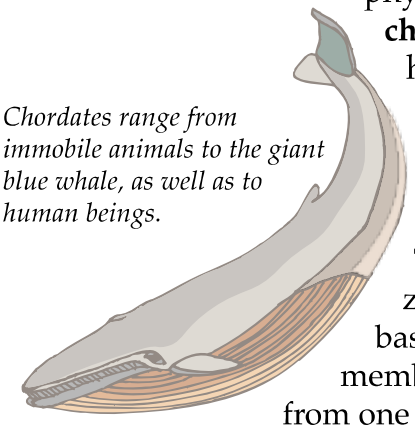
Introduction: Classifying Marine Animals—Primitive to Complex

Zoologists classify animals into major groups. One of the largest classification groups is called a **phylum**. See the chart called *Phyla of Marine Organism* on the following page. Animals belonging to a specific phylum will share similar traits. For example, **chordates**, animals in the phylum *Chordata*, all have notochords (rods that support their bodies), nerve cords, and gill slits at some point in their lives. Chordates range from immobile animals to the giant and complex blue whale, as well as to us—human beings. This broad range of chordates illustrates that zoologists group animals according to some basic traits they share. It also shows that members of a phylum may look very different from one another.



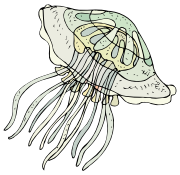
Chordates range from immobile animals to the giant blue whale, as well as to human beings.

The phylum Chordata includes **vertebrates**, a highly developed group of animals with backbones. Most animals, however, are in the other *phyla*. They do *not* have backbones and are classified as **invertebrates**. This unit will survey some of the invertebrates and vertebrates that are common in the marine environment.

Invertebrates: Well Adapted to Their Habitats

Invertebrates are often thought of as being more primitive—less complex—than vertebrates. Animals in some invertebrate phyla do have very simple body structures. But animals in other invertebrate phyla have nervous systems and skeletons as intricate as those of vertebrates.

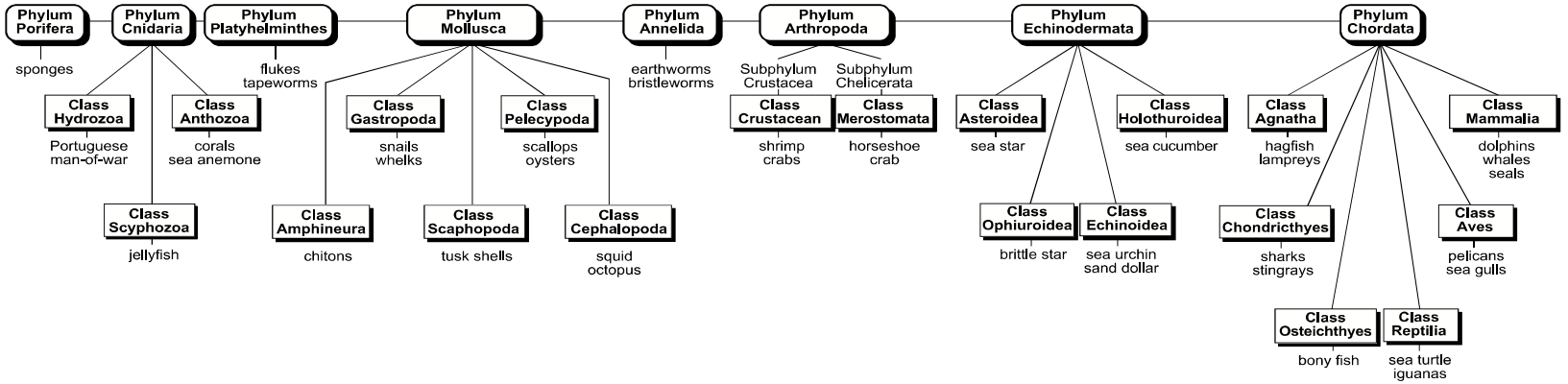
For example, marine invertebrates have a variety of different kinds of skeletons. The type of skeleton an animal has is specially suited to its environment. There are three types of skeletons: the **hydrostatic skeleton**, the **exoskeleton**, and the **endoskeleton**.



Jellyfish have a hydrostatic skeleton.

