**INVERTEBRATE ZOOLOGY- PHYLUM PORIFERA**

The members of the phylum Porifera are called sponges. Brightly coloured sponges abound in warm, shallow sea waters. Other marine sponges live at great depth and a few species even live in freshwater. Their growth patterns often depend on shape of the substratum, direction and speed of water currents, and availability of space, so that the same species may differ markedly in appearance under different environmental conditions. Sponges in calm waters may grow taller and straighter than those in rapidly moving waters. The bodies of most sponges completely lack symmetry and consist of little more masses of specialized cells embedded in a gel-like substance called mesohyl. Sponge’s cells are not organized into tissues and organs. Sponges have a body wall penetrated by tiny openings or pores, called ostia through which water enters.

The name of the phylum, Porifera, refers to this system of pores. They also have larger openings, oscula, through which water exits. They are also sessile and immobile, having neither nerve nor muscles. There may be slight contractility round the larger pores but it is very restricted. Early in their lives, sponges attach themselves firmly to sea bottom or some other submerged surface, like rock or coral reef and remain there for life. Most sponges are bag-shaped and have a large internal cavity; lining the internal cavity of a sponge is a layer of flagellated cells called choanocytes (collar cells). The flagella of these cells extend into the body cavity. As the flagella beat, water is drawn in through the pores in the body wall. The water is driven through the body cavity before it exits through the osculum.

To prevent the sponge from collapsing in on itself, the sponge body is supported by a skeleton. However, a sponge’s skeleton does not have a fixed frame-work like human skeleton does. The skeletal framework of a sponge can be fibrous and/or rigid. The rigid skeleton consists of calcareous or siliceous support structures called spicules. The fibrous part of the skeleton comes from collagen fibrils in the intercellular matrix of all sponges. One form of collagen is traditionally known as spongin. A spicule is a tiny needle composed of silica or calcium carbonate. Spicules have further important functions in preserving the sponge’s shape, keeping the pores open and maintaining the internal channels (as well as making the sponge even nastier to eat than it probably would be anyway). A few sponges have skeletons composed of a resilient, flexible protein fiber called spongin. Some sponges contain both spongin and spicules. These supporting structures are found throughout the mesohyl. Sponges have characterized canal systems.

 

**Types of Canal Systems in Sponges**

The essential elements of 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-ascon, sycon, and leucon.

**Asconoids-** Asconoid sponges have the simplest organization. The walls of these sponges are thin, lack canals, and are perforated by pores, which actually are opening through cells (porocytes). Water is drawn into the sponge through microscopic dermal pores by the beating of large numbers of flagella on the choanocytes. These choanocytes line the internal cavity known as spongocoel. As the choanocytes filter the water and extract food particles from it, used water is expelled through a single large osculum. This design has distinct limitations because choanocytes line the spongocoel and can collect food only from water directly adjacent to the spongocoel wall. Were the spongocoel to be large, most of the water and food in its central cavity would be inaccessible to choanocytes. Thus, asconoid sponges are small and tube-shaped. Asconoids are found only in the class Calcarea. Examples are *Leucosolenia, Clathrina*.

**Syconoids-** Syconoid sponges look somewhat like larger editions of asconoids. They have a tubular body and single osculum, but the body wall, which is really the spongocoel lining, is thicker and more complex than that of asconoids. The lining has been folded outward to make choanocyte-lined canals. Folding the body into canals increases the surface area covered by choanocytes. The canals are of small diameter compared with an asconoid spongocoel, so most of the water in a canal is accessible to choanocytes. Water enters the syconoid body through dermal ostia that lead into incurrent canals. It then filters through tiny openings, or prosopyles, into the radial canals. Here food is ingested by the choanocytes. The beating of the choanocyte’s flagella forces the used water through internal pores, or apopyles, into the spongocoel. Food capture does not occur in the syconoid spongocoel, so it is lined with epithelial-type cells rather than the flagellated cells present in asconoids. When the used water reaches the spongocoel, it exits the body through an osculum. Syconoids are found in class Calcarea and in some member of class classHexactinellida. Examples are *Sycon, Scypha*.

**Leuconoids-** Leuconoid organization is the most complex of the sponge types and permits an increase in sponge size. In this design, the radial canal are replaced by numerous small flagellated chambers in which the choanocytes are localized; that is, the surface area of the food-collecting regions with choanocytes is greatly increased; here the choanocytes line the walls of small chambers where they can effectively filter the water present. The sponge body is composed of an enormous number of these tiny chambers. 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 opening (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. Examples are *Leuconia, Euspongia*.

