PORIFERA-Cell types and Spicules

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Online Lecture, Semester I

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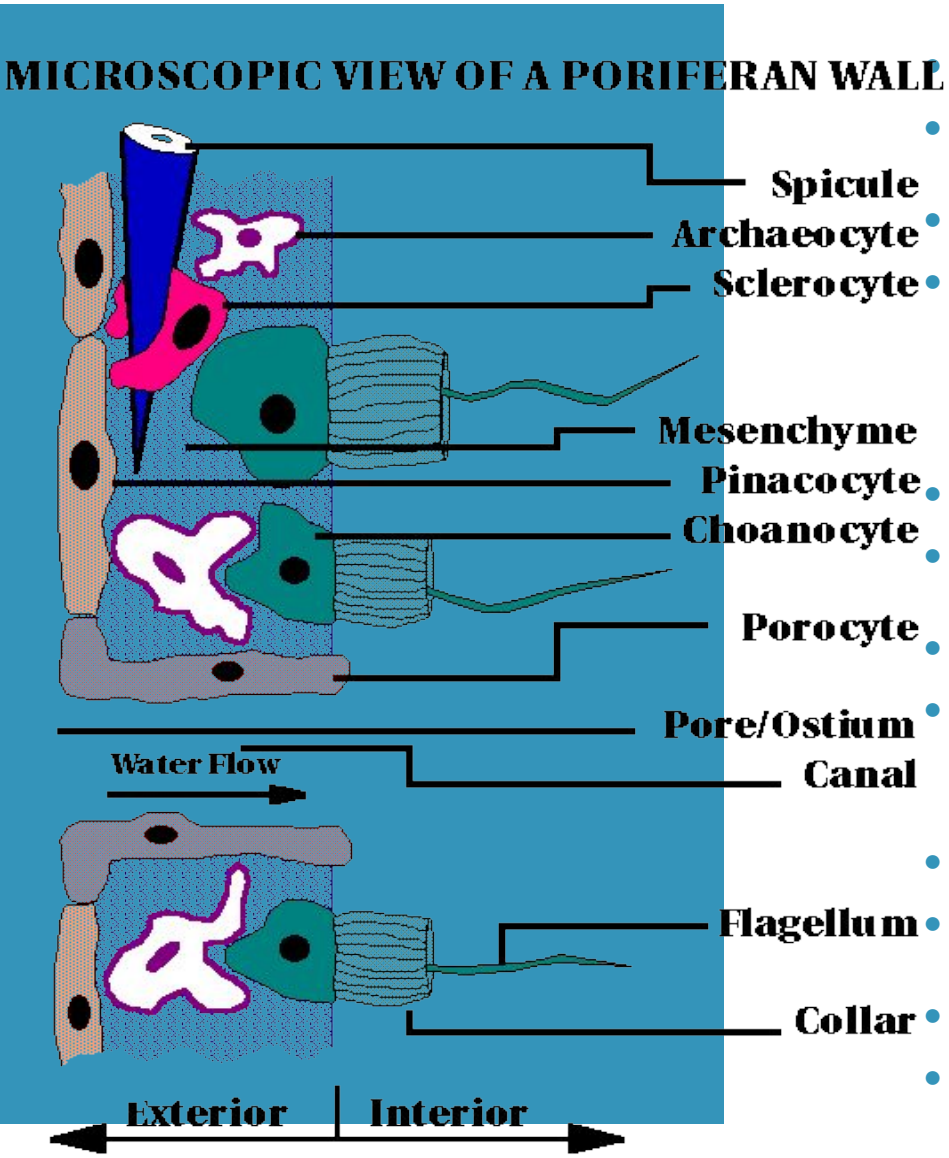
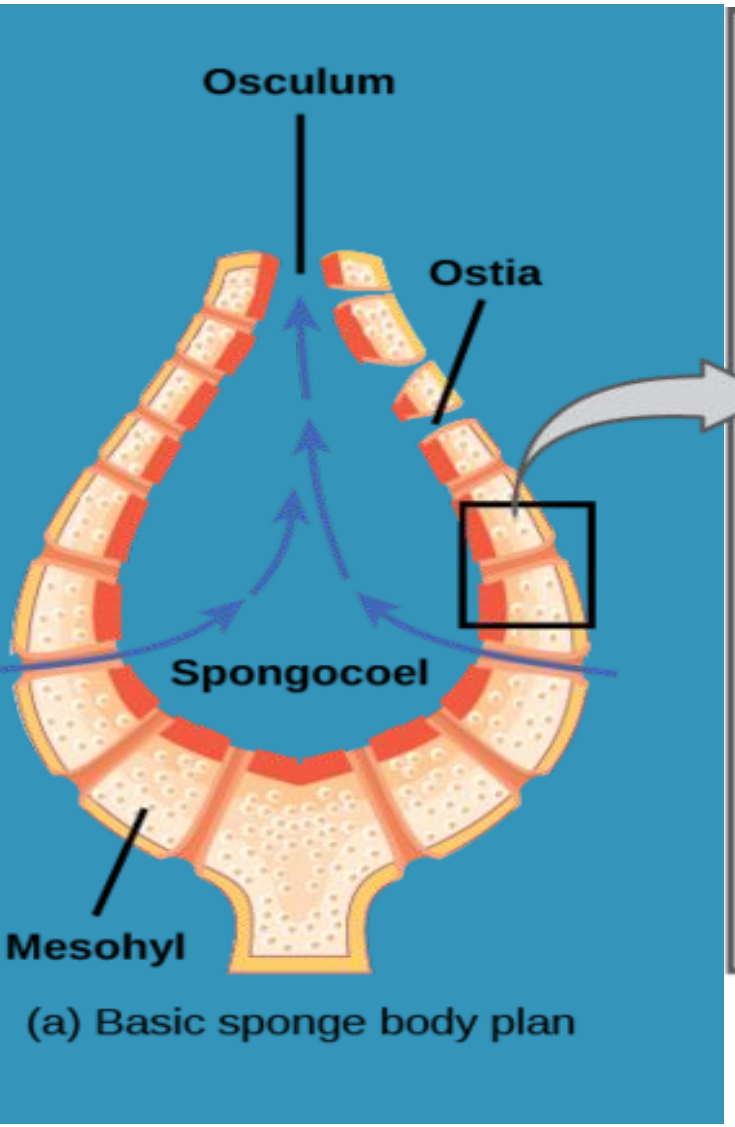


