FROM THE BIRCH AQUARIUM AT SCRIPPS

Voyager

FOR KIDS OF ALL AGES

By Memorie Yasuda

DAZZLING DRIFTERS IN THE SEA

Blue sea slug

PLANKTON ARE ORGANISMS that float freely in the ocean. Plankton are usually so tiny that you can't even see them under a regular microscope. When you do see them, it's difficult to understand just how important they are to the entire planet.

Plankton are mostly single-celled organisms that exist in huge numbers and in a variety of sizes. They are made up of photosynthetic living things like plants (called phytoplankton) and animals (called zooplankton).

FOOD FOR ALL

Phytoplankton float near the surface of the water. Instead of living attached to the ground, phytoplankton hang around in the sunlit upper layers of the ocean to catch rays of sunlight needed for photosynthesis. They become less abundant in deeper water because sunlight disappears at 200 meters (660 feet).

Phytoplankton fuel life in the ocean in the same way that green plants do on land. These organisms grow abundantly and quickly around polar regions, in eastern equatorial seas, and along selected coasts such as California's. Small fish, and some species of whales, eat both phytoplankton and zooplankton. Larger fish then eat the smaller fish. Humans catch and eat many of these larger fish (and now also zooplankton such as the shrimp-like krill). Phytoplankton form the base of the food pyramid in the ocean. In a typical food web on land, there is a greater mass of photosynthesizers than grazers—more grass than cows, for example. In the ocean, there can be more grazers than photosynthesizers so that the biomass food pyramid is inverted, which means that there is a greater mass of zooplankton than

