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PHYTOPLANKTON: DIVERSITY AND STRUCTURE

Beyond the shallow depths where marine flowering plants and the large seaweeds grow, the sunlit layer of water is dominated by the single-celled plants known as phytoplankton. Phytoplankton includes a variety of plant forms, all of which are autotrophic: they capture energy from sunlight, and require nutrients (phosphates, nitrates, etc.) and carbon dioxide (CO_2) for photosynthesis. A single liter of rich coastal sea water may contain dozens of different species of phytoplankton, and possibly as many as 10 to 20 million individual one-celled plants. Some species are small, flagellated forms, much too tiny to be captured in the finest-mesh plankton net. The larger, more common phytoplankton species are diatoms and dinoflagellates, which are found abundantly in temperate waters. These species can grow up to 1 millimeter across, but most are much smaller.

Color the diatoms in the upper left. Color each diatom structure as it is discussed. Use a dark color for the pores.

Diatoms are found in both marine and freshwater habitats. Marine diatoms are of two basic types: the elongated forms (Pennales or pennate diatoms), such as *Pleurosigma*, which are usually found in very shallow areas; and the round or wheel-shaped forms, such as *Coscinodiscus* (Centrales or centric diatoms). In the case of *Coscinodiscus*, you see that the diatom consists of a two-part *frustule* which is made of silica and appears like a glass jewel when viewed under the microscope. On the top of the frustule, an elaborate pattern of *pores* radiates out from the center; the pores help reduce the weight of the floating diatom and allow diffusion of materials into and out of the cell. Viewed from the side, the shape of the frustule can be seen: the upper half, or *epitheca*, fits over the smaller bottom half, the *hypotheca*. Inside the frustule is the *nucleus* of the diatom, which contains the genetic material, and the *chloroplasts*, or photosynthetic organelles.

In addition to diatoms that are found in the plankton, some diatoms grow attached to hard substrata or on the surface of soft substrata. Many pennate and centric diatom species grow attached to hard surfaces. When attached forms divide they often fail to separate, forming diatom chains or colonies. Some pennate species grow into flat, branching filamentous colonies that may be confused with small seaweeds. These colonies can coat intertidal rocks in a slippery brown mass during certain times of the year, and form an important food source for intertidal herbivores like chitons and limpets. Other species of pennate diatoms grow on the surface of mud flats, and can form colonies that coat the mud's surface with a conspicuous brown-green sheen during spring and early summer. Short chains of centric diatoms often occur attached to animate objects like the covering of hydroid colonies (Plate 23), where they grow outward from the point of attachment like a beaded necklace.

Next, color the various species of the diatom genus *Chaetocerus*. The generic name is abbreviated to *C*. Note the differences in the setae.

Diatoms cannot move in the water column under their own power, but have developed adaptations that keep them afloat. Within the widely distributed diatom genus *Chaetocerus*, a variety of adaptations are visible. The individual *Chaetocerus* cell has two pairs of thin spines or *setae* projecting from either end. These setae fuse with those of other cells to form long chains, thereby increasing the buoyancy of the chained group. As you see from the illustration, the length and shape of the setae vary with different species. *Chaetocerus decipiens* is found in cool, dense water, and needs only relatively short setae to stay afloat. *Chaetocerus* species living in warmer, less dense water have developed long setae that provide more resistance to sinking. *Chaetocerus denticulatus* has secondary spines on the setae to keep it from sinking in warm water.

Now, color the dinoflagellates in the upper right corner.

Unlike the diatoms, dinoflagellates are able to swim and move up and down in the water column. They have long *flagella* that are used for locomotion. The whiplike flagella are located in grooves — the longitudinal *sulcus* and the transverse *cingulum*. Dinoflagellates have a multilayered covering of cell material. In the armored (thecate) dinoflagellates, such as *Peridinium*, the cell is encased in an expandable, overlapping layer of cellulose *plates*; this is absent in naked, or unarmored dinoflagellates, such as *Gymnodinium*. Many dinoflagellates are known to be bioluminescent (light-producing), and this group also includes the organisms that cause the sea water to turn red during the so-called "red tides" (Plate 72). A group of dinoflagellates known as zooxanthellae live within the cells of a number of invertebrate hosts in a mutually beneficial symbiotic relationship (Plates 12, 91).

