# Chapter 2 : Diploblastic Metazoans

Presented by Pr. SOUTTOU Karim

Zoology course

**Diploblastic Metazoans :**

**Meta : after ; Zoon : animal.**
**Diplo : two ; Blaste : layers of cells.**

# Chapter 2 : Diploblastic Metazoans

- **Diploblastic organisms are, generally speaking, metazoans: an association of cells that share the work.**

- **Differentiated cells associate to form monostratified layers: the germ layers. When the cells form the two fundamental layers, they are referred to as diploblastic organisms.**

- **The inner layer is called endoderm and the outer layer is called ectoderm.**

- **The beginning of an animal is a unicellular stage (the egg) that then passes through the diploblastic stage (gastrula).**

- **In diploblastic organisms, development stops at this stage (gastrula).**

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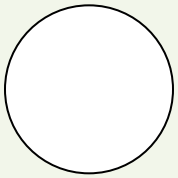
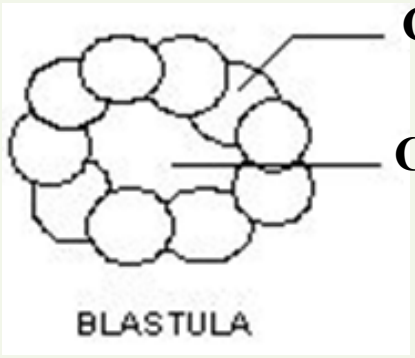
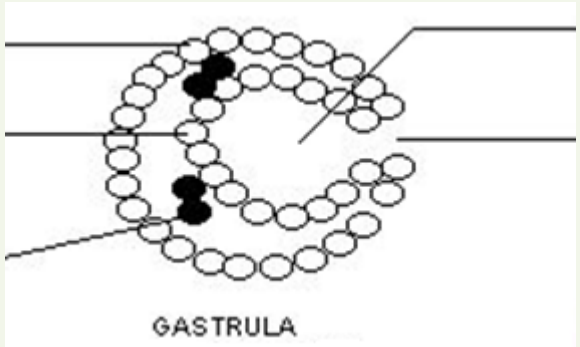
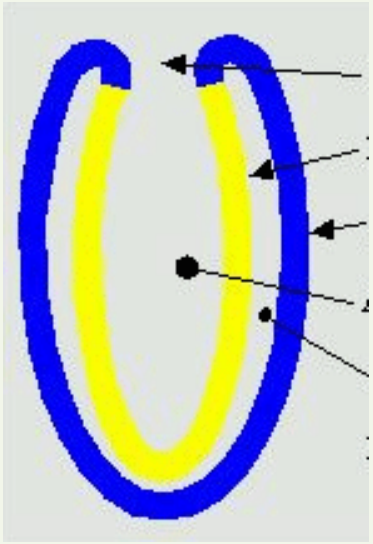


Zygote


Metazoans diploblastic

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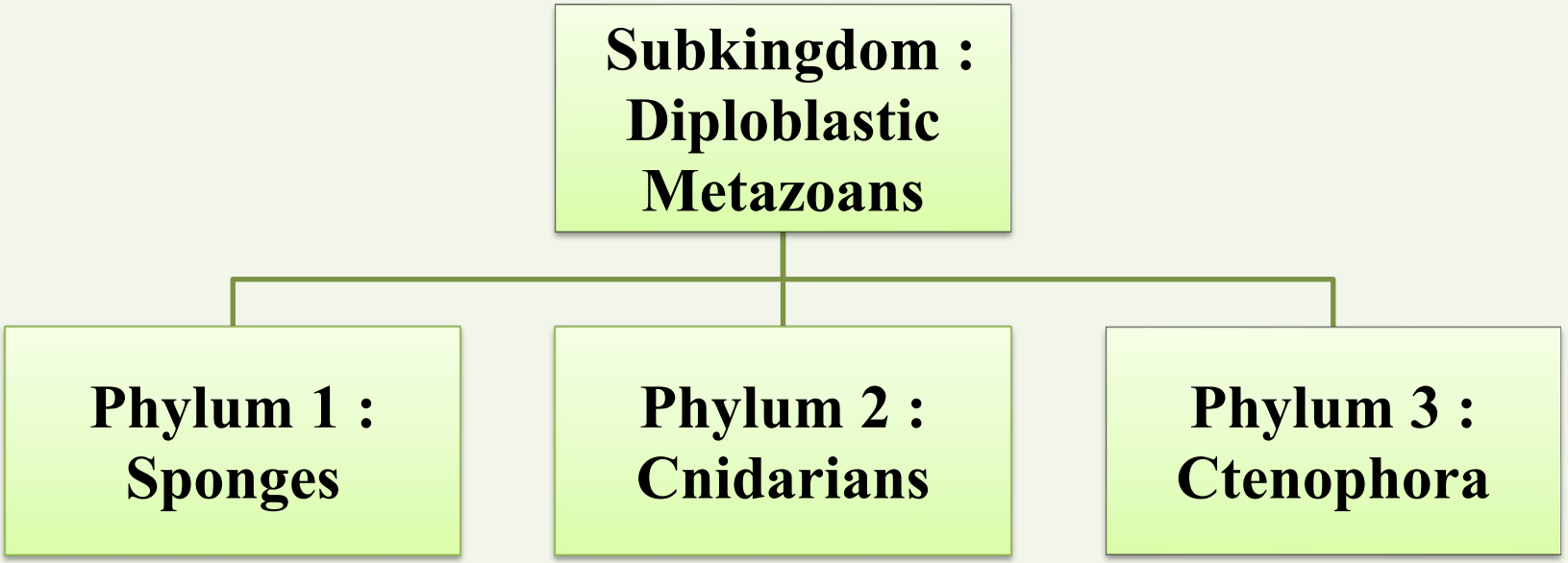

