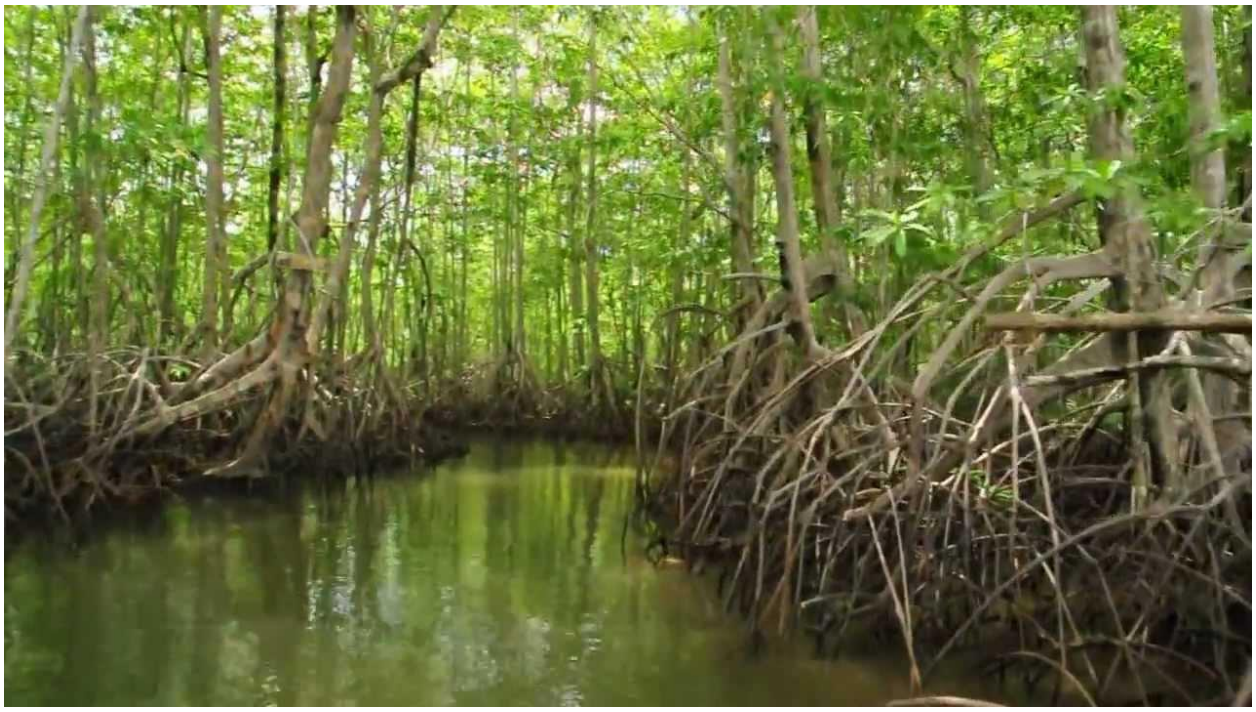
Mangrove Forests/Swamps

Mangroves a groups of trees and shrubs living in the coastal intertidal zone



Mangrove: Loxahatchee, Florida

These occur in areas where there isn't much oxygen in the soil. The are found only in tropical and subtropical areas near the equator since they cannot survive cold weather.

The tangle of roots above the water makes the mangrove easily recognizable. They need to be able to handle the rise and fall of the tide. Water is slowed and filtered by the roots and allows a build-up of a muddy bottom. This cleans the water of sediment.

The mangroves act as a stabilizing force for the coast line from the wear of tides, storm surges, currents and waves. The complicated root system is attractive to fish that need protection while looking for food. Larger

predators have difficulty getting into the small water areas between the roots.

Mangrove swamps, with salt-loving shrubs or trees, are common in tropical climates, such as in southern Florida and Puerto Rico.

Mangroves provide an array of ecosystem services, from coastal protection to fishery support to carbon sequestration, all of which are at risk in the Indo-Pacific region due to sea-level rise (SLR). SLR can lead to inundation of these habitats and shoreline retreat.

The mangroves are often cleared for crops, urban development, roads and garbage dumps.

About 75% of all sheltered tropical coast line were once covered by mangrove forests, but about ½ have been destroyed. Southeast Asia has a much higher rate of destruction

One of the places from which the water comes into the rivers is underground water. When rain falls, some falls into the ocean some into the rivers and streams and some is absorbed into the land where it permeates the ground and moves underwater to the same places that the rain falls – rivers, streams and ocean. Water moving through the ground brings with it many of the chemicals and materials. This includes fertilizer. Fertilizer is used to make plants grow and it does the same thing in the water that it does on the land. Fertilizer that enters the ocean causes eutrophication and the algae to grow in large numbers called "alga blooms". This increase initially causes an increase in the amount of photosynthesize which will produce a good amount of oxygen and uses up carbon dioxide. Since the algae grow in huge numbers, the cover the surface of the water that blocks sunlight from the plants on the bottom of the water. Without sunlight, they have no light to photosynthesize and die off. Heterotrophs in the water have some difficulty since there food supply is now cut off. On top of that, the algae die off and begin to decompose. The process of decomposition uses up the oxygen in the water and so the oxygen that is needed by the organisms, and so they may die off creating a "dead zone" where things can't live.