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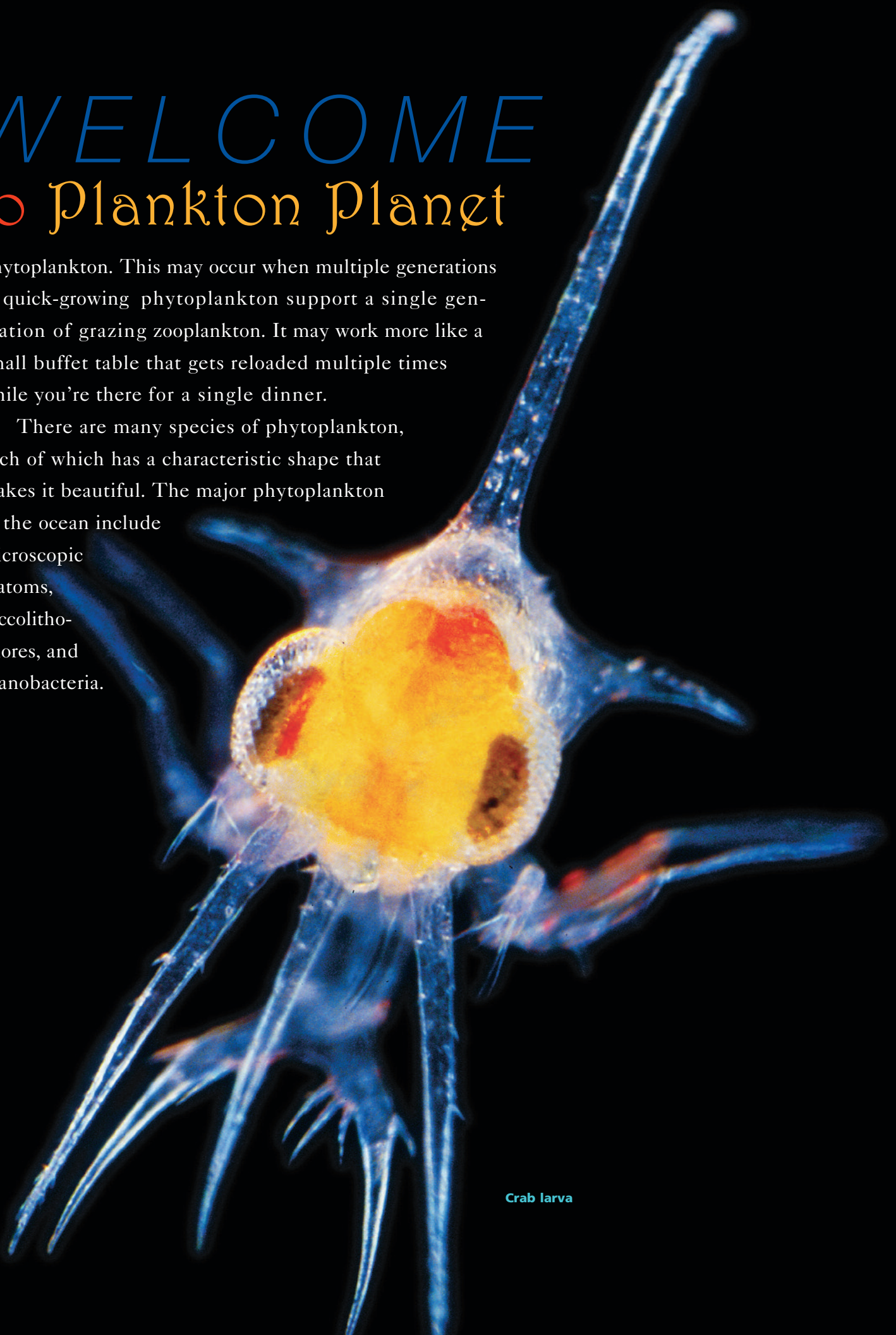
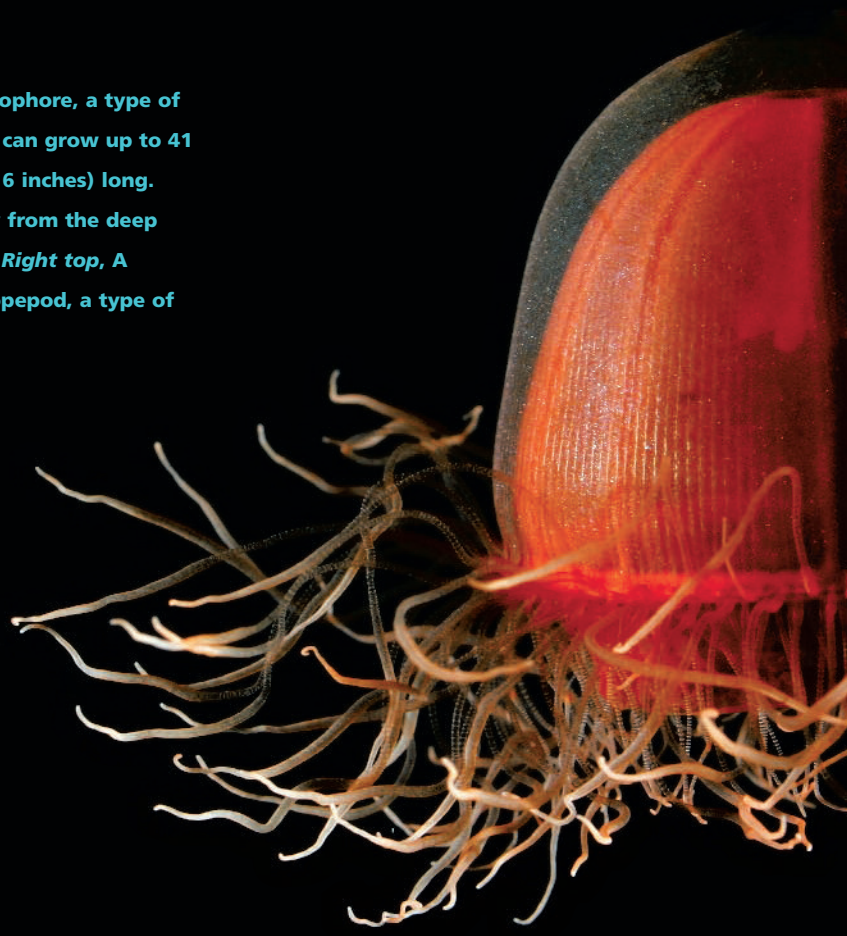
WELCOME to Plankton Planet

phytoplankton. This may occur when multiple generations of quick-growing phytoplankton support a single generation of grazing zooplankton. It may work more like a small buffet table that gets reloaded multiple times while you're there for a single dinner.