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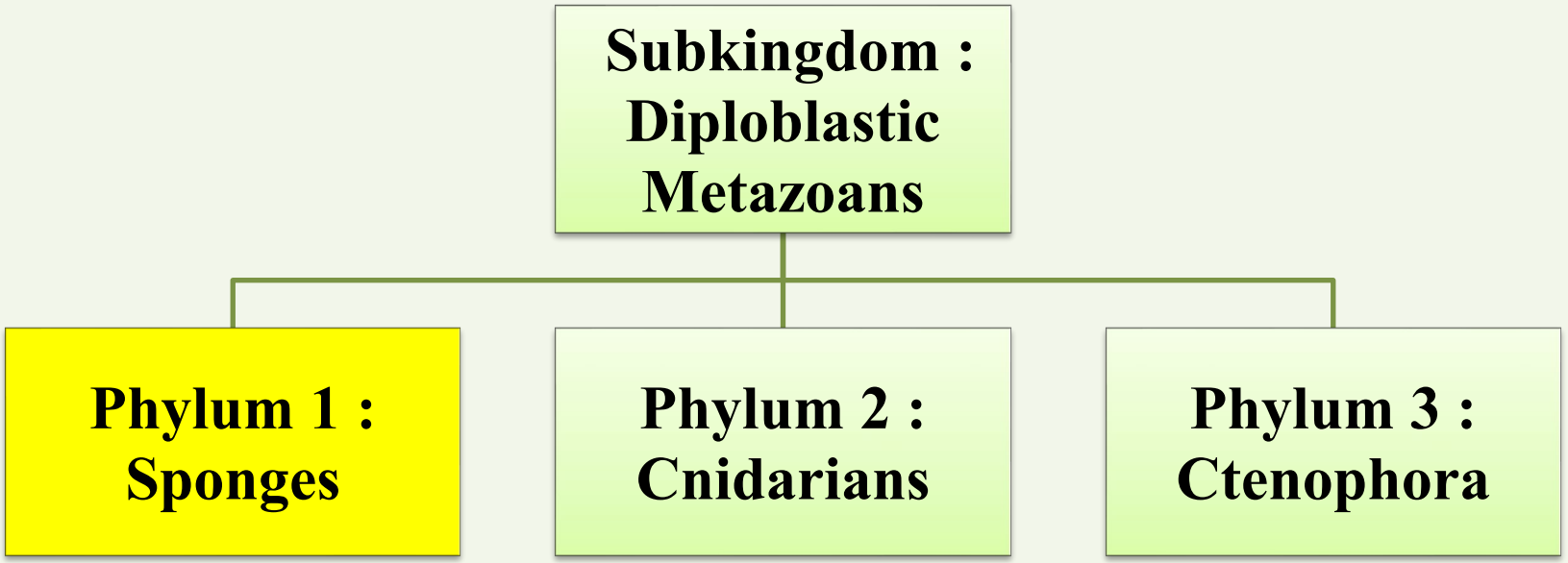


# Chapter 2 : Diploblastic Metazoans

## 1. – Phylum 1 Sponges

- They are diploblastic metazoans or with two embryonic layers (ectoderm and endoderm) and their development stops at the gastrula stage.