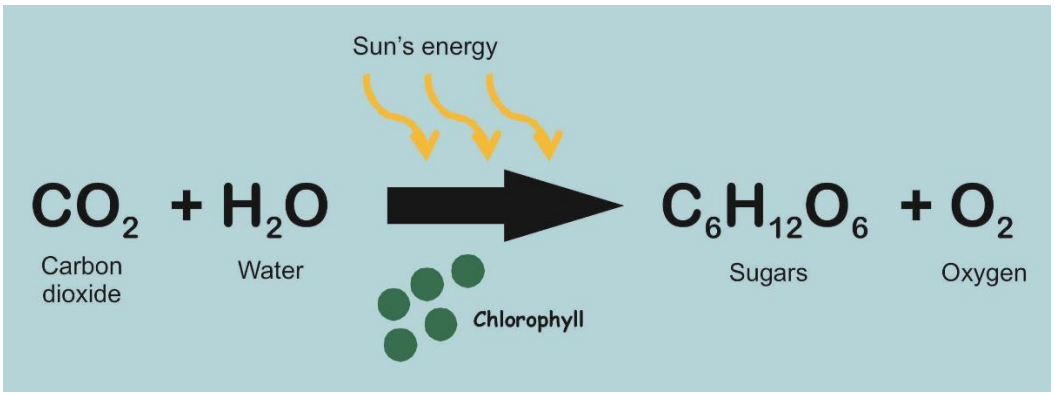
The wetlands are capable of purifying some of the water, but as they are destroyed, more of the nutrients from the run off do not get filtered and the eutrophication cycle begins.

In some cases, large bodies of water have formed as the result of rising sea levels over the last tens of thousands of years.

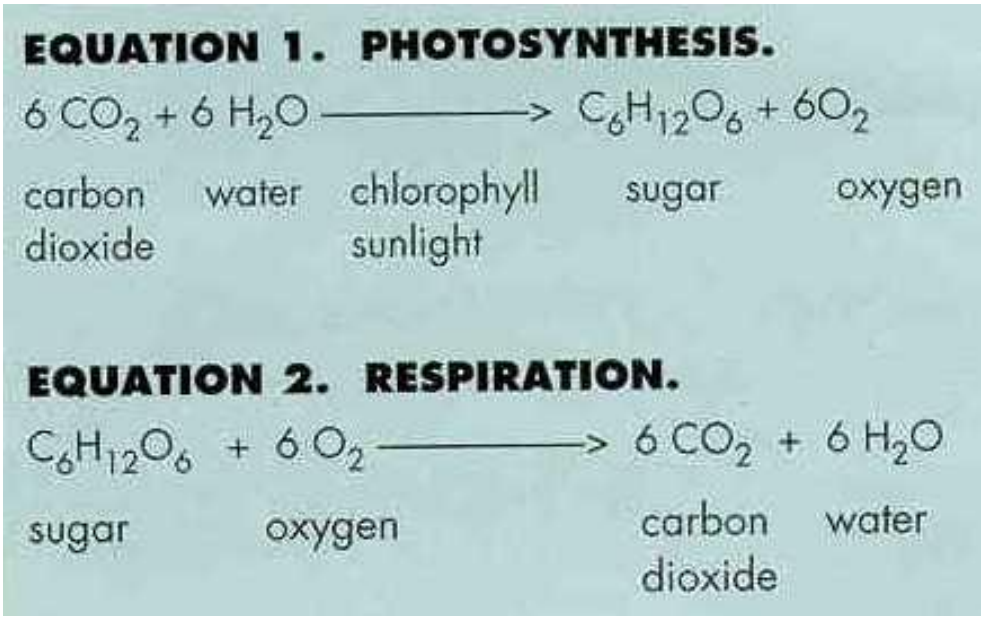
RED SEA: plate movement. As the plates move apart here, the Indian Ocean moved into the space.

ARABIAN GULF: Rising sea levels flooded into the area.

In addition to the animals there are many plant like organisms in the water. Most are photosynthetic storing energy by converting CO_2 and H_2O in the presence of sunlight into sugar and oxygen

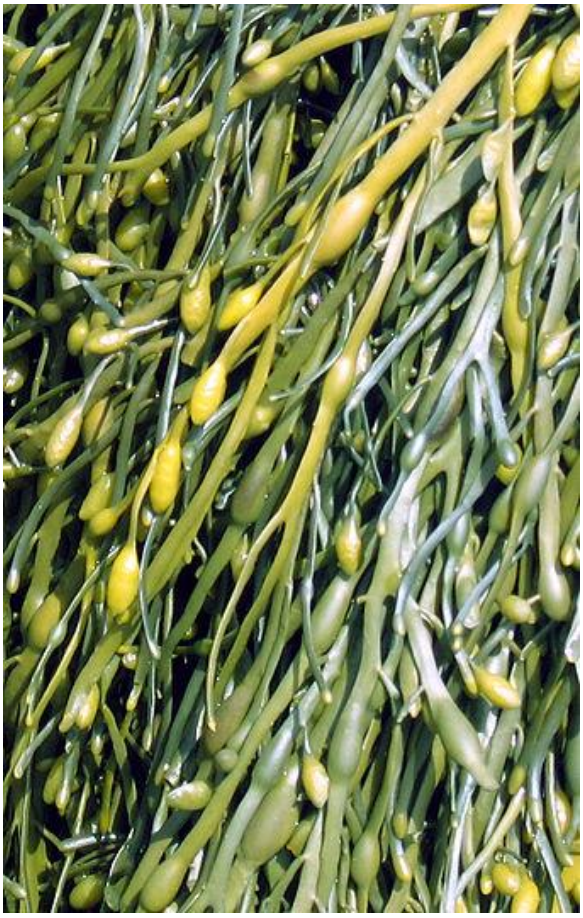


These organism also respire and take in oxygen and produce carbon dioxide.



More oxygen is generally produced than carbon dioxide.

Most of the organisms in the ocean that do this are microscopic protists. Algae, which are photosynthetic organisms may be multicellular, like sea weeds,



and some like kelp may grow a hundred or more feet in length!

They lack true roots, although kelp have “hold fasts” which look like roots, but are not involved in transportation of food and water, but rather are used to attach the organism to a substrate or base.

