European Centre for Information on Marine Science and Technology

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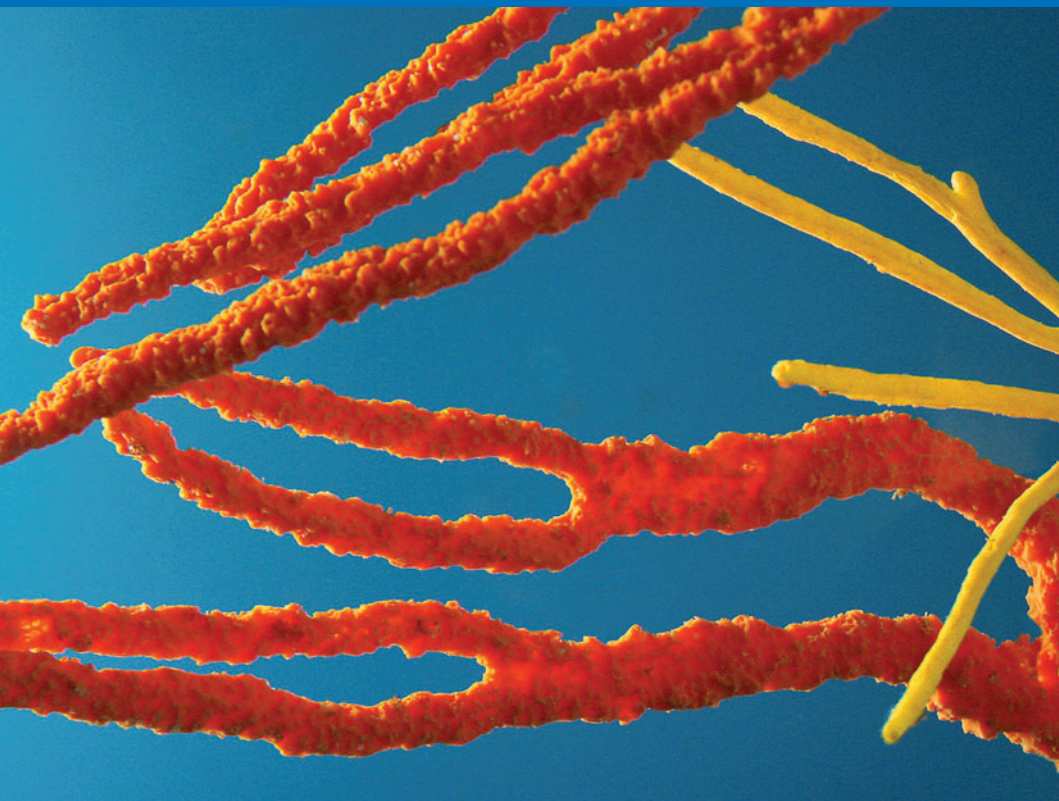
Uncovering the Ocean Secrets

A cruise through the Blue

Target Audience: Upper and Lower Secondary



This brochure is part of EurOcean dissemination project. EurOcean considers three types of dissemination: Dissemination for awareness, for understanding and for action. This brochure is intended for Dissemination for Understanding for the groups that can benefit from the project and need to have a deeper understanding on the ocean's basic key concepts. These are teachers and students on Lower and Upper Secondary. The project is an initiative, development and implementation of EurOcean.

Editorial coordination, research, design, general organisation and production
EurOcean Office (Telmo Carvalho, Sandra Sá, Rita Santos)