- Sponges are primarily marine organisms and live at all depths, except for the freshwater family Spongillidae.

- These are sessile organisms (living fixed). They attach themselves to the most diverse supports: rocks, polyps, shells, and even living Crustaceans.

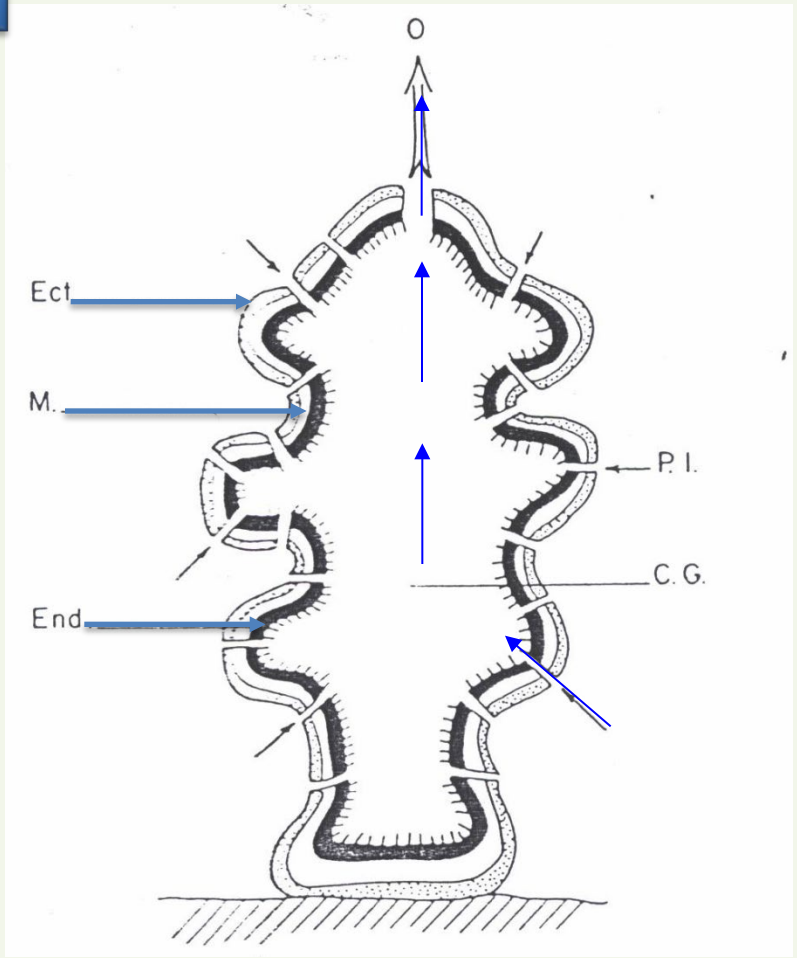
# Chapter 2 : Diploblastic Metazoans

## PARAZOA

Sponges


# Chapter 2 : Diploblastic Metazoans

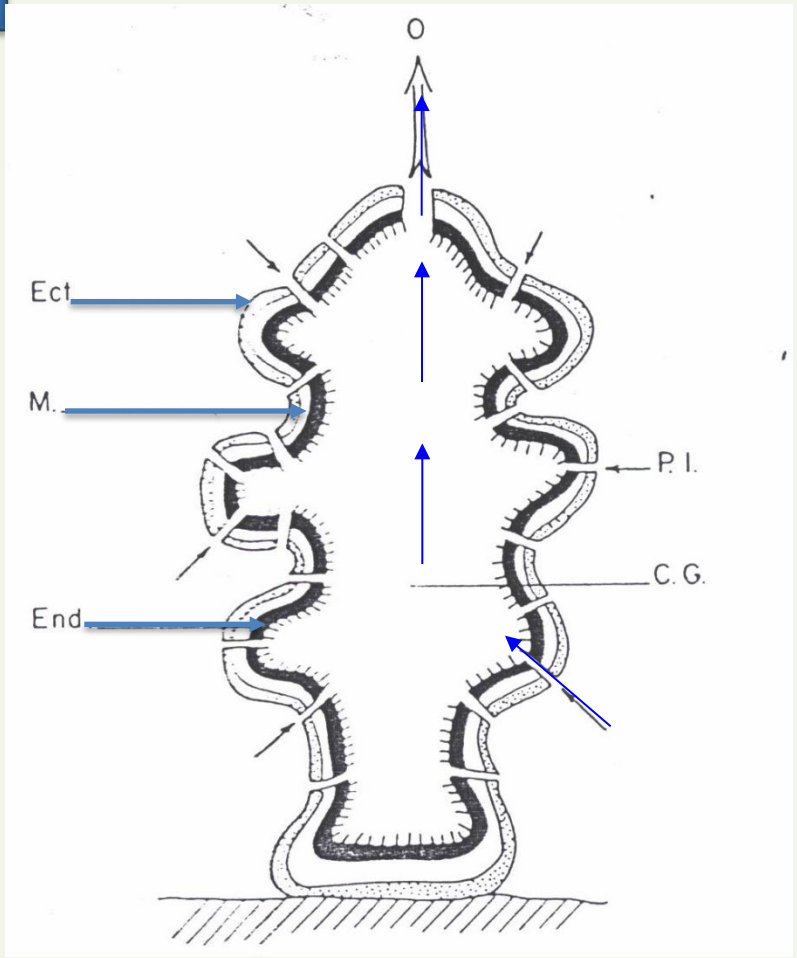
**- A sponge is a small sac without defined symmetry, without differentiated organs, and whose gastric cavity, internal or Atrium, communicates with the outside through an apical opening called Oscule.