



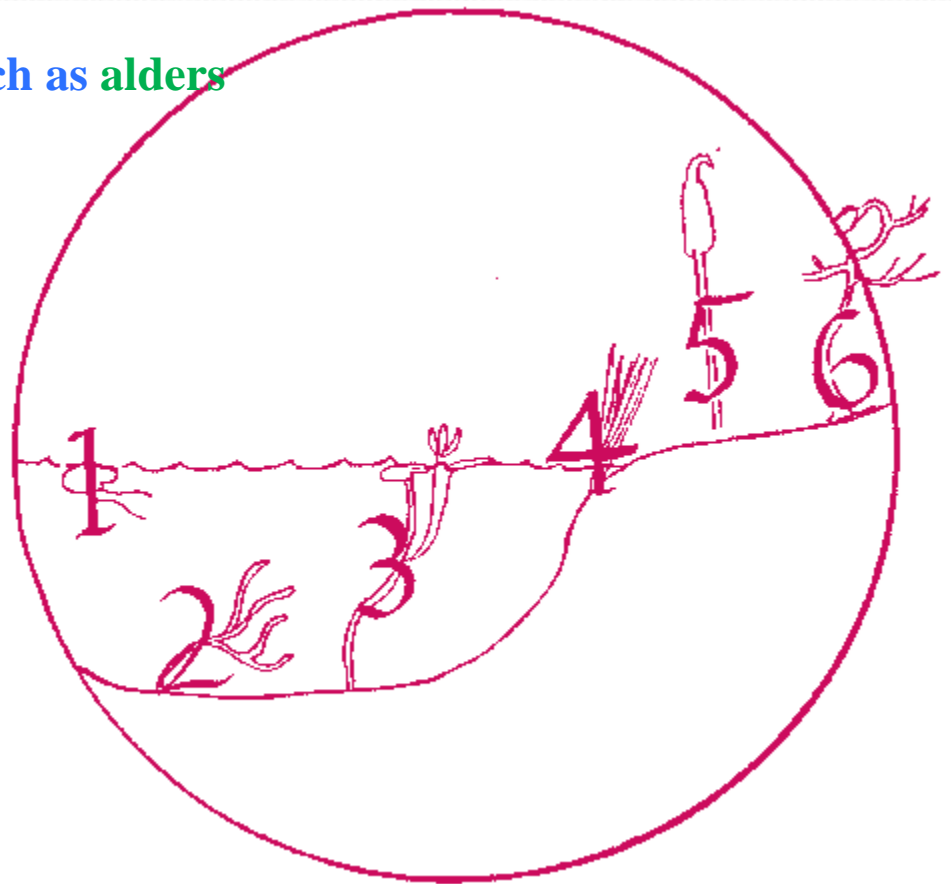
Aquatic Plants and Animals

Aquatic Plants:

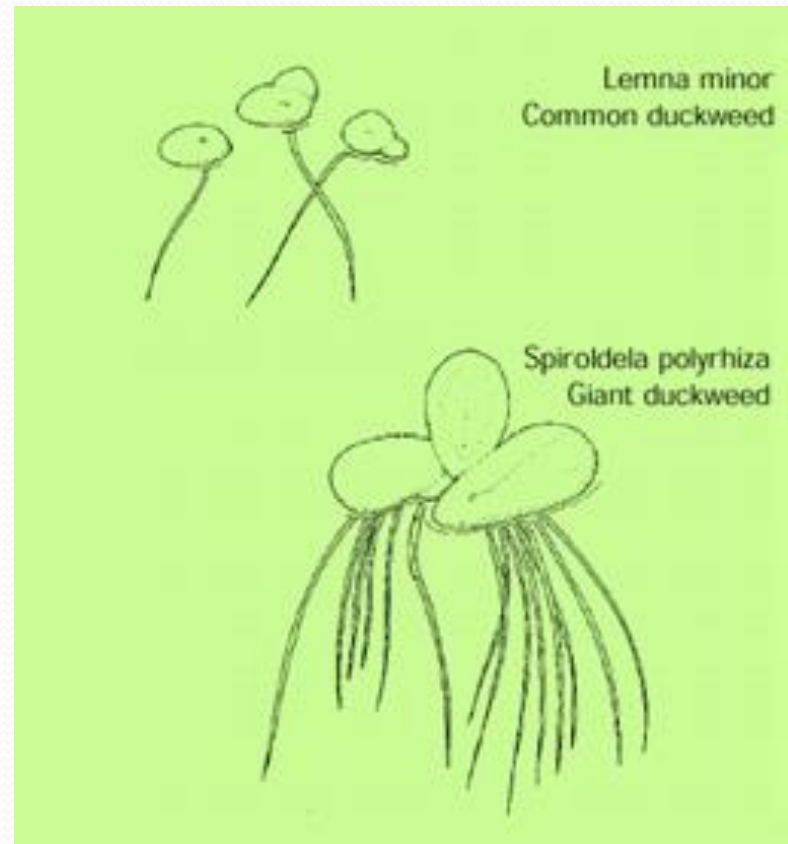
- ❑ Aquatic plants are important part of fresh water, brackish or marine aquatic ecosystems.
- ❑ They help removing the nutrients and other pollutants from streams and provide a habitat for fish, shrimp and other aquatic species and provide forage for waterfowl.
- ❑ **Hydrophytes** — are plants that have adapted to living in or on aquatic environments.
- ❑ They are characterized by thin cuticle, permanently opened stomatas with inactive guard cells, specialized flat leaves with well defined aerenchyma and feathery roots for oxygen intake.
- ❑ Fully aquatic plants have submerged or floating habits adapted to live in their habitats and do not grow well out of water.
- ❑ Semi-aquatic plants, on the other hand, have aerial stems with well developed root system.
- ❑ **Helophytes** are another group of plants that can withstand extended periods of time submerged under water.

Aquatic Plants can be of the following types:

1. Free floating, such as **duckweed**
2. Totally submersed, such as **naiad**
3. Bottom rooted and floating, such as **waterlily**
4. Emergent and rooted, such as **quillwort**
5. Totally emergent, such as **cattails**
6. Stream bank and wet area plants, such as **alders**



1. Common duckweed is a very small light green free-floating, seed bearing plant. Duckweed has 1 to 3 leaves, or fronds, of 1/16 to 1/8 inch in length. A single root (or root-hair) protrudes from each frond. Duckweeds tend to grow in dense colonies in quiet water, undisturbed by wave action.



