Aquatic Biota

Part 1

Biology – Grade 1

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Organisms & Ecosystems

Introduction

The term aquatic habitat covers a whole spectrum from the world´s oceans to the bays and estuaries, from major lakes to small ponds and the swamps that are found associated with them.

Introduction

It also includes rivers characterized by a one-way flow from the uplands, where they were fed by rainfall and springs, to their junctions with the sea at estuaries.

The Special Properties of Water

All living organisms contain a large proportion of water, and life as we know it would not be possible if it were not for the special properties of that water.

The Special Properties of Water

These special properties

compromise:

1- Specific Heat.

2- Density.

3- Gravity.

4- Viscosity.

1- Specific Heat

Water specific heat is very high;

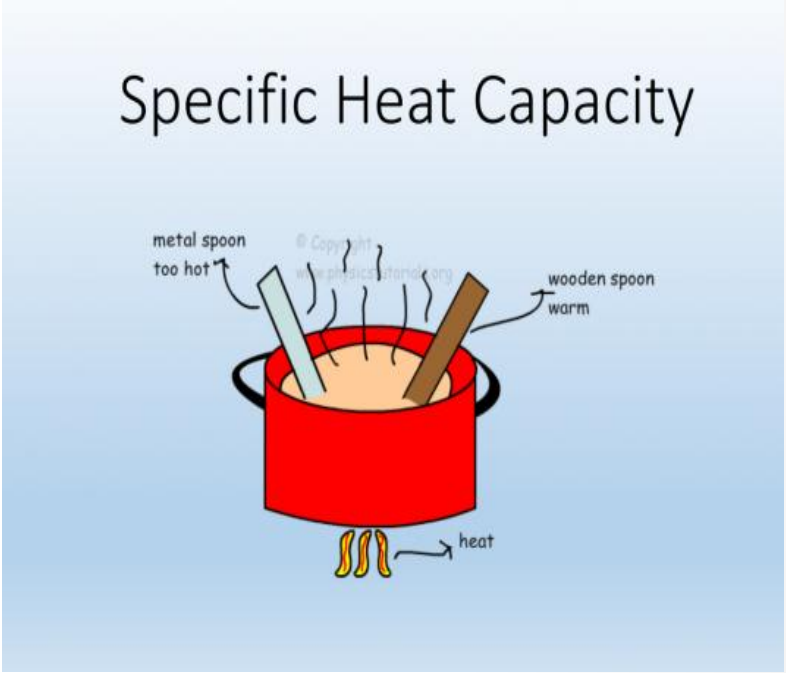
that is to say, for a given input of

heat, its temperature changes

relatively little.

1- Specific Heat

Note: Specific heat is the quantity of heat required to raise the temperature of one gram of a substance by one Celsius degree.



1- Specific Heat

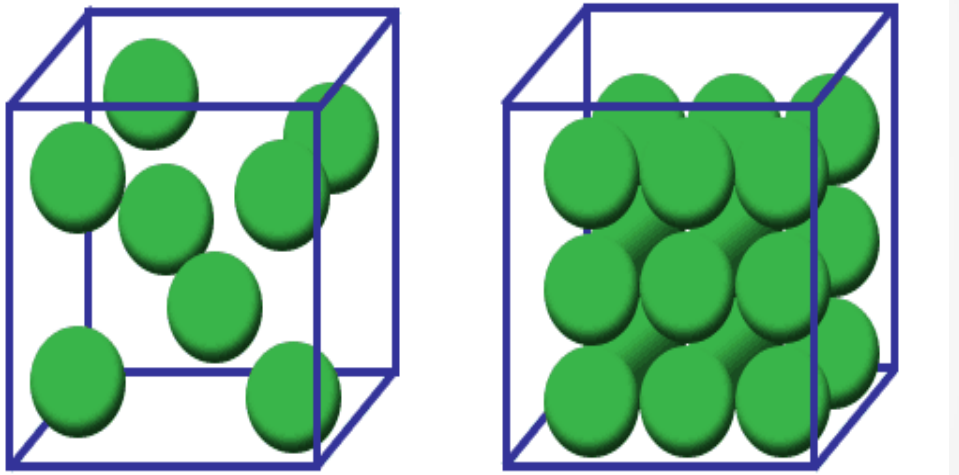
Pure water is taken as the standard, so that 1 calorie (4.17 joules) raises the temperature of 1 gram of water by 1 degree Celsius.

1- Specific Heat

Hence, water forms a valuable buffer against changing environmental temperature, both for the water within organisms and for the aquatic environment.

2- Density

Density is the quantity of something per unit volume.

