Remember that the environment is not simply the geography, but it includes other living things around it. So as one organism changes, it changes the environment for other organisms living around it. In effect, all things in the environment are the environment for other things! It just depends where your focus is. Consider a bird that eats a specific plant. The plant is in the bird's environment and the bird is part of the plant's environment! As the bird may develop better ways to eat the plant, the plant may develop better ways to block the bird from eating it!

This is important because organisms become more and more adapted to specific environments and if those environments are suddenly altered, the organisms living in them may not be able to adapt quickly enough(remember human vs. geological time). It also is important because organisms adapt often to very specific environments. They have an "ecological niche". The result is environmental biologist and others may define many different kinds of environments. Places where the water meets the land are divided into many different types – coral reefs, mangrove swamps, estuaries and the like. Each of these supports a variety of organisms that are adapted to this particular environment. We will look at some of these shortly.

Since in any population, breeding may be relatively random, those that have the ability to get their genes into more offspring, will lead the "direction" of the evolution. Sudden environmental shifts can be catastrophic because there is not enough time to "evolve" into the new environment. Most geological evolution is relatively slow so changes in organisms have time to move in the direction of the environmental changes.

Back to the life forms!

Organisms are divided (or classified) into different groupings. Eukaryotes and prokaryotes are further subdivided down into kingdoms, phyla (singular is phylum) classes, orders, families, genera (singular = genus) and species along with sub super and infer groups ad infinitum ad nasuseum!. Among the animals there are perhaps 20 or more phyla of animals ranging from "Porifera" (the sponges) to the "Chordates" (animals with a stiff rod running down their backs). The chordate phylum includes the sub phylum "vertebrata" (vertebrates) – animals with backbones. The vertebrates includes the fish, amphibians, reptiles, birds and mammals. Sometimes

people talk about vertebrates as opposed to invertebrates, in effect setting up an opposition between a sub phylum with the rest of the animal kingdom!

Another phylum is the Cnidaria which include most the jellyfish and corals. Others of interest to us this term are Mollusks (clams, mussels, squid, octopus), Arthropods (joint legged creatures – insects, crabs, spiders and so on) Echinoderms (starfish, sea urchins, sea cucumbers) and a number of other phyla contain a variety of worms (flatworms, round worms, segmented worms). We will talk about some of these later.

There are also a number of phyla within the other kingdoms, some of which have thousands of species within them.

There are certain groups we are going to be more interested in than others, although the others are not less important. But if you want to know more about them, the biology department gives a course in zoology which you can take. We will talk largely about certain phyla and only mention some of the others in passing.

You should be aware of the two groups in the prokaryotes – Archaea and Bacteria and what the cyanobacteria do.

Among the animals, you should be aware that sponges and corals, are animals and not made out of plastic or rock! Two of the other major phyla to be aware of are the arthropods and the mollusks. The arthropods are the joint legged animals like crabs, lobsters, insects and spiders; the mollusks contain the "shell fish" and include the squid and the octopus.

The echinoderms are yet another phylum which contains the star fish, sea urchins, and sea cucumbers.

Finally there is the chordate phylum which contains (in the Linnaean system, but not the cladistics one) the class known as the fish, amphibians, reptiles, mammals and birds.

A few other terms to remember (some of which we have mentioned before)

(a) Plankton (zooplankton (heterotrophic) and phytoplankton (autotrophic) unable to swim

(b) Nekton: can swim against a current

(c) Algae: autotrophic (photosynthetic) one celled organisms and some multicellular plants that lack true roots, flowers and the like (sea weeds, kelp)

(d) Sea weeds: macroscopic, multicellular, marine algae

(e) Kelp: a kind of sea weed which can grow 30 to 80 meters in length (100 feet to over 260 feet).

Plankton refers to organisms that are unable to swim against a current. These include phytoplankton which are photosynthetic and zooplankton which includes larvae and small animals like krill.