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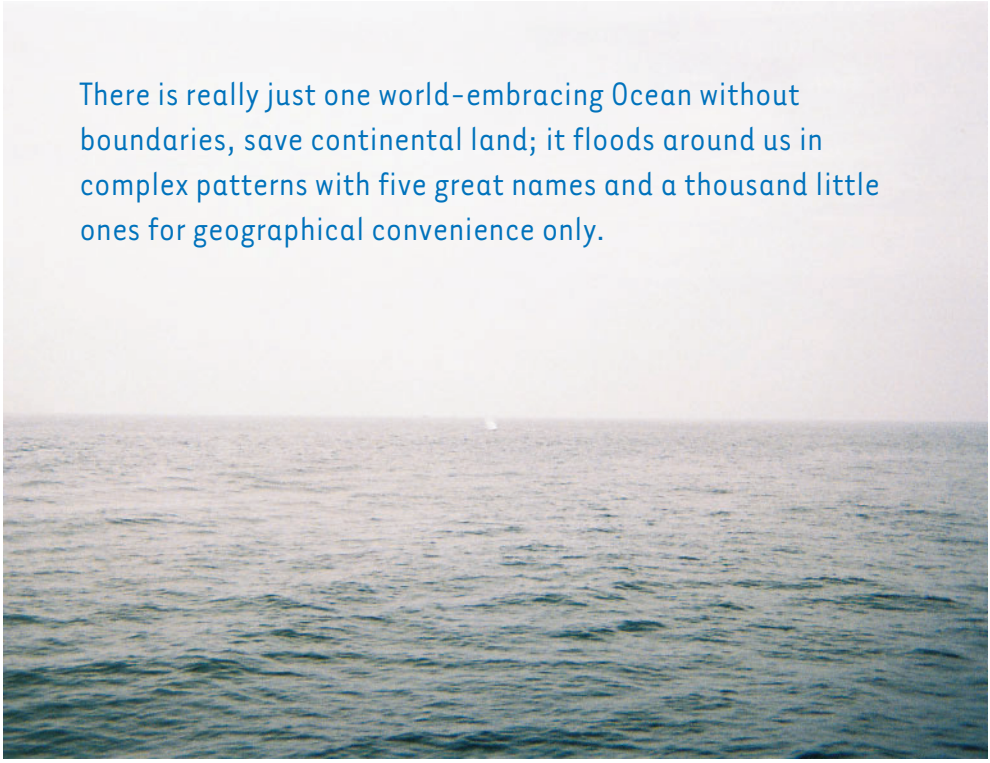
There is really just one world-embracing Ocean without boundaries, save continental land; it floods around us in complex patterns with five great names and a thousand little ones for geographical convenience only.

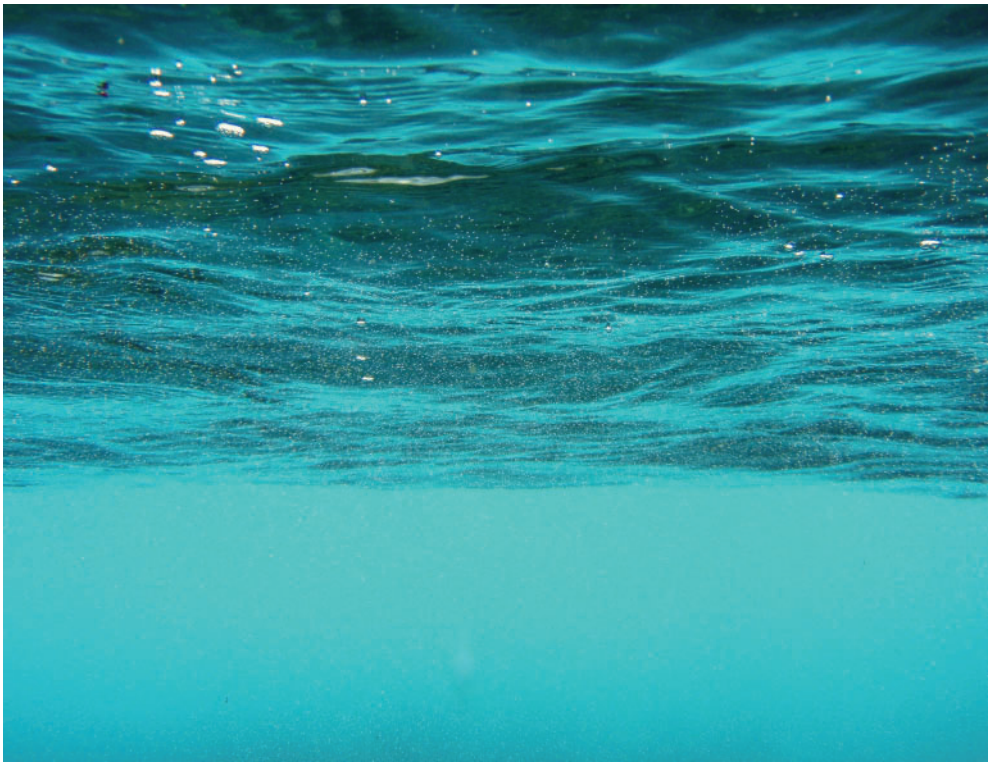


Whales in the Ocean © Sharesky

Ocean Facts and Figures

The Wide Ocean

The ocean covers more than 70% of the Earth's surface and contains 97% of the planet's water, yet more than 95% of the underwater world remains unexplored. An astounding 80% of all the life on Earth is found hidden in the ocean. The ocean offers vital sources of protein, energy, minerals and creates over half of our oxygen, drives weather systems and natural flows of energy and nutrients, transports water masses many times greater than all the rivers on land combined, and keeps the Earth habitable.