 

**Kinds of Sponges**

The phylum Porifera may be divided into three classes on the basis of the composition of the skeletal elements- the Calcispongiae (Calcarea) and Hyalospongiae (Hexactinellida) include about 20% of known species of sponges; the remainder are placed in the class Demospongiae.

**Calcarea:** They occur in shallow waters (less than 100 meters). Their spicules are composed of CaCO3. Spicules are straight (monaxons) or have three or four rays. The sponges tend to small and tubular or vase-shaped. All the three types of canal systems are represented. Examples are *Sycon, Leucosolenia, Clathrina*.

**Demospongiae:** Have siliceous spicules that are not six rayed, or spongin or both. Spicules may be bound together by sponging or may be absent. Examples are *Thenea, Cliona, Myenia, Halichondria, Spongilla, Oscarella* the breadcrumb sponge and *Spongia,* the once commonly used bath sponge, in which there are no siliceous spicules but only protein fibres (spongin).

**Hexactinellida:** The ‘glass sponges’ are very different from other sponges. Their distinguishing features include a skeleton of six-rayed siliceous spicules that are bound together into a network forming a glass-like structure. Examples are *Euplectella, Hexactinella,Hyalonema*.

**FEEDING & DIGESTION:** The porifera are filter feeders, utilizing food particles suspended in water and captured by the choanocytes. Food particles consist essentially of bacteria, other microorganisms, and particles of organic debris. Sponges also absorb dissolved organic substances. The capture of food depends on the movement of water through the body. As sea water passes through the sponge’s body cavity, the collar cells function as sieves. These cells trap plankton and other tiny organisms in the small hair-like projections on the collar cells. The trapped organisms are then pulled into the interior of the collar cells, where they are digested intracellularly. The collar cells release nutrients into mesohyl where other specialized cells called amoebocytes (archaeocytes) pick up nutrients. Amoebocytes are sponge cells that have irregular amoeba-like shapes. They move about the mesohyl, supplying the rest of the sponge’s cells with nutrients and carrying away their wastes. As the sea leaves the sponge, wastes are carried away in it.

**RESPIRATION & EXCRETION:** Respiratory and excretory organs are lacking; oxygen is supplied by a direct exchange between the cells and the surrounding water. Consequently, the consumption of oxygen is related to the velocity of the current. Excretion occurs through both ostia and the surface of the sponge. Freshwater sponges expel excess water via the contractile vacuoles in archaeocytes and choanocytes. The excretory products of the sponges are ammonia and other nitrogen-containing substances which account for their characteristic unpleasant odour.

**REPRODUCTION:** Sponges reproduce asexually and sexually. Asexual reproduction occurs in various ways. Firstly, they reproduce by fragmentation. A remarkable property of sponges is that they regenerate when they are cut into pieces. Each bit of sponge, however small, will grow into a complete new sponge. Sponges frequently reproduce by shedding fragments, each of which develops into a new individual. Sponges also reproduce by budding. External budding occurs as an outgrowth of the parent which after reaching a certain size may become detached from the parent and float away to form new sponges or they may remain to form colonies. Internal budding or gemmulation occurs in freshwater sponges and some marine sponges. Here, archaeocytes collect in the mesohyl and become surrounded by a tough spongin coat incorporating siliceous spicules. Sealed in with ample food, the cells survive even if the rest of the sponge dies. When the parent animal dies, the gemmules survive and remain dormant, preserving the species during periods of freezing or severe drought. Later, when conditions improve, the gemmules escape through a special opening, the micropyle, and develop into new sponges. Gemmulation is an adaptation to changing seasons. It is also a means of colonizing new habitats, since they can spread by streams or animal carriers.

Sexual reproduction is also common among sponges. Most sponges are hermaphrodites, meaning they reproduce both eggs and sperms. Sperms and oocyte sometimes arise from transformation of choanocytes and sometimes from archaeocytes. Since eggs and sperm are produced at different times, self-fertilization is avoided. Most sponges are viviparous; after fertilization the zygote is retained in and derives nourishment from its parent, and a ciliated larva is released. In such sponges, sperm are released into water by one individual and taken into the canal system of another. There choanocytes phagocytize the sperm; then the choanocytes transform into carrier cells, which carry the sperm through mesohyl to oocytes. Other sponges are oviparous, and both oocytes and sperm are expelled into water. The free-swimming larva of most sponges is a solid-bodied parenchymula. After a brief free-swimming stage, the larvae attach themselves to an object and develop into new sponges.