There are many species of phytoplankton, each of which has a characteristic shape that makes it beautiful. The major phytoplankton in the ocean include microscopic diatoms, coccolithophores, and cyanobacteria.



Crab larva



***Left*, A siphonophore, a type of plankton that can grow up to 41 centimeters (16 inches) long. *Center*, A jelly from the deep Arctic Ocean. *Right top*, A deep-water copepod, a type of zooplankton.**

FREE FLOW IN THE FAST LANE

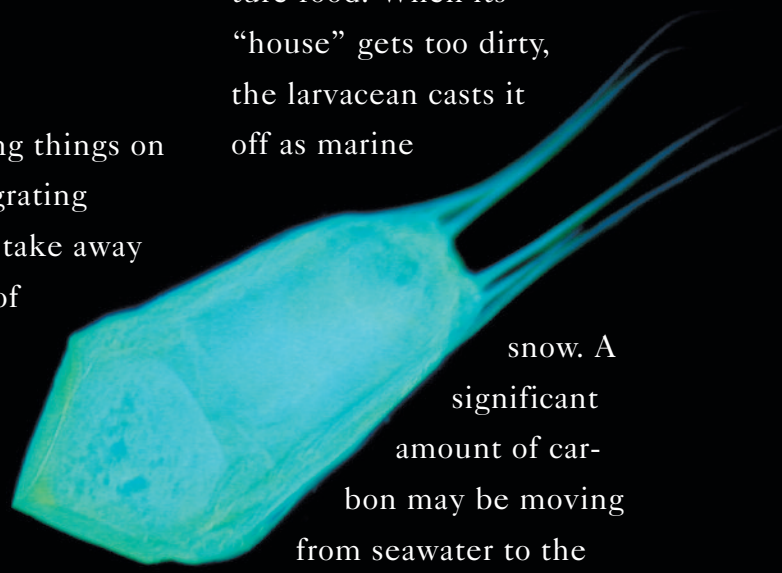
Zooplankton are very weak swimmers. They pretty much drift or move with the ocean currents. They are found in both the sunlit zone and in "deep, dark ocean waters." They are ocean animals that eat other plankton. Zooplankton make up the next steps up from the base on the food web.

There are two types of zooplankton: those that live their entire lives in the open ocean (holoplankton), which will always be planktonic, and those that live only part of their lives in the open ocean (meroplankton). The meroplankton are made up of the larvae of bottom-dwelling invertebrates such as crabs, barnacles, and clams, as well as larval fish and squid. For meroplankton, survival depends on changing lifestyle and trans-

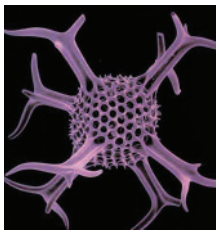
forming body shape as they grow into adulthood. These changes are often triggered by external cues from the environment, allowing them to change when conditions are right.

Along with the good swimmers in the open ocean, many types of zooplankton join in a massive vertical daily migration. Those hiding in deeper, dark waters during the day rise to the surface at night to feast on phytoplankton. This vertical migration is one of the greatest migrations of all living things on Earth. The migrating organisms may take away large amounts of food from the surface and deposit it into deeper waters every day, playing an important role in the global carbon cycle.

Sometimes it looks like it's snowing in the sea. "Marine snow," the polite term for what many marine biologists call "marine snot," is a mucouslike substance produced by many planktonic organisms such as the unfamiliar larvacean. A larvacean looks like a tiny tadpole and lives inside a sticky mucous bubble that it uses to capture food. When its "house" gets too dirty, the larvacean casts it off as marine snow. A significant amount of carbon may be moving from seawater to the seafloor in this way.

