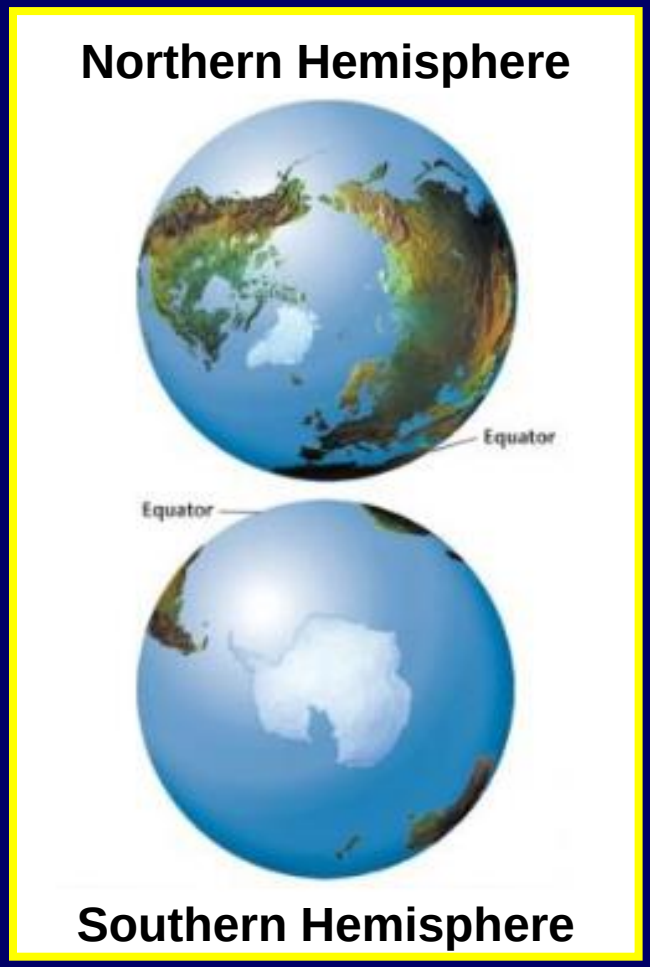
Earth's Oceans

The Blue Planet

71% of Earth is covered by oceans.



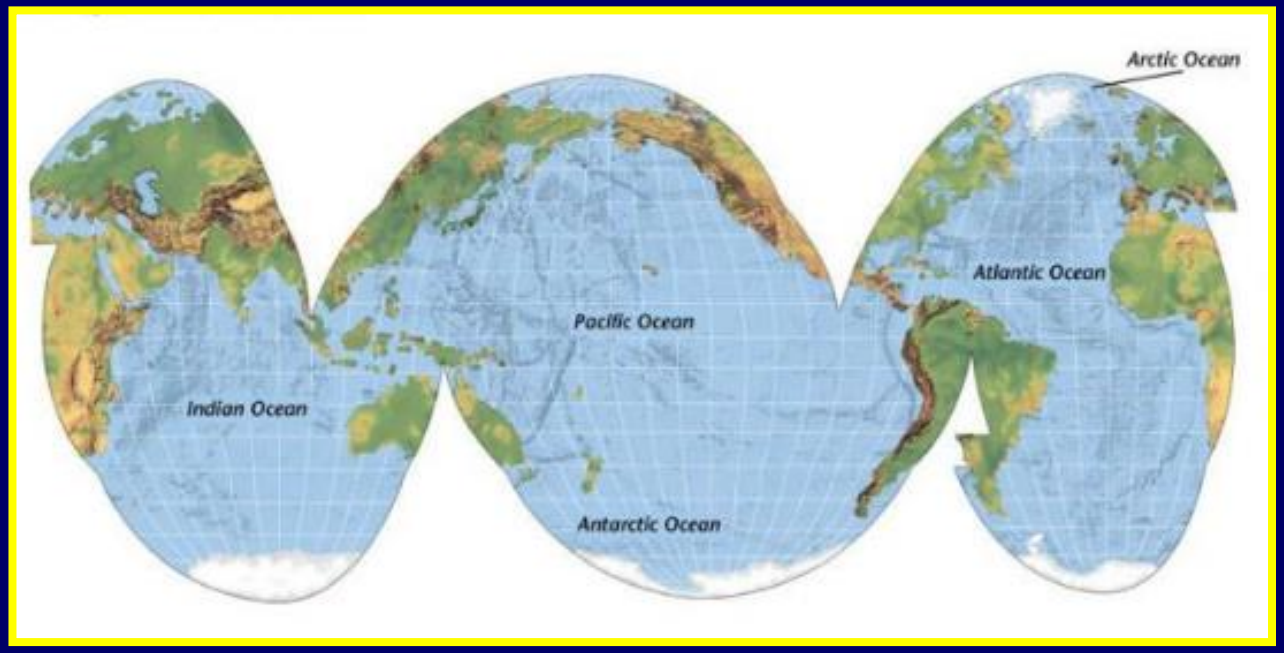
View from above the poles

Most of the landmass is in the northern hemisphere.