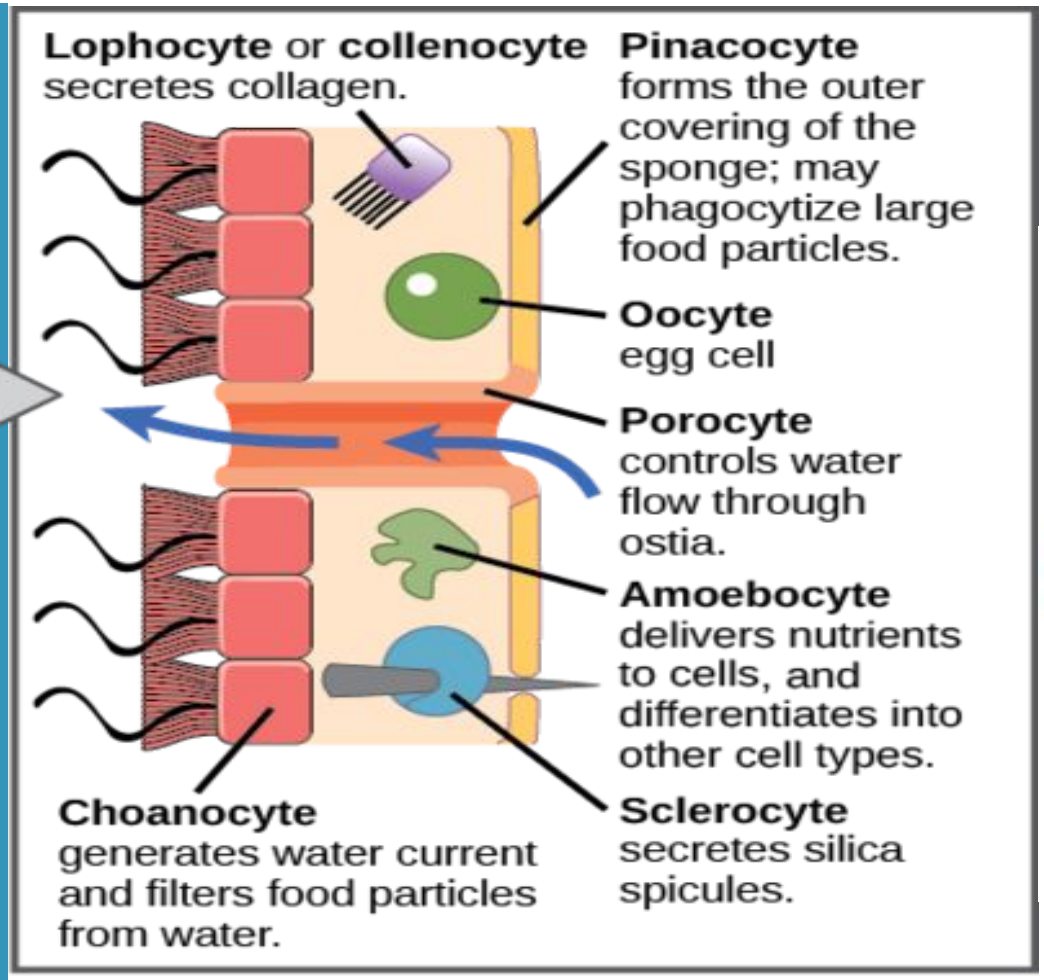
- **Sponges have a cellular grade of organization. They do not possess any structures that can be considered organs. Instead sponge cells of various types are responsible for bodily functions, the day-to-day activities that sustain life.**