An animal with a *hydrostatic* skeleton is built like a bag made of muscles. When the muscles contract, or shorten, they push against the water inside the muscle bag, or cavity. This is very easy to see in a jellyfish, which has a

Phyla of Marine Organisms



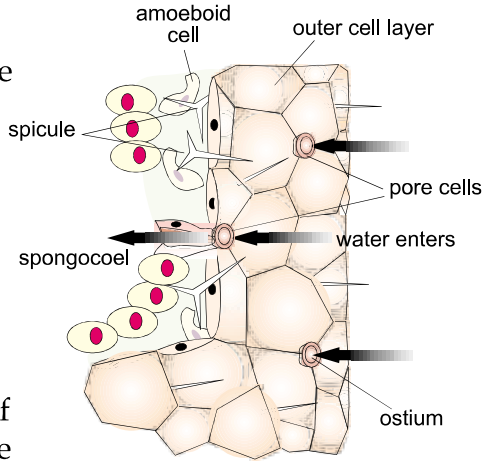
hydrostatic skeleton. An *exoskeleton* is a hard coating that covers an animal's internal organs and muscles. Insects are examples of animals that have exoskeletons. An *endoskeleton* is a framework that is located inside the body of an animal. One of the simplest animals in the world has an endoskeleton—the sponge. One of the most complex animals in the world also has an endoskeleton—the human!

Porifera: Phylum of the Ancient and Primitive

The phylum **Porifera (PO-rif-er-a)** contains the most primitive *multi*celled animals found on Earth. Sponges have been on our planet for at least 500 million years. They probably evolved from one-celled animals that lived together in colonies. The cells then became dependent on each other and lived together for mutual benefit. The sponge is a result of the close association of these cells. The sponges now found in the ocean have different cell types. Each type specializes in specific functions but relies on other types of cells for survival. A sponge can be ground up into individual cells that will reassociate to form a new animal.

Porifera means "pore bearer" and describes the sponge's structure. Its body is made up of two layers of cells that have pores or holes. Some cells have the task of drawing a current of water in through the pores and flushing it out through the top of the animal. As the water passes through the sponge, other cells filter out tiny particles of food, usually plankton. Other cell types then transport this food to all the cells in the sponge; and other groups of cells dispose of waste and reproduce. Inside their many pores, sponges sometimes provide shelter and habitat for numerous other organisms. The inside of a sponge may even serve as home for the entire life of some small or microscopic marine organisms.

Between the layers of cells in sponges are tiny support structures called *spicules*. These spicules interconnect to form an endoskeleton. When a sponge dies, it is this spicule skeleton that is left behind. Some sponges do not have spicules; instead they have a skeleton made of a protein called *spongin*.



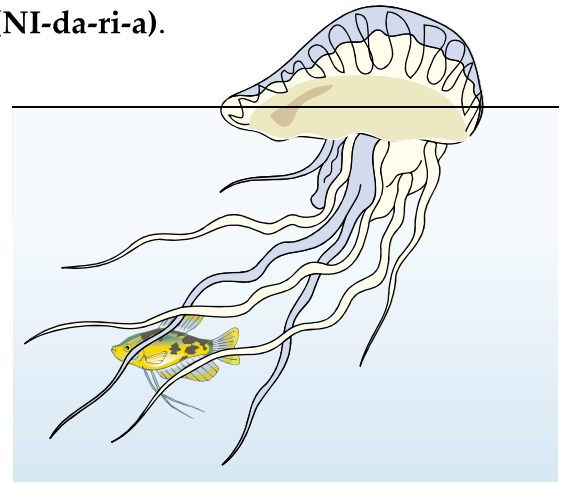
anatomy of a sponge

Most of the over 10,000 different kinds of sponges live in the ocean; however, some are found in freshwater habitats. Most are

found in shallow waters and all are *sessile*: They are immobile and attach themselves to permanent objects such as rocks, shells, coral, piers, and even boats. Until recently, these marine animals were used as the common "sponge" to "sponge" up water in our kitchens and bathrooms. Most sponges used today are made of synthetic materials.