Underwater World © Felipe Skroski

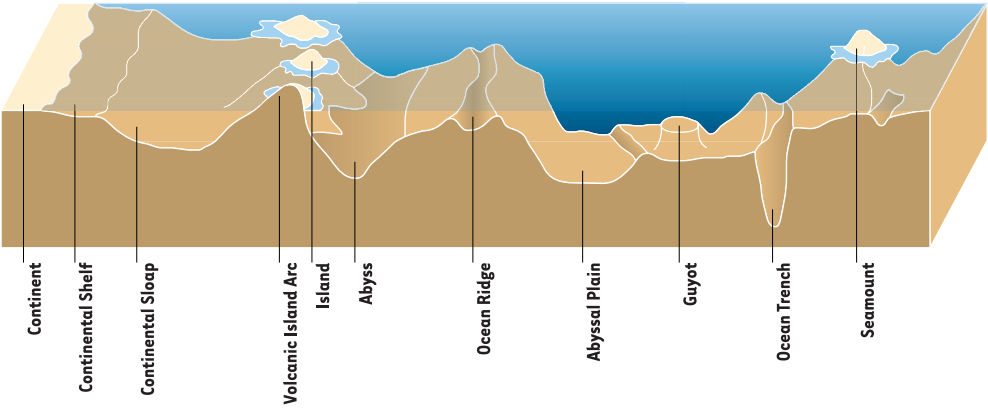
Ocean Chemistry

The Ocean water is composed by Sodium (Na^+), Magnesium (Mg^{2+}), Calcium (Ca^{2+}), Potassium (K^+), Strontium (Sr^{2+}), Chlorine (Cl^-), Sulfate (SO_4^{2-}), Bicarbonate (HCO_3^-), Bromine (Br^-), Boric Acid ($B(OH)_3$), and Fluor (F^-).
Ocean water contains an average 3,5% of salt.

Ocean Numbers

Area: about 362 million Km^2. Average Depth: 3,720 m.
Deepest point: 11,033 m in the Mariana Trench in the western Pacific.
Mountains: The ocean ridges form a great mountain range, almost 64,000 km long that weaves its way through all the major oceans. It is the largest single feature on Earth.
Highest Mountain: The island of Mauna Kea, in the Pacific, rises above the ocean floor 10,203m; with only 4,170m above ocean level.
Average temperature: about 3,8 °C.

Features of the Ocean Floor



Ocean Features

Continental shelf: is the submerged continental mass area extended seaward from the shorelines at an average distance of 75 km it varies in width from nearly zero to 1,500 km; **Continental slope:** At the seaward edge of the continental shelf is an immense drop-off, which descends to about 3,500 m.; **Continental rise:** Is a gradually sloping zone of sediment that is considered part of the ocean bottom. It extends about 600 km from the base of the continental slope to the flat abyssal plains of the deep-ocean floor. **Abyssal plains:** are the vast, flat or very gently sloping, sediment-covered areas of the deep ocean floor. They cover approximately 40% of the ocean floor and reach depths between 2,200 and 5,500 m.; **Oceanic ridge:** an area where seafloor spreading occurs and that may be characterized by an elevated position, extensive faulting, and volcanic structures that have developed on newly formed oceanic crust; **Accretionary wedge:** area where the leading edge of a continent is overrunning oceanic lithosphere; **Seamounts and Guyots:** isolated volcanic peaks on the ocean floor that originate near the mid-ocean ridge or in association with volcanic hot spots; **Oceanic plateaus:** vast accumulations of basaltic lava flows; **Submarine canyons:** steep-sided valleys that originate on the continental slope and may extend to the deep-ocean basin.

The Tube © sub_lime79

Ocean Movements

Ocean Waves The surface of the Earth's oceans is in constant motion, moving up and down, in the form of waves. The wind is the main cause of the waves. It transfers some of its energy to the water, through friction between the air molecules and the water molecules.

Ocean Currents There are a number of ocean currents found around the Earth. A current is like a vast river within the ocean, flowing from one place to another. These currents are caused by differences in temperature, differences in salinity, and by wind.