- **Pinacocytes**
- **These cells are the "skin cells" of sponges. They line the exterior of the sponge body wall. They are thin, leathery and tightly packed together.**
- **Choanocytes**
- **These distinctive cells line the interior body walls of sponges. These cells have a central flagellum that is surrounded by a collar of microvilli. It is their striking resemblance to the single-celled protists called choanoflagellates that make many scientists believe that choanoflagellates are the sister group to the animals. Choanocytes are versatile cells. Their flagella beat to create the active pumping of water through the sponge, while the collars of the choanocytes are the primary areas that nutrients are absorbed into the sponge. Furthermore, in some sponges the choanoflagellates develop into gametes.**
- **Mesenchyme**
- **Between the two layers is a thin space called mesenchyme or mesohyl. The mesenchyme consists of a proteinaceous matrix, some cells, and spicules.**
- **Archaeocytes**
- **Archaeocytes are very important to the functioning of a sponge. These cells are totipotent, which means that they can change into all of the other types of sponge cells. Archaeocytes ingest and digest food caught by the choanocyte collars and transport nutrients to the other cells of the sponge. In some sponges, archaeocytes develop into gametes.**
- **Sclerocytes**
- **The secretion of spicules is carried out by sclerocytes. Other cells, called spongocytes, secrete the spongin skeletal fibres when those are present.**
- **Myocytes and Porocytes**
- **Poriferans do not have any muscle cells, so their movement is rather limited. However, some poriferan cells can contract in a similar fashion as muscle cells. Myocytes and porocytes which surround canal openings and pores can contract to regulate flow through the sponge.**