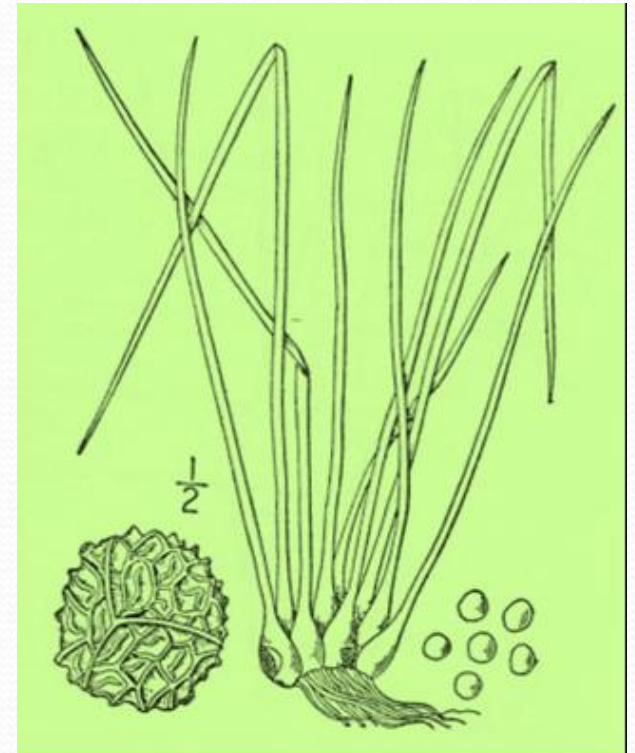
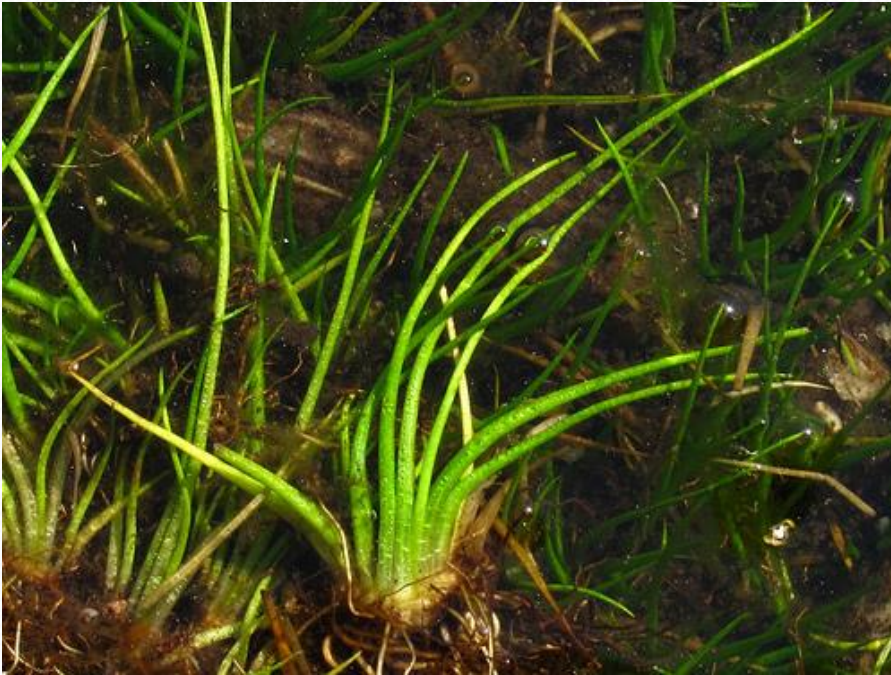
2. Bushy naiad, (pronounced NAY-ads) water naiad: Grow entirely below water surface; have long, waving stems in deep water and are dense and bushy in shallow water. These are annual plants which must start from seed each year. Leaves are tapered to a fine point with tiny "spines"; seeds are shiny and smooth.



The white water lily is a perennial plant that often form dense colonies. The leaves arise on flexible stalks from large thick rhizomes. The leaves are more round than heart-shaped, bright green, 6 to 12 inches in diameter with the slit about $\frac{1}{3}$ the length of the leaf. Leaves usually float on the water's surface. Flowers arise on separate stalks, have brilliant white petals (25 or more per flower) with yellow centers.



Quillworts are mostly aquatic or semi-aquatic in clear ponds and slow-moving streams, though several (e.g. *I. hystrix*, *I. nuttallii*) grow on wet ground that dries out in the summer. Quillwort [leaves](#) are hollow and quill-like, arising from a central [corm](#).



Cattails are wetland plants with a unique flowering spike, flat blade like leaves that reach heights from 3 to 10 feet. They are one of the most common plants in large marshes and on the edge of ponds.



Alder is the most common tree species in [riparian forests](#), and it plays a crucial role in these stream- and loch-edge woodlands. As a deep-rooted species, it helps to maintain the soil in river banks and reduces the effects of erosion. Alder root systems which are exposed in the water give shelter to fish during times of high water flow, and provide a safe [refuge](#) from [predators](#). Alder foliage provides shade which is beneficial to fish, including [salmon](#) (*Salmo salar*) and brown trout (*Salmo trutta*), and its leaves, which are relatively quick to decompose in water, provide nutrients for [invertebrates](#) such as the larvae of caddisflies, stoneflies and water beetles.


feet in the water - alder roots thrive in the wet,
and the trees protect river banks



Plant Adaptations to Aquatic Life:

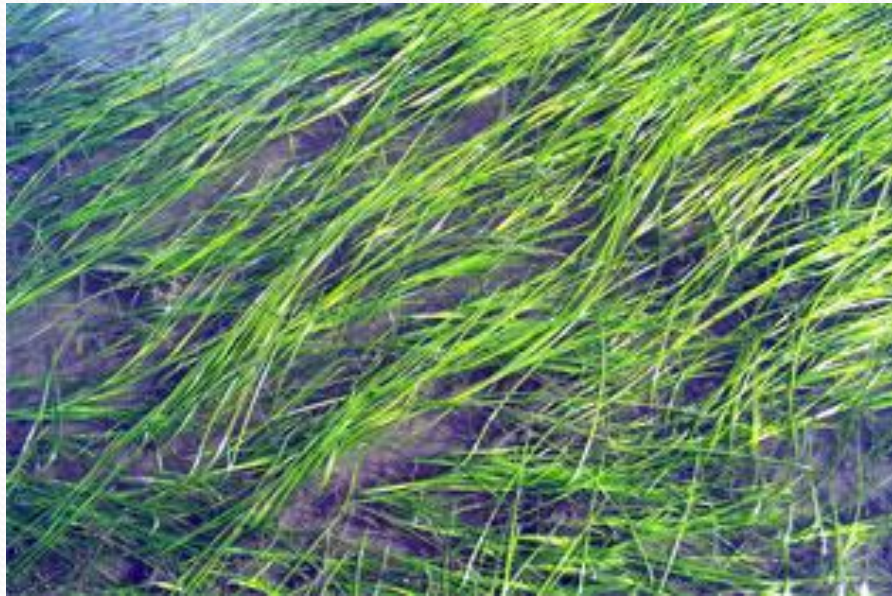
Adaptations hydrophytes (Fresh water plants):

- ❖ They have large air cavities called **aerenchyma** to act as a means of buoyancy and store gases for respiration.
- ❖ They possess photosynthetic chloroplast to make use of the less light in the water for photosynthesis
- ❖ They ones that emerge and float have broad leaves that contain numerous stomata on the upper side of the leaf to trap maximum light for photosynthesis.
- ❖ Some have breathing roots (**pneumatophores**) which grow above the water level to get enough oxygen for gaseous.
- ❖ They have such characteristics as hairy leaves, waxy cuticle to repel rain water as they don't need it.



