28.1A: Phylum Porifera

Sponges lack true tissues, have no body symmetry, and are sessile; types are classified based on presence and composition of spicules.

Learning Objectives

• Explain the position of the phylum Porifera in the phylogenetic tree of invertebrates

Key Points

• As larvae, sponges are able to swim, but as adults, they are sessile, spending their life attached to a substrate.
• Although the majority of sponges live in marine habitats, one family, the Spongillidae, is found in fresh water.
• Calcarea, Hexactinellida, Demospongiae, and Homoscleromorpha make up the four classes of sponges; each type is classified based on the presence or composition of its spicules or spongin.
• Most sponges reproduce sexually; however, some can reproduce through budding and the regeneration of fragments.
• The majority of sponges are filter-feeders, but a few species are carnivorous due to the nutrient-poor environment in which they are found.

Key Terms

• parazoan: include only one phylum known as the sponges
• endosymbiont: an organism that lives within the body or cells of another organism
- **spongin**: a horny, sulfur-containing protein related to keratin that forms the skeletal structure of certain classes of sponges
- **spicule**: a sharp, needle-like piece
- **holdfast**: a root-like structure that anchors aquatic sessile organisms, such as seaweed, other sessile algae, stalked crinoids, benthic cnidarians, and sponges, to the substrate

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**Introduction**

The invertebrates, or Invertebrata, are animals that do not contain bony structures such as the cranium and vertebrae. The simplest of all the invertebrates are the Parazoans, which include only the phylum Porifera. Phylum Porifera ("pori" = pores, “fera” = bearers) are popularly known as sponges. Sponge larvae are able to swim; however, adults are non-motile and spend their life attached to a substratum through a holdfast. The majority of sponges are marine, living in seas and oceans. There is, however, one family of fresh water sponges (Family Spongillidae). The great majority of the marine species can be found in ocean habitats ranging from tidal zones to depths exceeding 8,800 m (5.5 mi).

Sponges are classified within four classes: calcareous sponges (Calcarea), glass sponges (Hexactinellida), demosponges (Demospongiae), and the recently-recognized, encrusting sponges (Homoscleromorpha). The presence and composition of spicules and spongin are the differentiating characteristics between the classes of sponges. Demosponges, which contain spongin and may or may not have spicules, constitute about 90% of all known sponge species, including all freshwater ones, and have the widest range of habitats. Calcareous sponges, which have calcium carbonate spicules and, in some species, calcium carbonate exoskeletons, are restricted to relatively shallow marine waters where production of calcium carbonate is easiest. They contain no spongin. Hemoscleromorpha sponges tend to be massive or encrusting in form and have a very simple structure with very little variation in spicule form (all spicules tend to be very small). Hexactinellid sponges have sturdy lattice-like internal skeletons made up of fused spicules of silica; they tend to be more-or-less cup-shaped.

![Sponge Spicule](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/28%3A_Invertebrates/28.3%3A_Porifera)

**Sponge Spicule**: Sponges are classified based on the presence and types of spicules they contain.
Types of sponges: (a) *Clathrina clathrus* belongs to class Calcarea, (b) *Staurocalyptus* spp. (common name: yellow Picasso sponge) belongs to class Hexactinellida, and (c) *Acanthella erithacus* belongs to class Demospongia.

Unlike Protozoans, the Poriferans are multicellular. However, unlike higher metazoans, the cells that make up a sponge are not organized into tissues. Therefore, sponges lack true tissues and organs; in addition, they have no body symmetry. Sponges do, however, have specialized cells that perform specific functions. The shapes of their bodies are adapted for maximal efficiency of water flow through the central cavity, where nutrients are deposited, and leaves through a hole called the osculum. Many sponges have internal skeletons of spongin and/or spicules of calcium carbonate or silica. Primarily, their body consists of a thin sheet of cells over a frame (skeleton). As their name suggests, Poriferans are characterized by the presence of minute pores called ostia on their body.

Since water is vital to sponges for excretion, feeding, and gas exchange, their body structure facilitates the movement of water through the sponge. Structures such as canals, chambers, and cavities enable water to move through the sponge to nearly all body cells.

Most species use sexual reproduction, releasing sperm cells into the water to fertilize ova that in some species are released and in others are retained by the “mother.” The fertilized eggs form larvae which swim off in search of places to settle. Sponges are also known for regenerating from fragments that are broken off, although this only works if the fragments include the right types of cells. A few species reproduce by budding. When conditions deteriorate, such as when temperatures drop, many freshwater species and a few marine ones produce gemmules: “survival pods” of unspecialized cells that remain dormant until conditions improve. They then either form completely new sponges or recolonize the skeletons of their parents.

Most of the approximately 5,000–10,000 known species of sponges are filter-feeders, feeding on bacteria and other food particles in the water. However, a few species of sponge that live in food-poor environments have become carnivores that prey mainly on small crustaceans. Other species host photosynthesizing micro-organisms as endosymbionts; these alliances often produce more food and oxygen than they consume.