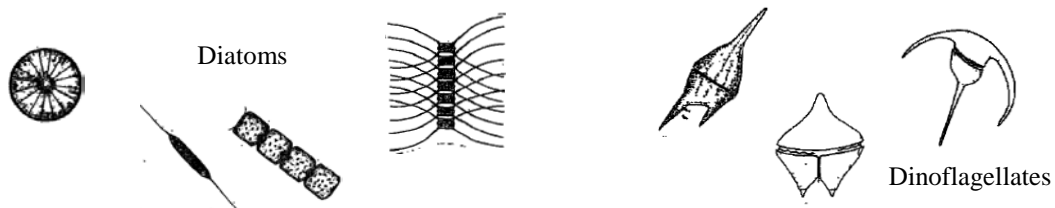


## PLANKTON

**Plankton**, defined as floating or weakly swimming organisms that drift with the currents, forms the basic food of the sea. Plankton is made up of microscopic plants (phytoplankton), which are the primary producers of food; and animals (zooplankton) which are mostly microscopic or at least small. Some large animals, like jellyfish, which can be several feet in diameter, are also considered plankton because they are mainly drifters rather than strong swimmers. Some small organisms become active swimmers and are called **nekton**.

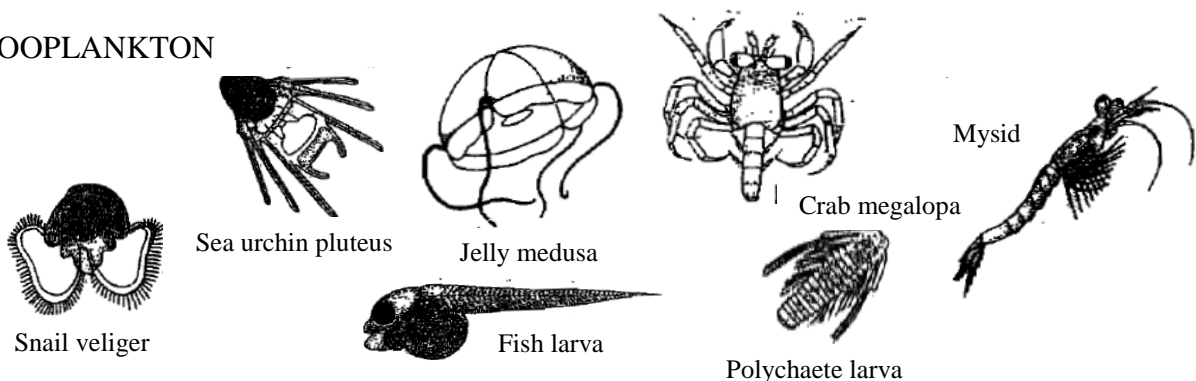
Plankton is classified into two main groups: the **Phytoplankton** and the **Zooplankton**. Phytoplankton refers to that part of the plankton that is in the plant kingdom. These plant plankton are the primary producers of the ocean. They can absorb radiant energy from the sun, and synthesize energy-rich carbohydrates and oxygen (photosynthesis). This food source, in turn, is consumed by small animals, jellyfish, and fishes.

### PHYTOPLANKTON

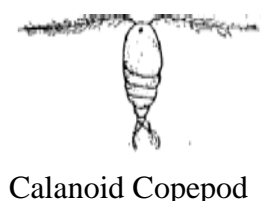


Zooplankton refers to that part of the plankton that is in the animal kingdom. Many of these animals are the larval forms of larger animals that float in the plankton until final development and are called **meroplankton**. The crab and starfish, for example, have larval forms that float as plankton. **Holoplankton** are phytoplankton and zooplankton which spend their entire lives as plankton, examples include diatoms and copepods.

### ZOOPLANKTON



Both plant and animal plankton are a source of food for many animals of the ocean. Very small fish to the largest animal that has ever lived, the blue whale, feed on this microscopic plankton. Plankton has been suggested as a possible food source for humans and a great deal of study has been done in this area. Studies have found the nutritive value of zooplankton to be equivalent to that of the best meats, and the nutritive value of phytoplankton equal to that of rye flour. An English scientist reported that **copepods**, small crustaceans, boiled in butter tasted similar to lobster.



Plankton also has many industrial uses. **Diatomaceous earth** consists of deposits of fossil **diatoms** and is used as an abrasive for cleaning and polishing, as a filter for liquids because of its porosity, as an absorbent for nitroglycerine in the manufacture of dynamite, and as an insulator. In the past, chalk that was used on chalk boards also came from shells of dead plankton organisms. Plankton also was important in the formation of petroleum in the Paleozoic era.

## ZONATION AND VERTICAL MIGRATION

Phytoplankton grow only in the upper layers of the ocean where there is sufficient sunlight. Much of the zooplankton tends to shift their vertical position daily, coming up to feed on phytoplankton at night and sinking into darker waters during the day. This behavior is thought to be adaptive to avoid fish predators which hunt by eyesight.

## THERMOCLINES, UPWELLING, AND PLANKTON BLOOMS

A **thermocline** in the ocean is a region of rapid temperature change with depth. Where there is a strong thermocline, there is little vertical mixing of water since cold water is heavier and stays below warmer surface water.