Plants make up the basis of all life, whether on land or in the sea. However, there aren't many plants that can survive in salt water, day in, day out. Almost all plant life in sea consists of microscopically small algae in suspension: the phytoplankton. That foam you sometimes find on the beach comes from phytoplankton species which have died. The small percentage of plants which are not phytoplankton grows attached to the sea bed, eelgrass and seaweed. But they too need sunlight to grow just like plankton. You only find these plants in shallower areas where enough sunlight can penetrate.

Eelgrass (*Zostera marina*) is the most widely distributed seagrass worldwide and dominates the intertidal and subtidal in the northern hemisphere. Eelgrass is a seed plant and not a seaweed. It has roots and seeds just like land plants.

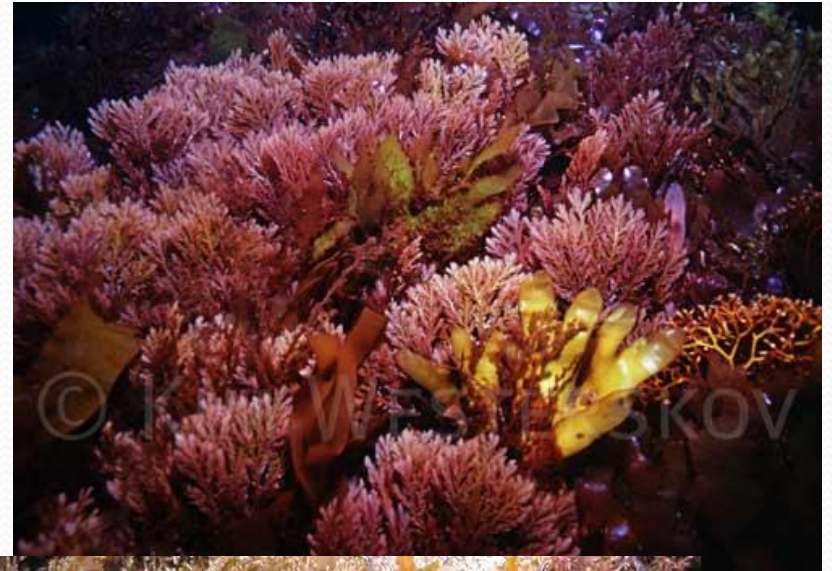


Seaweeds

The term seaweed refers to the large [marine algae](#) that grow almost exclusively in the shallow waters at the edge of the world's oceans. Seaweeds have two requirements in order to live: salt or brackish water and sufficient sunlight. They look like plants, but since recently they are no longer categorized as one because their internal structure is much simpler. They have no leaves, stems, roots or flowers. Biologists speak of a 'thallus' instead of a 'plant'. Seaweeds also have a different manner of reproducing.


Seaweeds are plants because they use the sun's energy to produce carbohydrates from carbon dioxide and water (this is called photosynthesis). They are simpler than the land plants mainly because they absorb the nutrients that they require from the surrounding water and have no need for roots.

Because they need light to survive, seaweeds are found only in the relatively shallow parts of the oceans, which means around the shores.



Three groups of seaweeds are recognised, according to their pigments that absorb light of particular wavelengths and give them their characteristic colours of green, brown or red.





Planktons are the drifting animals, plants in sea bed, ocean or fresh water. Planktons are responsible for providing major food source for the sea animals including fishes. There are three types of Planktons Zooplankton, Bacterioplankton and Phytoplankton.

Freshwater Communities & Plankton - Freshwater Ecology

Plankton are microscopic organisms that live suspended in the water environment, and form a very important part of the freshwater community. They move via convection or wind induced currents. In almost every habitat of a freshwater ecosystem, thousands of these organisms can be found, and due to their small size and simplicity, they are capable of occupying large expanses of water and multiplying at an exponential rate. Plankton can be subdivided into two categories.

❑ **Phytoplankton** - Phytoplankton are microscopic plants which obtain their energy via photosynthesis. However, some species of bacteria are also capable of photosynthesis and also fall under this taxonomic category.

❑ They are important to the ecosystem because they are part of the primary producing community and assist in recycling elements such as carbon and sulphur which are required elsewhere in the community.

❑ **Zooplankton** - Zooplankton consist mainly of crustaceans and rotifers, and on the whole are relatively larger than their phytoplankton counterparts.

❑ They are relatively unspecialised as their environment does not resist the large populations that can exist in within their environment.

❑ Physiologically, there are many evolutionary adaptations that can be found that assist in the buoyancy of them, and prevent their deaths by allowing themselves to be suspended in the water away from harm.

❑ Many factors can affect the distribution of plankton in an ecosystem, which has a detrimental effect on the rest of the ecosystem, because as mentioned, they form an essential part of the ecosystem.

❑ Phytoplankton harness new energy from sunlight and provide many other organisms as a means of food due to this while zooplankton are also an important source of food for many species.

❑ Here are some factors that affect the distribution of plankton in the freshwater community;