Ocean Tides Tides occur when the gravitational influence of the moon and the sun causes bulges of oceanic water to move around the earths surface, causing water levels to rise and fall. Typically, water will rise for about six hours, followed by six hours of falling water depths.

Canoe (Coast of Zanzibar, Indian Ocean) © blhphotography

The Five Oceans

The Pacific Ocean is the largest and the deepest of the five main oceans. It is 165,200,000 Km^2.

The Pacific Ocean is so big it could fit all of the Earth's continents.

The deepest known spot in the ocean is the Mariana Trench, southwest of Guam, it is 11,033 m below the surface.

The Indian Ocean is bordered by the continents of Asia, Africa, Antarctica, and Oceania. It is 73,441,700 Km^2. The deepest spot is 7,725 m south of Java.

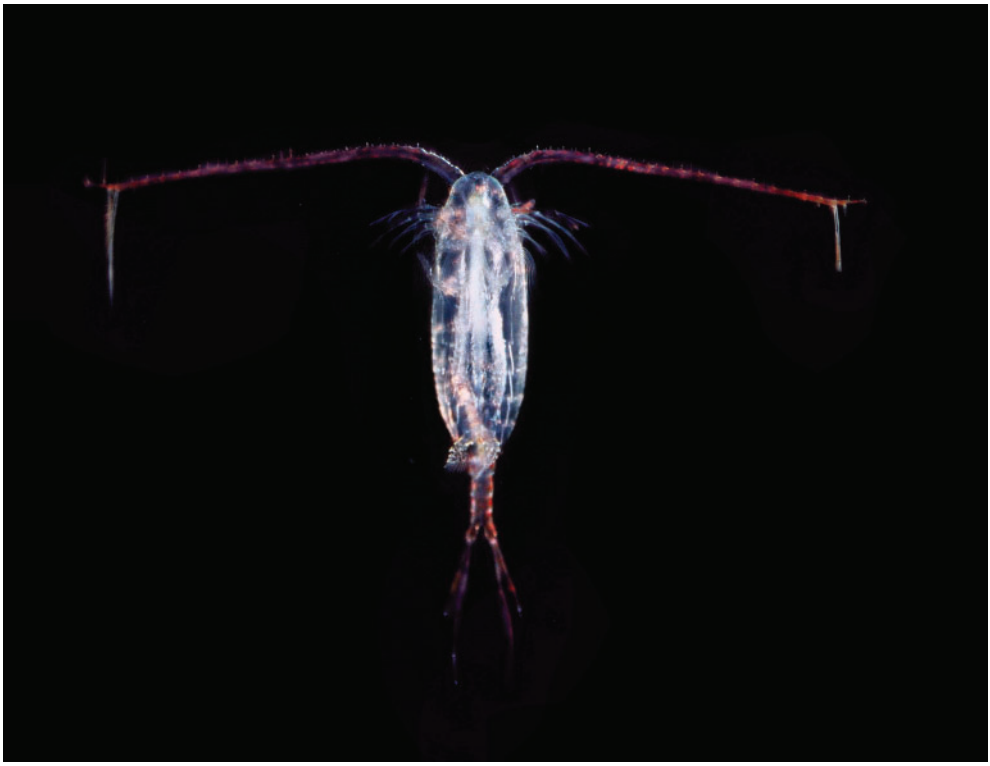
Azores Cliff View (Atlantic Ocean) © Pear Biter

The Atlantic Ocean is the world's second largest body of water.
It is also the busiest. Many ships cross the Atlantic, carrying cargo between the Americas, Africa and Europe.
It has an area of 81,662,000 Km^2 and average depth of about 4,270 m. The deepest part of the Atlantic Ocean is the Puerto Rico Trench with 8,648 m.

Baffin Island (Arctic Ocean) © NileGuide.com

The Arctic Ocean is the smallest and coldest and lies at the top of the world. The Arctic covers about 9,485,100 Km^2.

The Antarctic Ocean is the fourth-largest and one of the coldest oceans. With an area of 20,327,000 Km^2. It's lowest, already known, point is 7,235 m at the southern end of the South Sandwich Trench and the highest point is the sea level. In 2000, the International Hydrographic Organization created this fifth world ocean – the Southern Ocean – from the southern portions of the Atlantic Ocean, Indian Ocean, and Pacific Ocean.



