UG CBCS Semester-1

Phylum: PORIFERA (Sponges)

Sponges are multicellular organisms; invariably sessile and aquatic; with a single cavity in the body, lined in part or almost wholly by collared flagellate cells; with numerous pores in the body wall through which water passes in, and one or more larger openings through which it passes out; and generally with a skeleton, calcareous, siliceous, or horny.

The skeleton of sponges may be mineral in nature (calcareous $CaCO_3$ or siliceous SiO_2) or composed of protein and other components (spongin). The mineral skeleton is formed for the most part by units called spicules, either scattered throughout the sponge or united to form fibres; spicules are classified as megascleres, which function in support, and microscleres, which function in protection and also aid in support. Structure: Sponges are shapeless organisms, or they got tube-like or barrel-like shape. The Porifera are unusual animals in that they lack definite organs to carry out their various functions. The most important structure is the system of canals and chambers, called a water-current system, through which water circulates to bring food to the sponge.

Body consists of a sac with one opening, and with the wall composed of two cellular layers and a layer of secreted jelly between them. The inner layer is the **endoderm**. It consists of cells specialized for the processes of digestion, and the cavity which it lines is for the reception of food. The outer layer is the **ectoderm**: by its cells relations with the environment are regulated. The jelly substance in between is called **mesohyl**, in which cells of various types are scattered:

- **Collencytes** – star-like cells served for shape support;
- **Scleroblasts** (spicule cells) – skeleton-forming sells;
- **Amoebocytes** – reserve cells which can be transmuted into any type mentioned above or form sexual cells.

The essential elements of the water-current system include the pores, or ostia, through which water enters the sponge (incurrent system); the **choanocytes**, or collar cells, which are flagellated cells that capture food; and the **oscula**, openings through which water is expelled (excurrent system).

Three types of water-current systems of increasingly complex structure may be distinguished by the arrangement of choanocytes and the development of canals:

The simplest, or **ascon**, type, is characterized by an arrangement of **choanocytes** around a central cavity that directly communicates with the **osculum**. The walls of these sponges are thin, lack canals, and are perforated by pores, which actually are openings through cells (**porocytes**).

The **sycon** type of water-current system, is at first characterized by choanocytes that surround fingerlike projections called radial canals of the sponge wall. Water enters the radial canals directly through pores, makes its way into the central cavity, or spongocoel, and leaves by way of an osculum.

In the **leucon** type the radial canals are replaced by numerous small flagellated chambers in which the choanocytes are localized; the chambers, scattered throughout the body of the sponge, have pores through which water passes into a complex system of incurrent canals, then into a **spongocoel** (internal cavity) (**paragaster**) by way of excurrent canals. Water enters very small pores found among the cells (pinacocytes), which line the outer surface of the sponge. After passing through a system of incurrent canals and cavities, also lined with pinacocytes, the water reaches the flagellated chambers, enters them through openings (prosopyles), and

leaves through other openings (apopyles). The water is expelled through the osculum after passing through a system of excurrent canals and cavities lined with pinacocytes.

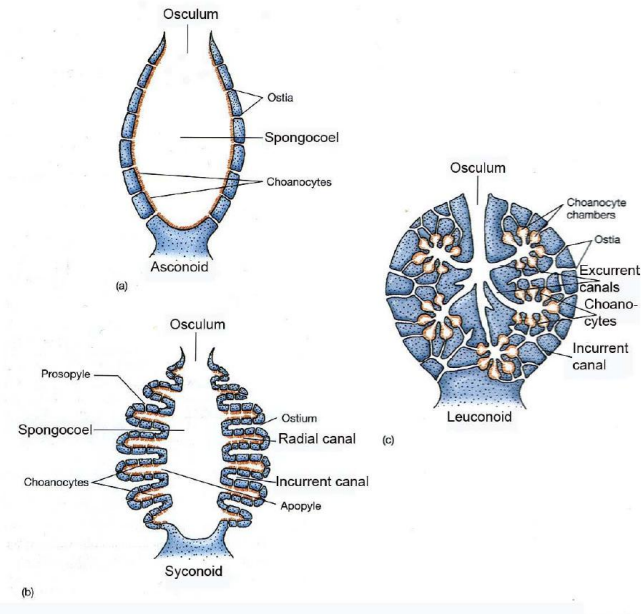


Figure: Body types in Sponges

In Phylum Porifera digestion takes place within cells (intra-cellular digestion). Spongocoel does not take part in digestion.