All the oceans are actually one vast, interconnected body of water.

Major Oceans

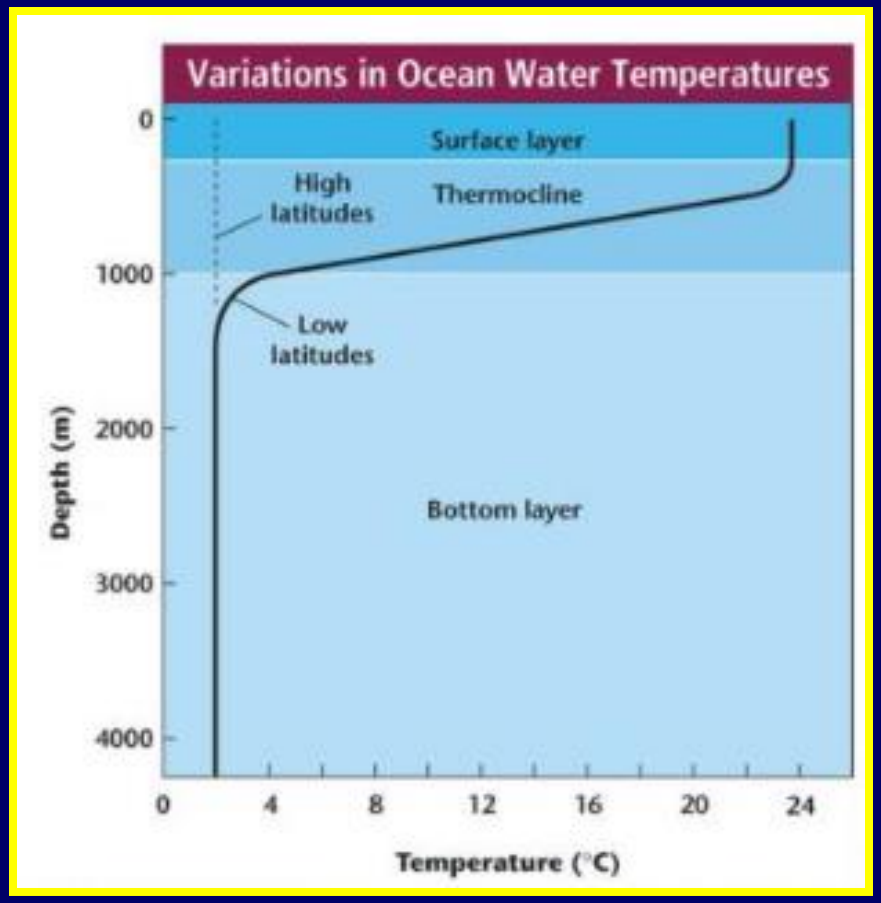
There are three major oceans: the Pacific, the Atlantic, and the Indian.



The smaller Arctic and the Antarctic, also called the Southern, Oceans are located near the poles.

Ocean Temperatures

Ocean surface temperatures range from – 2^{o}C (28^{0}F) in polar waters to 38^{o}C (100^{0}F) in tropical waters.