Copepod (Zooplankton) © Uwe Kils

Ocean Biodiversity

Main Components

Phytoplankton are unicellular algae, important producers of oxygen on a global scale. Some species may be collected through a fine mesh, but many of these microscopic plants can only be collected by filtering or by centrifuging considerable volumes of water. The distribution of phytoplankton exerts a controlling influence on the seasonal evolution of sea-surface temperatures, influencing weather patterns across the globe. Phytoplankton produces about half of the world's oxygen.

Zooplankton are heterotrophic animals, structurally and taxonomically diverse. By definition, are not able to move against the current but can move vertically in the water column.

Sea Squirt (Benthos) © Nick Hobgood

Nekton is the aggregate of actively swimming aquatic organisms in an ocean able to move independently of water currents. Fish account for lager proportions of nekton with crustaceans, squid, sea snakes, turtles, marine mammals and seabirds making up the lesser parts.

Benthos are the organisms which live on, in, or near the seabed. They have a great heterogeneity of habitats that may vary, for example in terms of depth, temperature, degree of immersion, type of substrate, etc...

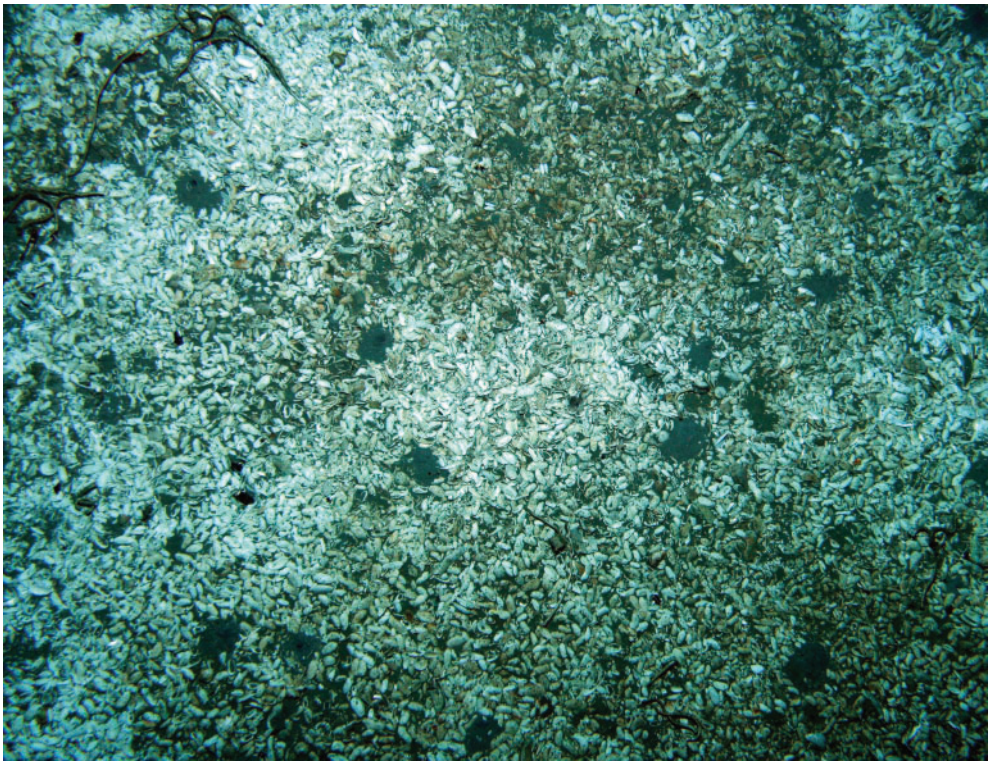
Consolidated substrates (eg rocks) are used as a means of attachment for sessile organisms such as barnacles, sponges and mussels. The hard substrates allow these organisms to maintain their position throughout their adult life and the resulting environments are often used by mobile animals as an area of refuge from predators.

Non-consolidated substrates (sand, mud, silt) are three-dimensional environments, offering food and shelter for digger animals.

Reef © Larsz

Special Ecosystems

Coral Reefs are vast rocky areas located in shallow tropical waters. They are the most diverse and beautiful of all marine habitats.
It harbours more than 25% of all known ocean fish.
Corals are anthozoans, the largest class of organisms within the phylum Cnidaria.
Kelp Forest are brown algae communities that grow in clean waters along rocky coastlines in depths of about 2 m to more than 30 m. Kelp favours nutrient-rich, cold waters that range in temperature from 5° to 20° C. Besides Brown algae it can be found there invertebrate individuals, including polychaetes, amphipods, decapods, ophiuroids, sea lions, harbor seals and sea otters, among others. All larger marine life, including birds and mammals, may retreat to kelp during storms or high-energy regimes because the kelp helps to weaken currents and waves.