Cnidaria: Stingers in the Ocean

Most beach-goers in Florida are quite familiar with members of the phylum **Cnidaria (NI-da-ri-a)**. Cnidaria means "stinging celled," and it aptly describes its members, which include the stinging jellyfish and Portuguese man-of-war. Most members of this phylum have tentacles armed with tiny, stinging cells that they use for gathering food and protecting their soft bodies. Some of these animals can cause severe stings and even death, whereas others are harmless to humans.



The Portuguese man-of-war is a member of the Cnidaria phylum and have tentacles armed with tiny, stinging cells that use for gathering food and protecting their soft bodies.

Animals in this phylum have bag-like bodies made up of two-cell layers. Their stomach cavity or "gut" has only one opening—the mouth. The jellyfish and Portuguese man-of-war are part of the *plankton* (drifting or floating organisms); other members such as the coral, sea whip, and sea anemone are *benthic*. They attach themselves to the seafloor or other surfaces.

Phyla of Worms

Many different phyla of worms swim and inch through the ocean. Most of them are benthic—crawling or burrowing in the sediments of the seafloor. A few types of worms, however, actually swim or float. Some worms build tubes out of cemented sand grains or small shells. Others are *parasitic* and survive by living on the **gills** or bodies of other marine animals. Three noteworthy and numerous worm groups are the *flatworms* (in the phylum *Platyhelminthes*), the *roundworms* (in the phylum *Nematodes*), and the *segmented worms* (in the phylum *Annelida*).

Flatworms are flat, ribbonlike worms that have a solid body wall with no body cavity and one body opening. Many survive as parasites on vertebrates and are commonly found on the gills of the horseshoe crab. Other flatworms, however, are "free living" and must search for food.

The most numerous group of worms is the roundworms, or nematodes. They are found in almost every type of habitat. Most roundworms are small—less than one centimeter long. Their bodies are round and *unsegmented*, containing a body cavity and a tube-like digestive track. They have well-developed muscles, and many roundworms survive as parasites.

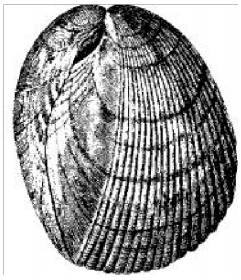
Many different phyla of worms swim and inch through the ocean.

Segmented worms, or **annelids**, are the most advanced of the worms. Their round bodies are elongated and divided internally and externally into repeating segments. They have a body cavity, circulatory system with blood vessels, a nerve cord, and an entrance and exit to their digestive system. Annelids can be fairly large. Some clamworms, for example, grow to over 18 inches long. Bloodworms and bristleworms are other common annelids found near shore.

Mollusks: Soft Bodies Protected by Shells

One of the largest groups of invertebrates is the phylum *Mollusca*. **Mollusks**, which means "soft bodied," are sometimes referred to as *shellfish*. Many mollusks have a special fold of skin called a *mantle*, which secretes some type of shell to protect their soft bodies. Another distinctive characteristic for all mollusks is the muscular "foot" they use to move from place to place. Mollusks include snails, nudibranchs, clams, oysters, mussels, octopus, and squid.

univalve



bivalve

The shelled mollusks are divided into those with one shell (the *univalves*), such as the snail, and those with two shells (the *bivalves*), such as the clam and oyster. The

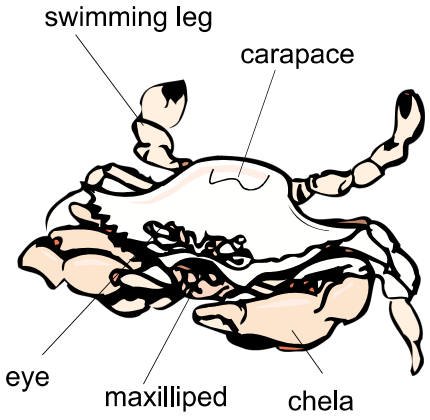
squid and octopus belong to a different group because they lack an external shell and have a well developed head. Most mollusks are valued as a food source, and their shells are sometimes used for jewelry.

Arthropods: From Lobsters to Spiders

Arthropods (meaning "joint-footed) range from lobsters to spiders to ants and other insects.

Members of the phylum *Arthropoda* are called **arthropods** (meaning "joint-footed") and range from lobsters to spiders to ants and other insects. They are the most numerous in the animal kingdom and share some very distinct traits. In addition to having jointed feet or legs, they have segmented bodies and a hard outer shell called an *exoskeleton*. Periodically, arthropods shed their shells, a process called *molting*, and secrete a new shell to accommodate growth.