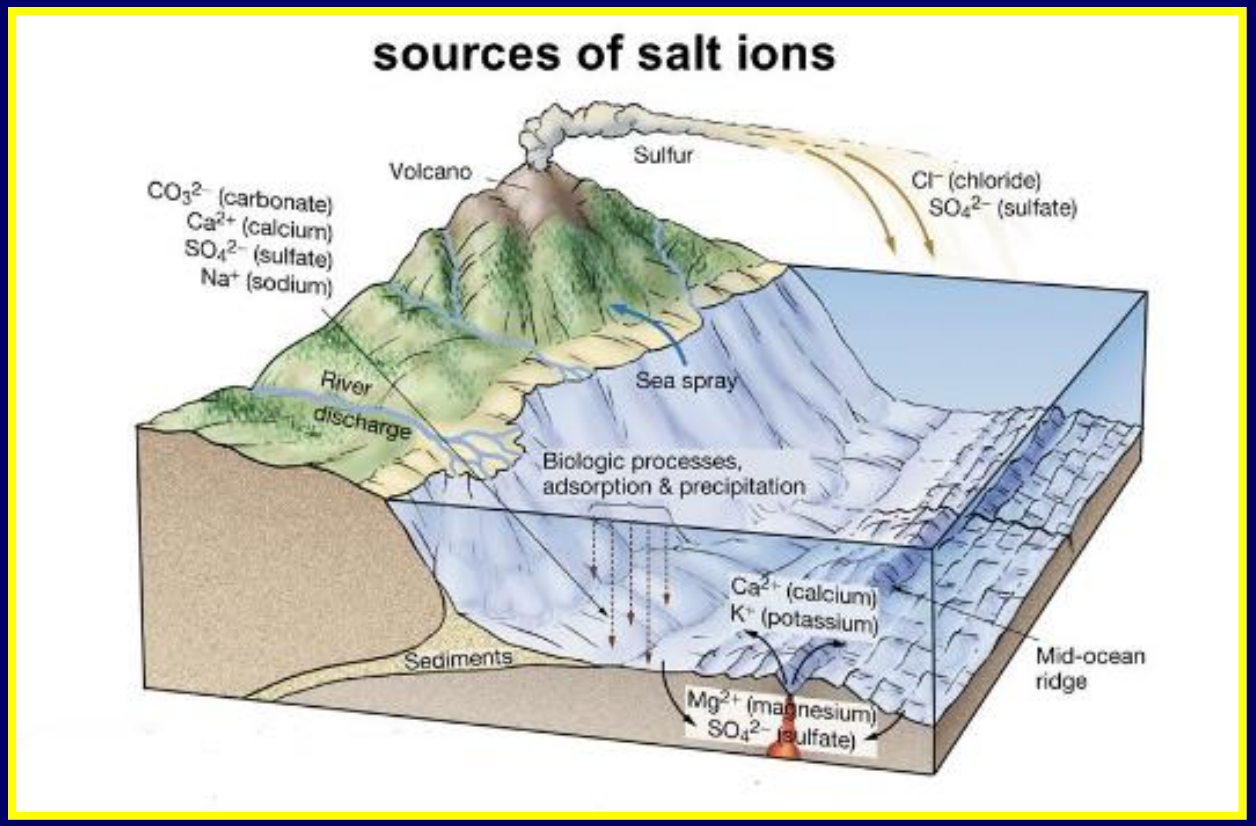
Water temperatures, however, decrease significantly with depth. Thus, deep ocean water is always cold, even in tropical oceans.

Polar Oceans

The Arctic and Antarctic/Southern oceans are covered by vast expanses of sea ice, particularly during the winter.

Sources of Ocean Salt

Most of the salt in the oceans come from the weathering of rock on land and are carried through runoff to the ocean.



But some of the salts come from the remains of marine animals, volcanoes, and hydrothermal vents.

Salinity

The average salinity of the ocean is 35 parts per thousand, ppt.

$$35\ \text{ppt} = \frac{35\ \text{grams salt}}{1000\ \text{grams saltwater}}$$

However, salinity can vary a lot depending upon evaporation levels and freshwater input.

Effect of Salinity on Density

Freshwater has an average density of 1.0 g/mL.

But, because salt ions add to the overall mass of the water it is dissolved in, ocean water has a higher density than freshwater.