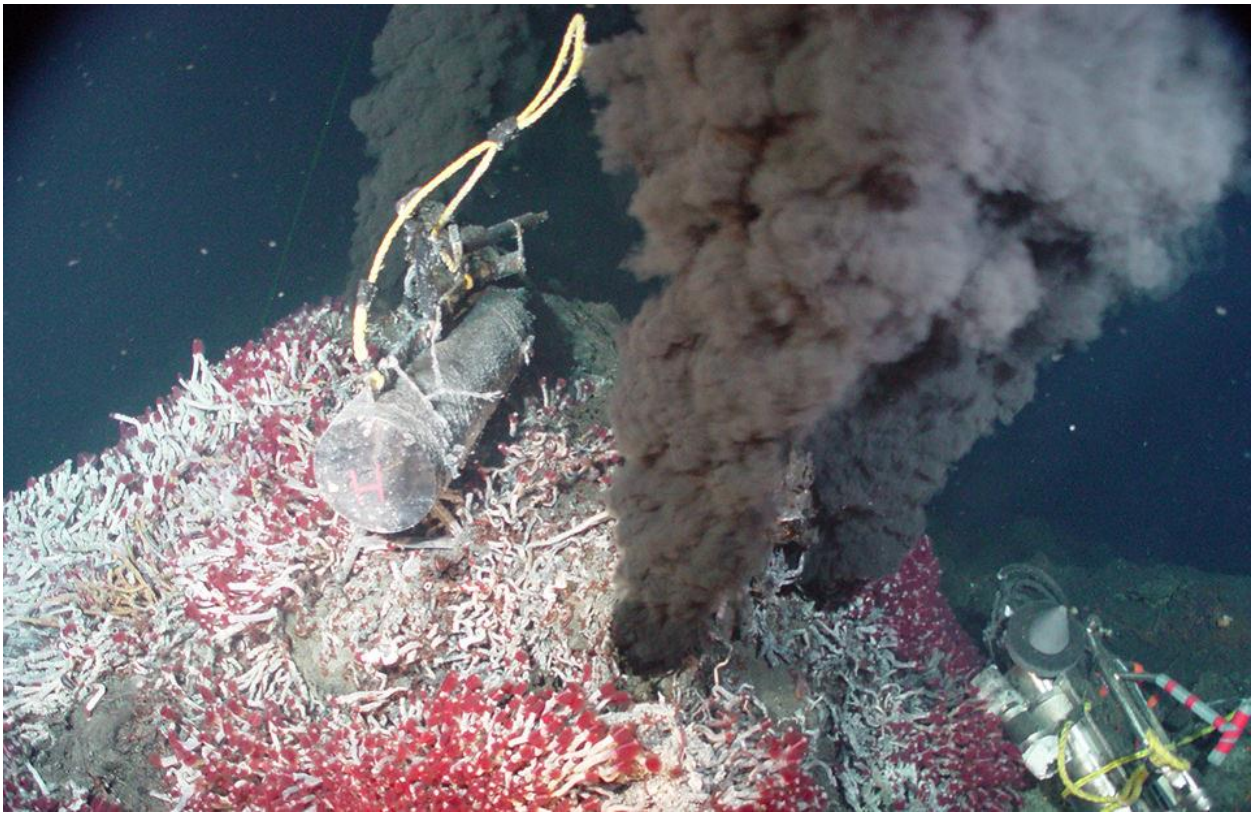
Some organisms live deep in the ocean where light does not penetrate and photosynthesis is not possible. Some organisms are able to produce a carbohydrate through a process called chemosynthesis. In this process one of more carbon sontaining molecules (carbon dioxide or methane)

The organisms that do this are largely bacteria and archaea.

Here 12 molecules of hydrogen sulfide and 6 molecules of carbon dioxide are converted into a carbohydrate along with 6 molecules of water and 12 sulfur atoms.

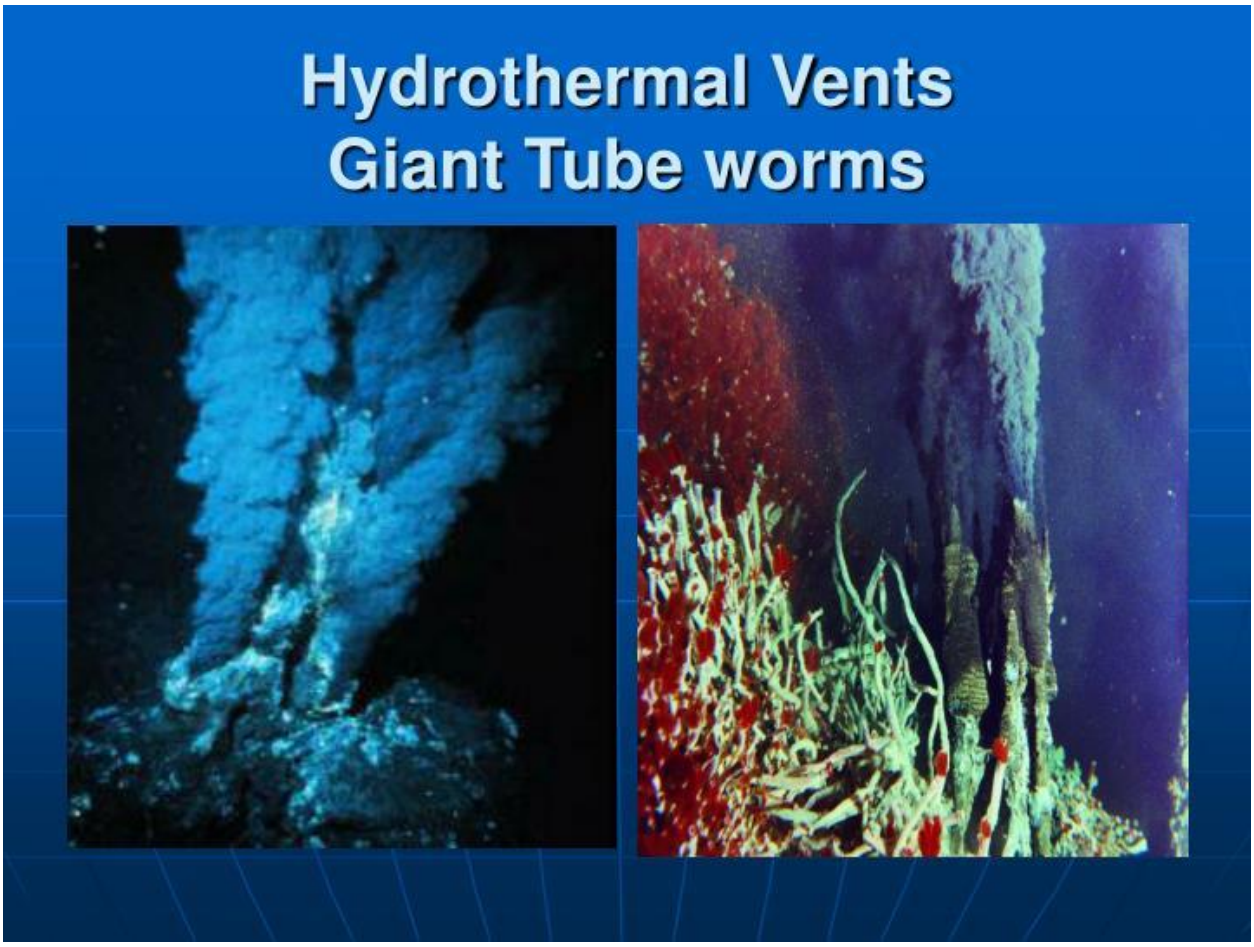
$12\mathbf{H}_2\mathbf{S} + 6C\mathbf{O}_2 \rightarrow C_6\mathbf{H}_{12}\mathbf{O}_6$ (=carbohydrate) $+ 6\mathbf{H}_2\mathbf{O} + 12S$