**




**O:** Osculum, **P.I.:** Inhalant pore, **C.G.:** gastric cavity, **Ect.:** ectoderm, **End.:** endoderm, **M.:** mesohyl.

# Chapter 2 : Diploblastic Metazoans

**- The wall of the sac is pierced with numerous pores, hence the other name of the phylum: <u>Porifera</u>. The water enters through these pores called <u>inhalant pores</u>, and exits through the osculum which functions like an anus (Figure).**

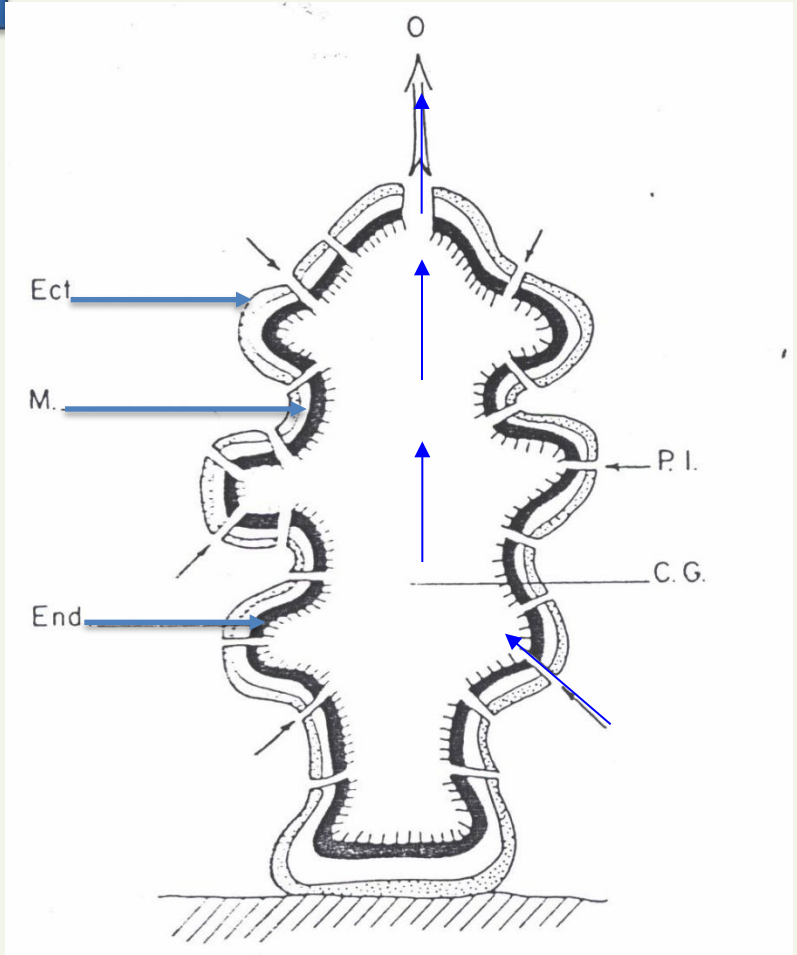



**O:** Osculum, **P.I.:** Inhalant pore, **C.G.:** gastric cavity, **Ect.:** ectoderm, **End.:** endoderm, **M.:** mesohyl.