Nekton refers to animals that can move against a current.

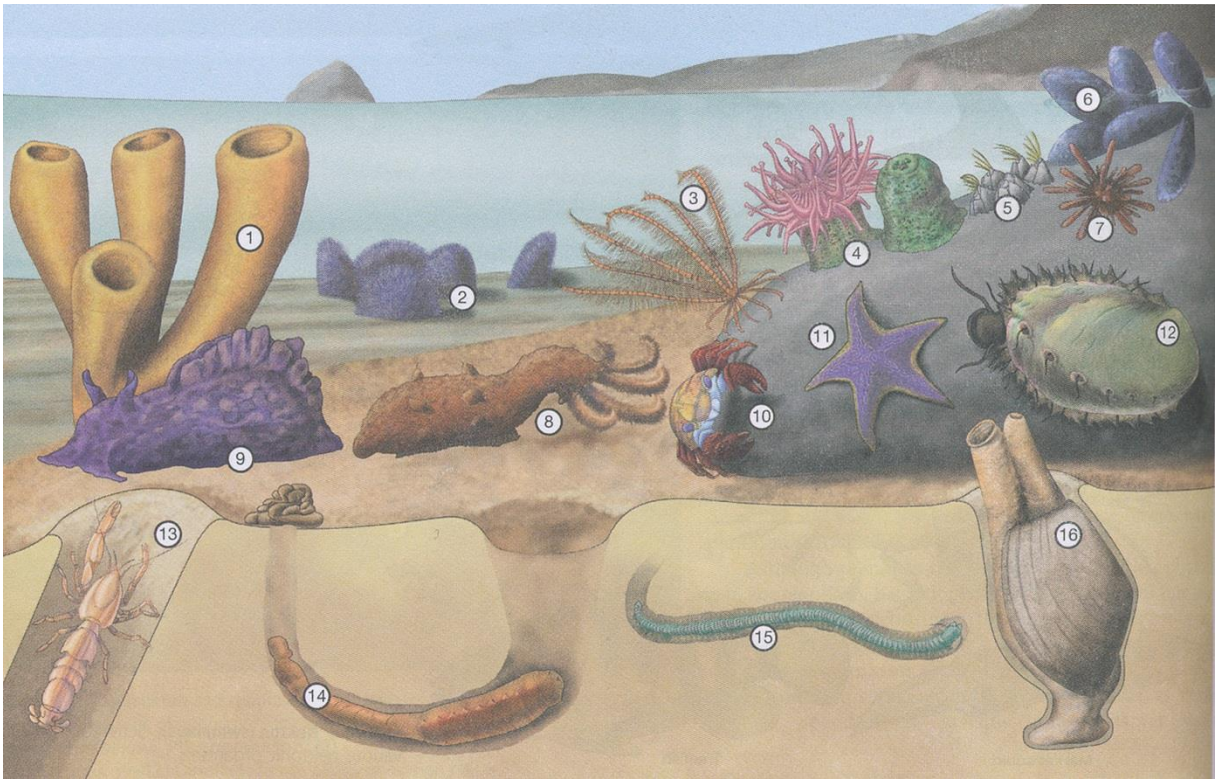
Algae is not a taxonomic classification, (nor are plankton or nekton). It refers to photosynthetic organisms, usually small, like phytoplankton, but some are quite large like the seaweeds, including kelp. It refers to simple nonflowering plants of a large group that includes the seaweeds and many single-celled forms. Algae contain chlorophyll but lack true stems, roots, leaves, and vascular tissue. Many algae are brown, red or other colors, but all have chlorophyll – their color results from other pigments in the cells.

Seaweed is not a technical term but refers to a number of macroscopic algae! One of the seaweeds is “kelp” which often grown into a kind of “forest”

SINCE WE HAVE SOME IDEA OF THE WAYS IN WHICH ANIMALS ADAPT TO SPECIFIC ENVIRONMENTS WE NEED TO LOOK AT SOME OF THE OCEANIC ENVIRONMENTS

We have looked at the ones going out from the shore – littoral, neritic and pelagic as well as the ones dealing with different depths – epipelagic (euphotic), mesopelagic (dysphotic), bathypelagic (aphotic) and hadalpelagic (also aphotic).