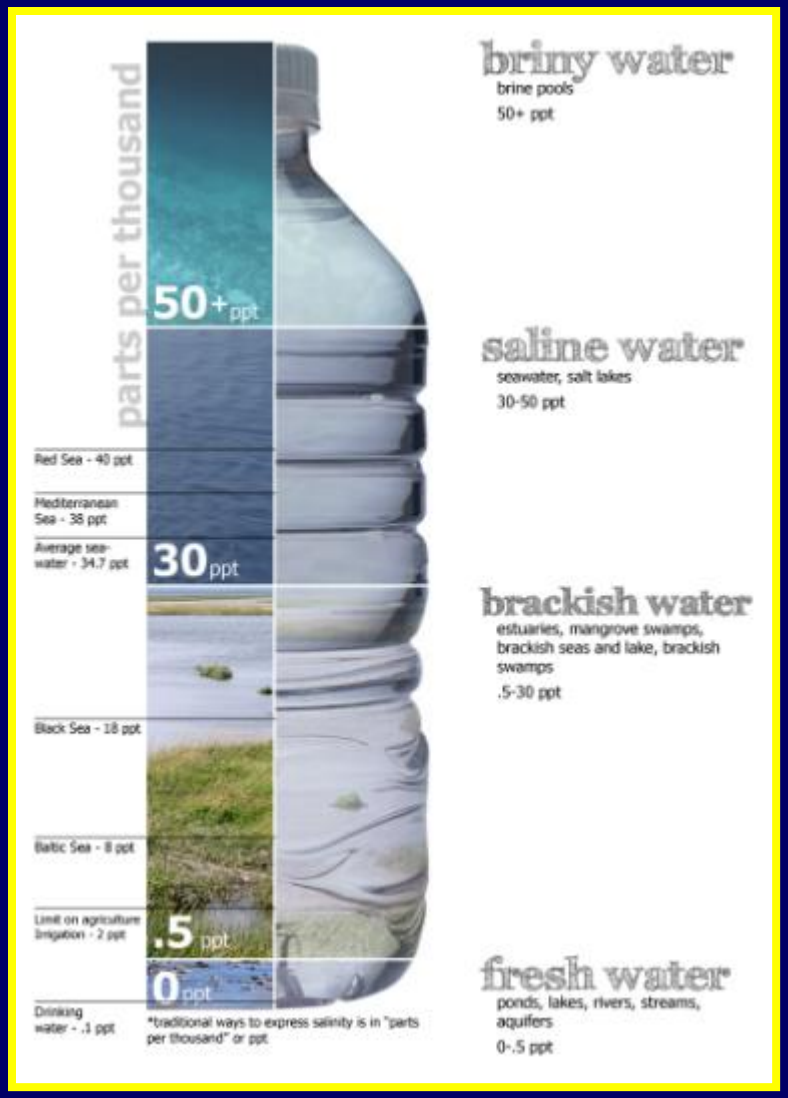
The higher the salinity, the greater the density.

Density of Ocean Water

Due to the higher salinity levels, the density of ocean water can vary between 1.02 and 1.03 g/mL.

The higher density of saltwater make it easier for large marine animals to float and move about in ocean water than in freshwater.

Categories of Salt Water



Briny water has a salinity greater than 50 ppt.

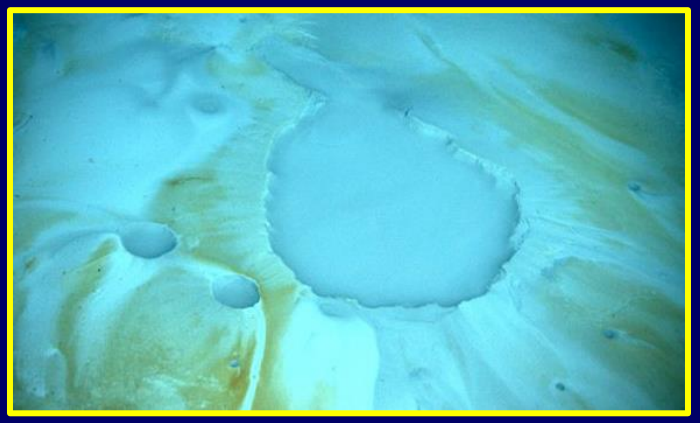
Saline water with salinities between 50 – 30 ppt.

Brackish water with salinities between 30 and 0.5 ppt.

Fresh water with salinities between 0 – 0.5 ppt.

Brine Pools (50+ ppt)

Brine pools are underwater pools of extremely salty water that doesn't mix with the surrounding less salty water.



They are usually found on the ocean floor of polar waters.

When water freezes, the dissolved salt is expelled, resulting in an increase in salinity and density of the surrounding water.

Saline Water (30 - 50 ppt)

The open ocean and most seas have salinities between 30 – 50 ppt.

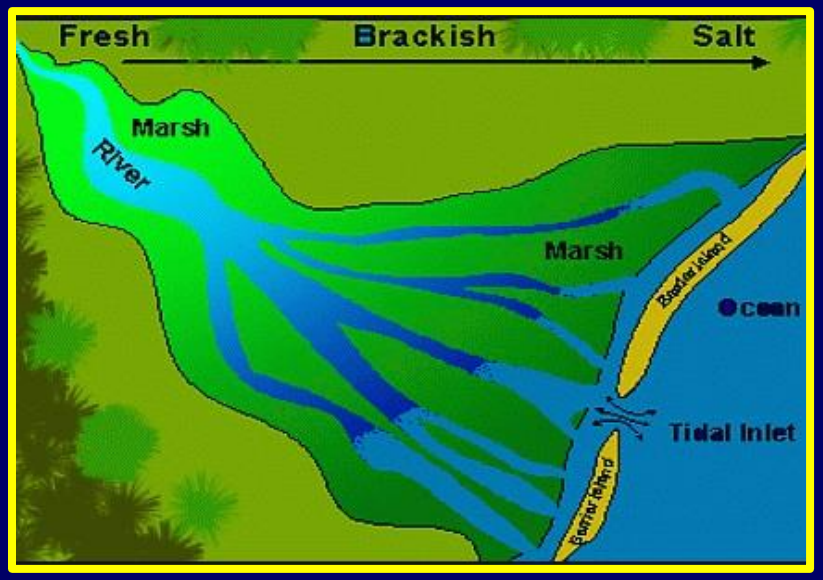
Ocean water near the tropics experience a lot of rainstorms and so have lower salinities.

