CANAL SYSTEM IN SPONGES

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Introduction-

The water circulatory system of sponges also called as canal system is the characteristic feature of the phylum Porifera. Canal system is also known as aquiferous system. The canal system of sponges helps in food acquisition, respiratory gas exchange and also in excretion.

The numerous perforations on the body surface of the sponges for ingression and egression of water current are the main constituents of the canal system. Inside the body, the water current flows through a certain system of spaces where by the food is captured from the incoming water and the excretory material is sent out into the outgoing water.

Functions of the water current-

Water current plays the most vital role in the physiology of the sponges. The body wall of the sponges consists of two epitheloid layers the outer pinacoderm and the inner choanoderm. Pinacoderm consists of porocytes cells which bear openings called ostia. Choanoderm is composed of choanocytes or collar cells. The choanocytes have collar of microvilli around the flagellum. The water current is caused by beating of flagella of the collar cells. The following are the functions of the water current which enters the body of the sponges through the canal system:

1. All exchanges between sponge body and external medium are maintained by means of this current.

2. Food and oxygen are brought into body through this water current.

3. Also the excreta are taken out of the body with the help of this water current.

4.The reproductive bodies are carried out and into the body of the sponges by the water current.

A typical canal system is composed by following components:

(a) Incurrent canal – It opens externally to the outside by a small pore known as incurrent pore or ostium, but internally it ends blindly.

(b) Radial canal or excurrent canal- It is closed externally but opens internally by minute pores or apopyles into a central cavity or cloacal cavity or gastral cavity or spongocoel, which cannot be compared in any way with the stomach or intestine of other animals.

(c) Prosopyle- It is a smaller canal or passage-way connecting incurrent canal with radial canal.

The incurrent canals are lined by flat squamous cells and their functions are only to form water conduits and to form a smooth and firm surface.

The radial canals are lined by collar cells opening at the surface and are provided with flagella or whips. The lashing movements of flagellum procure the food particles and push them into the cell-mouth. Thus, this is food-capturing arrangement of sponges.

Spongocoel or cavity is lined by a thin gastric epithelium. It opens to the outside by an aperture, called osculum.

The arrangement, and complexity of the canal system varies considerably in different sponges and has been divided into four types:

1. **Ascon type**
2. **Sycon type**
3. **Rhagon type**
4. **Leucon type**

Ascon type:

This canal system is the simples of all the three. It is found in asconoid type of sponges like Leucosolenia and also in some of the developmental stages of all the syconoid sponges.

The body surface of the asconoid type of sponges is pierced by a large number of minute openings called as incurrent pores or ostia. These pores are intracellular spaces within the tube like cells called porocytes.