We have noted that some animals can swim in the water column as are called nekton while others, called plankton cannot. Some organisms live at the bottom of the water column on the land below. Those are called "benthic". Some benthic animals live right on the surface of the ocean bottom (epifauna) while others burrow into the ground (infauna).



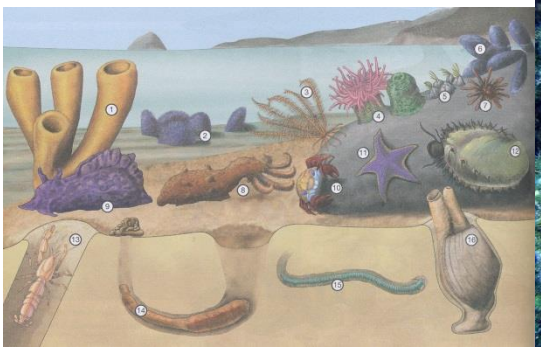
1. Sponge (porifera) 2. Sand dollars (echinoderms) 3. Crinoid (echinoderms) 4. Sea anemones - open and closed (Cnidarians) 5. Barnacles (arthropods crustaceans) 6. Mussels (mollusk bivalve) 7. Sea urchin (echinoderm) 8. Sea cucumber (echinoderm) 9. Sea hare (mollusk gastropod) 10. Shore crab (arthropod crustacean) 11. Sea star or star fish (echinoderm) 12. Abalone (mollusk gastropod) 13.

Ghost crab (arthropod crustacean) 14. Lug worm (annelid polychaetes) 15. Annelid worm 16. Clam (mollusk bivalve)

Animals (as well as plants) are most often thought of as a source of food, but many have other uses for humans as well. Shown here are "invertebrates" – animals without a backbone. We will mention several of these as well as some vertebrates during the term which you should have some familiarity with

SPONGES (PHYLUM PORIFERA)

Among the invertebrates the first are the sponges – the simplest perhaps of all animals. There are several thousand species but only about a dozen are used commercially. These are “picked” and known for their ability to clean. Now-a-days most sponges are not the animal, but rather made from cellulose which is derived from wood pulp, sodium sulphate and hemp fiber.



CNIDARIA

Cnidaria includes jellyfish, corals and sea anemones. They are equipped with stinging cells called nematocysts. Some jellies, like the box jelly are extremely dangerous and can be lethal to humans in less than a minute.
Some are very small and some (Nomura) measure as much as 4-6 feet across. These have had a huge impact on the fishing industry in Japan and are dangerous to the water cooling system of atomic reactors since they can block the intakes. Some people eat jellyfish but they need to be prepared carefully. Sea turtles also eat them alive
Some jellies, like the box jelly are extremely dangerous and can be lethal to humans in less than a minute.

In the picture you can see a clown fish swimming among anemones to which they have immunity. The clown fish develops an immunity toward the anemones, and is able to hide in the tentacles for protection. The clownfish also eats the dead tentacles of the anemone keeping the area clean around it.

The clown fish in return, lures fish to the sessile anemone and helps it to get food.

This process wherein 2 organisms help one another is often called symbiosis or mutualism. The terms are often used interchangeably. Technically, **mutualism** is an ecological interaction between at least two species (=partners) where both partners benefit from the relationship.

Symbiosis on the other hand is defined as an ecological interaction between at least two species (=partners) where there is persistent contact between the partners.