***Leucosolenia*:** It is a small delicate, sessile, delicate branching, colonial marine sponge found growing in shallow water below low-tide mark on sea shore rocks where wave actions are intense and is not found in calm water.

The colony of *Leucosolenia* is whitish or yellowish in colour and it consists of radially symmetrical, vase-like vertical tube-like individuals each ending in an osculum and united at their base by horizontal tubes and attached to the substratum by adhesive discs. The body wall is thin and consists of an outer epidermis, the pinacoderm and an inner endodermis, the choanoderm separated by a jellylike non-cellular layer of mesenchyme or mesogloea, enclosing a central cavity, the spongocoel. The wall of each tube is perforated by pores through which water enters the spongocoel and passes out by osculum. The pinacoderm consists of thin, scale-like, flattened cells, called pinacocytes while the choanoderm consists of choanocytes that form the lining of the spongocoel (gastrodermis). The mesenchyme contains spicules that constitute the endoskeleton that supports and protects the soft parts of the body and amoebocytes that perform variety of essential functions to the life of the sponge.

The wall of each tube is pierced by numerous pores called ostia or incurrent pores which pass through a space of cell called porocytes. Each ostium is intracellular i.e. it is a canal through a single, large, tubular and highly contractile porocyte cell communicating outside with the spongocoel.

No adult sponge is capable of locomotion. They are devoid of sensory or nerve cells. The flow of water into ostia and out through the osculum brings food and provides opportunity for gaseous exchange and the elimination of metabolic wastes. Digestion is intracellular as in protozoa. Respiration is by diffusion.

 

REPRODUCTION: It is both asexually and sexually. *Leucosolenia* reproduces by budding. It also has power of regeneration. Sexual reproduction takes place by the formation of gametes. *Leucosolenia* is hermaphrodite. The gametes are formed by the differentiation of amoebocyte cells. Fertilization is internal. The parenchymula swims freely for sometimes before it gets itself attached and later become an adult.

**Diagnostic features**

Body-cells are loosely arranged in two layers, which are separated by mesenchyme.

Numerous Ostia are present throughout the body and a large opening osculum is found on the upper end.

Canal system is present, through which water flows throughout the body supplying food and oxygen.

Endoskeleton is made up of calcareous and siliceous spicules, and spongin fibres.

Several Choanocyte-lined spaces are present.

**Adaptive features**

Skeleton types: Allows them to live in either hard or soft sediments.

2) Pores : Allows them to filter the water around them for food.

3) Flagella :Creates currents so their collar cells may trap the food.

4) Strong Structures : These enables the sponges to handle the high volume of water that flows through them each day.

5) Constricting Openings: This helps the sponges to control the amount of water that flows

through them.

6) Colours : The colours act as a protection from the sun’s harmful UltraViolet rays.

7) Toxins: They can release toxins into the environment around them to make sure they have a good place to grow in.

8) Body Repair: Sponges are also able to repair damages to their bodies. These characteristics of sponges are ideal because even small parts of sponges may survive in the water.

**Resemblances to Protozoa**

* Absence of digestive cavity and presence of intracellular digestion.
* Presence of collar cells and amoeboid cells like cells of colonial flagellates.
* The production of skeleton by single cell or a group of cells.
* The cells of sponge body are interdependent in their function.

**Differences from Protozoa**

* The canal system.
* The characteristic skeleton.
* The development of a multi-cellular body from fertilized eggs by cleavage.

**Economic Importance of Porifera**

* Sponges provide protective covering for algae, which in turn produce oxygen for the sponges.
* Crustaceans live parasitic life on them and some molluscs depend upon them for their diet.
* Sponges serve as protective houses for several animals like worms, moplluscs, small fishes because their enemies cannot feed on the sponges.
* The dried fibrous skeleton of many sponges are used for the purpose of bathing, polishing, washing cars, walls, furniture, and scrubbing floor etc.
* Sponge fishing and its industry is of great economic value to the present synthetic world.
* Only a few sponges are harmful and they may cause the death of sessile animals by covering them and cutting off their food and oxygen supply.