# Chapter 2 : Diploblastic Metazoans

## 1.1. – Structure of Sponges

**The body wall is formed of two cellular layers: the Ectoderm and the Endoderm, separated by a Mesohyl of ectodermic and endodermic origin that contains collagen (Figure).**




**O:** Osculum, **P.I.:** Inhalant pore, **C.G.:** gastric cavity, **Ect.:** ectoderm, **End.:** endoderm, **M.:** mesohyl.

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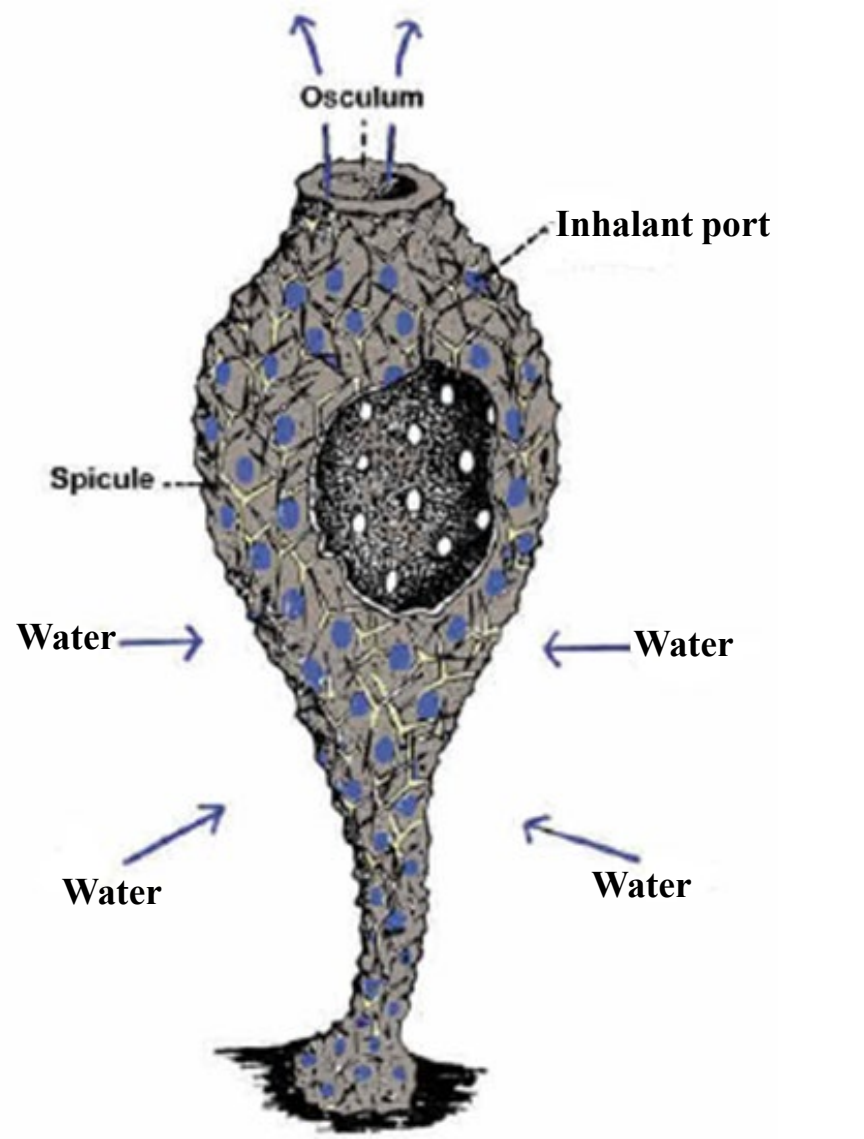