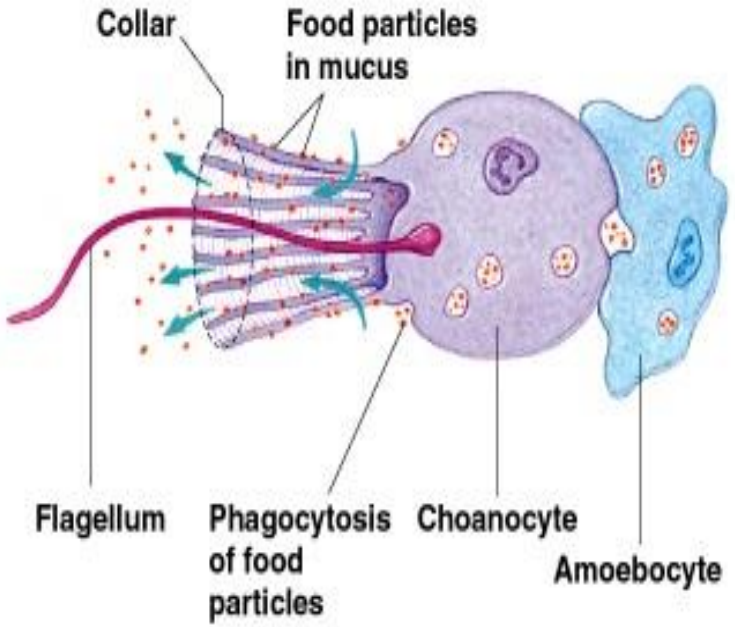
https://ucmp.berkeley.edu/porifera/pororg.html



(a) Basic sponge body plan



(b) Some sponge cell types

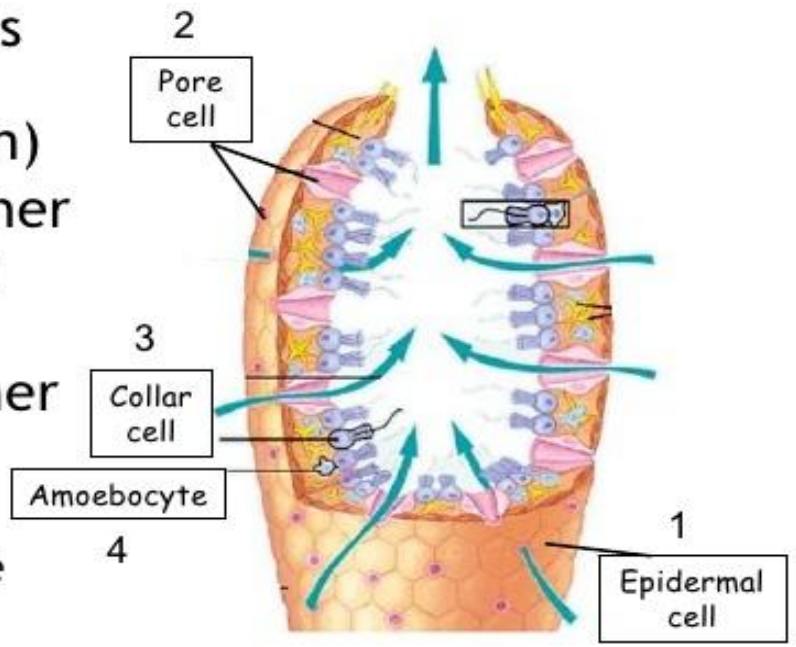


Cell types

Form and Function in Sponges

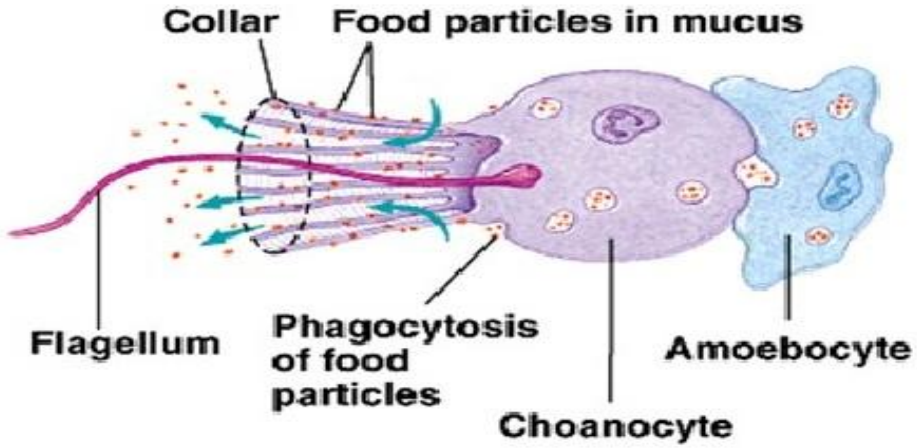
4 Cell Types:

- Epidermal cells - flat cells form outer covering (respiration and excretion)
- Pore cells - water and other substances enter through these cylindrical cells
- Collar cells - make up inner cell layer
  - Have collar of microvilli
  - Have a flagellum → they wave these to maintain a steady current that draws water in through pores



4) Amoebocytes – amoeba-like cells that crawl around the jellylike inner layer (using pseudopodia) and deliver food and O_2 to other cells

- Amoebocytes absorb nutrients and remove wastes
- Amoebocytes make spicules → create sponge skeleton



- Amoebocytes are also totipotent, meaning that they can change into other sponge cell types. In some species, amoebocytes are able to become egg or sperm cells for sexual reproduction.

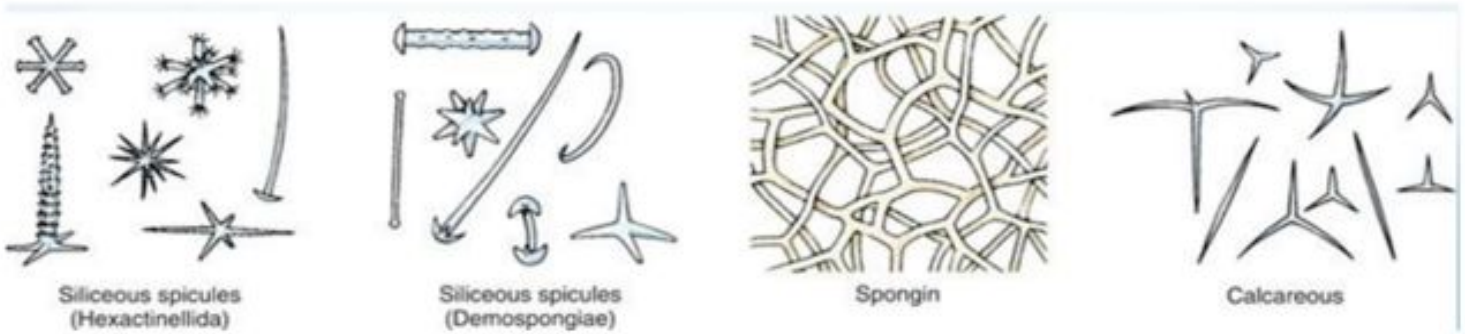
Spicules in sponges

The sponges are supported by spicules:

- It may be **calcareous** ($CaCO_3$) or **siliceous** spicules (SiO_2) or fibers composed of a collagenous protein called **spongin**.
- The cells secreting spicules are termed **sclerocytes** and those producing spicules fibers are termed **spongocytes**.
- Both of these cells are derived from **archaeocytes.**

Function of spicules & fibers :

- In species identification.
- Maintain the shape & prevent predation.



Spicules in sponges

- Spicules are microscopic crystalline structures which gives the sponges their rigidity and form. Spicule consists of spines or rays that radiate from a point. These are secreted by special mesenchymal amoebocytes called scleroblast cells. The following are various types of spicules:
- **On basis of type of deposit on core organic matter:** All kinds of spicules have a core of organic material around which either calcium carbonate or colloidal silica is deposited. Accordingly spicules are of two types:
- **Calcareous spicules:** The organic material in this type of spicules is calcium carbonate or calcite. This is the characteristic of the sponges of class Calcarea.
- **Siliceous spicules:** The organics material in this type of spicules is Colloidal silica or Silicon. These types of spicules are the characteristic of the sponges of class Hexactanellida.
- **On the basis of size and function:** Spicules can be of large size or small size. Accordingly spicules can be of two types:
- **Megascleres:** These are larger spicules constituting main skeleton of sponge body.
- **Microscleres:** These are the small spicules occurring interstitially.