In the depths of the ocean there are "hydrothermal vents" . These are places where geothermally heated water occurs – that is the water is heated by volcanic action. These areas are also known as "black smokers". An incredible amount of life forms exist in this very heated area which lacks sunlight and often oxygen.



The life forms (along with the photosynthetic forms) are the base of the food chain. All energy needs to be converted into a form that can be used by life forms. The bottom of the food chain consists of those organisms that can manufacture their own "food" from either sunlight by photosynthesis or by some chemical reaction (chemosynthesis). These organisms are called "primary producers" upon which all other life forms are dependent.

In many instances some symbiotic relationships have formed. The giant tube worm (Riftia pachyptila), for example grows as large as 8 feet. They lack a mouth and digestive tract. Within the giant tube worm live bacteria that "make" their food for them by converting chemicals from the hydrothermal vents into organic molecules. The bacteria are given a "safe" place to live within the worm, and get oxygen, carbon dioxide and hydrogen sulphide from the worms "tentacles".



The food chain starts with those organisms which do not eat, but can manufacture their own food. They are called "Primary Producers" and are at the lowest level of the food chain. Being autotrophs they need only energy and certain minerals to be able to survive. The energy may be light (photosynthesis) or some other source (chemosyntesis). These range in size from one celled organisms to huge plants like Sequoyah trees.

Algae: a group of photo-synthetic organisms that range from unicellular to multicellular

Kelp (a kind of large algae). It is not a true plant. It lacks a true root system

Primary producers are at the bottom of the food chain, but without them, all forms of life above them would cease to exists. The various levels of the food chain are known as “trophic levels”

Heterotrophs

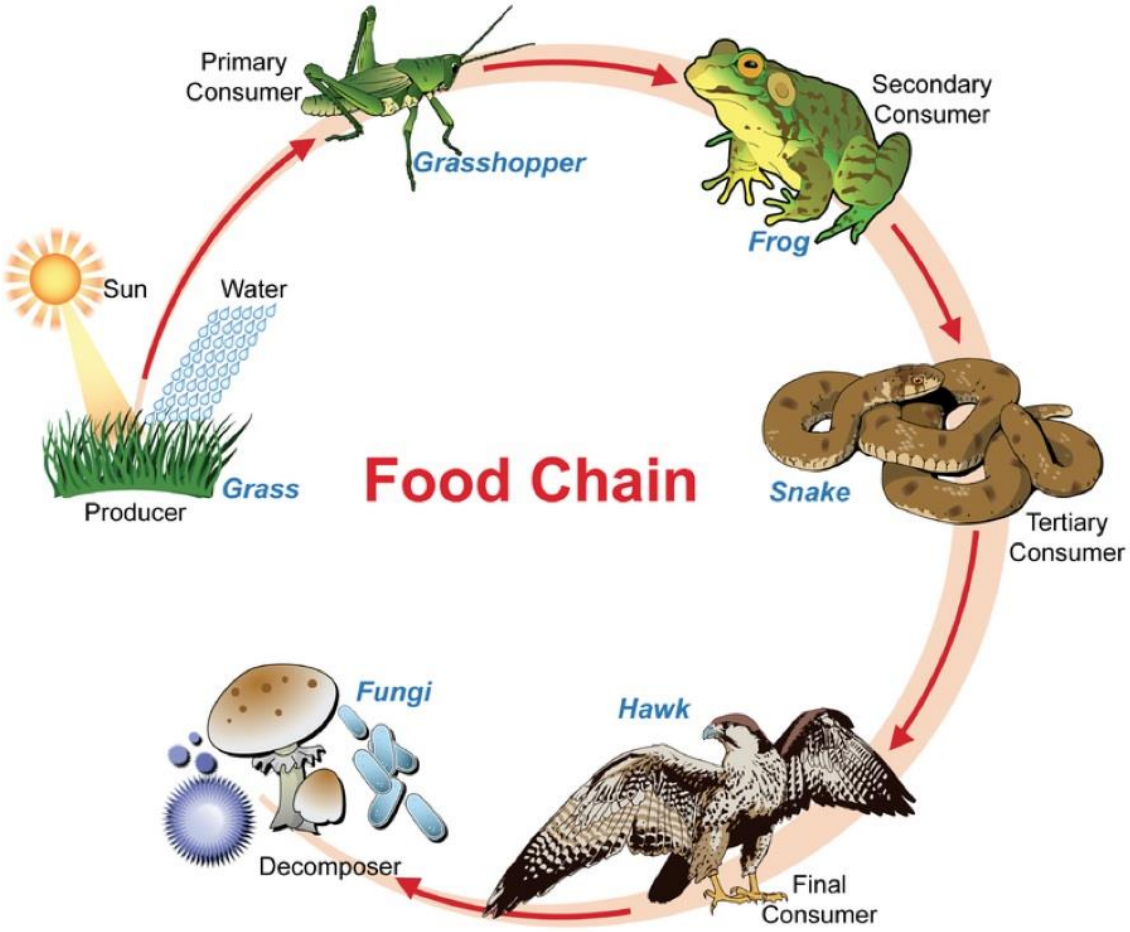
Apex predators (eat level I predators)