Most marine arthropods belong to a subgroup or class called **crustaceans**, which are found in all benthic environments. Barnacles, lobsters, shrimp, and crabs belong to this family. Most crustaceans use gills to breathe and have two pairs of sensory appendages on their heads called *antennae*. They also have paired limbs, or appendages, that are adapted to their specific habitat. The lobster and crab, for example, have large pincers which they use to grab their food and to protect themselves. Shrimp have legs modified for walking, feeding, and swimming. Barnacles, sessile animals, use their modified legs for filtering food from the water.



external anatomy

The phylum Arthropoda contains the widest variety of organisms in the ocean, from planktonic forms such as the copepod to the ancient horseshoe crab.

Echinoderms

Echinoderms are spiny-skinned marine animals such as the sea star (starfish). Adult echinoderms have radial symmetry, or a circular design, with five body parts.

Members of the phylum *Echinodermata*—called **echinoderms (eh-KY-noh-derms)** —are spiny-skinned marine animals quite familiar to beach-goers. You would know them as sea stars (starfish), sea urchins, sand dollars, brittle stars, and sea cucumbers. In addition to their spiny, bumpy external covering, adult echinoderms have *radial symmetry*, or a circular design, with five body parts. They also have an endoskeleton called a *test* made up of plates or bumps of calcium carbonate. Echinoderms move about by forcing water along a system of tubes and canals in their bodies connected to tubed feet. By alternately contracting and expanding these tube feet, most echinoderms can slowly crawl across the ocean floor. Their tube feet also function in sensing their surroundings and in feeding.

Chordates

Chordates—animals in the phylum *Chordata*—all have these traits at some point in their development:

(1) a notochord, a thin flexible rod to support their body;

(2) a nerve cord running down their back; and

(3) gill slits, which develop for respiration in **fish** and into pharyngeal arches, which aid in circulation, in **reptiles**, **birds**, and **mammals**.

These traits are *not* all apparent in all adult chordates. However, they do occur at some life stage in all chordates. For example, we do not see gill slits in humans because they are visible only in the embryo stage, before birth.

All of the *lower* chordates are marine animals. These include tunicates, which do not resemble animals at all. Tunicates are sessile-filter feeders that resemble a sponge or blob. Examples include sea porks and sea squirts.

The more advanced chordates belong to the subphyla *Vertebrata*. These animals with a backbone are commonly called *vertebrates* and are divided into five groups: fish, **amphibians**, reptiles, birds, and mammals.

Fish: Jawless, Cartilaginous, and Bony

Fish are *cold-blooded* animals that live in water and breathe through gills. Cold-blooded animals have a body temperature that changes with the temperature of their surroundings. There are three classes of fish: *the jawless fish* (lampreys), the *cartilaginous* fish (sharks and rays), and the *bony fish*. Each class of fish has distinguishing characteristics. (See Unit 15.)

Familiar cartilaginous fish include sharks and stingrays.

Lampreys are slimy, scaleless, jawless fish. They resemble a muscular tube with a mouth full of razor-sharp teeth and a strong tongue. A lamprey is parasitic and feeds on the body fluids of other living fish.

Cartilaginous fish have flexible skeletons made of cartilage: a softer version of bone. They have fine, sharp, toothlike spines covering their bodies. Familiar cartilaginous fish include sharks and stingrays.

Bony fish—all 30,000 species—include most other fish, including the goldfish.

Bony fish—all 30,000 species—include most other fish: the goldfish, mullet, flounder, and seahorse, to name just a few. Bony fish are distinguished by skeletons made of bone, and broad, flat scales covering their bodies.

Amphibians: Living in Water and on Land

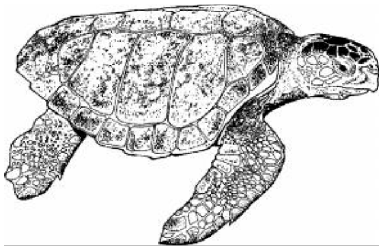
After hatching from eggs, most *amphibians* live in water and breathe through gills. After developing into adults, they live most of their lives on land, although near water, and breathe through lungs. Nearly all amphibians return to water to reproduce. Among the most familiar

amphibians are frogs, toads, and salamanders. Most amphibians are not able to live in saltwater because their skin is too thin to protect them from the drying effect of salt.