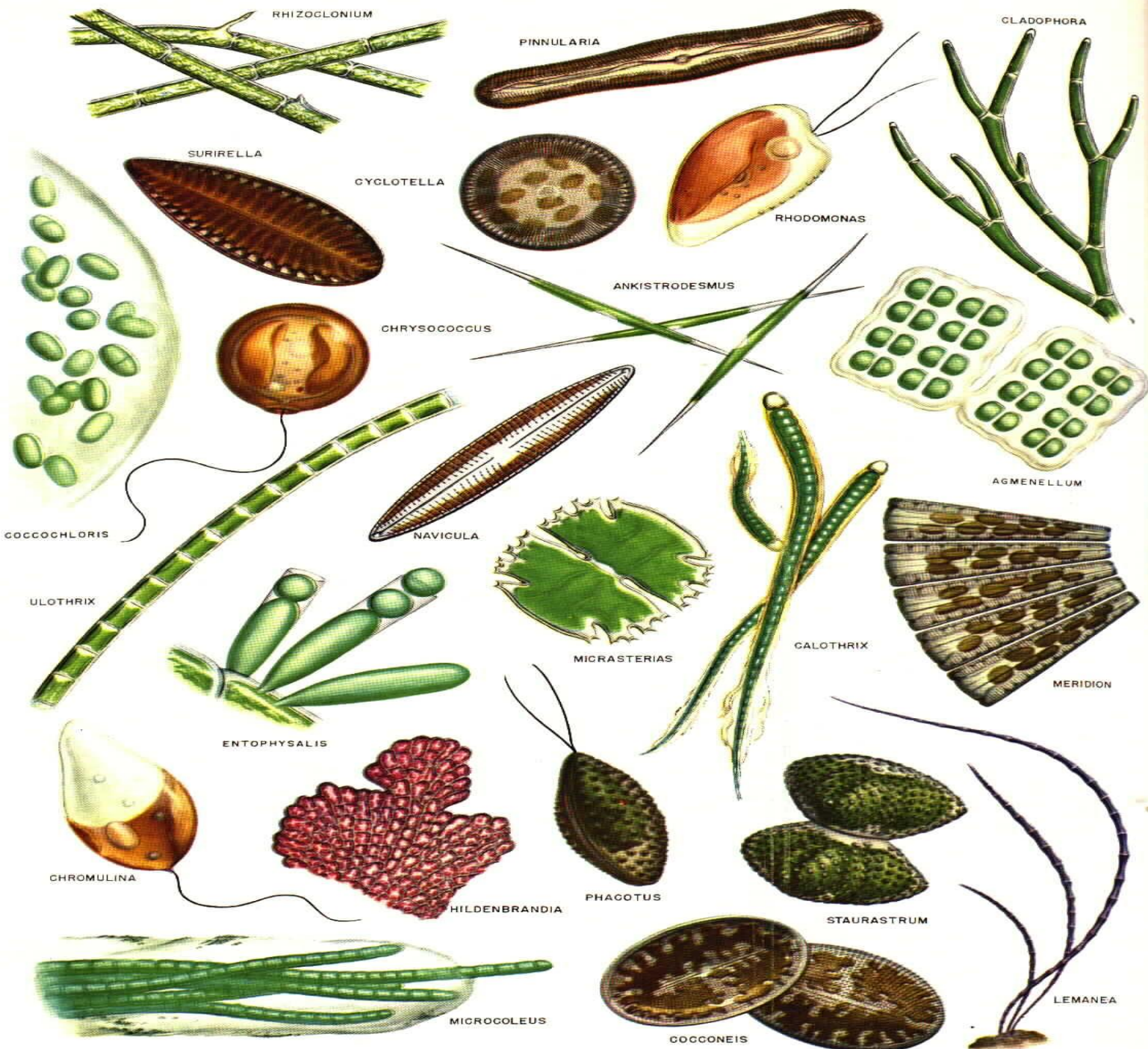
❑ Phytoplankton are more abundant in areas with a high intensity of light, as they can convert this light energy into chemical energy while higher temperatures increase growth and multiplication of the both phytoplankton and zooplankton.

❑ Elementary, the amount of available nutrients in the environment also plays a part in the distribution and density of phytoplankton.

❑ The **term phytoplankton** encompasses all photoautotrophic microorganisms in aquatic [food webs](#).

❑ Phytoplankton serve as the base of the aquatic food web, providing an essential ecological function for all aquatic life. However, unlike terrestrial [communities](#), where most autotrophs are [plants](#), phytoplankton are a diverse group, incorporating [protistan eukaryotes](#) and both [eubacterial](#) and [archaeobacterial prokaryotes](#).

❑ There are about 5,000 known species of marine phytoplankton. In terms of numbers, the most important groups of phytoplankton include the [diatoms](#), [cyanobacteria](#) and [dinoflagellates](#), although many other groups of [algae](#) are represented.



RHIZOGLONIUM

PINNULARIA

CLADOPHORA

SURIRELLA

CYCLOTELLA

RHODOMONAS

ANKISTRODESMUS

CHRYSOCOCCUS

AGMENELLUM

COCCOCHLORIS

NAVICULA

ULOTHRIX

MICRASTERIAS

CALOTHRIX

MERIDION

ENTOPHYSALIS

CHROMULINA

HILDENBRANDIA

PHAGOTUS

STAUSTRUM



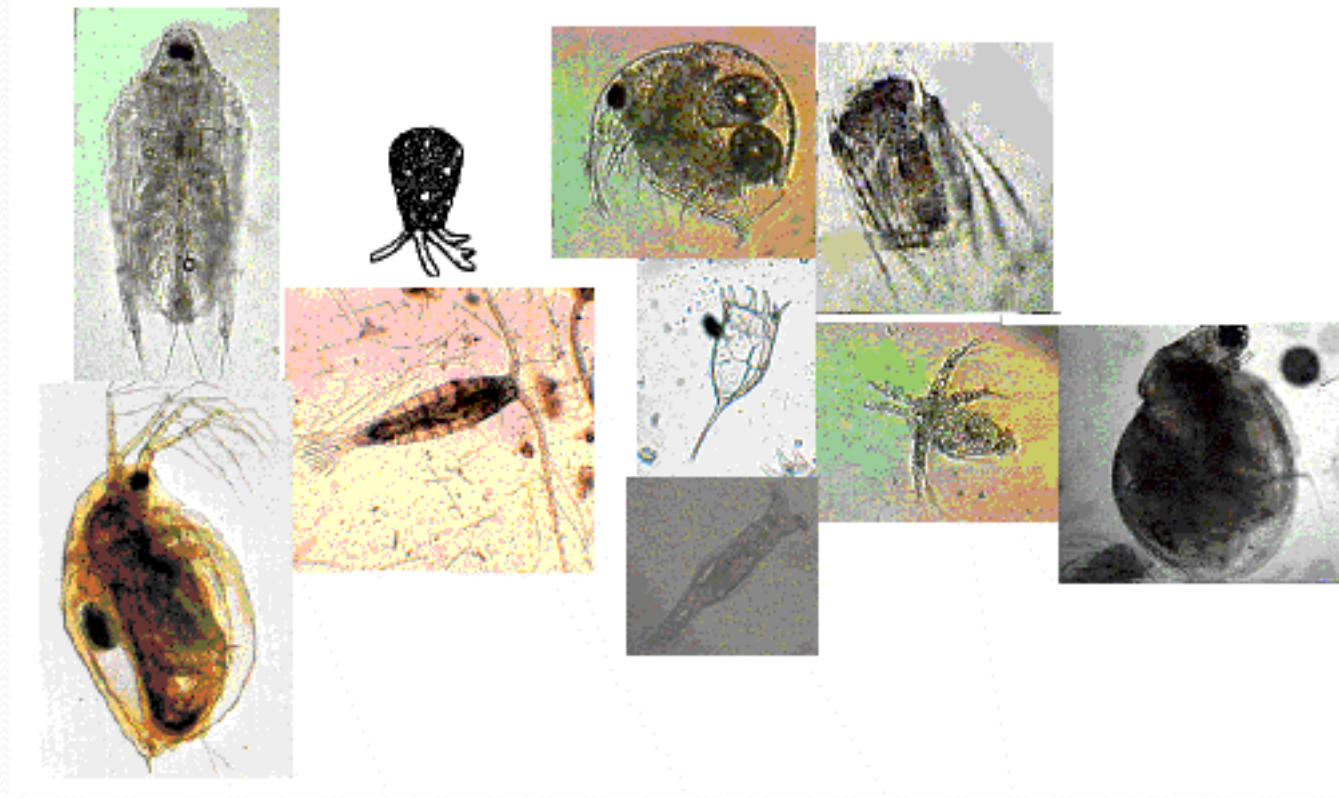
MICROCOLEUS



COCCONEIS



LEMANEA



Examples of microscopic zooplankton (marine & freshwater)

While almost all phytoplankton is microscopic, not all zooplankton is so small - some

An **aquatic animal** is an [animal](#), either [vertebrate](#) or [invertebrate](#), which lives in water for most or all of its life.