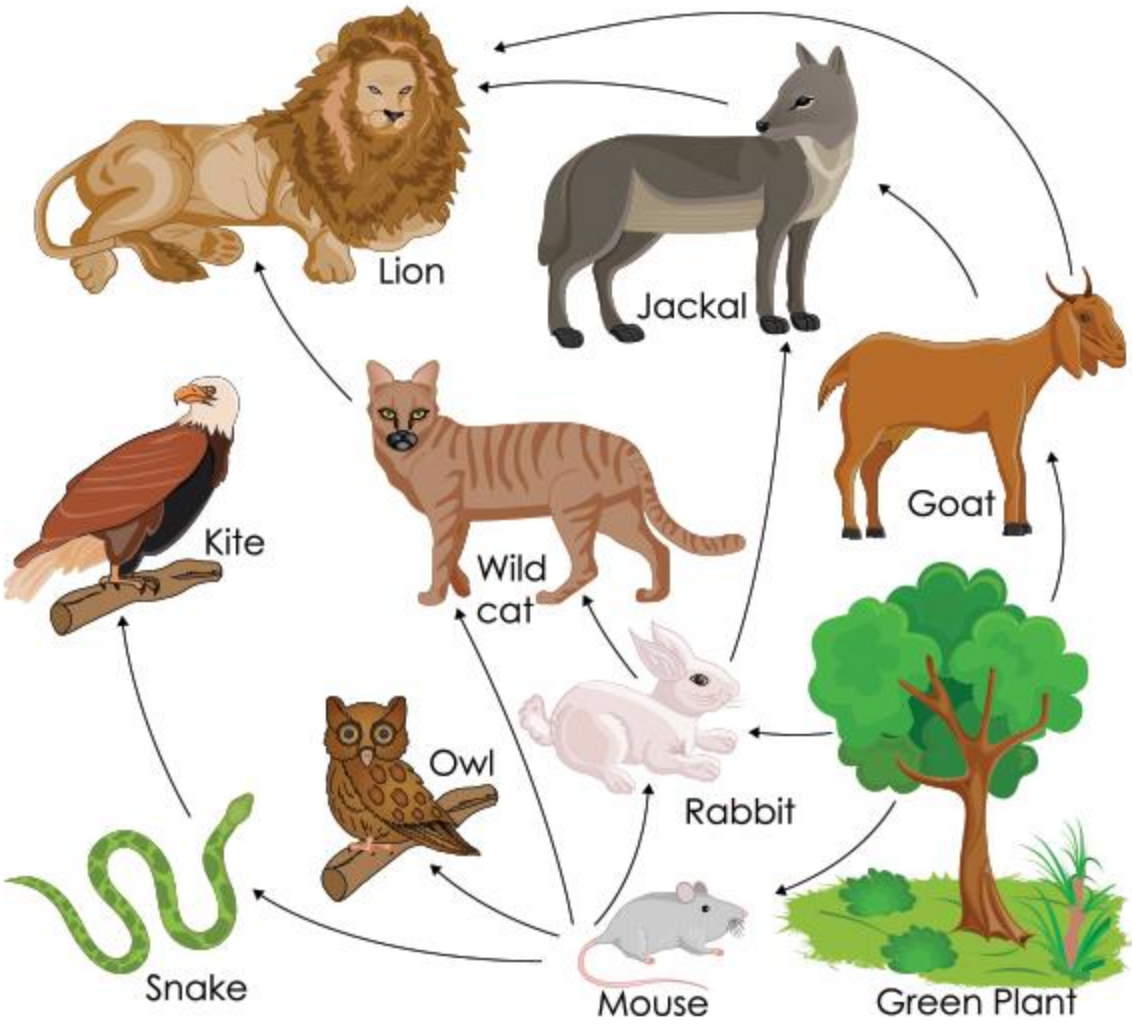
Predators (eat grazers)