Reptiles: Adapted to Life on Land

A group of cold-blooded, air-breathing vertebrates known as *reptiles* includes turtles, lizards, alligators, crocodiles, and snakes. Reptiles do not have to live in water because they have dry, scaly skin that protects against water loss. In addition, their eggs have a coating or shell that keeps them from drying out. Several types of reptiles, however, do live in water. Poisonous sea snakes are found in tropical waters; alligators and crocodiles are common in near-shore habitats such as swamps and marshes; and marine iguanas can be found on rocky shores, mangrove swamps, and beaches in the Galapagos Islands.

Many huge turtles also make the sea their home. Two species of sea turtles, the green and the loggerhead, grow to weigh over 400 pounds. The Atlantic Ridley and the hawksbill turtles are found in Florida waters and nest on our beaches. Female sea turtles crawl above the high-tide line on the beach to lay their eggs in nests under the sand. Then they leave their nests and return to the sea to feed. When the young turtles hatch, they must find their way to the sea on their own. Many are eaten by dogs or raccoons; some head towards lighted roads instead of the water, and only a very few survive to adulthood. Marine turtles are classified as *endangered*. It is illegal in the United States to kill or possess sea turtles or their eggs, harass nesting turtles, or disturb turtle nests.



Many huge turtles make the sea their home.

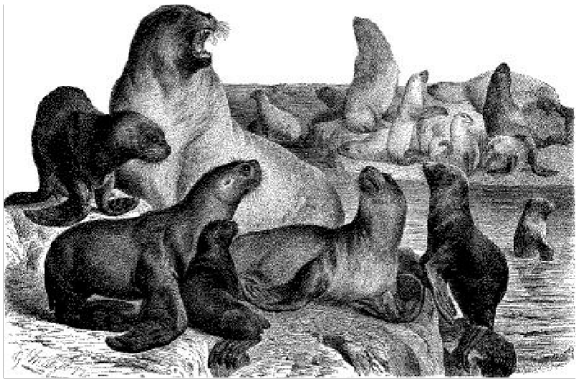
Birds: Low Weight and High Power

Birds are *warm-blooded* vertebrates with feathers. Warm-blooded animals have a body temperature that stays about the same temperature no matter what the temperature of the surroundings is. All birds also have wings, although some use them for purposes other than flying. Penguins, for example, use them to swim. Most birds have two traits that make them well adapted for flying. Birds have a lightweight skeleton of hollow bone that is easy to carry in flight. They also have a high metabolic rate that generates energy and power necessary for flight.

Sea birds are common in coastal habitats. Many birds rely on the ocean for food during long migrations. Common marine birds include the gulls, terns, skuas, albatross, and penguins.

Mammals: Earth's Largest Creatures

Mammals are another group of vertebrates. They have lungs, breathe air, provide milk for their young, and have hair. Mammals also maintain a regular body temperature, making them warm-blooded. The largest creature to have ever lived is a mammal—the blue whale—which may weigh in at over 150 tons and can measure 100 feet in length—about the length of two and one-half school buses. Marine mammals include the whale, porpoise, seal, sea lion, sea otter, and manatee. A separate unit is devoted to marine mammals (see Unit 16).



Marine mammals include the whale, porpoise, seal, sea lion, sea otter, and manatee.

Summary

Animals are classified in major groups called *phyla*. One phylum of animals—the chordates—has notochords, nerve cords, and gill slits at some point in their development. *Vertebrates*, a more developed subphylum of chordates, are animals with backbones such as fish, amphibians, reptiles, birds, and mammals. Three classes of fish, the jawless fish (lampreys), cartilaginous fish (sharks and rays), and bony fish (30,000 species), make their home in the marine environment. With the exception of amphibians, other types of vertebrates live in saltwater habitats, too. Most animals do *not* have backbones and are classified as *invertebrates*. Groups of invertebrates commonly found in the marine biome include sponges (Porifera), jellyfish (Cnidaria), worms, mollusks, arthropods, and echinoderms.