Air breathing aquatic animals

In addition to water breathing animals, e.g., fishes, mollusks etc., the term "aquatic animal" can be applied to air-breathing [aquatic or sea mammals](#) such as those in the order [Cetacea](#) ([whales](#)), which cannot survive on land, as well as four-footed [mammals](#) like the [river otter](#) (*Lontra canadensis*) and beavers (family [Castoridae](#)).

Aquatic animals include for example the seabirds, such as gulls (family [Laridae](#)), pelicans (family [Pelecanidae](#)), and albatrosses (family [Diomedeidae](#)), and most of the [Anseriform](#) (ducks, swans and geese).

[Amphibious](#) and amphibiotic animals, like [frogs](#) (the order [Anura](#)), while they do require water, are separated into their own environmental classification. The majority of amphibians (class [Amphibia](#)) have an aquatic [larval](#) stage, like a [tadpole](#), but then live as terrestrial adults, and may return to the water to [mate](#).

Certain [fish](#) also evolved to breathe air to survive oxygen-deprived water, such as [arapaima](#) (family [Osteoglossidae](#)) and [walking catfish](#) ([Clariidae](#)).

AQUATIC INVERTEBRATES

IN STILL AND FLOWING WATERS

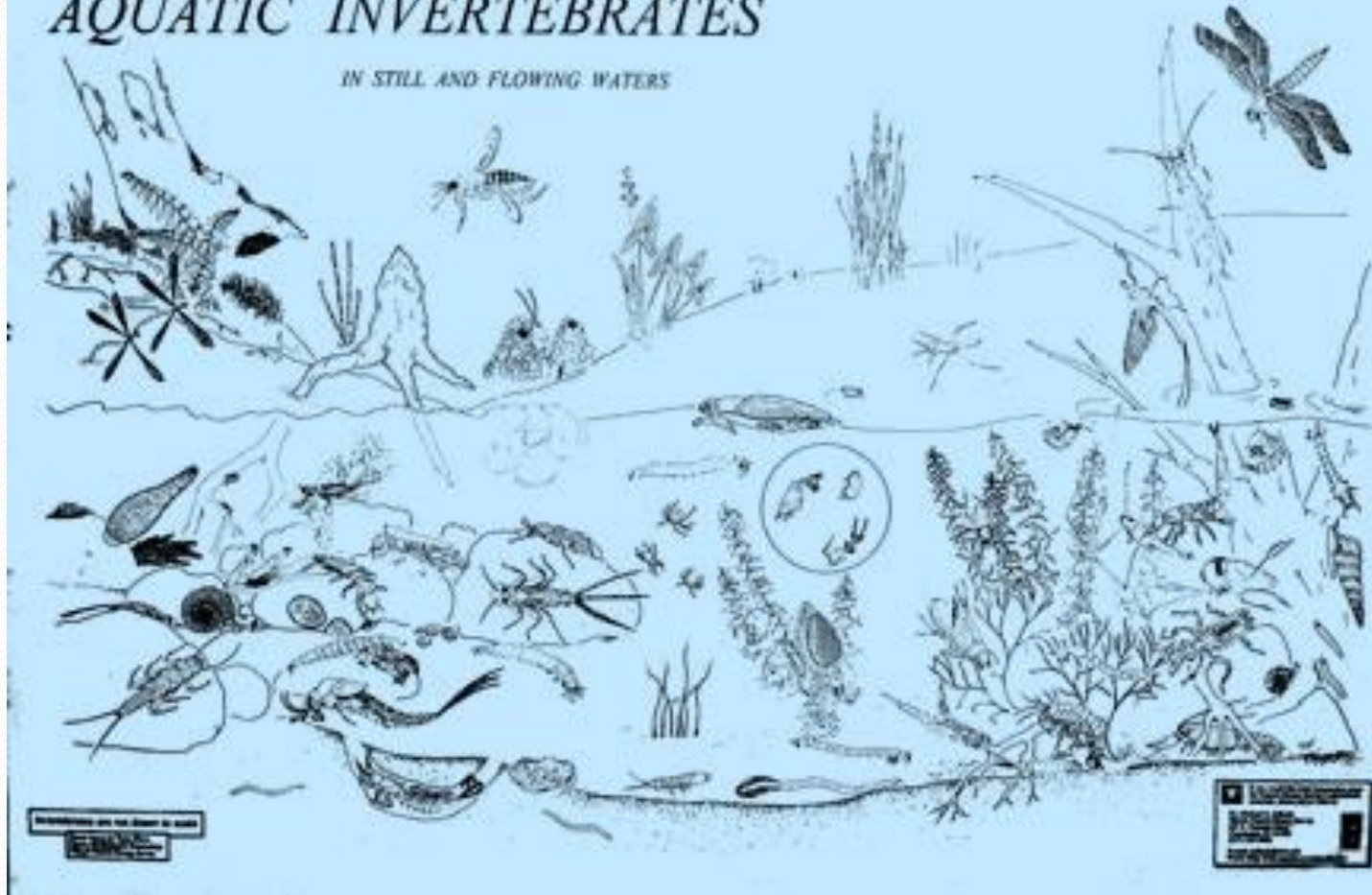


Illustration of aquatic invertebrates and plants in a pond or stream.