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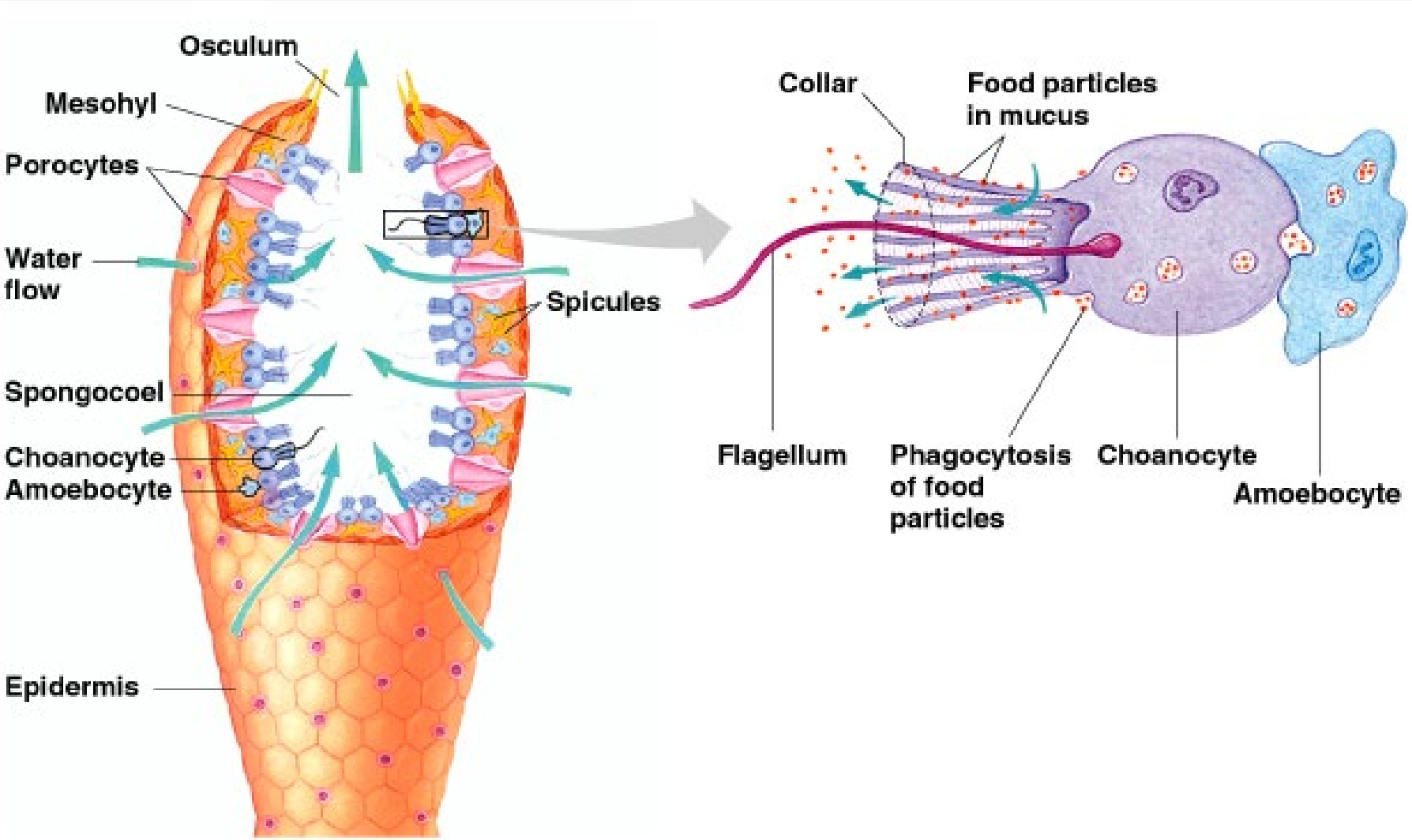