Life cycle: Most sponges reproduce sexually, although asexual reproduction may occur. Sponges are generally **hermaphroditic** (male and female germ cells in one animal); sometimes **dichogamy**, in which male and female germ cells develop at different times in the same animals, occurs.

Sexual reproduction: The fertilization of an egg by a spermatozoan is peculiar in sponges in that a spermatozoan, after its release from a sponge, is carried by the water current until it is captured by a specialized cell called a **choanocyte**, or collar cell, in another sponge. A larva swims for a period of time that may vary from a few hours to a few days before it descends to find a surface suitable for attachment. After attachment, the larva undergoes developmental changes (metamorphosis) becoming a young individual, and the young individual gradually develops into an adult sponge.

Asexual reproduction: Asexual reproduction occurs in sponges in various ways; the best known method is called gemmulation. Gemmulation begins when aggregates of cells become isolated at the surface of a sponge and are then called gemmules. These are expelled from the adult sponge and, in some marine species, serve as a normal reproductive process or, sometimes, as a means to carry the sponges over periods of unfavourable conditions when the adults degenerate; e.g., drought, temperature extremes.

Regeneration: The extraordinary capacity of sponges to regenerate is manifested not only by restoration of damaged or lost parts but also by complete regeneration of an adult from fragments or even single cells. Sponge cells may be separated by mechanical methods (e.g., squeezing a piece of sponge through fine silk cloth) or by chemical methods (e.g., elimination of calcium and magnesium from seawater).

Distribution and abundance: The Porifera are present at all water depths, from the tidal zone to the deepest regions (abyss). They occur at all latitudes and are particularly abundant in Antarctic waters. Calcispongia and Demospongia are found mainly on the rocky bottoms of the continental shelf; the Hyalospongia are characteristic of the deepest muddy bottoms of oceans and seas. In some environments, sponges are the dominating organisms; sometimes they cover wide areas, especially on rocky overhangs and in the caves of the littoral, or shore, zone. A restricted number of species are adapted to brackish waters; and members of the family Spongillidae (class Demospongiae) populate the fresh waters of rivers and lakes.

Classification

Class I: CALCAREA (Calcareous sponges)

Spicules of mineral skeleton composed entirely of calcium carbonate laid down as calcite, secreted extracellularly within a collagenous sheath (but with no axial filament); skeletal elements often not differentiated into megascleres and mi croscleres; spicules usually 1-, 3-, or 4-rayed; body with asconoid, syconoid, or leuconoid construction; many species exhibit superficial radial symmetry around a long axis, but in others there is no visible axial symmetry; early cleavage is total and equal; embryonic *cleavage* patterns probably fundamentally radial; all studied species are viviparous. All marine; occurring at all latitudes.

Subclass I: CALCINEA Free-living larvae are hollow, flagellated "coeloblastulas" (calciblastula); choanocyte nuclei located basally, and flagellum arises independent of nucleus (a presumptive synapomorphy of this subclass); with free, regular, triradiate spicules. (e.g., *Clathrina, Dendya, Leucascus, Leucetta, Soteneiscus).*

Subclass II: CALCARONEA Free-living larvae are unique, partly flagellated amphiblastulas, these typically forming by way of eversion of earlier stomoblastula "prelarvae" (which are held internally) a presumptive synapomorphy of this subclass; choanocyte nuclei apical, and flagellum arises directly from nucleus; spicules free or fused (e.g., *Arnphoriscus, Grantia, Leucosotenia, Sycon)*

Class II: HEXACTINELLIDA (Glass sponges)

Skeleton composed of a large array of siliceous spicules of various shapes and sizes, secreted intracellularly around a square proteinaceous axial filament; spicules with fundamental 3-axon or 6-rayed symmetry (triaxonic); both megascleres and microscleres always present. Entire sponge formed by a single continuous syncytial tissue, the trabecular reticulum, which stretches from the outside or dermal membrane, to the inside or atrial membrane, enclosing the cellular components of the animal. All studied species are viviparous; some produce a uniquely hexactinellid larva, the trichimella. Long lived, exclusively marine, usually vase- or tube-shaped (never encrusting), primarily deep water sponges.