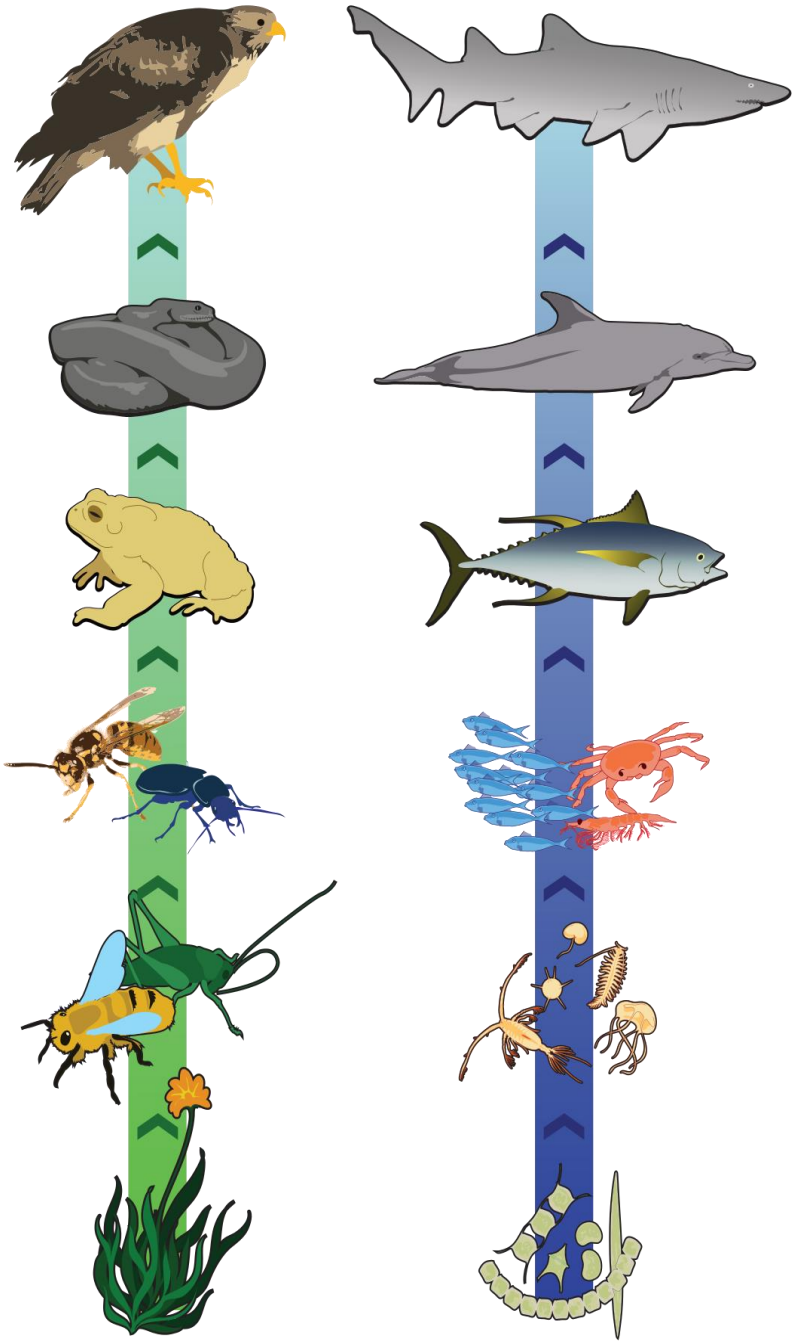
Grazers (eat primary producers)

Autotrophs

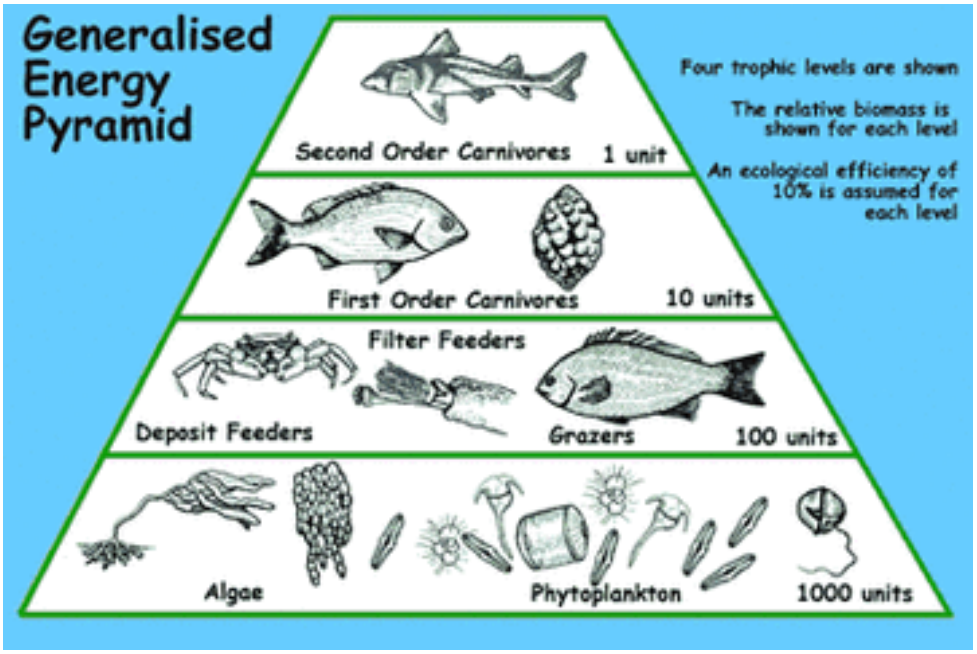
Primary producers (autotrophs)


Food Chain
Primary Consumer
Grasshopper
Secondary Consumer
Frog
Tertiary Consumer
Snake
Final Consumer
Hawk
Decomposer
Fungi
Producer
Grass
Sun
Water