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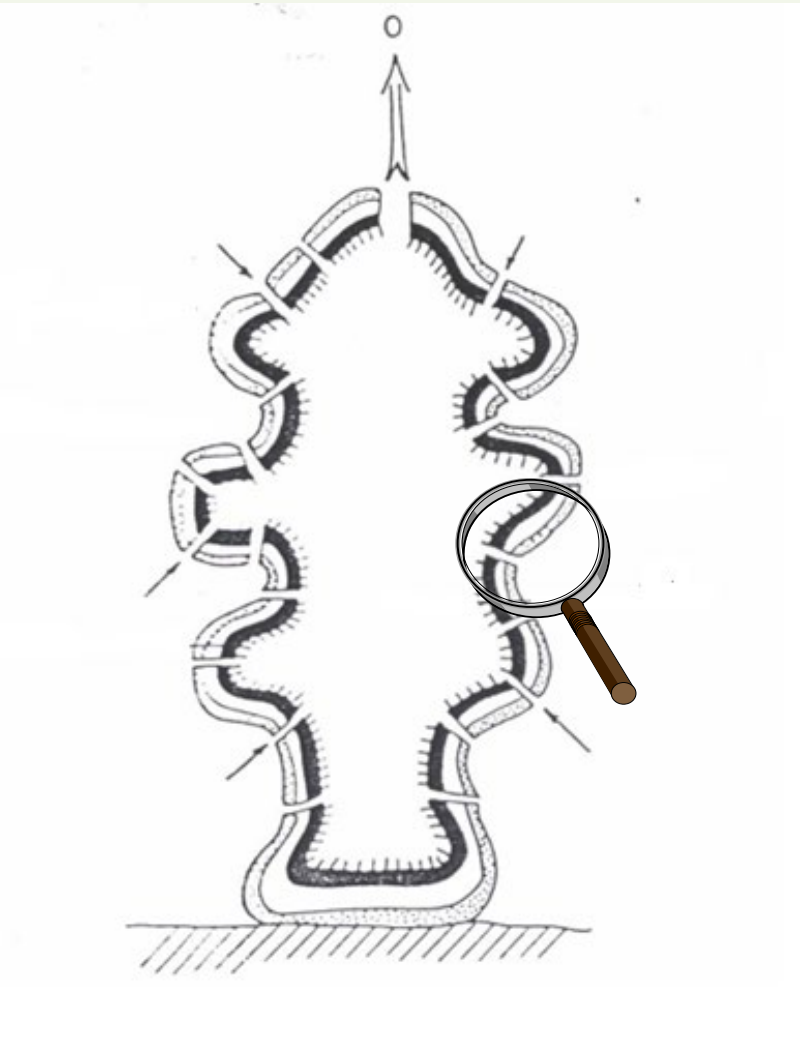