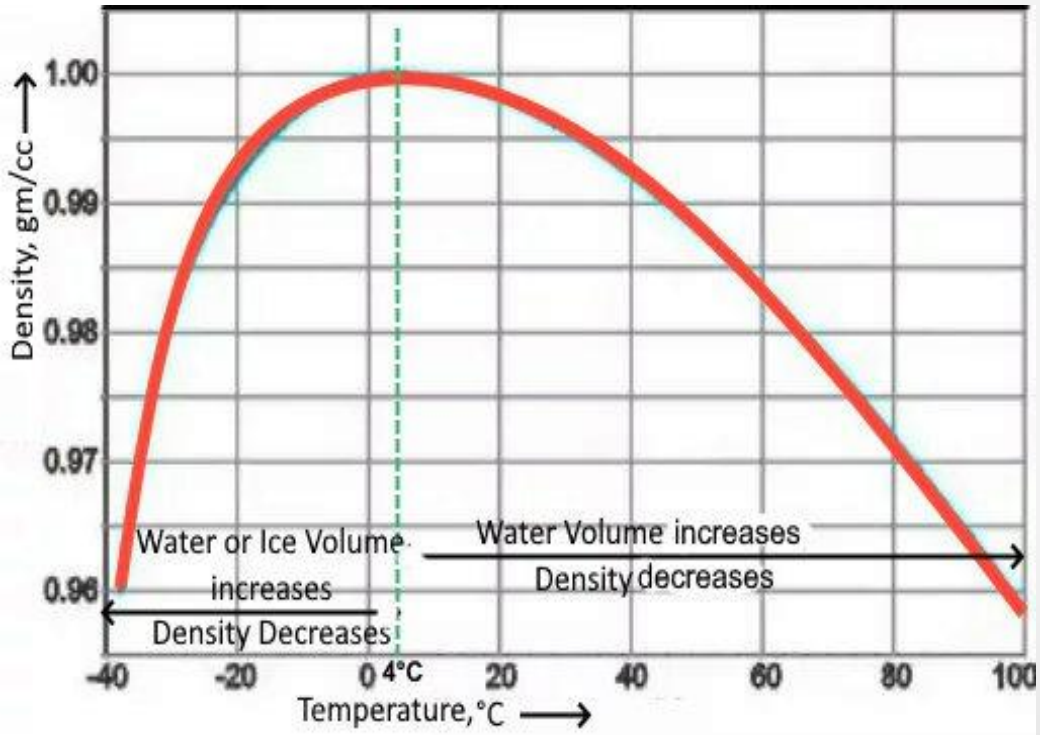


Fresh water density

Density relationships are also important. Pure water is the standard, with a maximum density of 1000 kg m-3. It reaches this density at a temperature close to 4°C.

Fresh water density

As it is warmed above this temperature it becomes lighter, but it also becomes lighter as it cools between 4°C and its freezing point, at 0°C.



Fresh water density

This is of critical

importance for preserving

an ice-free environment

in a lake or pond.

Fresh water density

How can aquatic biota survive in frozen lakes?

Suppose the weather is getting colder and the surface of a lake is cooling from about 10°C to 4°C. The density of the surface water is increasing so it sinks through the layers below and convective mixing occurs. The lake may eventually have a uniform temperature and density from top to bottom.

Fresh water density

How can aquatic biota survive in frozen lakes?

If the surface cooling process continues, the surface water may drop to 3°C, but instead of becoming denser; the water now becomes less dense, and floats at the surface. Convective mixing no longer occurs and freezing of the lower layers is delayed.

Fresh water density

How can aquatic biota survive in frozen lakes?

Once the surface temperature reaches 0°C, ice forms, with a density about 8% lower than that of the water. It remains at the surface and still further delays freezing of the water below.

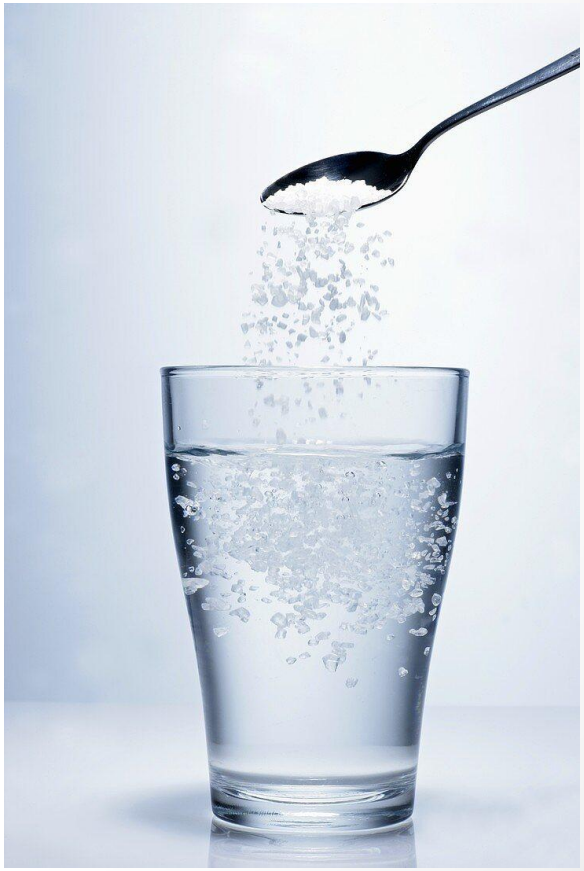
Fresh water density

How can aquatic biota survive in frozen lakes?

In this way, lakes of moderate depth retain a lower layer of unfrozen water in which aquatic biota can survive the coldest winters.