Subclass I: AMPHIDISCOPHORA Body anchored in soft sediments by a basal tuft or tufts of spicules; megascleres are discrete spicules, never fused into a rigid network; with birotulate microscleres, never hexasters (e.g., *Hyalonema, Monorhaphis, Pheronema)*

Subclass II: HEXASTEROPHORA Usually attached to hard substrata, but sometimes attached to sediments by a basal spicule tuft or mat; microscleres are hexasters; megascleres free, or can be fused into a rigid skeletal framework, in which case sponge may assume large and elaborate morphology (e.g., *Aphrocallistes, Cautophacus, Euptectella, Hexactinella, Leptophragmetfa, Lophocalyx, Rosella, Sympagella)*

Class III: DEMOSPONGIAE (Demosponges)

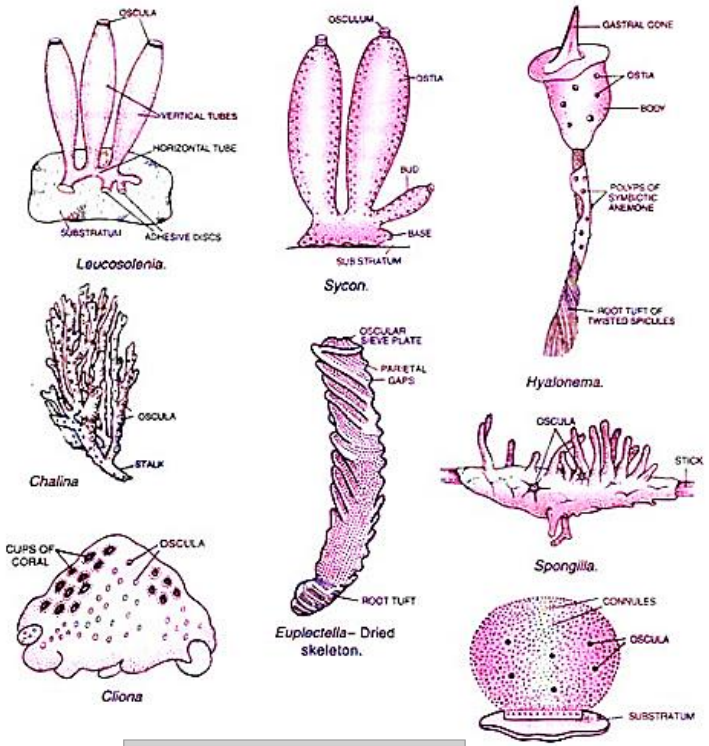
With siliceous spicules and/or an organic skeleton (or, occasionally, with neither) or in some groups, a solid calcific skeleton; spicules secreted intra- or extracellularly around a triangular or hexagonal axial filament; spicules never 6 -rayed (i.e., not triaxons); organic skeleton a collagenous network ("spongin"); most produce parenchymella larvae; viviparous or oviparous; marine, brackish, or freshwater sponges occurring at all depths. Many species exhibit a mesohyl community of Eubacteria, mainly Proteobacteria and gram-positive bacteria, as well as species of Archaea.

Subclass I: KERATOSA Skeleton of spongin fibers only, or with a hypercalcified skeleton *(Vaceletia).* Spongin fibers either homogenous or pithed, and strongly laminated with pith grading into bark. Reproduction typically viviparous, larvae are parenchymella. All commercial sponges belong to this subclass (e.g., *Spongia, Hippospongia, Coscinoderma, Rhopateoides).*

Subclass II: MYXOSPONGIAE Without a skeleton or with skeleton of spongin fibers only (with a laminated bark and finely fibrillar or granular pith); one genus with skeleton of siliceous asters *(Chondrilla).* All demosponges lacking a skeleton belong to this subclass *(e.g., Chondrosia, Aplysina, Aplysinella, Chondrosia, Chondrilla, Halisarca, Hexadefla).*

Subclass III: HAPLOSCLEROMORPHA With an isodictyal anisotropic or isotropic choanosomal skeleton; spicules diactinal megascleres (oxeas or strongyles); microscleres, if present, sigmas and/or toxas, microxeas, or microstrongyles. Reproduction typically viviparous, with the exception of some petrosid genera that are oviparous. Larvae typically parenchymella. e.g., *Haliclona, Callyspongia, Petrosia, Xestospongia, Niphates.*

Subclass IV: HETEROSCLEROMORPHA Skeleton composed of siliceous spicules that can be monaxones and/or tetraxones and, when present, highly diversified microscleres. Reproduction mostly viviparous, but oviparous species occur in some genera. This subclass contains most of the Demospongiae. *(e.g., Ceratoporella, Geodia, Discodermia, Spongilla, Halichondria, Cliona).*



Some important Sponges