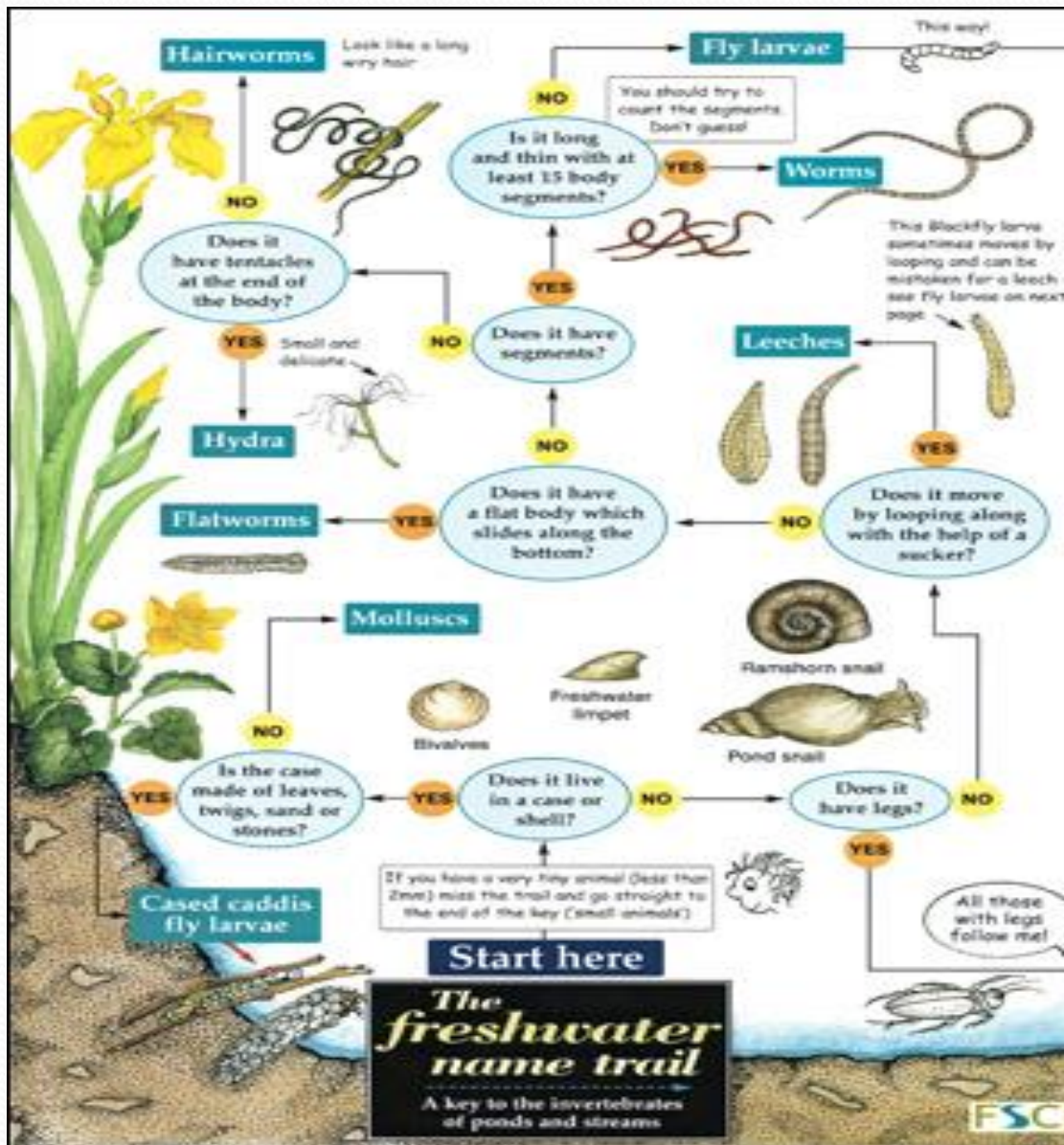
Illustration of aquatic invertebrates and plants in a pond or stream.

Aquatic Invertebrates

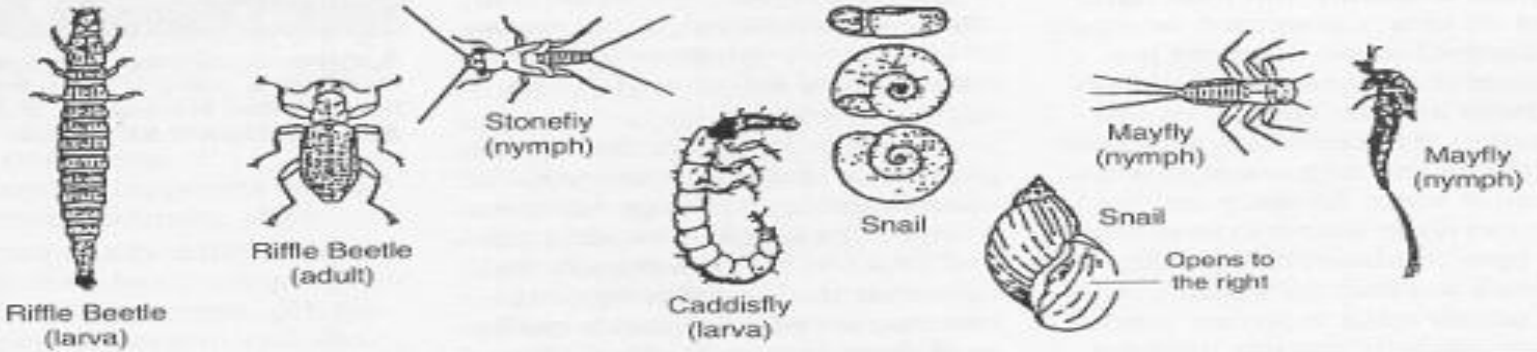
Freshwater Invertebrates:

❑ Freshwater ecosystems support an amazing diversity of life. Over half of the ~100,000 freshwater animal species world-wide are insects, and more than 10,000 crustacean and 5000 molluscan species depend on water.

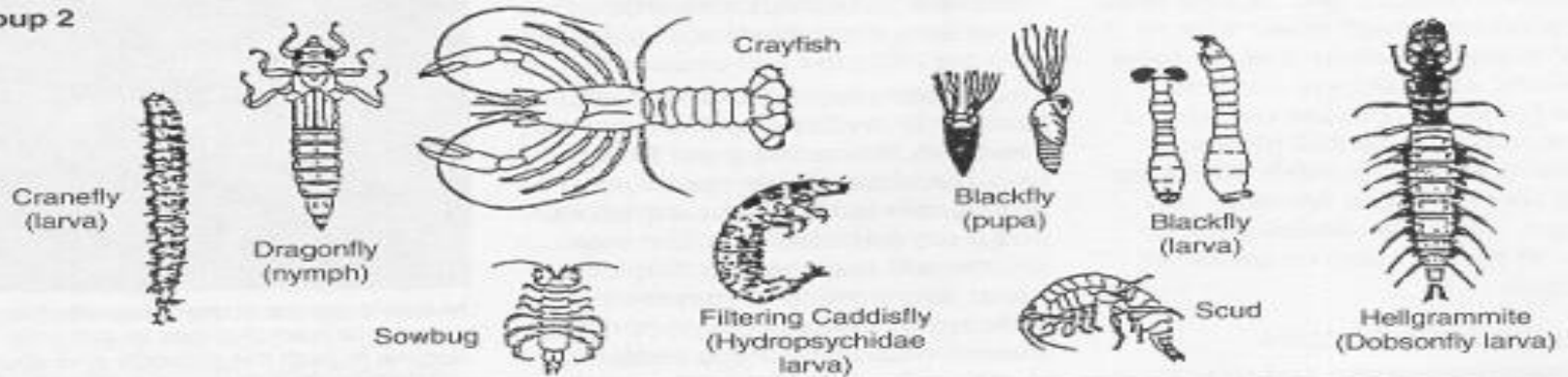
❑ Freshwater invertebrates are invertebrates that spend at least part of their lifecycle in freshwater (e.g. rivers, streams, ditches, spring, seepages, ponds and lakes). Freshwater invertebrates play a vital role in maintaining the quality of our water; they help to breakdown organic matter and provide a food source for other species such as fish, birds and mammals. They can also be used to assess the health of freshwater systems.



