Section 15.2

# 1 FOCUS

## Section Objectives

**15.5** **Recognize** how marine organisms can be classified.
**15.6** **Differentiate** between plankton and nekton.
**15.7** **Describe** the area of the ocean in which most benthic organisms live.
**15.8** **List** the factors used to divide the ocean into marine zones.

**Reading Focus**

## Build Vocabulary L2

**Concept Map** Have students make a concept map using the term *marine life zones* as the starting point that connects to the following three terms: *availability of sunlight, distance from shore,* and *depth*. Students should use the following terms to complete their concept map: *pelagic zone, photic zone, oceanic zone, benthic zone, abyssal zone, intertidal zone,* and *neritic zone*.

## Reading Strategy L2

**a.** plankton capable of photosynthesis
**b.** microscopic algae
**c.** animal plankton
**d.** larval fish
**e.** organisms capable of moving independently of ocean currents
**f.** fish
**g.** organisms living on or near the ocean bottom
**h.** marine worms

# 2 INSTRUCT

## Classification of Marine Animals

### Build Reading Literacy L2

Refer to **p. 362D** in **Chapter 13**, which provides the guidelines for this reading strategy.

**Use Prior Knowledge** Have students write the names of several ocean organisms they know about or have heard about. Next to each name, have students write a description of the organism, where it lives, and how it obtains food. After students have read the section, have them review their lists and make corrections, if necessary. **Logical**



# 15.2 The Diversity of Ocean Life

**Reading Focus**

## Key Concepts

- How can marine organisms be classified?
- What is the difference between plankton and nekton?
- In which area of the ocean can most benthos organisms be found living?
- What factors are used to divide the ocean into marine life zones?

## Vocabulary

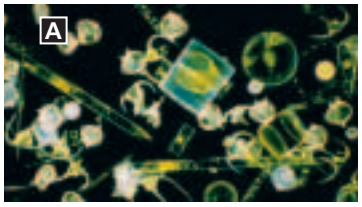
- plankton
- phytoplankton
- zooplankton
- nekton
- benthos
- photic zone
- intertidal zone
- neritic zone
- oceanic zone
- pelagic zone
- benthic zone
- abyssal zone

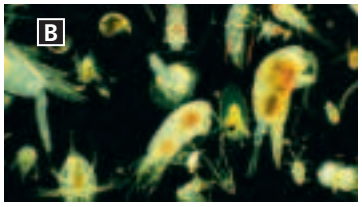
## Reading Strategy

**Building Vocabulary** Copy the table below. As you read, add definitions and examples to complete the table.

| Definitions | Examples |
|---|---|
| Plankton: organisms that drift with ocean currents | bacteria |
| Phytoplankton: a. ? | b. ? |
| Zooplankton: c. ? | d. ? |
| Nekton: e. ? | f. ? |
| Benthos: g. ? | h. ? |

**Figure 7** Plankton are organisms that drift with ocean currents. **A** This photo shows a variety of phytoplankton from the Atlantic Ocean. **B** The zooplankton shown here include copepods and the larval stages of other common marine organisms.




A wide variety of organisms inhabit the marine environment. These organisms range in size from microscopic bacteria and algae to the largest organisms alive today—blue whales, which are as long as three buses lined up end to end. Marine biologists have identified over 250,000 marine species. This number is constantly increasing as new organisms are discovered.

Most marine organisms live within the sunlit surface waters. Strong sunlight supports photosynthesis by marine algae. Algae either directly or indirectly provide food for the majority of organisms. All marine algae live near the surface because they need sunlight to survive. Most marine animals also live near the surface because this is where they can find food.

## Classification of Marine Organisms

**Marine organisms can be classified according to where they live and how they move.** They can be classified as either plankton (floaters) or nekton (swimmers). All other organisms are benthos, or bottom dwellers.

### Plankton

**Plankton** (*planktos* = wandering) **include all organisms—algae, animals, and bacteria—that drift with ocean currents.** Just because plankton drift does not mean they are unable to swim. Many plankton can swim but either move very weakly or move only vertically.

Among plankton, the algae that undergo photosynthesis are called **phytoplankton.** Most phytoplankton, such as diatoms, are microscopic. Animal plankton, are called **zooplankton.** Zooplankton include the larval stages of many marine organisms such as fish, sea stars, lobsters, and crabs. Figure 7 shows members of each group.

