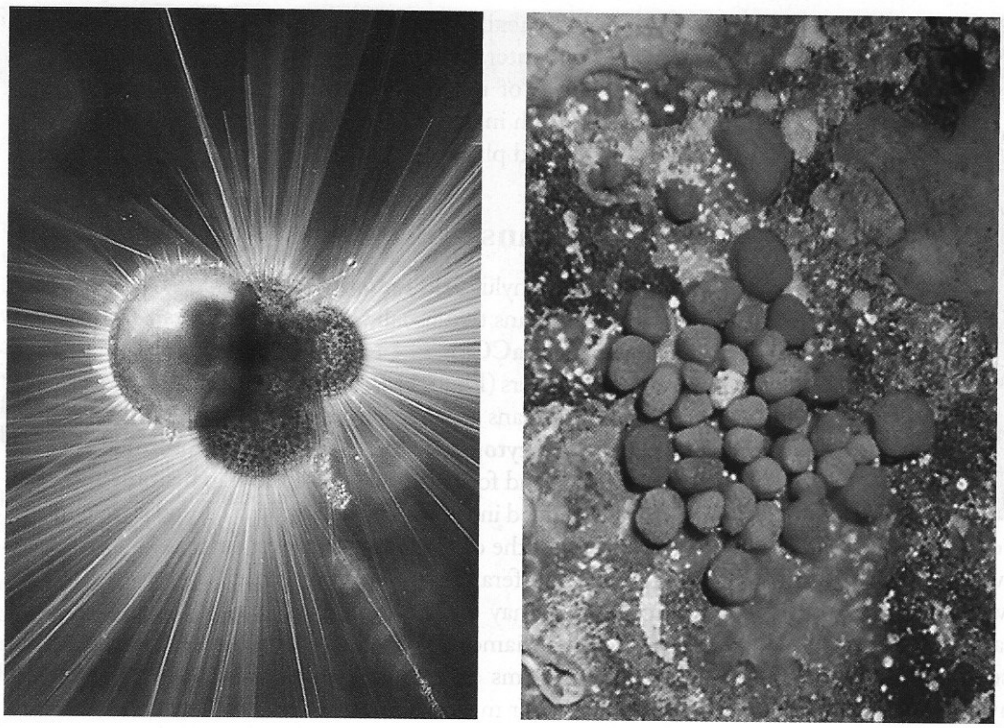

(a) (b)

FIGURE 5.11 Foraminiferans. (*a*) Foraminiferans typically have calcareous shells that consist of a spiral arrangement of chambers. The thin, long strands are the pseudopodia used to capture food. (*b*) *Homotrema rubrum* is a foraminiferan that forms bright red calcareous growths several millimeters in diameter at the base of corals in the tropics. It is so common in Bermuda that its skeletons are responsible for the island's famous pink beaches.

Radiolarians

Radiolarians (phylum **Polycystina**) are planktonic marine protozoans that secrete elaborate and delicate shells made of glass (silica) and other materials. Typical shells are spherical with radiating spines (Fig. 5.12), though the structure varies. Thin, needle-like pseudopodia capture food, as in foraminiferans.

Most radiolarians are microscopic, but some form sausage-shaped colonies that reach 3 m (9 ft) in length, making them true giants among protozoans. Radiolarians inhabit open water throughout the oceans. When abundant, the remains of their shells settle to the bottom and form a siliceous ooze known as **radiolarian ooze.** This ooze is more extensive in deep water because radiolarian shells are more resistant to dissolving under pressure than those of forams.

The shells of radiolarians are made primarily of silica (glass). These shells form siliceous sediments that cover large areas of the ocean floor.

Ciliates

Ciliates (phylum **Ciliophora**) are protozoans that have many hair-like **cilia,** which are used in locomotion and feeding. The most familiar ciliates are freshwater forms, such as *Paramecium.* Many marine ciliates are found creeping over seaweeds and in bottom sediments. Some live on the gills of clams, in the intestines of sea urchins, on the skin of fishes, and in other unusual places. Other ciliates live attached to surfaces, even forming branched colonies of tiny individuals. **Tintinnids** are common ciliates that drift in the water and build vase-like cases, or **loricas,** loosely fitting shells that drift in the water (Fig. 5.13). The cases may be transparent or made of bits of particles. Planktonic ciliates are important in the so-called microbial loop of open-water food webs, which facilitates the flow of energy from dissolved organic matter to the larger plankton (see Fig. 15.25).

FUNGI

Fungi (kingdom **Fungi**) are eukaryotic and mostly multicellular, though some, such as molds and yeasts, are unicellular. Multicellular fungi typically form long filaments called **hyphae.** Fungi are heterotrophs that lack chloroplasts and chlorophyll and cannot perform photosynthesis. As in plants and bacteria, however, fungi have cell walls.

There are at least 1,500 known species of marine fungi, mostly microscopic. Fungi absorb nutrients from their environment by secreting digestive enzymes, and many, as in bacteria, decompose detritus. They can decompose the cellulose in the cell walls of seaweeds and plants. Cellulose, which is abundant in driftwood and the dropped leaves of seagrasses and salt-marsh plants, is not digested by most bacteria. Fungi are the most important decomposers of dropped mangrove leaves and thus contribute to the recycling of nutrients in mangrove forests (see "Mangrove Forests," p. 279). Some are parasites of seagrasses or borers in mollusc shells. Others are parasites that cause diseases of economically important seaweeds, sponges, shellfish, and fishes. Some marine fungi are being investigated as a source of antibiotics for use in medicine.

FIGURE 5.12
A typical radiolarian cell consists of a dense central portion surrounded by a less dense zone that is involved in the capture of food particles and in buoyancy.