Some seas, like the Dead Sea, experience very little rain but a lot of evaporation and so have very high salinities.

Salt deposits left behind as water evaporates. (Dead Sea)

Brackish Water (30 - 50 ppt)

Brackish water has a lower salinity than open ocean water but a higher salinity than freshwater.

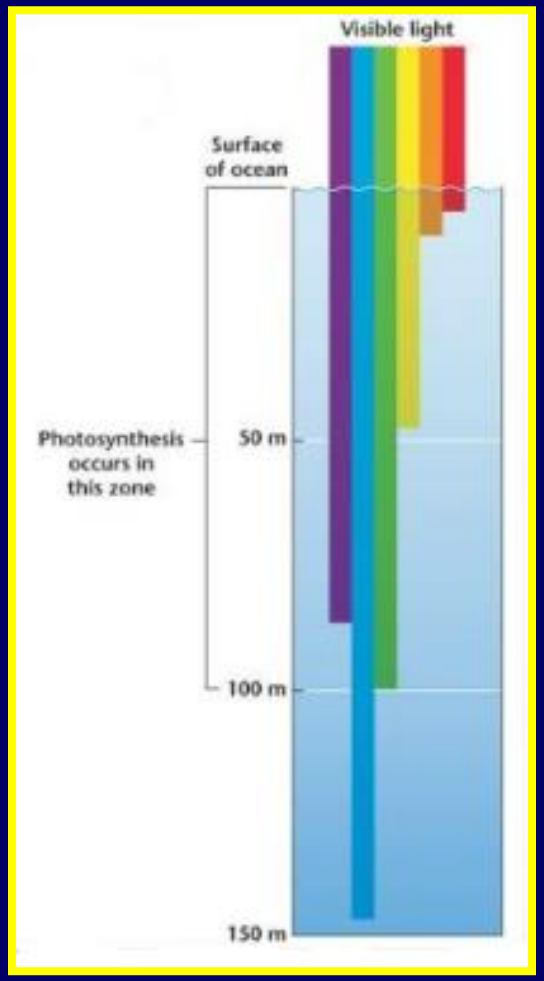


Brackish water is found in estuaries where rivers empty in the ocean.

Brackish water receives saltwater input when the tides come in and freshwater input from the rivers, creating a very wide range of daily and seasonal salinities.

Light Absorption

Most light only penetrates about 100 m of seawater, below that depth is total darkness.

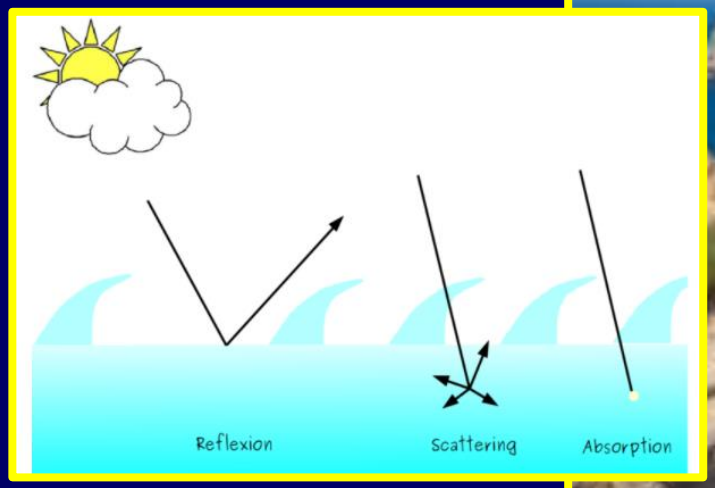


Different wavelengths of light are absorbed differently, with the longer red wavelengths of light being absorbed first.

The blue wavelengths of light are absorbed the least.

Why is the Ocean Blue?