## Nekton

**Nekton** (*nektos* = swimming) **include all animals capable of moving independently of the ocean currents, by swimming or other means of propulsion.** Nekton are able to determine their position within the ocean and in many cases complete long migrations. Nekton include most adult fish and squid, marine mammals, and marine reptiles. Figure 8 shows examples of nekton.

Fish may appear to exist everywhere in the oceans, but they are more abundant near continents and islands and in colder waters. Some fish, such as salmon, swim upstream in fresh water rivers to spawn. Many eels do just the reverse, growing to maturity in fresh water and then swimming out of the streams to breed in the depths of the ocean.

## Benthos

**The term *benthos*** (*benthos* = bottom) **describes organisms living on or in the ocean bottom.** Figure 9 shows some examples of benthos organisms. The shallow coastal ocean floor contains a wide variety of physical conditions and nutrient levels. Most benthos organisms can be found living in this area. Shallow coastal areas are the only locations where large marine algae, often called seaweeds, are found attached to the bottom. These are the only areas of the seafloor that receive enough sunlight for the algae to survive.

Throughout most of the deeper parts of the seafloor, animals live in perpetual darkness, where photosynthesis cannot occur. They must feed on each other or on whatever nutrients fall from the productive surface waters. The deep-sea bottom is an environment of coldness, stillness, and darkness. Under these conditions, life progresses slowly. Organisms that live in the deep sea usually are widely distributed because physical conditions vary little on the deep-ocean floor.

**Figure 8** Nekton includes all animals capable of moving independently of ocean currents. **A** This squid can use propulsion to move through the water. **B** This school of grunts swims through the water with ease.
**Inferring** ***Why do you think some organisms, such as fish, are classified as plankton during some stages of their lives and nekton during other stages?***

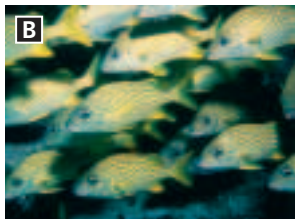




**Figure 9** Benthos describes organisms living on or in the ocean bottom. **A** Sea star **B** Coral crab





## Use Visuals

L1

**Figure 7** Have students examine the two photographs. Explain that the phytoplankton organisms shown in photograph A include dinoflagellates and diatoms. Explain that long narrow projections and other distinctive shapes contribute to the ability of these organisms to stay afloat. Remind students that diatoms have shell-like tests. Ask: **What may happen to these hard parts after these organisms die?** *(decay, or fall to the bottom and contribute to the sediment layer)* Explain that the zooplankton shown in photograph B are larval and adult copepods. Inform students that copepods are small crustaceans (related to crab and shrimp) on which many larger organisms depend for food. Ask: **What are the likely functions of the appendages on the larger specimens shown in the photograph?** *(feeding and swimming)*
**Visual, Logical**

## Build Science Skills

L2

**Classifying** Show students photographs or dried or preserved specimens of organisms to classify as plankton, nekton, or benthos. Ask students to explain the reasoning behind their classification decisions. *(Possible answers: Plankton are microscopic or very small. Phytoplankton have green pigment and show the ability to photosynthesize. Zooplankton have small swimming appendages; examples include diatoms, dinoflagellates, copepods, jellyfish, larval fish. Nekton have swimming appendages, are large and strong enough to swim against ocean currents; examples include adult fish, dolphins, whales, squid. Benthos live on the ocean bottom; examples include sea stars, most crabs, sea anemones, sea snails, clams, mussels.)*
**Visual, Logical**

## Customize for Inclusion Students

**Behaviorally Disordered** Have students work together to create a two-dimensional model of ocean life zones on the classroom bulletin board. Students can use Figure 10 as a starting point. Challenge students to draw or paint and label continental shelf, continental slope, ocean basin, photic zone, aphotic zone, and benthic zone on a large piece of poster board or butcher paper. Have students add labeled organisms to appropriate areas of their model. Students can make their own drawings of organisms, cut out photographs from old magazines, or photocopy illustrations from books.