- **On the basis of number of axes and rays:** Spicules may occur in several forms like the simple rod form or in the form of forks, anchors, shovels, stars, plumes etc. The spicule forms depend on the presence of number of axes and rays. Accordingly, they can be divided into the following forms:
- **1. Megascleres:**

  The megascleres are the larger skeletal spicules that constitute the chief supporting framework of the sponge. There are five general types of megasclere spicules, viz., monaxons, tetraxons, triaxons, polyaxons and spheres.
- **(i) Monaxon:** These kinds of spicules are formed by the growth along one axis. They may be straight needle-like or rod like or may be curved. Their ends may be pointed or hooked or knobbed. Monaxons can be both calcareous and siliceous types.

  These monaxon spicules are further divided into two kinds,
- **Monactinal-** the growth of the spicule takes place only in one direction
- **Diactinal-** The growth of the spicule takes place in both the directions.
- **(ii) Tetraxon** spicules are also called tetractines and quadriradiates. They consist typically of four rays, not in the same plane, radiating from a common point. The four rays of the tetraxon spicule may be more or less equal, in which case the spicule is called a calthrops.

- Generally one ray, rhabdome, is elongated bearing a crown of three smaller rays; such spicules are termed triaenes. By loss of one smaller ray results into a diaene. If the elongated ray bears a disc at both ends, it is called amphidisc. Loss of elongated ray results into a triradiate or triactinal spicule, called a triod characteristic of calcareous sponges.
- **(iii) Triaxons:**
- The triaxon or hexactinal spicule consists fundamentally of three axes crossing at right angles, producing six rays extending at right angles from a central point. From this basic type all possible modifications arise by reduction or loss of rays, branching and curving of the rays, and the development of spines, knobs, etc., upon them. The triaxon spicules are characteristic of class Hexactinellida.
- **(iv) Polyaxons:** These spicules in which several equal rays radiate from a central point.
- **(v) Spheres:**
- These are rounded bodies in which growth is concentric around a centre.
- **(vi) Desma:**
- A special type of megasclere known as desma occur in a number of sponges. A desma consists of an ordinary minute monaxon, triadiate,or tetraxon spicule, termed the crepis, on which layers of silica have been deposited irregularly. Desmas are named from the shape of the crepis, as monocrepid, tricrepid and tetracrepid. They are usually united into a network and such a reticulated skeleton is called lithistid

- **2. Microscleres:**
- The microscleres are the smaller flesh spicules that occur strewn throughout the mesenchyme. However, they do not form the supporting framework. The microspheres are of two types, viz., spires and asters.
- **(i) Spires:**
- Spires are curved in one plane or spirally twisted and exhibits many shapes. The most common types are the C-shaped forms, called sigmas; the bow-shaped ones, or toxas and the chelas with recurved hooks, plates or flukes at each end. When two ends are alike, chelas are called isochelas, when unlike, anisochelas. Spirally twisted sigmas are termed sigmaspires.
- **(ii) Asters:**
- Asters include types with small centres and long rays and large centres and small rays. Among the small centred forms are oxyasters with pointed rays, strongylaster with rounded ends and tylasters with knobbed rays. Large-centred forms include spherasters with definite rays and sterrasters with rays reduced to small projections from the spherical surface.
- Short spiny microscleric monaxons are known as streptasters, of which the principal sorts are the spirally twisted spirasters, rod shapes or sanaidasters, plesioasters with a few spines from a very short axis, and amphiasters with spines at each end. Microscleric forms of diactines are microrhabds, microxeas, and microstrongyles.

Types

- **1. Class Calcarea:**
- Having calcareous spicules.
- **2. Class Hexactinellida:**
- Having six-rayed (hexasters) siliceous spicules.
- **3. Class Demospongiae:**
- Having siliceous spicules and spongin fibres.