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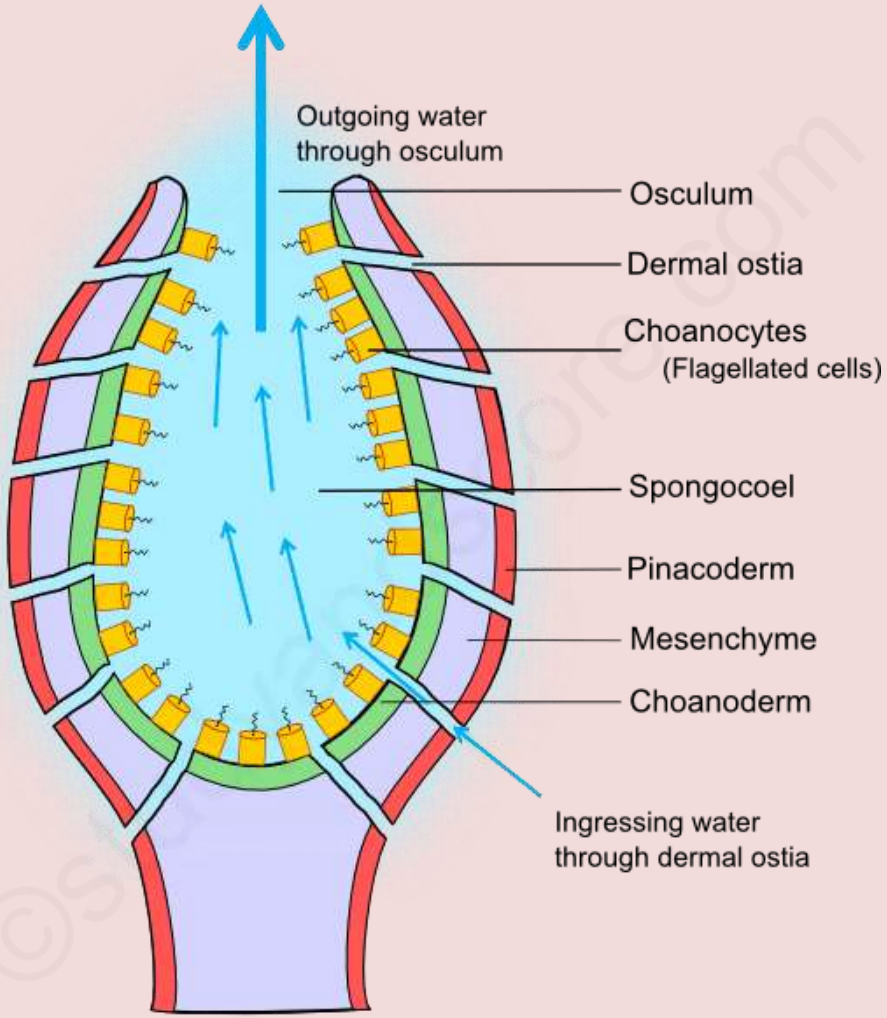
The body surface of the asconoid type of sponges is pierced by a large number of minute openings called as incurrent pores or ostia. These pores are intracellular spaces within the tube like cells called porocytes. These pores extend radially into mesenchyme and open directly into the spongocoel.
The spongocoel is the single largest spacious cavity in the body of the sponge. The spongocoel is lined by the flattened collar cells or choanocytes. Spongocoel opens outside through a narrow circular opening called as osculum located at the distal end and it is fringed with large monaxon spicules.
The surrounding sea water enters the canal system through the ostia. The flow of the water is maintained by the beating of the flagella of the collar cells. The rate of water flow is slow as the large spongocoel contains much water which cannot be pumped out through a single osculum.
EX. – Clalhrina & *Leucosolenia*and simple sponges.
The course of water current through the canal system can be represented as follows:
Ingressing water-dermal ostia – Spongocoel- Osculum - Outside



Ascon type canal system (Ex: Leucosolenia)

Sycon type

Sycon type of canal system is more complex compared to the ascon type. This type of canal system is the characteristic of syconoid sponges like Scypha. Theoretically this canal system can be derived from asconoid type by horizontal folding of its walls. Also embryonic development of Scypha clearly shows the asconoid pattern being converted into syconoid pattern.

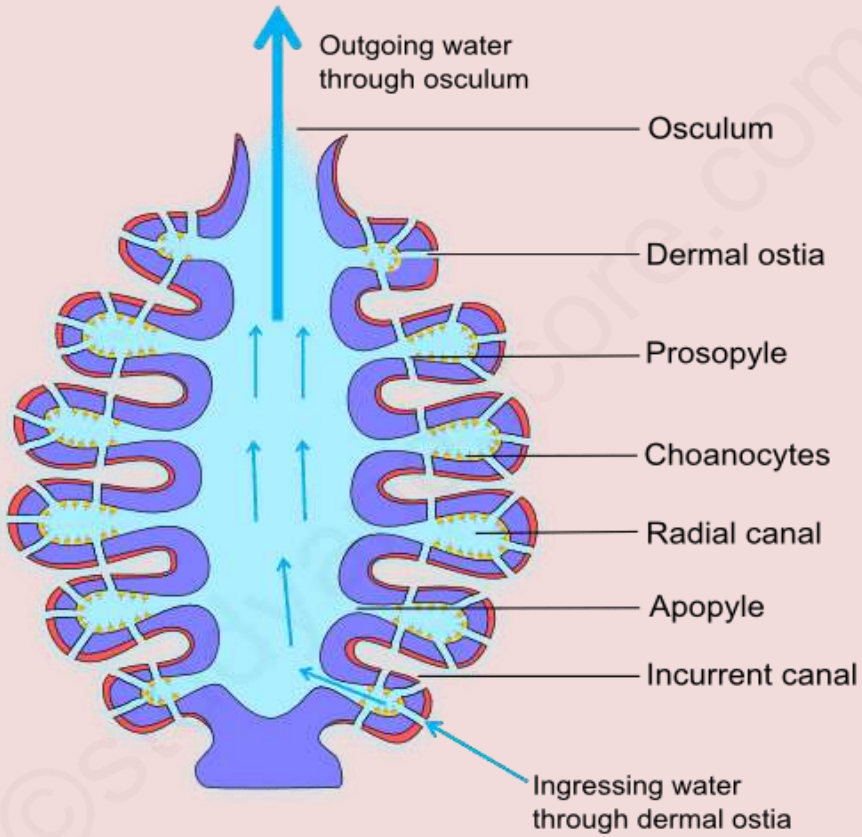
Body walls of syconoid sponges include two types of canals, the radial canals and the incurrent canals paralleling and alternating with each other. Both these canals blindly end into the body wall but are interconnected by minute pores. Incurrent pores also known as dermal ostia are found on the outer surface of the body. These incurrent pores open into incurrent canals.