### *Answer to . . .*

**Figure 8** *As larvae, fish are not able to move against ocean currents, they drift with the current. As adults, fish are able to swim and move independently of ocean currents.*

## Marine Life Zones

### Use Community Resources

L2

**Aquarium Field Trip** Take students on a field trip to a local public aquarium or museum with ocean life exhibits. Alternatively, students could visit a pet store that specializes in saltwater aquariums. Have students select one or more organisms they observe during their visit and write a short paper describing it. Encourage students to classify each of their organisms as belonging to plankton, nekton, or benthos; to identify the ocean zone in which the organism lives; and to explain how the organism obtains food.
**Kinesthetic, Logical**

### Use Visuals

L1

**Figure 10** Have students examine the drawing of the ocean basin. Ask: **What marine life zones are found on or above the continental shelf?** *(intertidal, neritic, photic)* **Where does photosynthesis take place?** *(euphotic zone)*
**Visual, Logical**

### Build Science Skills

L2

**Inferring** After students have examined Figure 10, ask: **Should all intertidal and neritic organisms be classified as benthos? Why?** *(No. Not all of the organisms in these zones live on the ocean bottom. Some of these organisms, including many fish species, jellyfish, and plankton, live above bottom in the water column.)*
**Logical, Verbal**

Go Online NSTA SciLinks

Download a worksheet on marine ecosystems for students to complete, and find additional teacher support from NSTA SciLinks.

Go Online NSTA SciLinks

**For:** Links on marine ecosystems
**Visit:** www.SciLinks.org
**Web Code:** cjn-5152

## Marine Life Zones

The distribution of marine organisms is affected by the chemistry, physics, and geology of the oceans. Marine organisms are influenced by a variety of physical factors. **Three factors are used to divide the ocean into distinct marine life zones: the availability of sunlight, the distance from shore, and the water depth.** Figure 10 shows the different zones in which marine life can be found.

**Availability of Sunlight** The upper part of the ocean into which sunlight penetrates is called the **photic zone** (*photos* = light). The clarity of seawater is affected by many factors, such as the amount of plankton, suspended sediment, and decaying organic particles in the water. In addition, the amount of sunlight varies with atmospheric conditions, time of day, season of the year, and latitude.

The euphotic zone is the portion of the photic zone near the surface where light is strong enough for photosynthesis to occur. In the open ocean, this zone can reach a depth of 100 meters, but the zone will be much shallower close to shore where water clarity is typically reduced. In the euphotic zone, phytoplankton use sunlight to produce food and become the basis of most oceanic food webs.

Although photosynthesis cannot occur much below 100 meters, there is enough light in the lower photic zone for marine animals to avoid predators, find food, recognize their species, and locate mates. Below this zone is the aphotic zone, where there is no sunlight.

Reading Checkpoint

***What is the difference between the photic zone and the aphotic zone?***

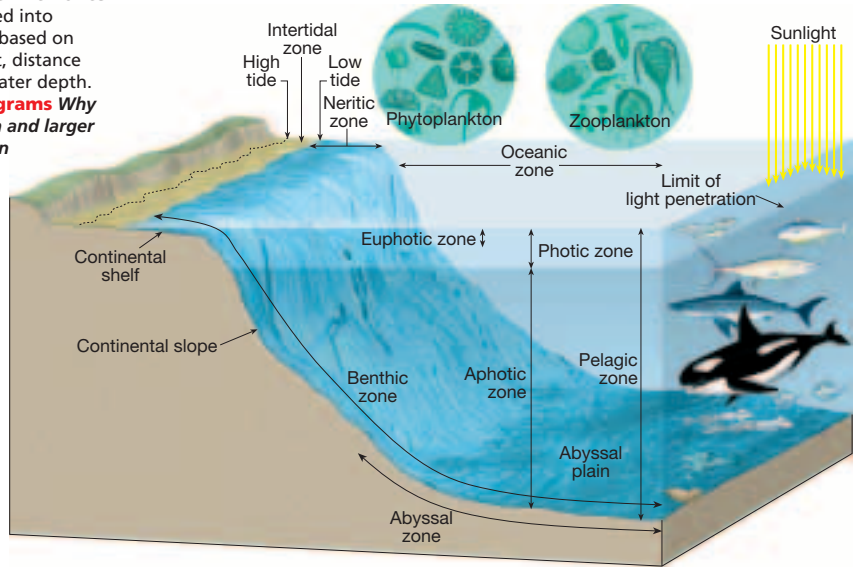



**Figure 10 Marine Life Zones** The ocean is divided into marine life zones, based on availability of light, distance from shore, and water depth. **Interpreting Diagrams** ***Why are phytoplankton and larger algae found only in surface waters?***