Salt water density

Salt content depresses the freezing point of water. For sea water with a salt content of 35%, the freezing point is -1.91°C.



Salt water density

However, the temperature of maximum density is also changed, and as salt water cools towards its freezing point it becomes progressively denser, so that convective sinking occurs continuously.

Salt water density

The oceans are prevented from freezing by:

1- Sheer volume.

2- Ceaseless movement driven by wind and tides.

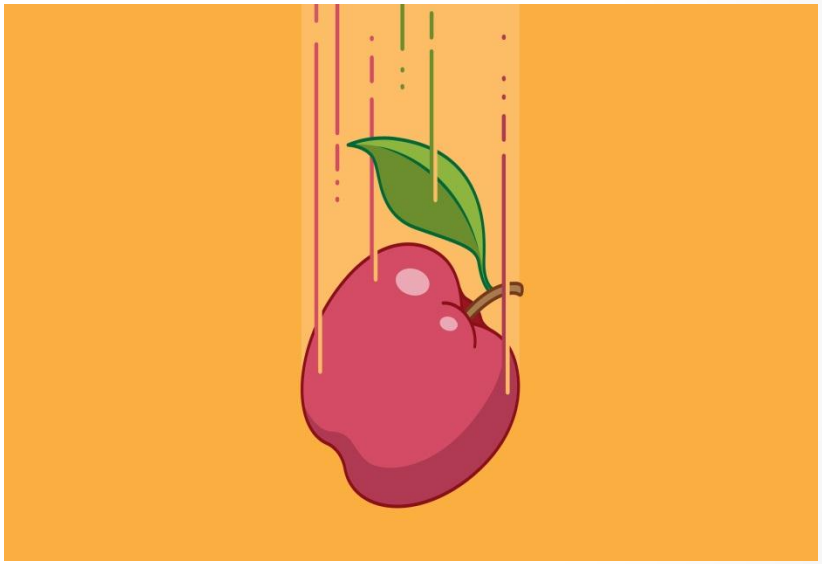
3- Convective currents, not by the special density properties found in fresh water.

3- Gravity

Gravity is a force which

tries to pull two objects

toward each other.



3- Gravity

Small organisms often

have a specific gravity

close to that of water.

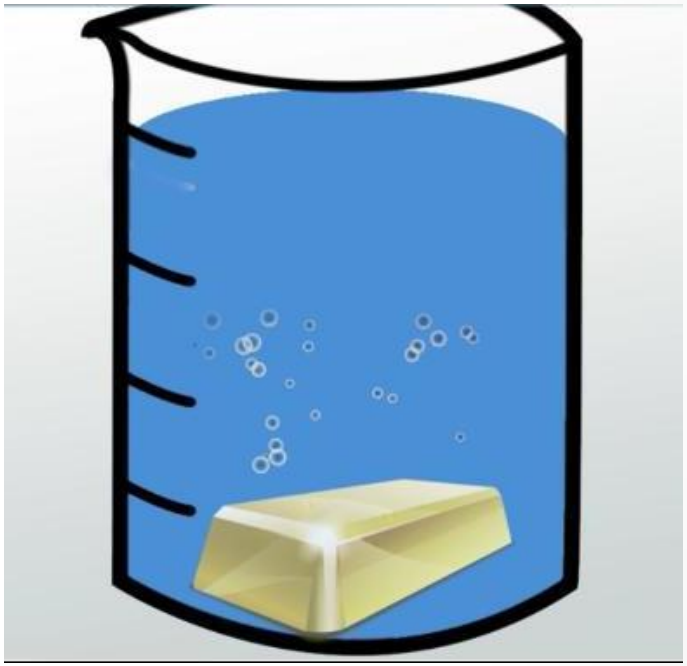
3- Gravity

The specific gravity of

an object is the density

of that object divided by

the density of water.