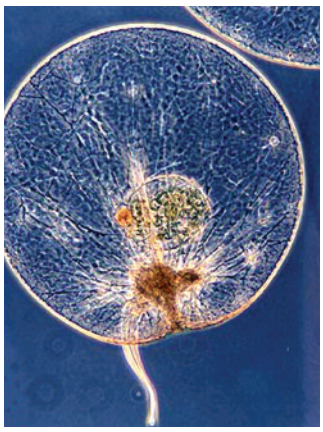


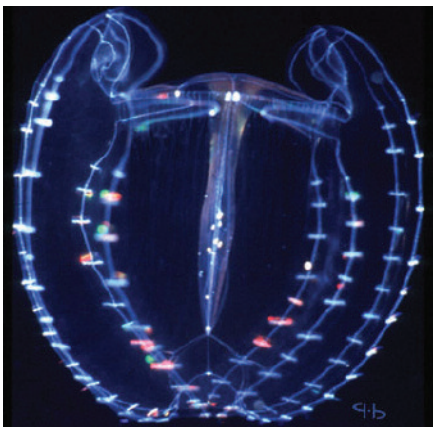
The most abundant zooplankton are tiny, grazing, shrimplike organisms such as copepods and krill, as well as the most abundant carnivores like the predatory arrow worms. Jellyfish, also known as jellies, are well-known larger zooplankton.

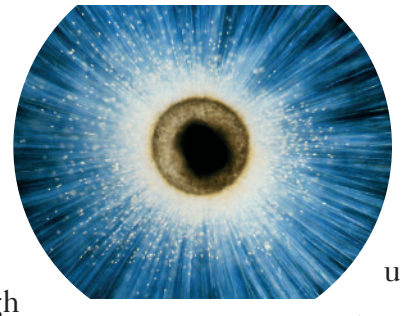


BIG, BILLOWY JELLIES

Most plankton are microscopic in size, but some, like jellies, can be as big as a large pizza. Jellies are like transparent bags of Jell-O trimmed with dangling decorations. They are poor swimmers because their appendages are too flimsy to propel their bell-shaped bodies. Instead of swimming, they glide around slowly and gracefully through pulsed motions of their bells. Because they cannot run and there is no place to hide, jellies tend to be transparent so as to keep a low profile and avoid predators.