### Facts and Figures

Of the more than 300 shark species, about 80 percent are unable to harm people or rarely encounter people. The largest shark—also the largest fish in the world—is the whale shark *(Rhincodon typus)*. It reaches lengths of up to 15 m but eats only plankton and is therefore not considered dangerous. The great white shark *(Carcharodon carcharias)* is a predator that feeds preferentially on pinnipeds (seals and sea lions) and has attacked humans swimming or surfing in pinniped habitat areas. A great white can grow to 7 m long and weigh up to 2250 kg. Sharks are classified as nekton.

**Distance from Shore** Marine life zones can also be subdivided based on distance from shore. The area where the land and ocean meet and overlap is the **intertidal zone.** This narrow strip of land between high and low tides is alternately covered and uncovered by seawater with each tidal change. It appears to be a harsh place to live with crashing waves, periodic drying out, and rapid changes in temperature, salinity, and oxygen concentrations. However, the species that live here are well adapted to the constant environmental changes.

Seaward from the low-tide line is the **neritic zone.** This zone covers the gently sloping continental shelf. The neritic zone can be very narrow or may extend hundreds of kilometers from shore. It is often shallow enough for sunlight to reach all the way to the ocean floor, putting it entirely within the photic zone.

Although the neritic zone covers only about 5 percent of the world ocean, it is rich in both biomass and number of species. Many organisms find the conditions here ideal because photosynthesis occurs readily, nutrients wash in from the land, and the bottom provides shelter and habitat. This zone is so rich that it supports 90 percent of the world's commercial fisheries.

Beyond the continental shelf is the **oceanic zone.** The open ocean reaches great depths. As a result, surface waters typically have lower nutrient concentrations because nutrients tend to sink out of the photic zone to the deep-ocean floor. This low nutrient concentration usually results in smaller populations than the more productive neritic zone.

**Water Depth** A third method of classifying marine habitats is based on water depth. Open ocean of any depth is called the **pelagic zone.** Animals in this zone swim or float freely. The photic part of the pelagic zone is home to phytoplankton, zooplankton, and nekton, such as tuna, sea turtles, and dolphins. The aphotic part of this zone has giant squid and other species that are adapted to life in deep water.

Benthos organisms such as giant kelp, sponges, crabs, sea anemones, sea stars, and marine worms that attach to, crawl upon, or burrow into the seafloor occupy parts of the benthic zone. The **benthic zone** includes any sea-bottom surface regardless of its distance from shore and is mostly inhabited by benthos organisms.

The **abyssal zone** is a subdivision of the benthic zone. The abyssal zone includes the deep-ocean floor, such as abyssal plains. This zone is characterized by extremely high water pressure, consistently low temperature, no sunlight, and sparse life. Food sources at abyssal depths typically come from the surface. Some food is in the form of tiny decaying particles that steadily "rain" down from the surface. These particles provide food for filter-feeders, brittle stars, and burrowing worms. Other food arrives as large fragments or entire carcasses of organisms that sink from the surface. These pieces supply meals for actively searching fish, such as the grenadier, tripodfish, and hagfish.


**Q** *Do any deep-sea organisms produce light themselves?*

**A** Over half of deep-sea organisms—including fish, jellies, crustaceans, and deep-sea squid—can bioluminesce, which means they can produce light organically. These organisms produce light through a chemical reaction in specially designed structures or cells called photophores. Some of these cells contain luminescent bacteria that live symbiotically within the organism. In a world of darkness, the ability to produce light can be used to attract prey, define territory, communicate with others, or avoid predators.



## Build Science Skills

L2

**Classifying** After students have finished reading about marine life zones, have them create a table with two columns. Have students label the left column Photic Zone and the right column Aphotic Zone. Ask students to place each of the following marine life zones in the correct column: intertidal, neritic, oceanic, benthic, abyssal. If necessary, offer students the hint that some marine life zones may exist in both photic and aphotic zones. *Photic: intertidal, neritic, oceanic (partly), pelagic (partly) benthic (partly); Aphotic: benthic (partly), oceanic (partly), pelagic (partly), abyssal*

**Logical**

## Customize for Inclusion Students

**Gifted** Invite interested students to create classroom exhibits describing an ecosystem from one of the marine life zones. For example, students could put together a labeled photo collage of intertidal benthos organisms or a poster depicting a pelagic food web.