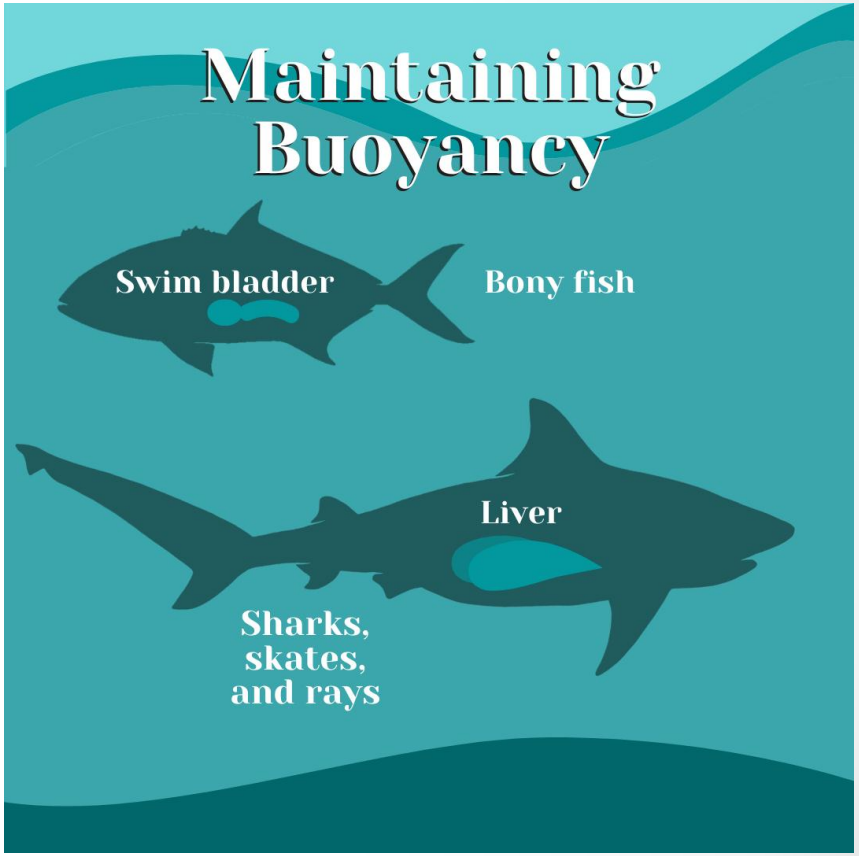


3- Gravity

They are thus close to neutral buoyancy and compared with terrestrial organisms, expend very little energy in counteracting the forces of gravity.

3- Gravity

Even larger organisms, with dense skeletal material, obtain some buoyancy support from being immersed in the water and are able to save energy otherwise needed for counteracting gravity.



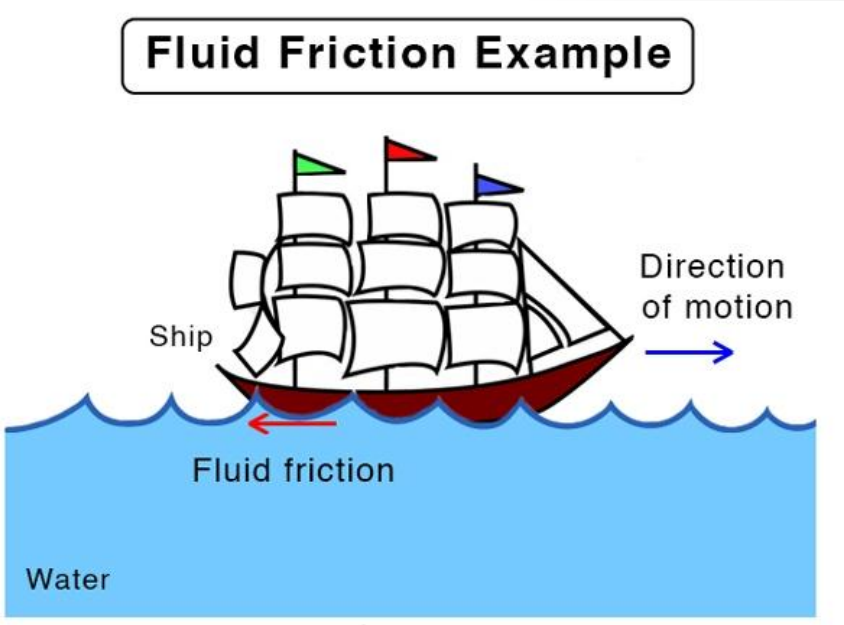
4- Viscosity

Viscosity is a measure of a

fluid's resistance to flow.