Lion
Jackal
Goat
Kite
Wild cat
Owl
Rabbit
Snake
Mouse
Green Plant

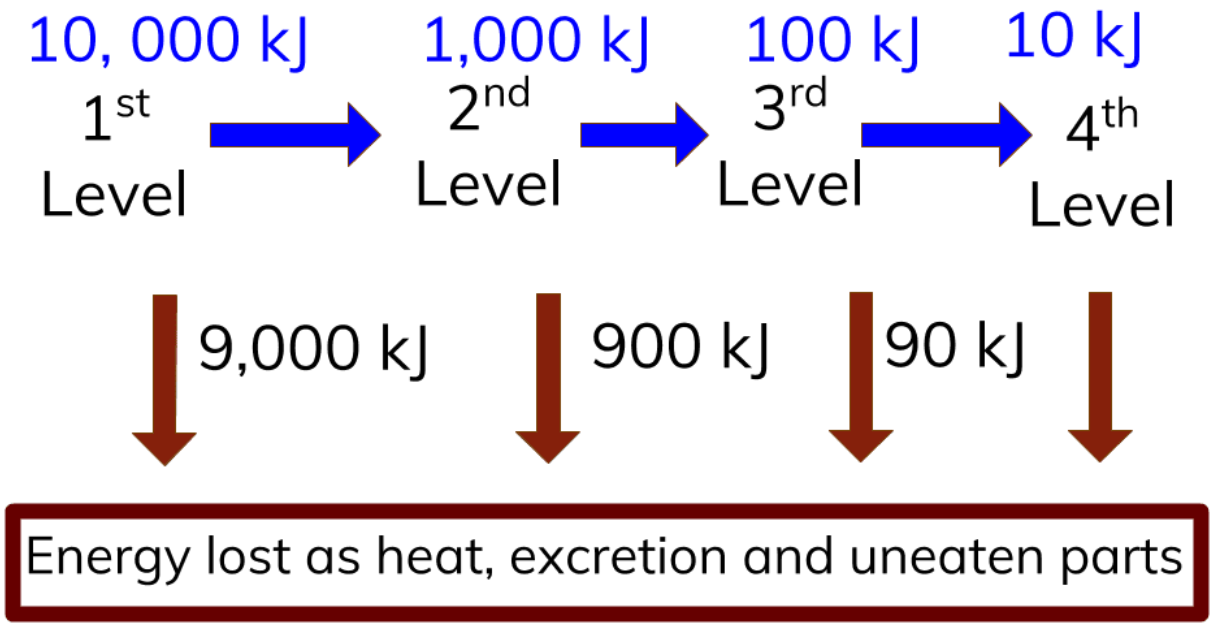


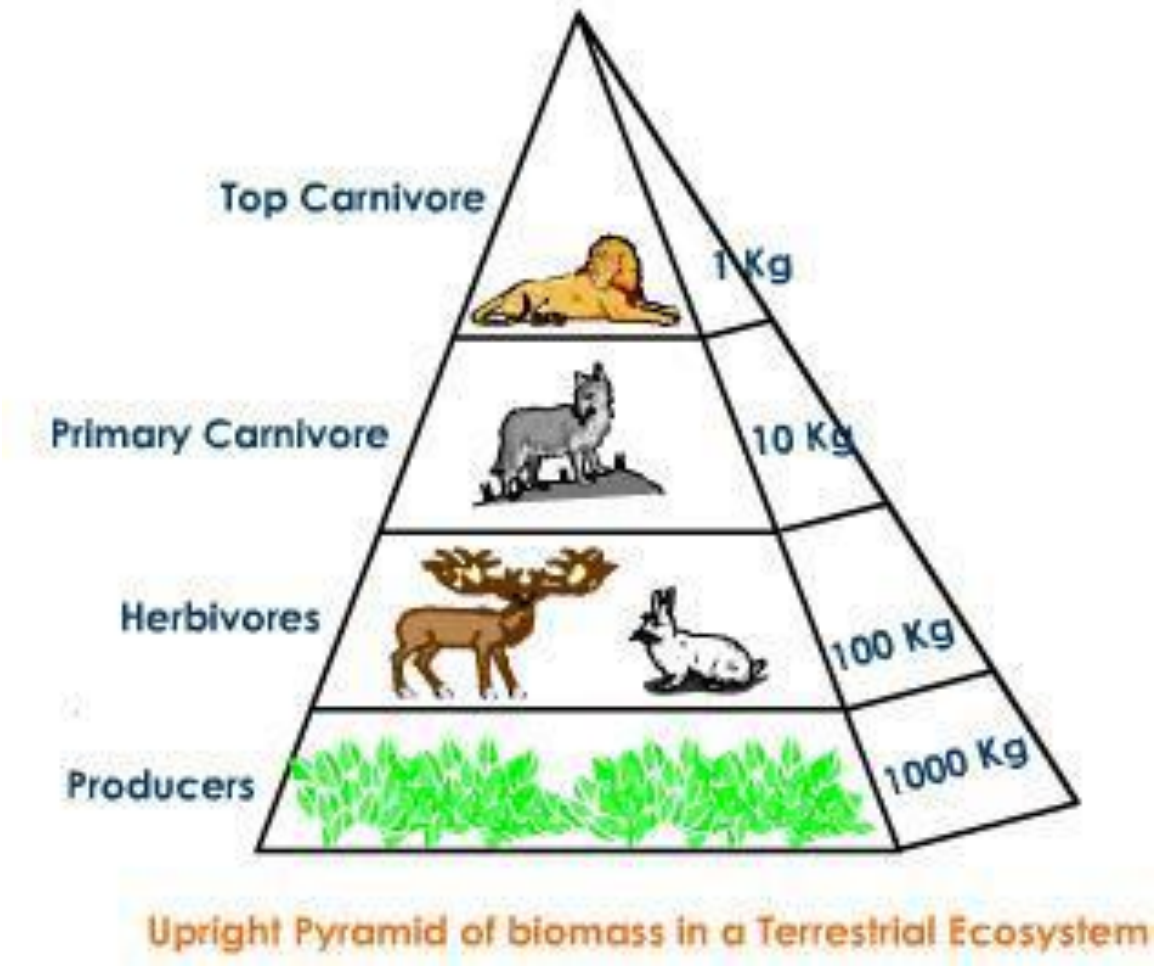
A food chain may have many levels and Is often far more complex than the one pictured here. What is important to note is that upper level consumers are dependent on, and to some degree control the growth of the population of the organism they eat. Changes in the population numbers of any organism can seriously impact the organisms below it and above it. Lower Level organisms may grow out of control while upper level organisms may find that Their food supply is gone.