### *Answer to . . .*

**Figure 10** *Both types of organisms need sunlight for photosynthesis.*

Reading Checkpoint *Sunlight penetrates the photic zone; no sunlight reaches the aphotic zone.*

## Hydrothermal Vents

### Integrate Biology L2

Explain to students that the giant tubeworms living in hydrothermal vent communities do not have digestive systems. Even so, they can grow up to 3 m long. When scientists first discovered these organisms, they were baffled as to how they could grow so large with no obvious means of obtaining energy. Eventually, scientists learned that the worms get all the nutrition they need from bacteria growing inside their body cavities. Encourage students to look up more information about hydrothermal vents and the biological communities they support.

**Verbal, Logical**

## 3 ASSESS

### Evaluate Understanding L2

To assess students' understanding of section content, present a profile of the ocean floor and have them label the locations of the following marine life zones: intertidal, neritic, oceanic, benthic, abyssal, photic, aphotic, and euphotic.

### Reteach L1

Help students review the marine life zones by asking them to identify similarities and differences in pairs of terms, such as *intertidal* zone and *neritic* zone *(both in photic zone, continental shelf region, include benthos, nekton, and plankton; interidal is between tides, neritic is below tides); phytoplankton* and *zooplankton (float with ocean currents, found in oceanic and intertidal zones, phytoplankton photosynthesize, zooplankton do not); benthic* zone and *abyssal* zone *(both involve ocean bottom, abyssal is deep ocean bottom only)*

Writing in Science

Student tables should reflect the material presented in this section.

**Figure 11** When super-heated water meets cold seawater, minerals and metals precipitate out of the water to form this black smoker.

## Hydrothermal Vents

Among the most unusual seafloor discoveries of the past 30 years have been the hydrothermal vents along the oceanic ridge. Here seawater seeps into the ocean floor through cracks in the crust.

The water becomes super-heated and saturated with minerals. Eventually the heated water escapes back into the ocean. When the hot water comes in contact with the surrounding cold water, the minerals precipitate out, giving the water the appearance of black smoke. These geysers of hot water are referred to as black smokers, like the one shown in Figure 11.

At some vents water temperatures of 100°C or higher support communities of organisms found nowhere else in the world. In fact, hundreds of new species have been discovered surrounding these deep-sea habitats since scientists found some vents along the Galápagos Rift in 1977. Chemicals from the vents become food for bacteria. The bacteria produce sugars and other foods that enable them and many other organisms to live in this very unusual and extreme environment. Look at Figure 12 for another example of organisms found along hydrothermal vents.

**Figure 12** Tube worms up to 3 meters in length are among the organisms found along hydrothermal vents.

## Section 15.2 Assessment

### Reviewing Concepts

1. How can marine organisms be classified?
2. What is the difference between plankton and nekton?
3. In which area of the ocean do most benthos organisms live?
4. What factors are used to divide the ocean into marine life zones?
5. Why is the neritic zone rich in life?

### Critical Thinking

6. **Inferring** Why do many fish in the abyssal zone locate food through chemical sensing?
7. **Inferring** Organisms that live in the intertidal zone must deal with harsh and changing conditions. What types of adaptations would benefit organisms living in this zone?

Writing in Science

**Making Tables** Make a table to organize the information about marine life zones presented in this section. Include the basis by which the zone is classified, any subdivisions of the zone, and the characteristics of each zone within the table.



## Section 15.2 Assessment

1. by where they live and how they move
2. Nekton are able to move independently of ocean currents. Plankton are not.
3. on the shallow coastal ocean floor
4. availability of sunlight, distance from shore, water depth
5. Conditions are ideal for photosynthesis because there is light and nutrients from runoff; the bottom provides shelter and habitat.
6. The abyssal zone is vast and there is no light, so fish cannot depend on being able to find food by sight.
7. Students' answers will vary but should show that they understand the factors an organism living in the intertidal zone has to deal with. Answers may include having a shell that can be sealed to prevent drying out, having a way to attach firmly to rocks, having a shell to protect against wave action, being able to live in an area with a wide temperature and salinity range.