4- Viscosity

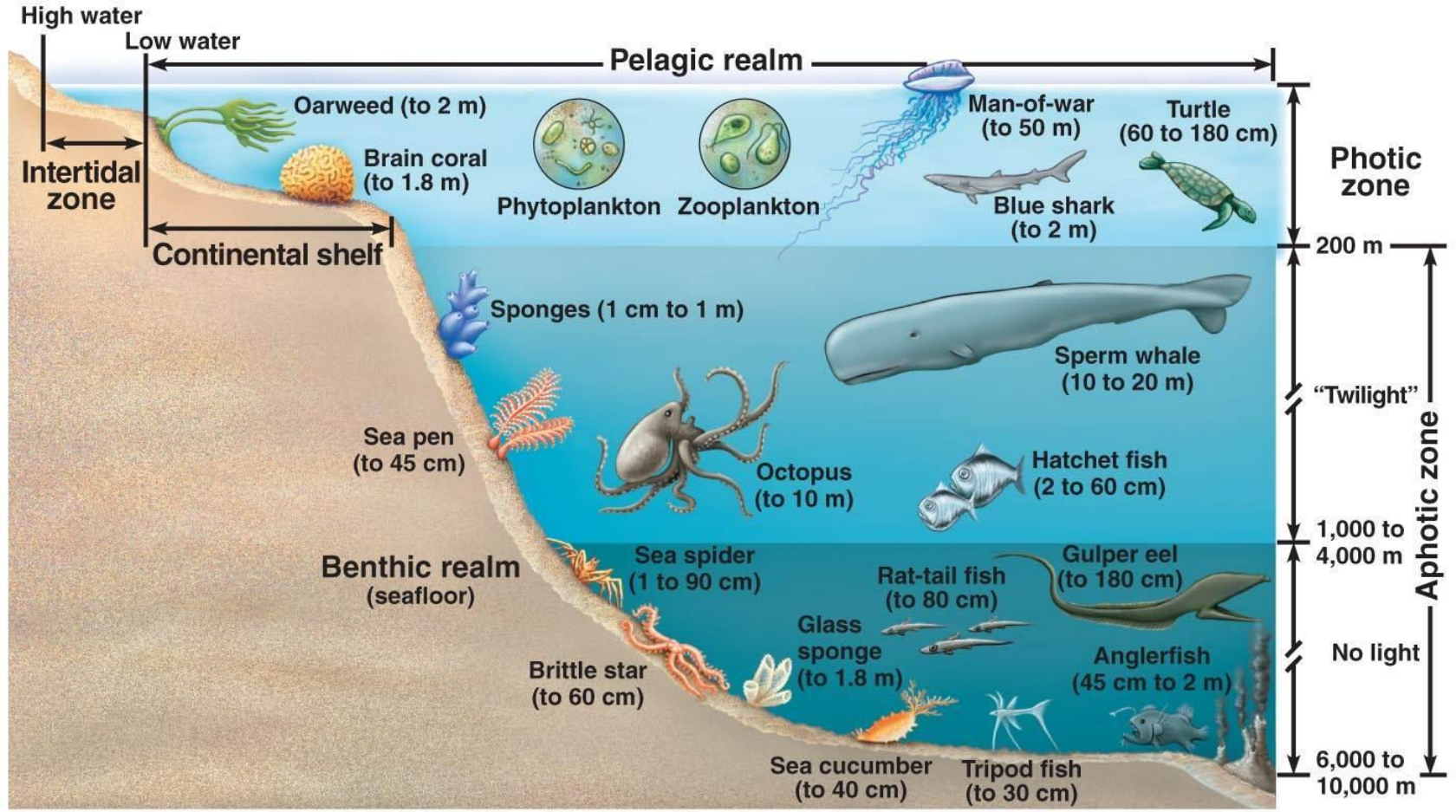
The high viscosity of water compared with air means that there is increased frictional resistance to the movement of organisms through it.



4- Viscosity

Viscosity decreases as temperature increases, but at 10°C for example, the frictional resistance to an organism moving through water is about 100 times what it would be for that organism in air.

Living Organisms in the Aquatic Environment



Living Organisms in the Aquatic Environment

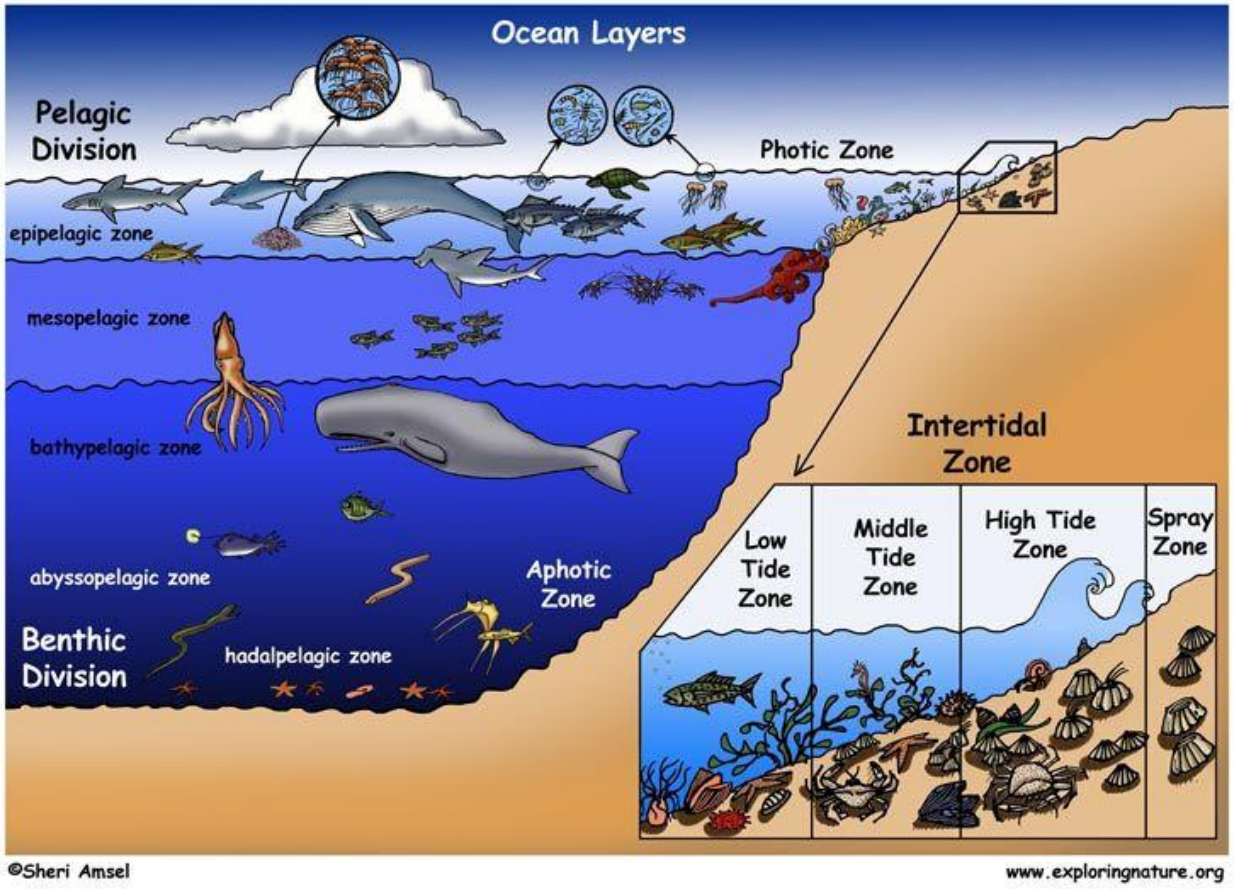
In almost all kinds of aquatic habitat we can find three communities:

