays are outlined in the Marine Biology Reader provided.

1.2. Science and Marine Biology

Oceans cover 71% of the earth, and affect climate and weather patterns that in turn impact the terrestrial environments. They are very important for transportation and as a source of food, yet are largely unexplored; it is commonly said that we know more about the surface of the moon than we do about the deepest parts of the oceans!

Oceanography is the study of the oceans and their phenomena and involves sciences such as biology, chemistry, physics, geology, meteorology. Marine biology is the study of the organisms that inhabit the seas and their interactions with each other and their environment.

1.3. Brief History of Marine Biology

Marine biology is a younger science than terrestrial biology as early scientists were limited in their study of aquatic organisms by lack of technology to observe and sample them. The Greek philosopher Aristotle was one of the firsts to design a classification scheme for living organisms, which he called "the ladder of life" and in which he described 500 species, several of which were marine. He also studied fish gills and cuttlefish. The Roman naturalist Pliny the Elder published a 37-volume work called *Natural History*, which contained several marine species.

Little work on natural history was conducted during the middle ages, and it wasn't until the late 18th century and early 19th century that interest in the marine environment was renewed, fueled by explorations now made possible by better ships and improved navigation techniques. In 1831, Darwin set sail for a 5 year circumnavigation on the *HMS Beagle*, and his observations of organisms during this voyage later led to his elaboration of the theory of evolution by natural selection. Darwin also developed a hypothesis on the formation of atolls, which turned out to be correct. In the early 19th century, the English naturalist Edward Forbes suggested that no life could survive in the cold, dark ocean depths beyond 500m deep. There was little basis for this statement, and he was proven wrong when telegraph cables were retrieved from depths exceeding 1.7 km deep, with unknown life-forms growing on them. In 1877 the American Alexander Agassiz collected and catalogued marine animals as deep as 4,240 m. He studied their coloration patterns and hypothesized about the absorption of different wavelengths at depth. He also noted similarities between deep water organisms on the east and west coast of Central America and suggested that the Pacific and Caribbean were once connected.

Modern marine science is generally considered to have started with the *HMS Challenger* expedition, led by the British Admiralty between 1872 and 1876. During a circumnavigation that lasted 3.5 years, the *Challenger* sailed on the world's oceans taking samples in various locations. The information collected was enough to fill 50 volumes that took 20 years to write up. The samples taken during the Challenger expedition led to the identification of over 4,700 new species, many from great depths, and the chief scientist, Charles Wyville Thomson, collected plankton samples for the first time.

The Challenger Expedition was the start of modern marine biology and oceanography and is still to date the longest oceanography expedition ever undertaken. However modern technology has allowed us to sample organisms more easily and more effectively and to quantify things more accurately. Scuba diving and submersibles are used to directly observe and sample marine life; remote sampling can be done with nets, bottles and grabs from research vessels, and satellites are used extensively for remote sensing.

1.4. Why Study Marine Biology?

1.4.1. To dispel misunderstandings about marine life

Though many people fear sharks, in reality 80% of shark species grow to less than 1.6m and are unable to hurt humans. Only 3 species have been identified repeatedly in attacks (great white, tiger and bull sharks). There are typically only about 8-12 shark attack fatalities every year, which is far less than the number of people killed each year by elephants, bees, crocodiles or lightning.

1.4.2. To preserve our fisheries and food source

Fish supply the greatest percentage of the world's protein consumed by humans, yet about 70% of the world's fisheries are currently overfished and not harvested in a sustainable way. Fisheries biologists work to estimate a maximum sustainable yield, the theoretical maximum quantity of fish that can be continuously harvested each year from a stock under existing (average) environmental conditions, without significantly interfering with the regeneration of fishing stocks (i.e. fishing sustainably).

1.4.3. To conserve marine biodiversity

Life began in the sea (roughly 3-3.5 billion years ago), and about 80% of life on earth is found in the oceans. A mouthful of seawater may contain millions of bacterial cells, hundreds of thousands of phytoplankton and tens of thousands of zooplankton. The Great Barrier Reef alone is made of 400 species of coral and supports over 2000 species of fish and thousands of invertebrates. Each year, three times as much rubbish is dumped into the world's oceans as the weight of the fish caught. There are areas in the North Pacific where plastic pellets are 6 times more abundant than zooplankton. Plastic is not biodegradable and can kill organisms that ingest it. Many industrial chemicals biomagnify up the food chain and kill top predators. Some chemicals can bind with hormone receptors and cause sex changes or infertility in fish. Understanding these links allow us to better regulate harmful activities.

1.4.4. To conserve the terrestrial environment

Phytoplankton and algae use CO_2 dissolved in seawater in the process of photosynthesis, and together are much more important than land plants in global photosynthetic rates.

Marine photosynthesizers therefore have the ability to reduce the amount of CO_2 dissolved in the oceans and consequently in the atmosphere, which has important implications for the entire biosphere. Many marine habitats, such as coral reefs and mangroves, also serve to directly protect coastlines by acting as a buffer zone, reducing the impact of storm surges and tsunamis which may threaten human settlements.

1.4.5. For medical purposes

Because the architecture and chemistry of coral is very similar to human bone, it has been used in bone grafting, helping bones to heal quickly and cleanly. Echinoderms and many other invertebrates are used in research on regeneration. Chemicals found in sponges and many other invertebrates are used to produce several pharmaceutical products. New compounds are found regularly in marine species.

1.4.6. For human health

Several species of phytoplankton are toxic and responsible for shellfish poisoning or ciguatera. Understanding the biology of those species allows biologists to control outbreaks and reduce their impact on human health.

1.4.7. Because marine organisms are really cool

Many fish are hermaphrodites and can change sex during their lives. Others, including several deep-sea species, are simultaneous hermaphrodites and have both male and female sex organs at the same time. The blue whale is the largest animal to have ever live on earth and has a heart the size of a Volkswagen Beatle. The Indonesian mimic octopus has the ability to mimic the color and behavior of sole fish, lion fish and sea snakes, all toxic animals, which greatly reduces its likelihood of encountering predators.

1.5. How is Marine Biology studied? Using the Scientific Method

1.5.1. Science

The word *science* comes from the Latin (scientia) and means "knowledge". Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the world.