Phylum Porifera (Characters, Classification and Types)

Phylum Porifera includes animals having pores in the body wall. The name porifera (L., *porous* = a pore; *ferre* = to bear) was coined by **Robert Grant** (1836) for the plant-like sessile (permanently attached, hence nonmotile) multicellular creatures, called **sponges**. **Aristotle**, **Pliny** and other ancient naturalist considered sponges to be plants. In fact, it was not until 1765, when internal water currents and movements of the oscula were first observed by **Ellis**, that the animal nature of sponges became clearly established. The morphology and physiology of sponges were first worked out by **Grant** (1875). **Huxley** (1875) and **Solas** (1884) suggested their complete separation from other Metazoa on the basis of numerous peculiar features of sponges. **Solas** created an isolated branch of Metozoa called **Parazoa** for the sponges. In evolutionary terms, phylum Porifera is considered as **"dead-end" phylum** since it has not given rise to any group of organisms.

11.1 GENERAL CHARACTERS

Poriferans are sessile, suspension-feeding, multicellular animals that utilise flagellated cells called **choanocytes** to circulate water through a unique system of water canals. (**Note.** Suspension feeding is the removal of suspended food particles – bacteria, phytoplankton, zooplankton and some detritus – from the surrounding medium by some sort of capture, trapping or filteration mechanism). They are metazoa lacking true embryological germ layering. Not only true tissues are absent, but most of the body cells are **totipotent** – they are capable of changing form and function. Despite being multicellular, poriferans function like organisms at the unicellular grade of complexity, *i.e.*, their nutrition, cellular organization, gas exchange, and response to environmental stimuli are all protist like.

Box 11.1

Two unique organizational attributes *define* sponges and have played major roles in poriferan success: the **water current channels** or **aquiferous system** (and its **choanocytes**), and the highly **totipotent** nature of sponge cells (**Brusca** and **Brusca**, 2003). A totipotent cell is capable of developing into a complete organism or differentiation into any of its cells or tissues.

General Characters

1. Multicellular animals having **cellular grade of construction**. The cells are arranged in loose aggregations, hardly forming any tissue, organs or systems.

2. There occurs some cellular differentiation or **division of labour**, but no tissue organization. Unlike epithelium of most other animals, a basal lamina and intracellular junctions are absent.
3. All are aquatic, mostly marine, some are freshwater animals.
4. Solitary or colonial, all sessile—attached to various objects in water. (**Note.** According to **Bond** (1997, 1998) some sponges can move from one place to another).
5. Shape and size of body of sponges are variable. Size ranges between 1cm to 1m. Shape may be cylindrical, vase-shaped, cup-shaped, spherical or disc-shaped.
6. Body is either asymmetrical or superficially radially symmetrical.
7. Sponge's body is **diploblastic** with an outer ectodermal layer of flattened pinacocyte cells (called **pinacoderm**) and an inner endodermal layer of collared flagellate cells or choanocytes (called **choanoderm**). In between is a mesoglea, mesenchyme or **mesohyl** which is gelatinous and proteinaceous matrix containing collagen fibres, skeletal material and amoeboid cells (which are migratory cells of both layers). (For contradiction of these facts see Box 11.2).

Box 11.2. Sponges are monoblastic—they lack an endoderm

According to current reports body of sponges is **monoblastic**, consisting of a layer of cells which lines a non-living matrix (the mesohyl). According to them, the spongocoel and choanocyte-lining are not homologous to the gut of other metazoan animals. The choanocytes are not endodermal derivatives. **Indeed there is no endoderm in sponges**. Sponges are gutless animals and the gutless condition is primary (**Ruppert** and **Barnes**, 1994).

8. Sponge's architecture is unique, being constructed around a system of water canals, called **canal system** or **aquiferous system**, an arrangement that is correlated with sponge's sessility.
9. Body surface of sponge is perforated by numerous pores, called **ostia**, serving for the inflow of water. By collective lashing, the flagellated collar cells draw water through these pores. The water currents pass through ostia into the chambers (some of which are lined by choanocytes) and finally in the central cavity called **atrium** or **spongocoel**. From spongocoel water currents escape out through a single large exhalent opening, the **osculum**. Sponge cells obtain food and oxygen from these water current, and release carbon dioxide, excretory substance (ammonia) and reproductive products (sperm, ova) into it.

Box 11.3

The one-cell thick choanoderm may remain simple and continuous (the **asconoid** condition), or it may become folded (the **syconoid** condition), or it may become greatly subdivided into separate flagellated chambers (the **leuconoid** condition) (Fig. 11.1).

10. Sponges contain a single body cavity (*i.e.*, spongocoel). They lack gut (*i.e.*, digestive cavity) and coelom.
11. The body is strengthened by an internal skeleton of calcareous or siliceous **spicules** or horny **spongin** fibres.
12. Digestion is **intracellular** in food vacuoles as in protozoa.
13. Sponges are **ammonotelic**; their chief excretory waste is **ammonia**.
14. The sensory cells and nerve cells are absent, but each cell is directly stimulated and also transmits sensations to other cells.
15. Amoebocytes are the workhorses of sponge economy. They function in internal transport of food and for a variety of other metabolic activities.

11.2 OUTLINE CLASSIFICATION OF PHYLUM PORIFERA

Phylum Porifera

Classes (4)

- **1. Calcarea or Calcispongiae**
  - Orders (2)
    - **1. Homocoela**
      Examples: *Leucosolenia*, *Clathrina* (*Olynthus*)
    - **2. Heterocoela**
      Examples: *Sycon* (= *Scypha*), *Grantia*, *Leucilla*
- **2. Hexactinellida or Hyalospongiae**
  - Orders (2)
    - **1. Hexasterophora**
      Examples: *Euplectella*, *Farrera*
    - **2. Amphidiscophora**
      Examples: *Hyalonema*, *Pheronema*
- **3. Demospongiae**
  - Subclasses (3)
    - **1. Tetractinellida**
      - Orders (3)
        - **1. Myxospongida**
          Examples: *Oscarella*, *Halisarca*
        - **2. Carnosa**
          Examples: *Chondrilla*, *Plankina*
        - **3. Choristida**
          Examples: *Geodia*, *Thenea*
    - **2. Monaxonida**
      - Orders (4)
        - **1. Hadromerida**
          Examples: *Cliona*, *Tethya*, *Ephydatia*
        - **2. Halichondrida**
          Example: *Halichondria*
        - **3. Poecilosclerida**
          Examples: *Microciona*, *Cladorhiza*
        - **4. Haplosclerida**
          Examples: *Chalina*, *Spongilla*
    - **3. Keratosa**
      Examples: *Euspongia*, *Hippospongia*
- **4. Sclerospongiae**
  Examples: Hard sponges