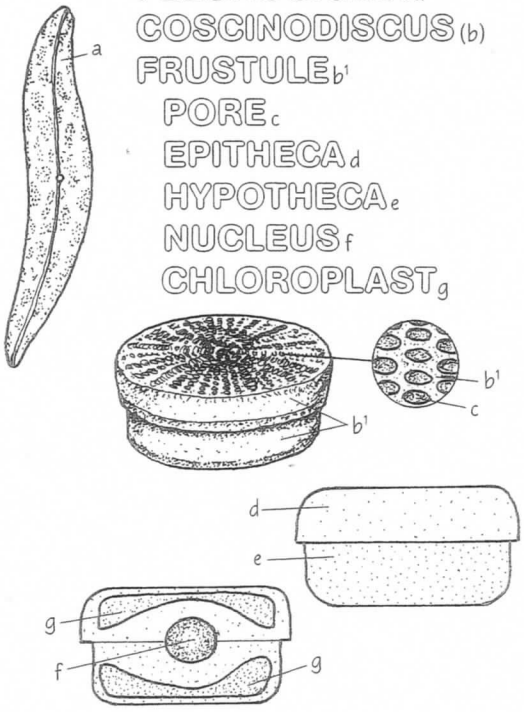
Name/Period/Date

Phytoplankton: Diversity and Structure

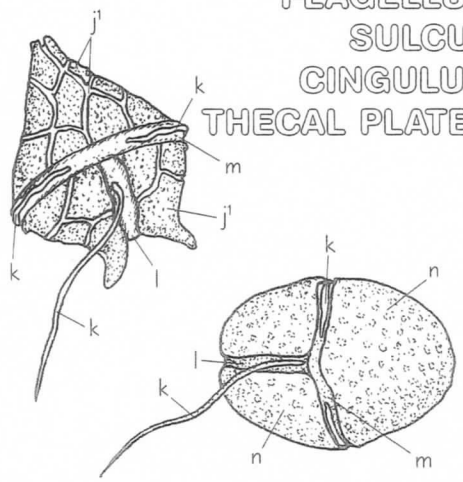
1. What is necessary for photosynthesis?
2. Describe two types of marine diatoms.
3. How do dinoflagellates differ from diatoms?
4. Define bioluminescent.
5. Color!

DIVERSITY AND STRUCTURE

DIATOMS ✡
PLEUROSIGMA a
COSCINODISCUS (b)
FRUSTULE b^1
PORE c
EPITHECA d
HYPOTHECA e
NUCLEUS f
CHLOROPLAST g

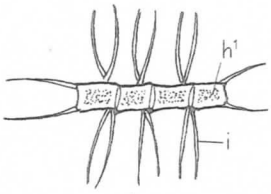


DINOFLAGELLATES ✡
PERIDINIUM (j)
FLAGELLUM k
SULCUS l
CINGULUM m
THECAL PLATES j^1

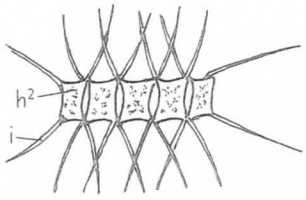


GYMNODINIUM n

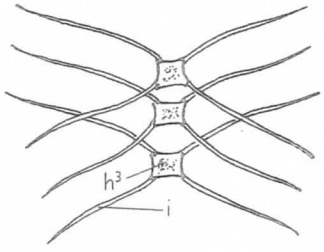
SPECIES OF CHAETOCERUS (h)
SETA i



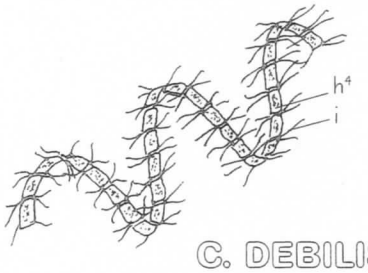
C. DECIPIENS h^1



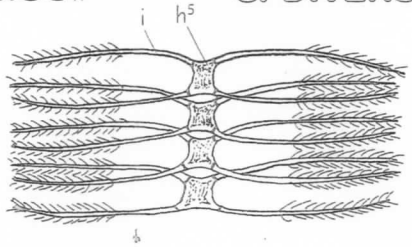
C. DIDYMUS h^2



C. DIVERSUS h^3



C. DEBILIS h^4



C. DENTICULATUS h^5