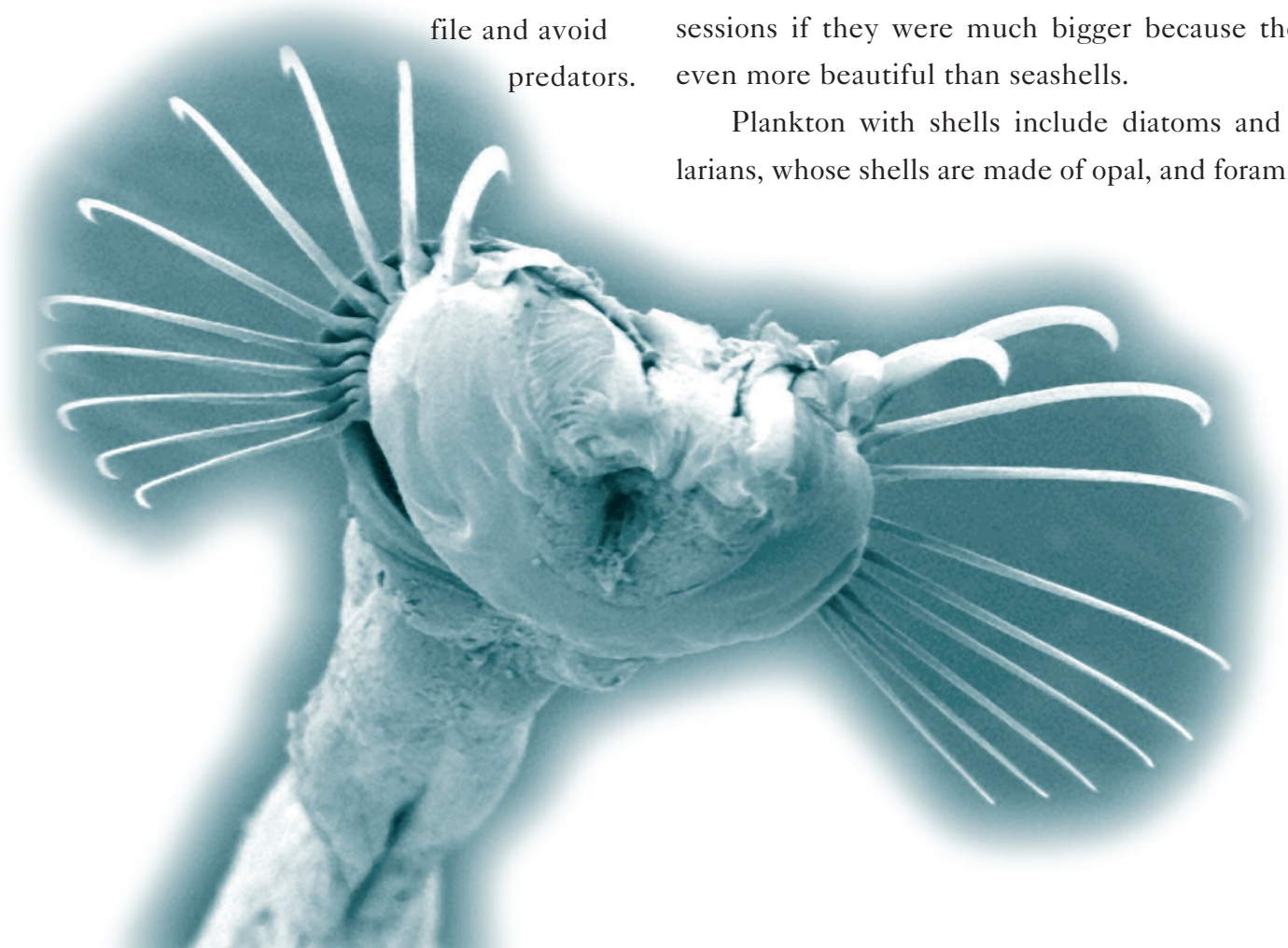


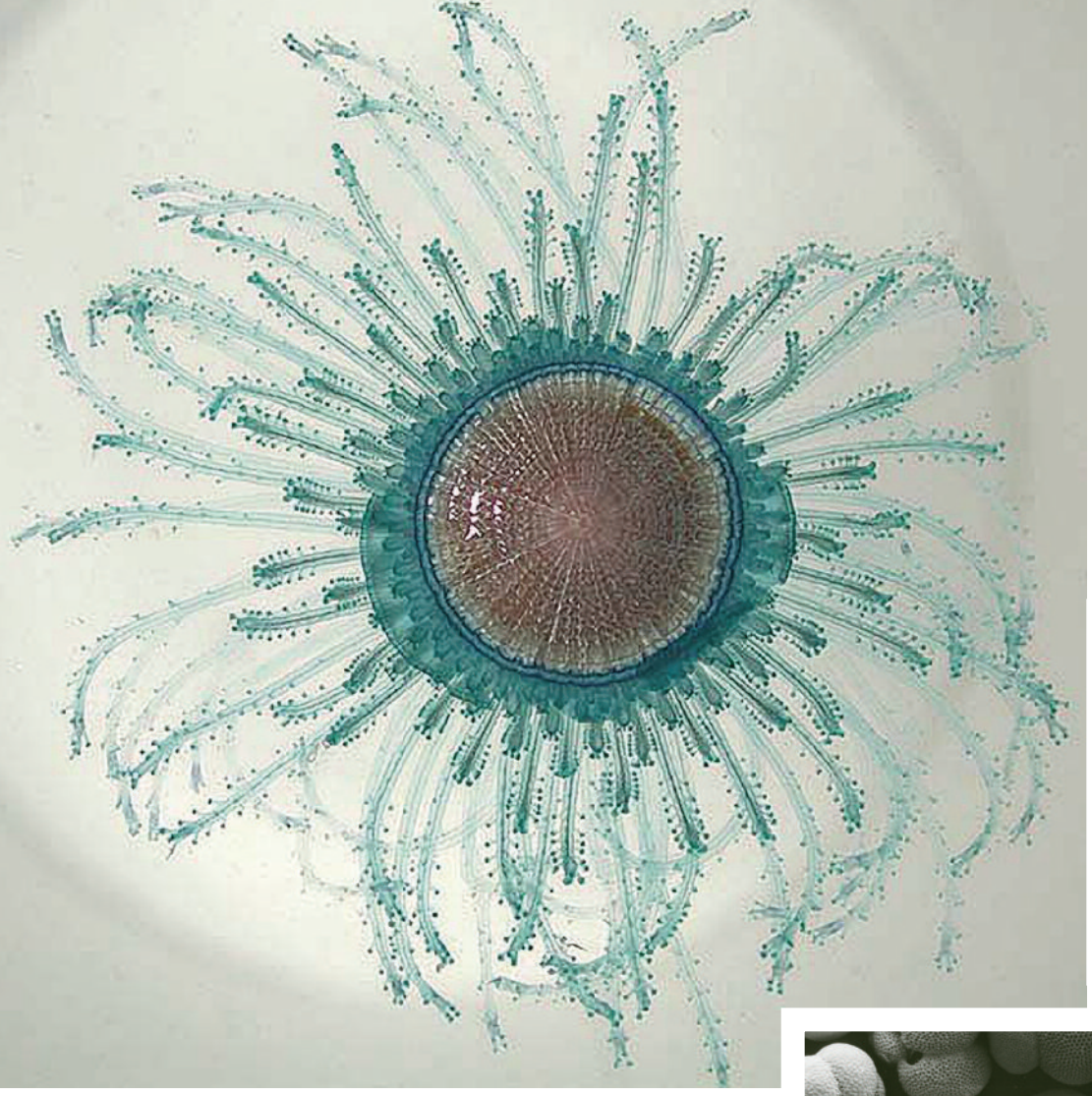
Most jellies, including cube jellies and siphonophores, are in a group called cnidarians (pronounced with a silent "c"). Very different and unrelated organisms called ctenophores (pronounced with a silent "c") and salps are also jellies.

WITH AND WITHOUT SHELLS

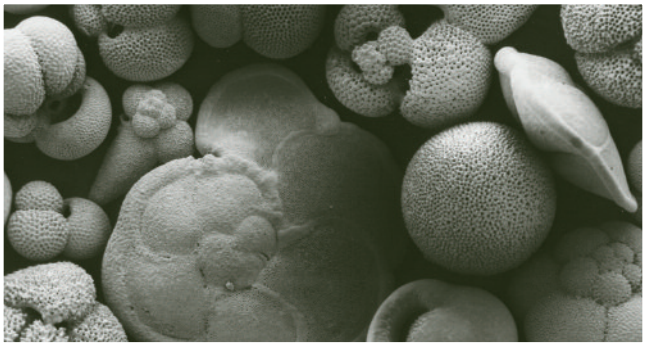
The shells of minute plankton would be prized possessions if they were much bigger because they are even more beautiful than seashells.