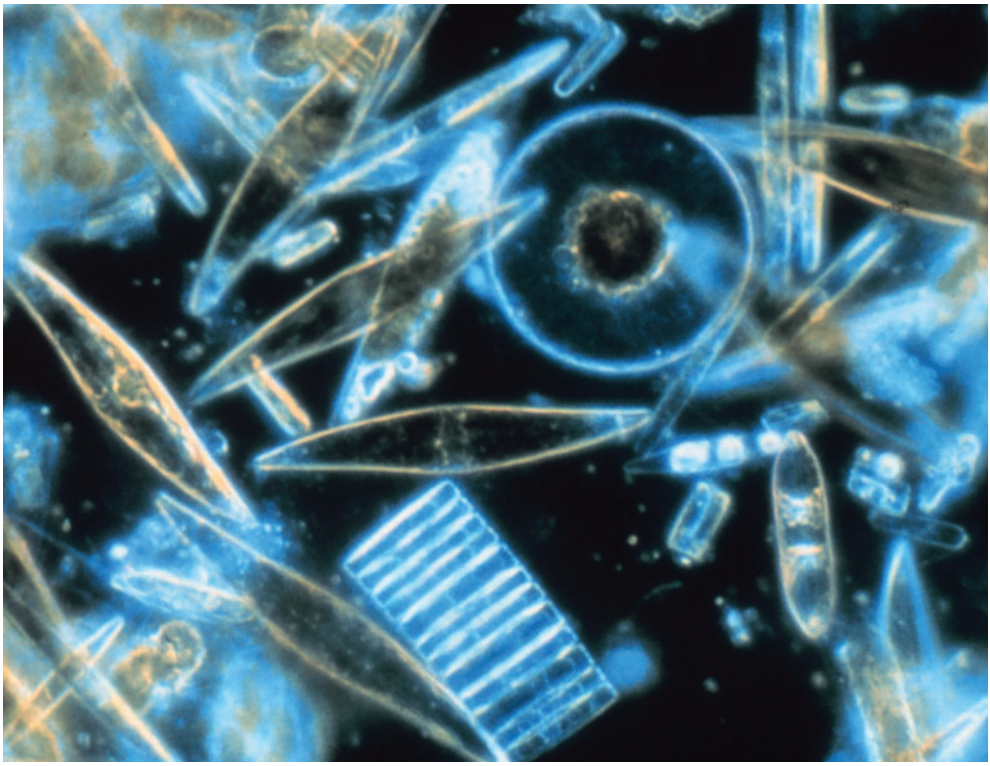


Cold Seep © NOAA/NIWA

Mangroves are typical ecosystems of coastal flooded areas in tropical and subtropical areas. Besides mangroves (the typical trees from these ecosystems), the mangrove host a variety of other plants and animals. Among the plants, there are orchids and Lichens. Concerning the fauna it can be divided into three major groups: the first consists of animals which live throughout their adult life in the mangroves such as crabs, oysters and alligators. The second group consists of animals (mostly fish) that inhabit the mangrove during their juvenile phase. The third group consists mainly of seabirds but also includes some mammals.

Hydrothermal Vents are the result of volcanic activity on the ocean floor. Water seeps through cracks in the Earth's crust, dissolving metals and minerals whilst it becomes super-heated by nearby magma. More than 300 species have, so far, been identified in deep-sea hydrothermal vent ecosystems, of which over 95% were new to science.

Cold Seep environment, as opposed to the hydrothermal environment, is a soft sediment environment with no volcanic activity. Clams, mussels and vestimentiferan tubeworms are dominant animals, and they rely on symbiotic bacteria in their feeding tissues which uses H_2S (Sulphuric Acid) or methane for producing energy.