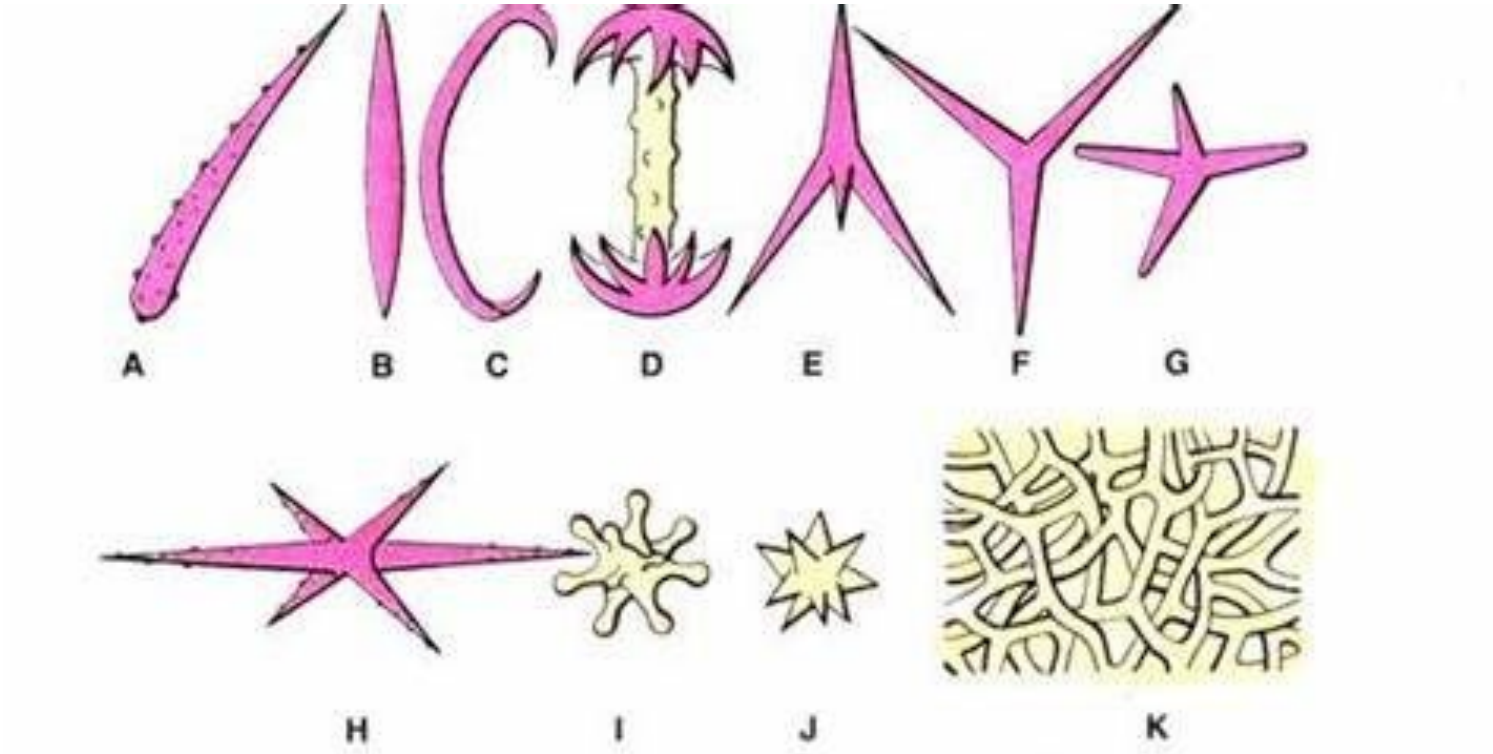


Fig. 28.9. Spicules and spongin. A—Monactinal monaxon; B—Diactinal monaxon; C—Curved monaxon; D—Monaxon with hooked ends; E—Tetraxon; F—Triradiate; G—Calthrops; H—Hexactinal triaxon; I and J—Polyaxon; K—Spongin fibres.

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