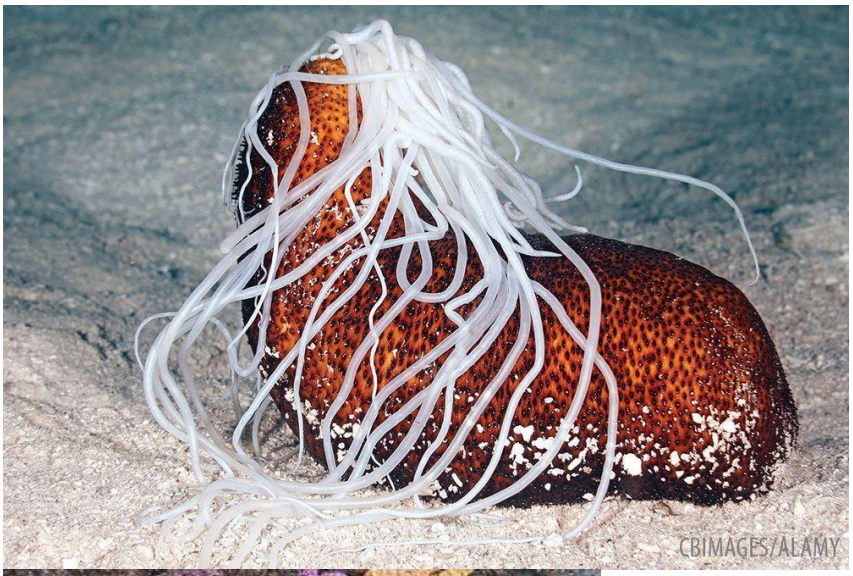
WORMS

Several different phyla Nematodes, Platyhelminthes, annelids etc) .

Some people do eat worms but several kinds are parasitic and there are dangers in doing this. Many marine animals will eat worms.

ECHINODERMS

Some examples: Star fish, sea cucumbers, crinoids
Possible to eat, but not much meat! More likely eaten by other animals. Interesting regenerative powers.



ARTHROPODS (joint legged animals)
Some examples: Crabs, lobsters and so on. Some are edible. Insects are arthropods and many people in the world eat them. Horseshoe

crabs, are here too but are more closely related to the spiders than to the crabs proper.

Lobster

crab

Barnacles

Horseshoe crab

MOLLUSKS

Examples: Clams, mussels , snails

Clams and other mollusks are regularly eaten around the world. Oysters produce pearls as well.

Sea hare

Abalone

Oyster with pearl

Clams

VERBRATES

Fish

Anchovies

Salmon

Haddock

Shark

Alaskan pollok

Chondrichthyes: Sharks, rays, etc. – cartilaginous. Very old. Edible. Often just the fin is used. Bear young alive but without placental connection (ovoviviparous). The eggs are held in the mother's body. Over 300 species some dangerous to humans others not. Some, like the largest shark, the whale shark, are filter feeders.

Bull shark

Tiger shark

Osteichthyes or "bony fish". This class has the largest number of vertebrates in it over