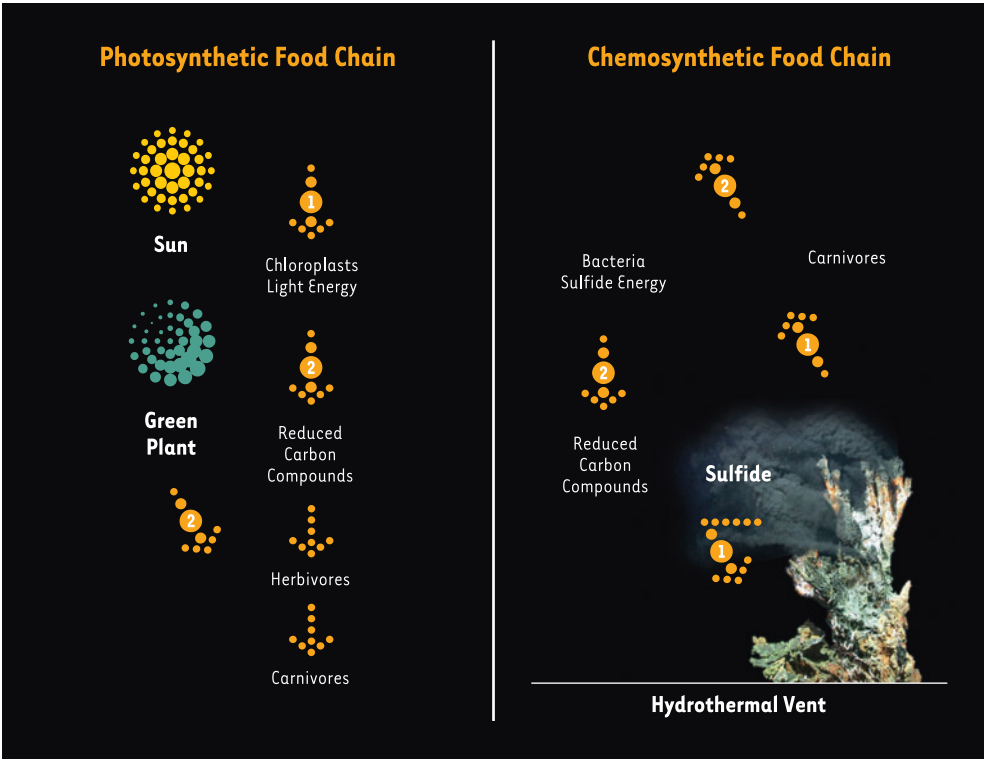


Diatoms through the Microscope © Prof. Gordon T. Taylor, Stony Brook University

Food Webs

Food webs are often used to portray the interactions of organisms with other organisms and with their physical environment. Plants (producers) use sunlight and inorganic materials to produce the organic compounds that become food and nutrients for other organisms — the consumers. Those animals that feed upon plants are called primary consumers, while animals that eat other animals are secondary or even tertiary consumers. Scavengers feed on dead organisms, while decomposers break down nonliving organic matter into materials, that again, are available to enter the food chain as nutrients.

Scientists once thought that sunlight was the only source of energy for all life and that photosynthesis was the only way to make food. But In Deep Ocean is now known the chemosynthesis process of energy.



Food Webs © EurOcean

Photosynthesis Food Web Nutrients on the marine ecosystem tend to settle on the seafloor. Upwelling of cold water brings the nutrients closer to the surface where they are available to phytoplankton (very small plants drifting in the sea that capture the energy of the sun and turn it into food — see pp. 11). The phytoplankton, in turn, becomes food for zooplankton (very small ocean animals) and larger organisms.

Chemosynthesis Food Web It is now known that some reduced chemicals from hydrothermal vents provide chemosynthetic energy for some life forms. High temperatures and high concentrations of dissolved minerals in seawater form compounds. In a biochemical process, bacteria oxidize those compounds and use the liberated energy to produce chemical energy. Unlike photosynthesis, chemosynthesis requires no light and can occur at the extreme temperatures and high pressures of the deep ocean. The chemosynthetic food web supports dense populations of uniquely-adapted organisms.

Ocean Uncovered

The Ocean is essential to humanity.
The interactions between the ocean and atmosphere affects the climate, not only the distribution of heat in the world, through the sea currents, but also for its importance in the water cycle.
On this continuous cycle, a drop of water remains, on average, nine days in a cloud, two hours in a river and 5,000 years in the ocean before it evaporates again.
Moreover, the ocean is vital to the ecological balance of the planet, because almost 70% of the oxygen released into the atmosphere is produced by phytoplankton during the photosynthetic process.
Ocean water serves as a source of food and valuable minerals, a vast highway for commerce, and a place for both recreation and waste recycle.

Don't take it for granted.

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