Because the ocean absorbs all the colors of light before it absorbs blue light, more blue light is scattered and reflected into the air.



Our eyes see the scattered and reflected blue light.

Midnight Zone

Below 1,000 meters, it is completely dark and so it is called the midnight zone.

In the midnight zone, some animals create their own light through bioluminescence.

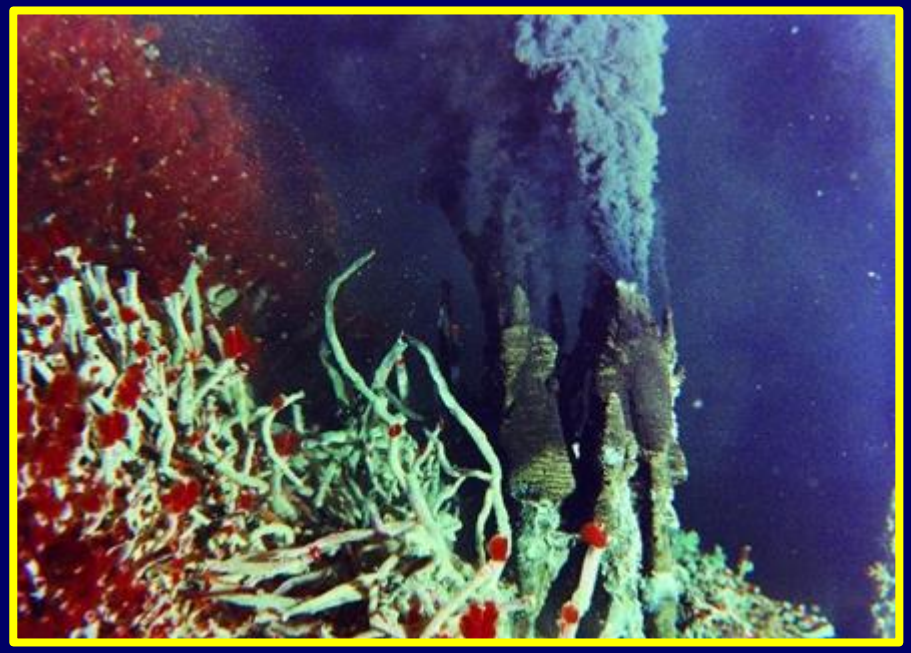
Hydrothermal Vents

While lots of nutrients, from plant and animal wastes, do drift down to the bottom of the ocean, there are also large communities of organisms that thrive around hydrothermal vents.

Hydrothermal vents are places at the bottom of the ocean where hot gases, from deep inside the Earth, are emitted into the ocean.

Chemosynthesis

Since there is no sunlight at the bottom of the ocean, photosynthesis cannot take place.