1- **The pelagic community** of the open water.

2- **The benthic community** living on or in the bottom deposits.

3- **The fringing community** where water is shallow and there is usually an abundance of rooted aquatic plants.

The Pelagic Community

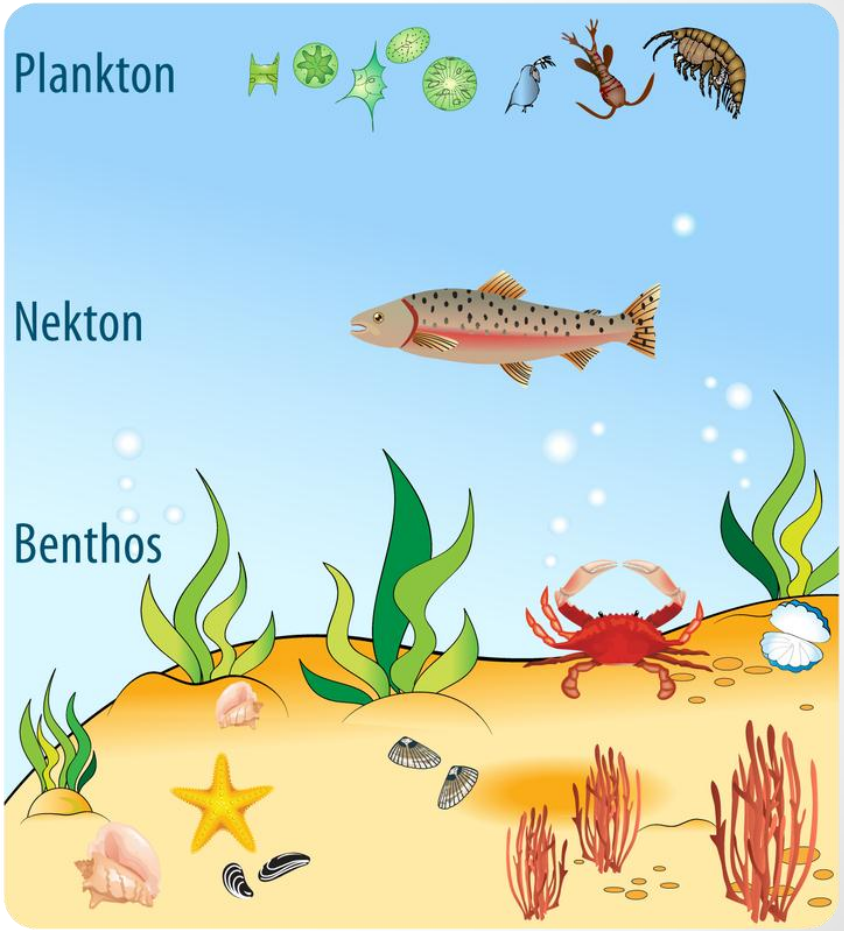


The Pelagic Community

The pelagic community has two components:

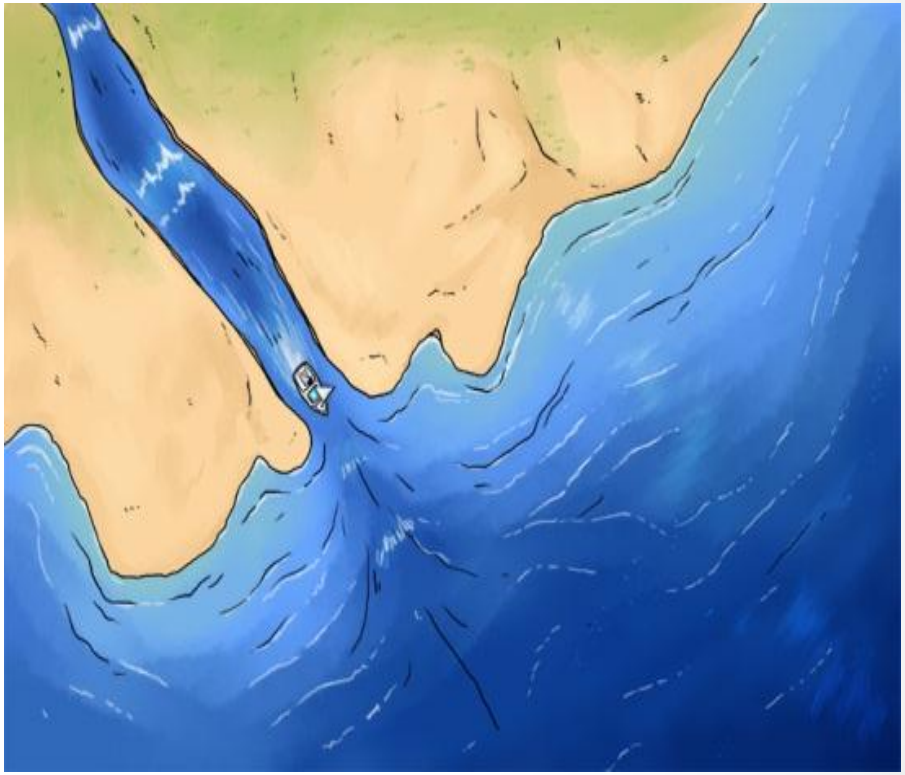
1- **Plankton:** Those close to neutral buoyancy, suspended relatively passively in the water.