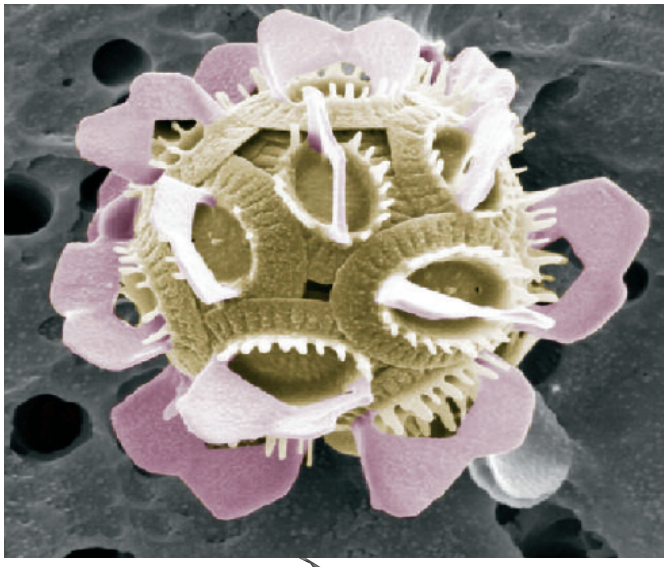
Plankton with shells include diatoms and radiolarians, whose shells are made of opal, and foraminifera

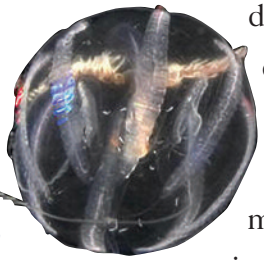




***Left top*, The blue bottom (*Porpita porpita)* is related to the jellyfish; this species floats at the surface of the water. *Right top*, Local moon jellies that can be viewed at the Birch Aquarium. *Below left*, A coccolithophore is a type of plankton that is encased in microscopic plating made of calcite. *Below right*, Foraminifera from recent sediments in the western Equatorial Pacific.**







***Opposite page: Left top*, Fossil radiolarian from the Paleogene period. *Left bottom*, Head of the predatory arrow worm. *Right top, left to right*, Dinoflagellate *Noctiluca scintillans*; *Deiopea* is a type of jelly found in surface waters around the world. *Middle*, *Foraminifera orbulina universa* with thousands of golden dinoflagellates living in its spines.**

and coccolithophores whose shells are made of calcium carbonate. The shells of these organisms account for almost all of the sediment piled up at the bottom of the open ocean. Though dinoflagellates are also abundant, they are seldom found in the sediment because they have a less durable shell made up of cellulose, which is similar to land plants.

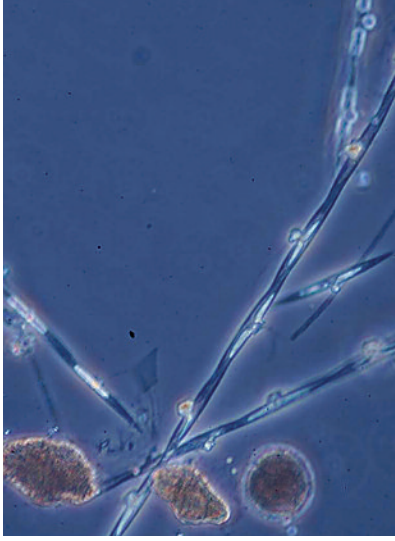
DYNAMITE DINOFLAGELLATES

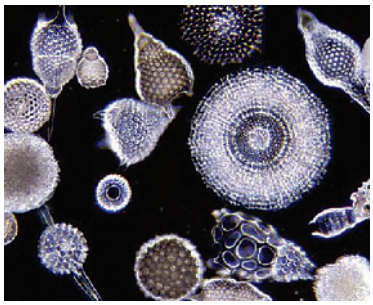
One kind of minute dinoflagellate, *Pfiesteria piscida*, has been described as "shape-shifting in minutes from docile grazer to voracious carnivore that maims and eats fish, inflicts appalling sores, and makes people act like zombies." The trigger for this animal's transformation may be nutrient runoff from hog and other livestock farms that drains into coastal waters.

Scripps marine ecologist Lilian Busse samples the waters off the La Jolla coast twice a week from the Scripps Pier to check for dangerous outbreaks of such plankton or harmful algal blooms in local waters. She checks for the diatom *Pseudo-nitzschia*, which produces the neurotoxin domoic acid under certain conditions. This toxin poisons marine mammals, birds, and people who eat contaminated shellfish. Busse looks out for these organisms as part of a statewide monitoring network team.