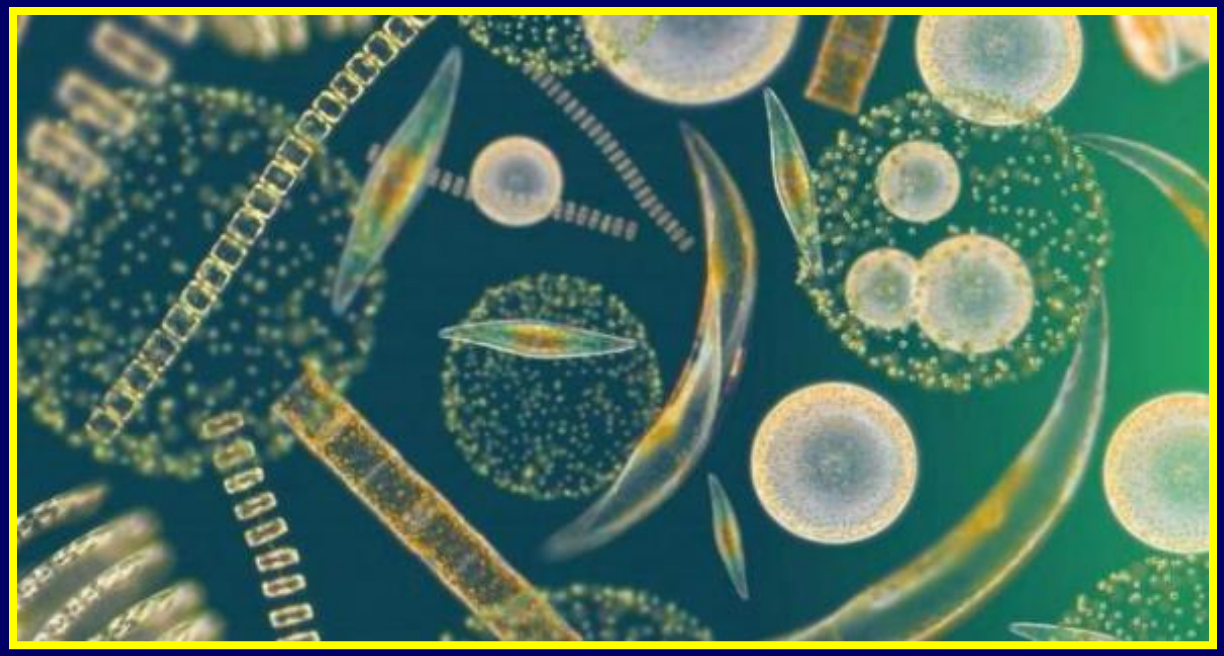


Instead, bacteria use the chemicals released from the hydrothermal vents to produce food, in a process called chemosynthesis.

The chemosynthetic bacteria form the base of the food chain for entire communities that live around hydrothermal vents.

Phytoplankton

Within the region that light can penetrate, live microscopic, photosynthetic algae called phytoplankton.



Phytoplankton are the base of the marine food web and contribute between 50 to 80% of the oxygen in Earth's atmosphere.

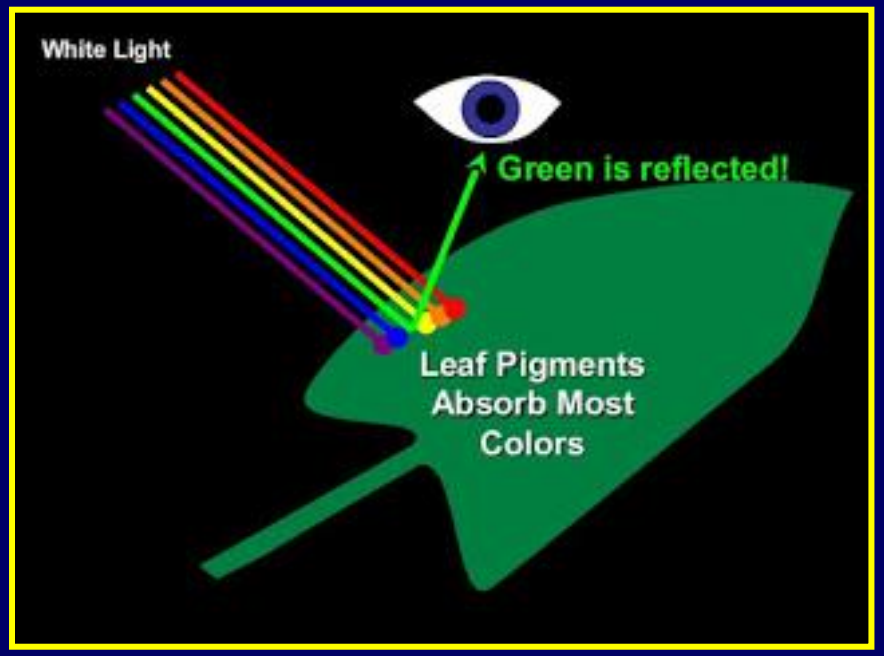
Zooplankton

Zooplankton are microscopic animals that drift in the ocean and feed upon the phytoplankton.

Zooplankton are generally the second level in the marine food web.

Green Phytoplankton

Photosynthetic phytoplankton, like terrestrial plants, use chlorophyll pigments to absorb light during photosynthesis.



Chlorophyll absorbs the other colors of light but reflects green light.

This causes plants and phytoplankton to appear green.

Green Ocean Water

Ocean water rich in photosynthetic phytoplankton, like the Gulf Stream, appears green, rather than blue.

Tropical Ocean Water

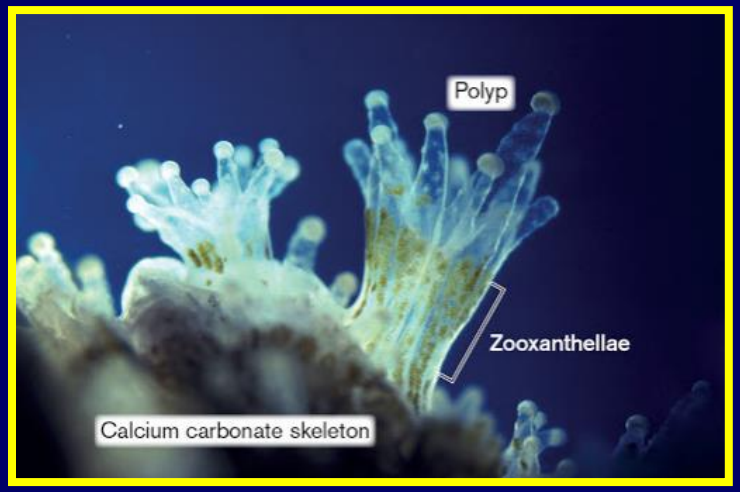
Due to warmer temperatures, tropical ocean water has very little phytoplankton and is also very shallow, so most of the light is reflected. Because of this we see clear, light blue water.