The incurrent canals are non-flagellated as they are lined by pinacocytes and not choanocytes. The incurrent canals leas into adjacent radial canals through the minute openings called prosopyles. On the other hand radial canals are flagellated as they are lined by choanocytes. These canals open into the central spongocoel by internal ostia or apopyles.

In sycon type of canal system, spongocoel is a narrow, non-flagellated cavity lined by pinacocytes. It opens to the exterior though an excurrent opening called osculum which is similar to that of the ascon type of canal system.

The course of water current through the canal system can be represented as follows:

Ingressing water-dermal ostia- incurrent canal - Prosopyles - Radial canals - Apopyles – Spongocoel- Osculum - Outside.



Sycon type canal system (Ex: Scypha)

Rhagon type

This type of canal system is found in the larva of Demospongiae called rhagon which has a broad base and is conical in shape. Due to excessive growth of mesenchyme sub-dermal spaces are formed in its body wall. The ostia open in these spaces which lead into incurrent canals. The incurrent canals open by prosopyles into flagellated canals which are lined with choanocytes. The flagellated canals open by apopyles into excurrent canals which lead into paragastric cavity. The paragastric cavity opens to the outside by the osculum which is present at the apex. The incurrent and excurrent canals may be complex and branched in it, The source of water through this system is as follows:

Leuconoid type

This type of canal system results due to further folding of body wall of the sycon type of canal system. This canal system is the characteristic of the leuconoid type of sponges like Spongilla. In this type the radial symmetry is lost due to the complexity of the canal system and this result in an irregular symmetry.

The flagellated chambers are small compared to that of the asconoid and syconoid type. These chambers are lined by choanocytes and are spherical in shape. All other spaces are lined by pinacocytes. The incurrent canals open into flagellated chambers through prosopyles. These flagellated chambers in turn communicate with the excurrent canals through apopyles. The excurrent canals develop as a result of shrinkage and division of spongocoel. The large and spacious spongocoel which is present in the asconoid and syconoid type of canal systems is absent here. Here the spongocoel is much reduced. This excurrent canal finally communicates with the outside through the osculum.