2- **Nekton:** Those larger, actively swimming animals.



The Pelagic Community

Plankton, nekton, benthic and fringing communities are found in almost all aquatic habitats, though their proportions may differ widely.



The Pelagic Community

In general:

1- **Marine habitats** have a wider diversity of plant and animal types than fresh water.

2- **Estuaries** with intermediate salinity may have the lowest diversity of all.

The Pelagic Community

Plankton

The open water of both lakes and seas is colonized by a rich assortment of algae and animals that drift passively, or, if they swim, are in general not able to move against the prevailing currents.

The Pelagic Community

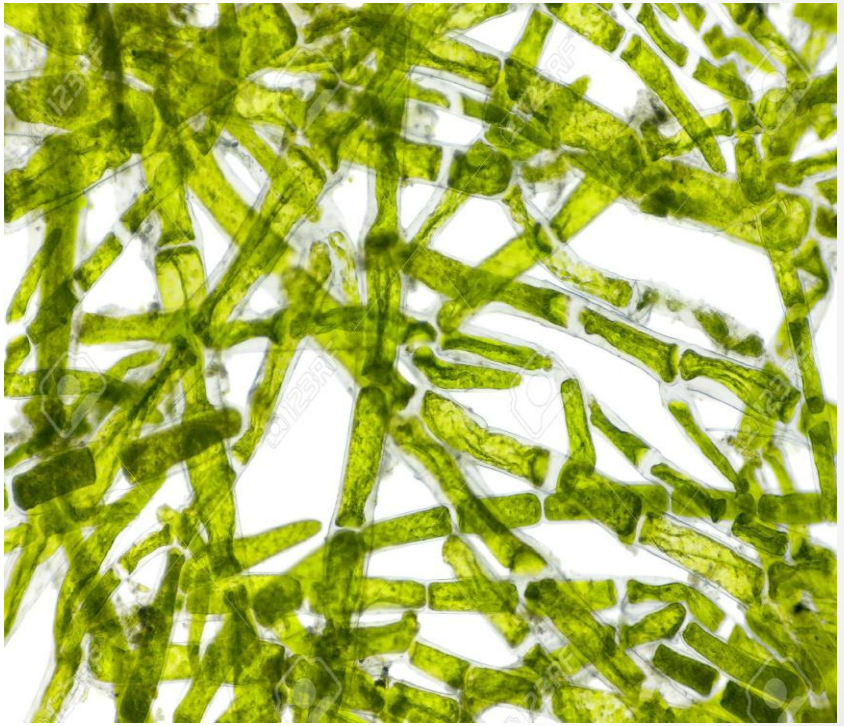
Plankton

It should not be assumed that zooplankton are totally passive in their horizontal movements. They can sink to the dark depths by day to avoid predators and rise to the surface waters at night to feed.