During a red tide, when waters turn reddish-brown as organisms rapidly multiply and "bloom," her counts have reached 4–5 million cells in a liter of seawater.

The nontoxic and bioluminescent dinoflagellates *Lingulodinium polyedra* and *Noctiluca scintillans* often cause red tides off our coasts. During these events, you should find a beach at night and view the bright light of their bioluminescence in the breaking waves. Scripps marine biologist Mike Latz, who studies bioluminescence in marine organisms, suggests that you collect a water sample and shake it up in a dark closet at night to see the glow.

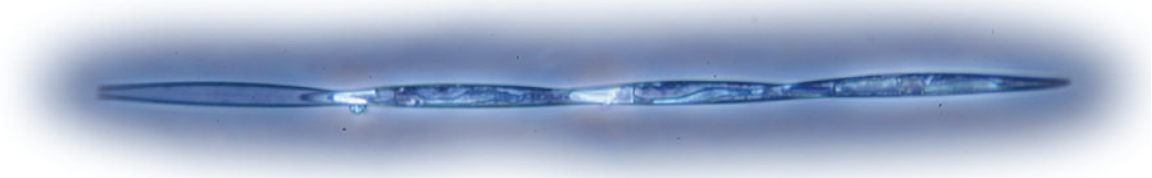


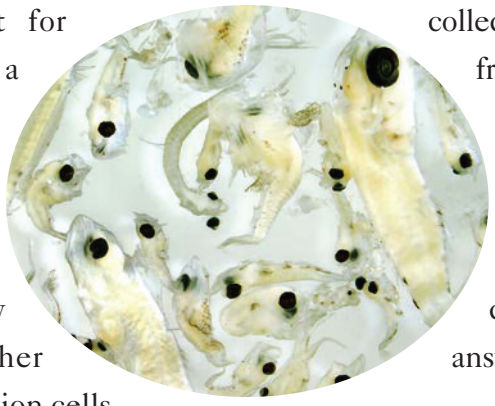


MONITORING THE MASSES

Long-term monitoring programs show that the mass of zooplankton off the coast of southern California has decreased by about 80 percent since 1951. What will that mean for our fisheries and wildlife? Scientists are working on this and other important questions.

Scientists like Busse continue work that began in 1917 when Scripps scientist W. E. Allen began collecting daily phytoplankton samples from the Scripps Pier. Samples and measurements from the past are valuable markers for comparison. Without them, researchers would not know whether conditions have changed and that they must seek out answers to new questions.

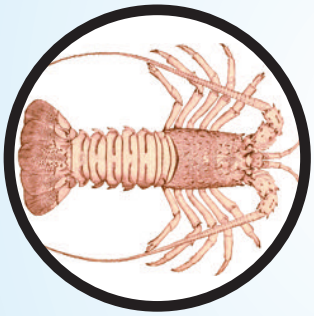
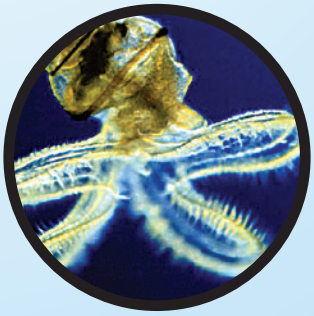




Left top, Lilian Busse samples the water from the Scripps Pier for harmful algal blooms. **Right top**, Diatoms **Right bottom**, Radiolarians. **Middle**, The diatom *Pseudo-nitzschia*. **Bottom**, Larval fish.

What Will I Be When I Grow Up?

Marine invertebrates undergo radical changes before becoming adults. Can you match the adults on the left with their larval form on the right?

ADULTS		LARVAE	
1. Marine snail			A.
2. Sea star			B.
3. Spiny lobster			C.
4. King crab			D.
5. Barnacle			E.

ANSWERS 1-E; 2-B; 3-D; 4-C; 5-A