Group 1



Group 2



Group 3

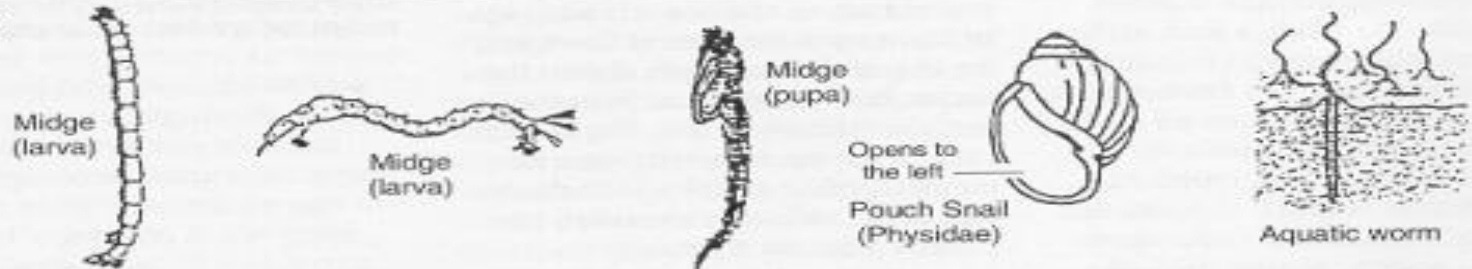


Figure 5. Macroinvertebrate groups picture key. **Group 1** organisms are generally pollution intolerant. Their dominance generally signifies excellent to good water quality. **Group 2** organisms exist in a wide range of water quality conditions. **Group 3** organisms are generally tolerant of pollution. Their dominance usually signifies fair to poor water quality. Courtesy Bio-Assess, Auburn University.

The most common marine invertebrates are sponges, cnidarians, marine worms, lophophorates, mollusks, arthropods, echinoderms and the hemichordates.

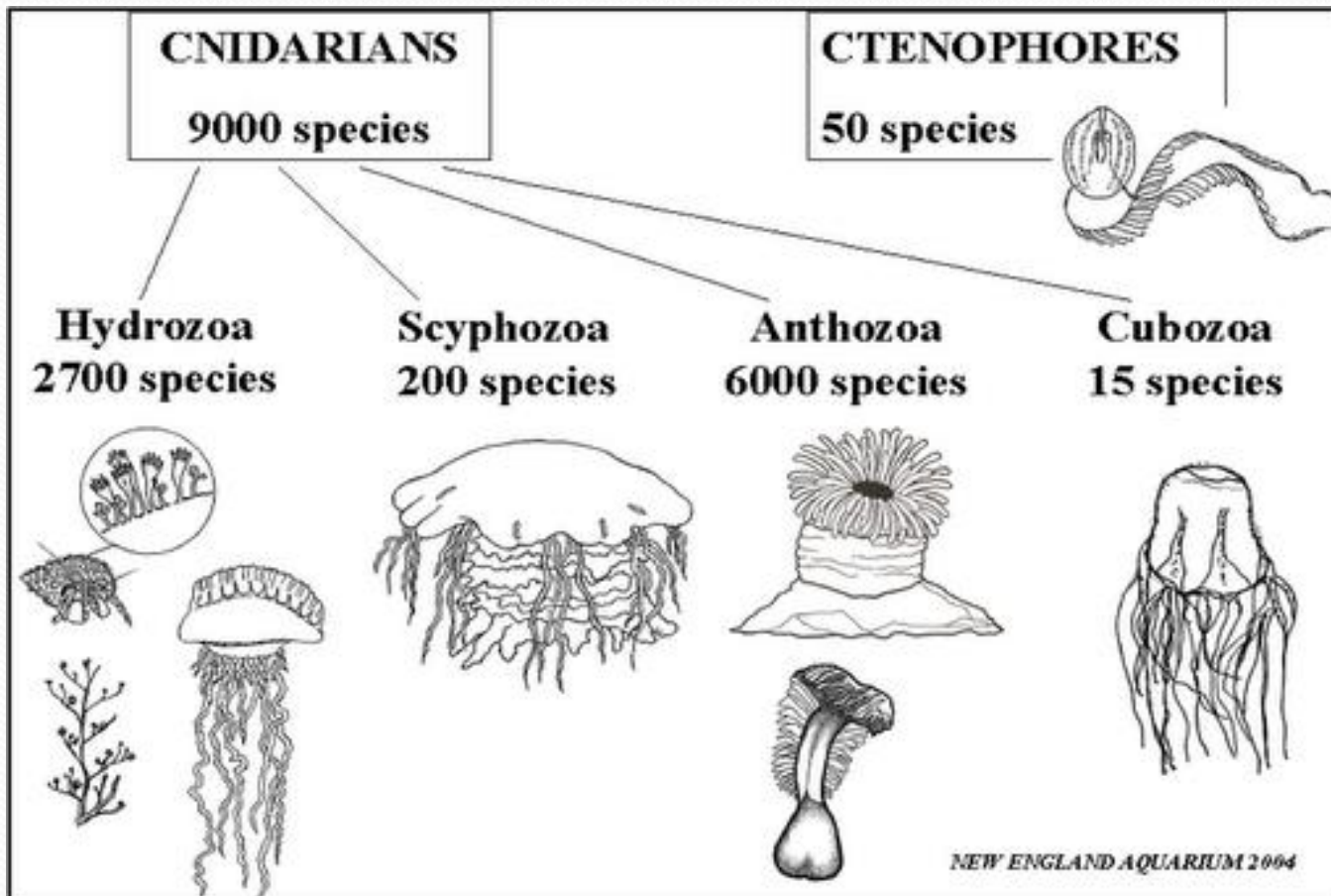
Sponges

There are between 9,000 and 15,000 species of sponges classified under the [Phylum Porifera](#)



Cnidarians

The [Phylum Cnidaria](#) consists of about 10,000 species of "simple" animals found only in marine habitats and includes Class Anthozoa ([corals](#) and [sea anemones](#)), Class Hydrozoa ([hydrozoans](#)), Subphylum Medusozoa: Class Cubozoa ([box jellyfish](#)), Class Scyphozoa ([jellyfish](#))