All heterotrophs need to use energy to search for food, eat it, digest it and excrete non digestible parts. All of this takes energy and about 90% of what is eaten is used for that purpose. Only about 10% on the average is used for maintaining the organism and building tissue etc. So only 10% of what each level eats gets used for its own needs outside of food gathering.

Biomass in level:





Upright Pyramid of biomass in a Terrestrial Ecosystem

So, almost all energy ultimately comes from the sun. Those organisms that can turn the sun's energy into food are called "primary producers". The do not need to eat. They are able to take carbon dioxide and water and with the energy from the sun, change those into sugar and oxygen. This process is called "photosynthesis". Organisms which cannot photosynthesize (or in rare cases - chemosynthesize - that is use chemical energy to make their own food) have to eat other life forms. So there is a food chain - called trophic levels, starting with the bottom level of primary producers and working up to apex predators.

Carbon dioxide comes into the water from respiration and also because the ocean is able to absorb it from the atmosphere. This is something that becomes significant when we talk later about pollution and climate change.

WHAT KINDS OF THINGS DO WE GET FROM THE OCEAN?

(a) Food.

All kinds of edible material comes from the ocean. The most obvious is probably fish (Pisces) but also shellfish, which are not "fish" at all. In addition to animal life, some algae (including seaweeds) are edible. Sea mammals are also edible and people in different parts of the world eat whales and seals. What people regard as food is part of their "culture"

(b) Minerals.

Salt is one of the most common minerals taken from the ocean. One need only let the water evaporate and the minerals remain. Salt is used for food, but was used as money for the Roman legions. The word "salary" is derived from the Latin word for salt.

Along the shores of South Africa and Nambia there are large numbers of diamonds found. They are formed by pressure deep in the Earth and are moved to the surface through volcanic vents.

Heavy metals known as placers are more often mined along the coasts. These are moved by waves and being heavy than the water, get deposited in pockets and depressions along the coast. Gold has been mined off shore of Nova Scotia; tin ore off Malaysia, Indonesia and Thailand.

Aggregates. These are needed for building materials (concrete etc.) Marine aggregate resources are the second largest off shore extraction industry after hydrocarbons. These aggregates were obtainable from beaches, but with the growth of the tourism industry, beaches are a conflict area. The tourism industry is a greater source of dollars so the extraction of aggregates has moved out onto the continental shelf – half of the surface of which is covered with supplies of aggrgates (sand and gavel). Japan, the major producer, generating about ½ the world's production.
Many other minerals are found that in the ocean as well that are mined.

(c) Energy

Energy comes from the ocean as well. In some places, hydro electric power is derived from turbines driven by tidal movements.

Fuels like oil do not literally come from the ocean, but can be found from the land under the ocean.

(d) Pharmaceutical/Medical materials.

Most currently come from terrestrial sources.
NOAA reports (http://oceanexplorer.noaa.gov/facts/medicinesfromsea.html)

systematic searches for new drugs have shown that marine invertebrates produce more antibiotic, anti-cancer, and anti-inflammatory substances than any group of terrestrial organisms. Particularly promising invertebrate groups include sponges, tunicates, ascidians, bryozoans, octocorals, and some molluscs, annelids, and echinoderms.
Some chemicals produced by marine animals that may be useful in treating human diseases include:

a. Ecteinascidin: Extracted from tunicates; being tested in humans for treatment of breast and ovarian cancers and other solid tumors
b. Discodermalide: Extracted from deep-sea sponges belonging to the genus *Discodermia*; anti-tumor agent
c. Bryostatin: Extracted from the bryozoan, *Bugula neritina*; potential treatment for leukemia and melanoma
d. Pseudopterosins: Extracted from the octocoral (sea whip) *Pseudopterogorgia elisabethae*; anti-inflammatory and analgesic agents that reduce swelling and skin irritation and accelerate wound healing

e. w-conotoxin MVIIA: Extracted from the cone snail, *Conus magnus*; potent pain-killer

A striking feature of this list is that all of the organisms (except the cone snail) are sessile (non-moving) invertebrates. To date, this has been true of most marine invertebrates that produce pharmacologically active substances. Several reasons have been suggested to explain why sessile marine animals are particularly productive of potent chemicals. One possibility is that they use these chemicals to repel predators, because they are basically "sitting ducks." Another possibility is that since many of these species are filter feeders, they may use powerful chemicals to repel parasites or as antibiotics against disease-causing organisms.

Competition for space may explain why some of these invertebrates produce anti-cancer agents. If two species are competing for the same piece of bottom space, it would be helpful to produce a substance that would attack rapidly dividing cells of the competing organism. Since cancer cells often

divide more rapidly than normal cells, the same substance might have anti-cancer properties.

Up to this point we have been talking about the ocean and the ways that it has an impact on people. The way in which the people make use of the ocean and the way the ocean is perceived is all based on questions of "culture".

The nature of culture.

There are two ways in which "culture" is used. One is something we have just defined – something which is uniquely human, while the other is peculiar to a specific group. These are sometime designated as "Culture" with an upper case letter for the universal meaning and "culture" with a lower case for a specific culture (e.g. Japanese culture, Navajo culture, Swazi culture and so on).

You can compare this with language as well. All human societies have Language (with an upper case "L") but specific societies have specific languages (with a lower case "l"). So German is a different language than Japanese, both are "languages" so they share something in common which allows people to classify them as "Language". Similarly, some group A, has culture A; group B has culture B. A and B are not alike, but they share enough in common to be called "cultures" What they share in common is "Language".