Coral Reefs

The shallow, clear tropical water allows coral reef systems to thrive due to high amount of light penetration.

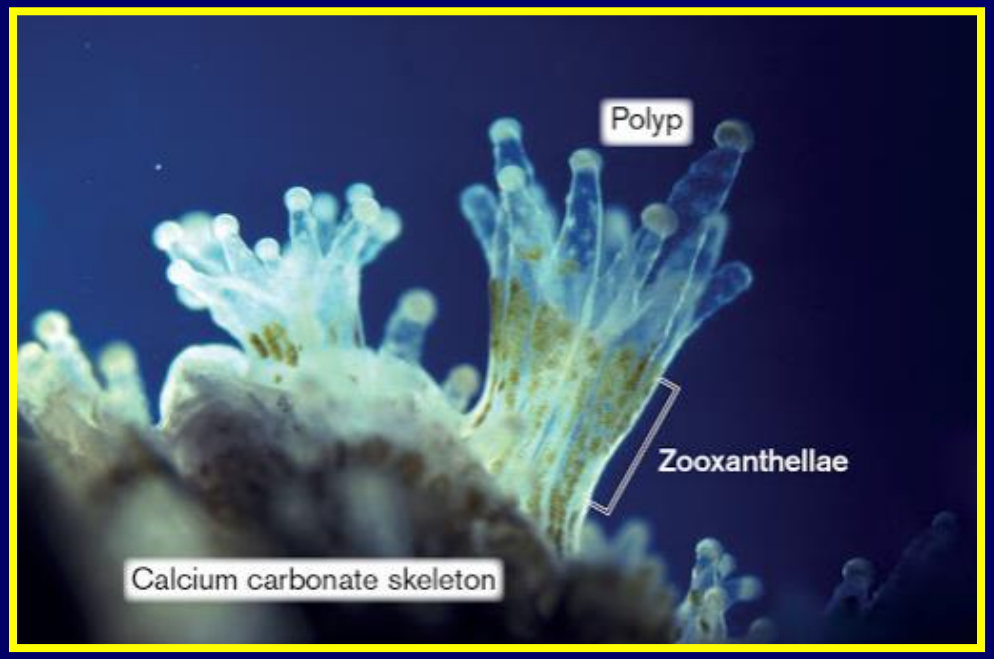
Coral are tiny stationary animals that live in colonies and produce calcium carbonate or limestone skeletons.

Each individual coral animal is called a polyp.



Coral Reefs

Tiny, photosynthetic algae, called zooxanthellae, live on top of the coral polyps.



Living on top of the coral helps the algae reach the sunlight it needs to perform photosynthesis.

The coral benefits from the oxygen the algae produce during photosynthesis.

Mutualism

When two different species benefit from a relationship it is called mutualism.

The coral and the algae have a mutualistic relationship.

Biologically Diverse

Overtime, the skeletons of the coral build up to form a reef that provides habitat for a large variety of marine life.

Coral reefs are the most biologically diverse ecosystems in the ocean and are homes to more than 25% of all marine life.

Kelp Forests

Another very biologically diverse marine ecosystem are kelp forests that provide not only food but also habitat to a wide range of marine organisms.

Kelp is a brown algae, sometimes called seaweed, capable of growing 2 feet a day.

Purple Sea Urchins

The largest threat to kelp forests are purple sea urchins that live in large herds and consume the kelp at rapid rates.

Sea Otters

Sea otters live in and around kelp forests.

Sea otters were once hunted to near extinction because fishermen thought they were eating their fish.

However, as the number of sea otters decreased, the fish populations began declining even faster.

Keystone Species

It turned out that sea otters protected kelp forests because their favorite prey were purple sea urchins.

Removing the sea otters caused the kelp forests to disappear, along with the fish populations that depend upon the kelp forests.

A keystone species is one that not only depends upon a specific ecosystem but also maintains and protects that ecosystem. Sea otters are a keystone species for the kelp forests and are now protected.

The End