Reptiles

Examples: Sea turtles – marginally alligators and crocodiles

ALLIGATOR

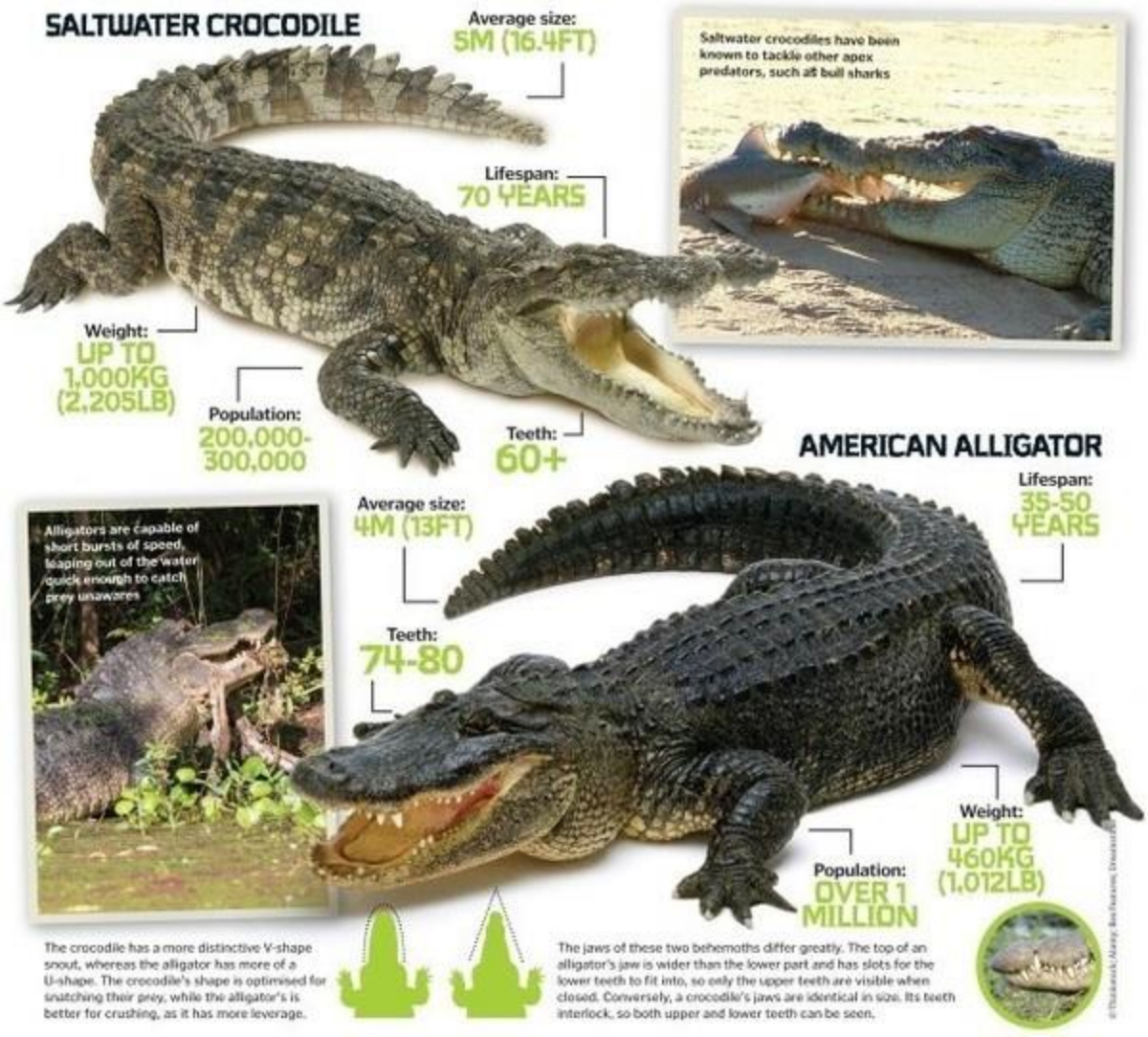
Residence:	mainly freshwater habitats
Jaw:	shaped like the letter 'U'
Teeth:	upper teeth visible when mouth is closed
Skin:	dermal pressure receptors located on the jaw

Photo: ©Luis Castaneda Inc./Riser/Getty

CROCODILE

Residence:	freshwater and saltwater habitats
Jaw:	shaped like the letter 'V'
Teeth:	upper and lower teeth visible when mouth is closed
Skin:	dermal pressure receptors located on the entire body

Photo: ©Raphael Van Butsele /The Image Bank/Getty



While in early times a number of huge reptiles dominated the oceans, most are now gone. Only the sea turtles are representing these animals at this time.

Crocodiles and alligators are more associated with rivers than the ocean, but in some cases, they may wander into the ocean near the shore.

While alligators can tolerate some salt water they are largely fresh water animals. Some crocodiles are salt water crocodiles but are not very good swimmers so they are usually close to the shore. There are reports of them far out to sea on occasion.