The Pelagic Community

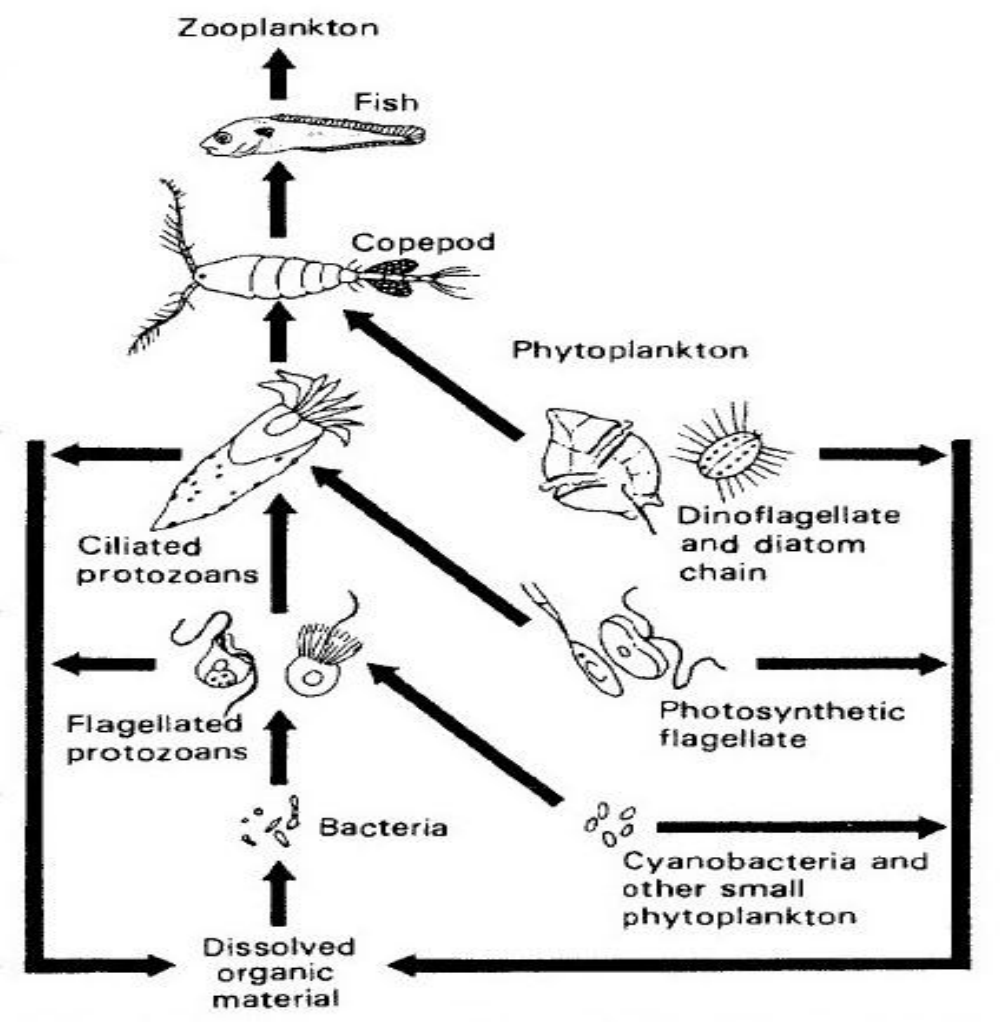
Plankton

For a planktonic alga to obtain its supplies of inorganic nutrients by diffusion from the water, it is necessary to have a large surface area relative to its volume.



The Pelagic Community

Feeding Transfers Within Plankton Community



The Pelagic Community

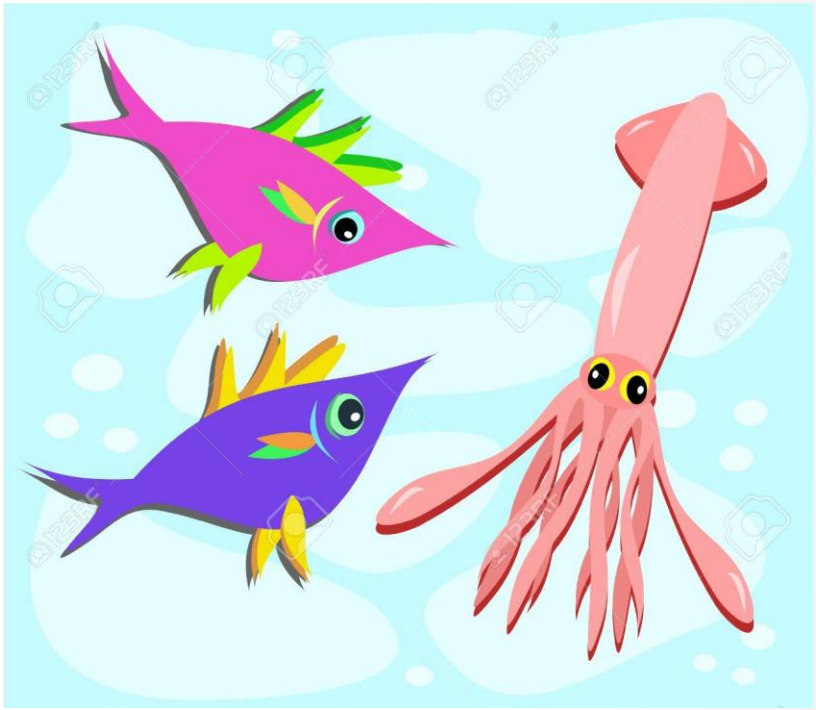
Nekton

The consumer organisms that inhabit the pelagic zone but are active swimmers are known as the nekton.

The Pelagic Community

Nekton

Fish are the most frequently encountered, but especially in the sea, invertebrates such as squid also constitute important nektonic predators.



The Pelagic Community

Nekton

In lakes and coastal areas

of the ocean, diving birds

are locally important.

The Pelagic Community

Nekton

Whales and seals tend to congregate in highly productive areas of the ocean and are then major components of the food web.

The Pelagic Community

Nekton Vs Plankton

Compared with plankton, the nekton are long-lived and slow growing. Some invertebrates (plankton) may complete their life histories in 1 year, but for most fish (nekton) their lifespan is of the order of 5-10 years.