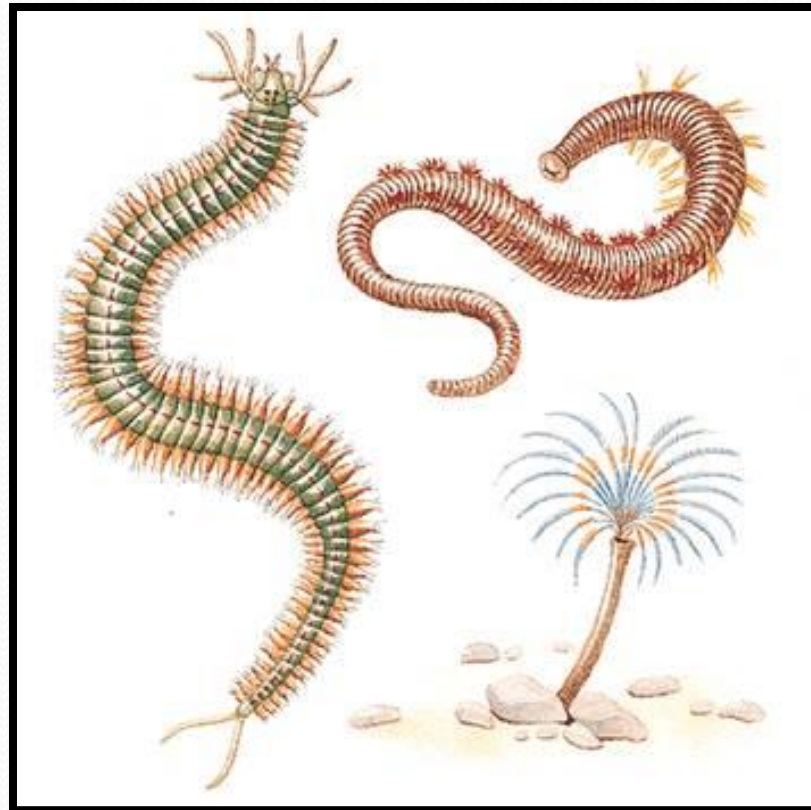


Mollusks

Animals classified under the phylum Mollusca are extremely diverse in form, but all have a fairly simple body plan. Familiar mollusks include oysters, chitons, clams, snails, slugs, octopus, and squid. Most mollusks have a soft body and a hard or “calcareous” shell.

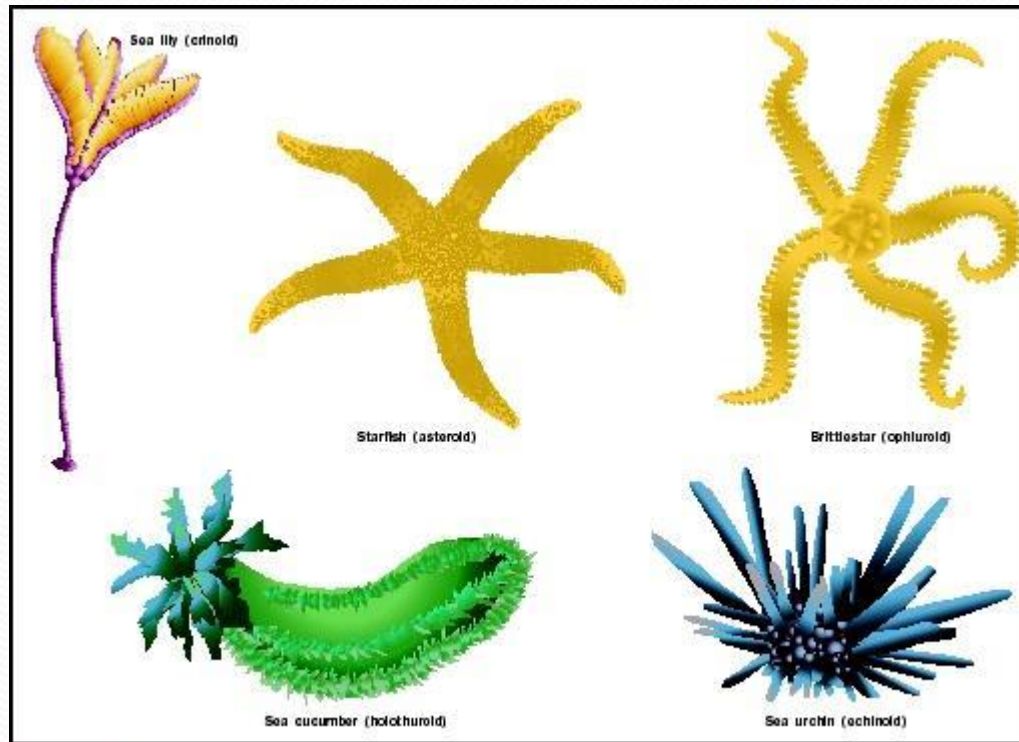
Marine Worms

Marine worms can be placed into more than ten different phyla and come in a variety of colors, shapes, and sizes. Marine worms are often confused with other animals with thin and long bodies. Most marine worms are grouped into the Annelids, a group that includes the Polychaetes (bristle worms), Oligochaetes, Hirudinae, and the *Eunice aphroditois*.



Echinoderms

The Echinoderms lack a head and have five-point radial symmetry. These fascinating animals live only in marine environments. They have an endoskeleton made out of calcareous plates, which is often protected by spines.



Aquatic Vertebrates

- They include the water dwelling mammals, reptiles, amphibians, fish and birds.

1) **Aquatic and semi-aquatic mammals** are a diverse group of mammals that dwell partly or entirely in bodies of water. They include the various marine mammals (Whales, Dolphins, Porpoises, Sirenians, Seals) who dwell in oceans, as well as various freshwater species, such as the Platypus, Beaver and the Otter.



2) Reptiles: All reptiles share characteristics that originally evolved to suit life on land, but many have returned to a life in the water. There are four main groups of reptiles alive today. Each group has its marine and freshwater representatives: sea turtles; freshwater turtles, sea and freshwater snakes, marine lizards (iguanas), and freshwater and



3) Fish are aquatic vertebrates that live around water points on the planet. They are all aquatic vertebrates, both freshwater and saltwater. They are divided into two groups, the bone and cartilaginous fish according to the characteristics of the skeleton. Its body is simple, is divided into three parts, head, trunk and tail.



Amphibians are a class of vertebrates who spend at least part of their lives both in water and on land. The name amphibian comes from the Greek words *amphi*, meaning “both,” and *bios*, meaning “life.” In essence amphibians live a “double life” as they progress through their life cycle. For example: a frog lays its eggs in a pool of water, which is the only place the eggs can remain viable. An amphibian’s skin requires moisture and is one of the ways through which it breathes, therefore a certain degree of dampness is required for an amphibian to survive on land. Amphibians are totally dependent on water as part of their life cycle and water quality is an important issue to them.

African Clawed Frog (*Xenopus laevis*),