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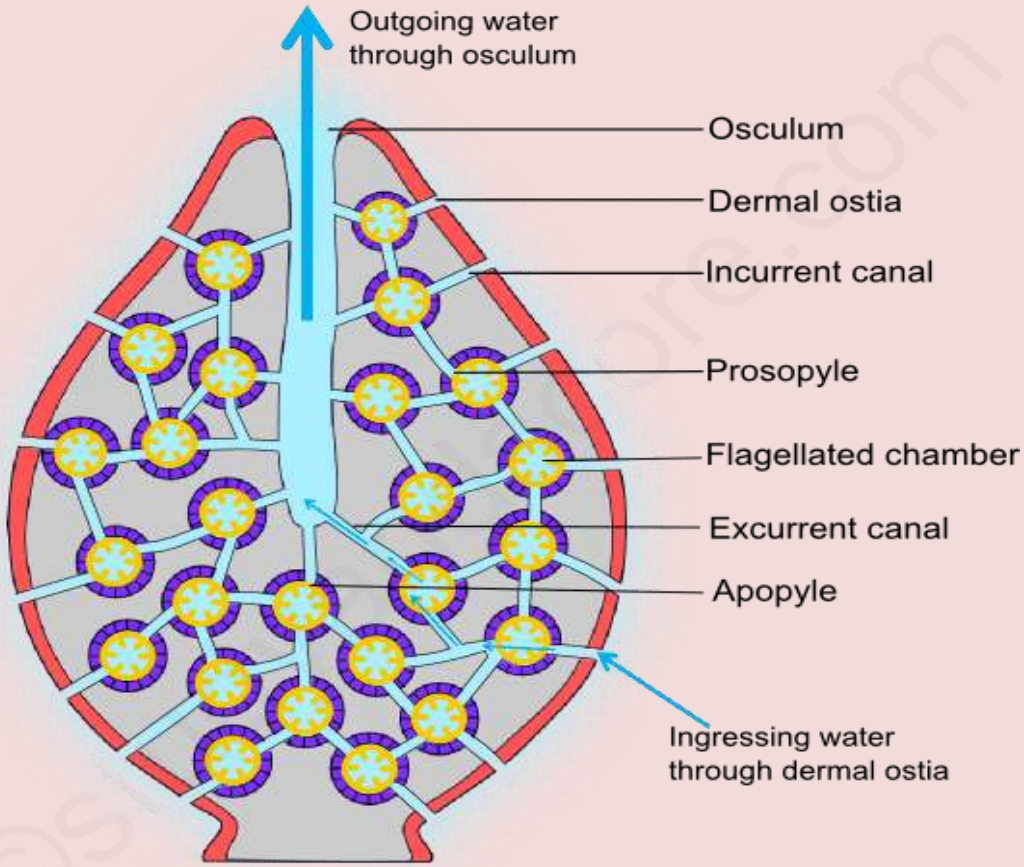
Ingressing water -dermal ostia- incurrent canal- Prosopyles -Flagellated chambers - Apopyles - excurrent canals -Osculum- Outside



Leucon type canal system (Ex: Spongilla)

Eurypylous type: This is the simplest and the most primitive type of leuconoid canal system. In this type the flagellated chambers directly communicate with the excurrent canal through broad apertures called the apopyles.
Ex: *Plakina*
Aphodal type: In this type of canal system the apopyles are drawn out as a narrow canal called aphodas. This connects the flagellated chambers with the excurrent canals.
Ex: *Geodia*
Diplodal type: in some of the sponges, along with aphodas another narrow tube called prosodus is present between incurrent canal and flagellated chamber. This arrangement gives rise to diplodal type of canal system.
Ex: *Spongilla*

Mechanism of current production
To produce an incurrent or cxcurrent condition there are two factors which are essential:
(i) For entering water through ostia into the body there must be a pressure within it less than that in the incurrent canals.
(ii) For escaping water through osculum there must be a pressure within chambers higher than that in the excurrent canals.
But as the pressure in the incurrent and excurrent canals is the same, there must be a difference of pressure within the chamber itself and the lower pressure must be towards the periphery. Such a distribution of pressure is set up when each flagellum causes a flow of water towards the centre of the chamber.

Functions of the Canal System

1. The canal system serves the purpose of nutrition. It is regarded as a highway for the food through the body cells in the radial canal with flagella, which capture the food particles. Water-currents are produced by flagella. Thus, waters flows into the central cavity or spongocoel. Smaller food-particles e.g. diatoms, protozoa and particles of organic debris are ingested into the cells protoplasm and digested. The digestion is intracellular. Robert Grant first of all observed the flow of water in the body-wall by adding powdered carmine to the water. Thus, canal system here does the same functions as circulatory system in higher animals.
2. In sponges, as a result of development of elaborate canal system, massive growth is found.
3. Streaming currents of water have dissolved air, therefore, gaseous exchange or respiration takes place in the cells. Oxygen is taken in by simple process of diffusion and carbon-dioxide is given out. The respiration is also intracellular.
4. The function of the canal system is also excretory. Currents of water, which pass outside the osculum remove the carbonic acid and other nitrogenous waste substances, which are the excretory products of the body.
5. The purpose of the canal system is also to increase the surface area of the animal in water. This is a characteristic point by which increase of volume is allowed by keeping the ratio of the surface to the volume.

Thanks