### Summer:

A thermocline develops as the sun heats surface waters. The greater amount of sunlight plus warm surface temperatures promote the growth of phytoplankton, producing **phytoplankton blooms**.

Since there is little vertical mixing of water, mineral nutrients are eventually depleted as phytoplankton grows, dies, and sinks to the bottom. This depletion of minerals, coupled with increases in zooplankton populations which feed on the phytoplankton, leads to a decline in phytoplankton numbers. Eventually, zooplankton populations drop as food becomes less available.

### Winter:

The thermocline disappears as surface waters cool with decreasing sunlight and air temperatures. As temperature differences decline, density differences in the water also decline and vertical mixing becomes easier, aided by the turbulence caused by winter storms. The mineral nutrients of upper waters are thus replenished and again available for phytoplankton growth in surface waters as temperature and light increase in the spring.

The nutrient mixing off the southern California coast that is the result of **upwelling** results in the diversity of species and the rich marine life found. Upwelling is caused by winds that blow surface water away from the shore. Water from the depths moves upward, replacing the surface water, and with it the minerals necessary for phytoplankton growth.

## Plankton Vocabulary

adaptation	modification of traits, characteristics or behavior of an organism in structure, behavior or function in adjusting to a new condition
bioluminescence	the production of light by a living organism
copepod	crustaceans that compose the majority of the zooplankton. They feed primarily on diatoms and are a food source for pelagic fish and whales
current	continuous movement of water in a certain direction
diatom	a yellow-green alga that contains a cell wall of hydrated silica; forms great deposits of diatomaceous earth
ecology	interactions of plants and animals with the environment
habitat	natural home or dwelling of an organism. The environment in which specified organisms live
holoplankton	animals that spend their entire lives as plankton
longshore drift	the movement of water, sand and other loose particles in a given direction along the coast
meroplankton	animals who in larval stages are planktonic and are shore-dwelling, bottom dwelling or nektonic as adults
migrate	to pass periodically from one region to another for purposes of feeding or breeding
nekton	active swimmers
nocturnal	animals which are active at night
photic zone	near-surface layer of water that receives ample sunlight for photosynthesis
phytoplankton	plant plankton, primary producers of food and of oxygen
plankton	floating or weakly swimming organisms that move with the currents in all natural waters; drifters of the sea
plankton bloom	unusually high concentration of plankton in an area due to rapid or gradual reproduction

pollution	a contamination of water, soil and/or air from the discharge of wastes, gases or chemicals
predatory	living by killing and eating other animals
red tide	reddish or brownish discoloration of surface waters caused by a concentration of dinoflagellates, some of which are bioluminescent
salinity	the total amount of dissolved salt in the water
sediment	any matter deposited in water (that settles to the bottom)
siphon	a tube like structure for drawing in or expelling fluids
thermocline	region of rapid temperature change with depth
tides	daily rise and fall of ocean waters produced by gravitational pull of the earth by the moon and sun
waves	a moving flow of energy through air or water which causes the up and down movement called swells, generally caused by wind
zooplankton	animal plankton; many are larval forms of invertebrates

## Plankton Curricular Extensions

- Brainstorm as a class or in small groups to identify animals and plants that might be found in a plankton sample.
- Have students design a new plankton species. Have them include some of the physical characteristics of the chosen organism as well as any adaptations the organism would need for survival.
- Have students create an ocean mural with animals and plants that make up the plankton that the students have seen. Include any biological or physical features or add human impacts like storm drains, harbors, jetties, piers, etc.
- Locate San Pedro and Pt. Fermin on a map. Have the students map the route to the museum from school using a freeway or local map. Note rivers and streams in the Los Angeles Basin.
- Map the currents in the Pacific Ocean.
- Review the water cycle. Map a path that water follows from the mountains to the ocean and discuss what blocks the sand that the water would have brought to the ocean (dams, cemented rivers, etc.).
- Fill two containers, one with fresh water and one with salt water. (The percentage density of salt in ocean water is approximately 965 grams fresh water and 35 grams salt per liter.) Add a variety of objects to determine if they float. Discuss how/where objects float in salt water as compared to fresh water. Continue adding salt to the fresh water until the objects float at a higher level in the water.
- Make ice cubes with colored water. Fill a flat clear pan such as a baking dish with saltwater solution. Add two or three ice cubes. Observe and record what happens.
- If your class is in the Spring and we have grunion eggs available, we will be hatching grunion eggs. A broad knowledge of which animals reproduce by laying eggs and eggs in general will allow students to make comparisons.
- Discuss prefixes used in oceanography (hydro, zoo, bi, aqua, sub, phyto, chloro, uni).
- Present students with an opportunity to imagine being plankton in the ocean environment (tapes of the ocean could be used or could be done through guided imagery). Encourage the students to recall the details of what they imagine including colors, actions, sounds, etc. Then write a poem (Haiku, Cinquain or Diamante work well).

- Have students further explore the ways people harvest plankton.
- Create a life cycle mobile of an invertebrate including the different planktonic stages of development.
- Examine surface tension. Test and/or design objects that are able to rely on the surface tension to float.
- Make food webs showing the connections to plankton, plankton blooms and what happens with the negative impacts of pollution on plankton.