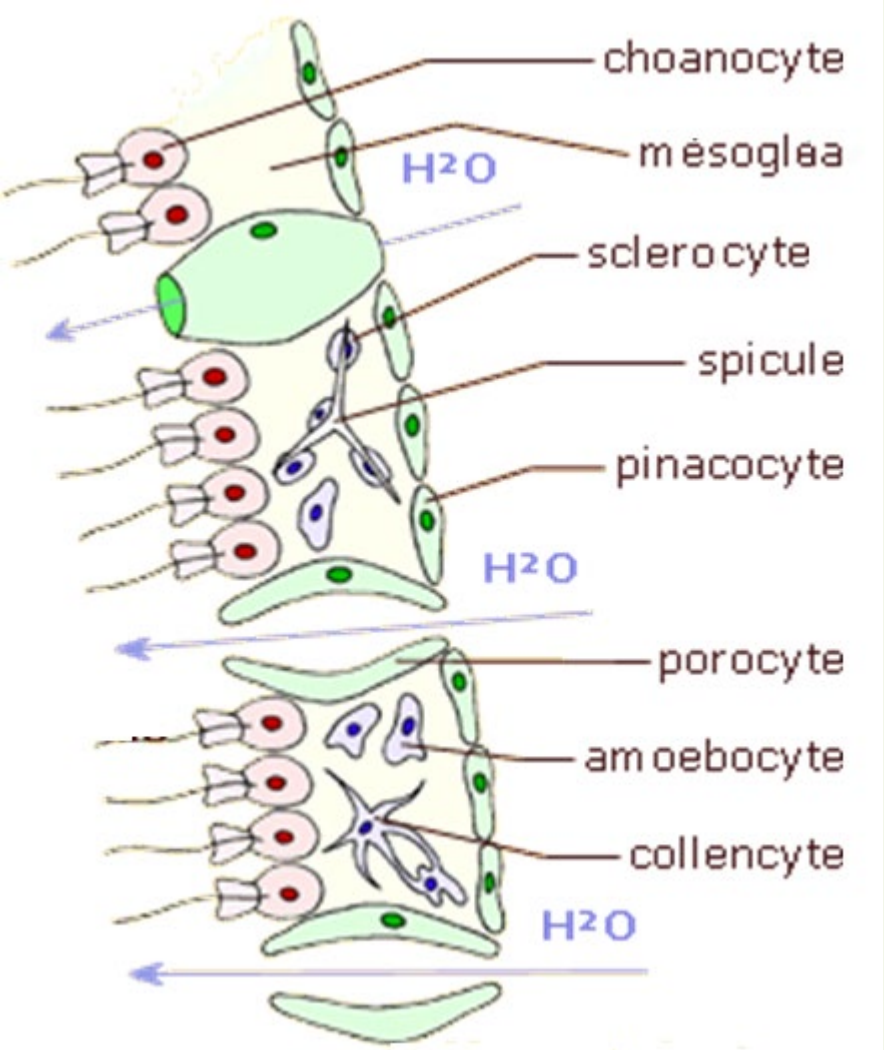

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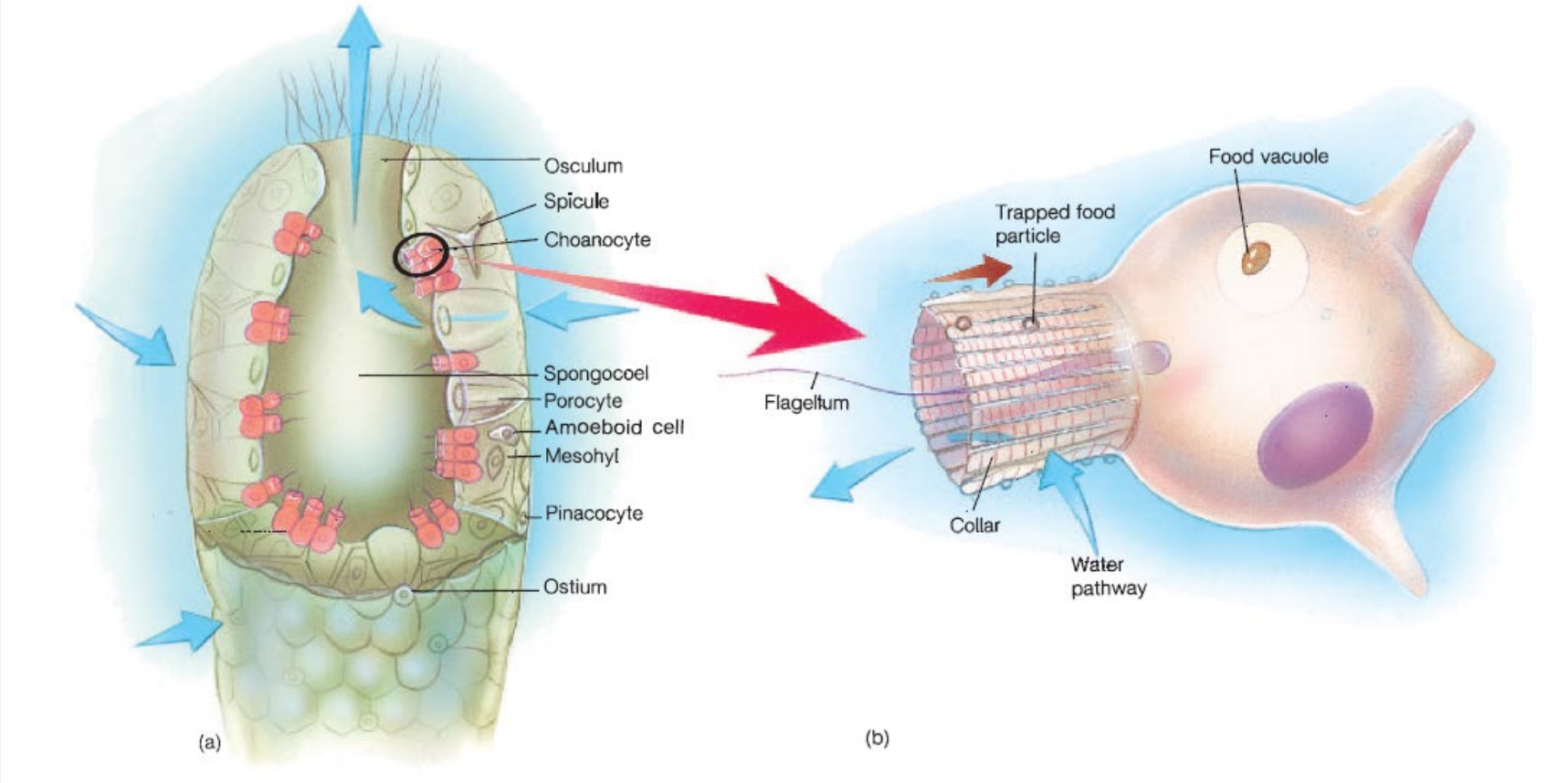


***The ectoderm is formed by a layer of flat and contiguous cells, or <u>pinacocytes</u>.**

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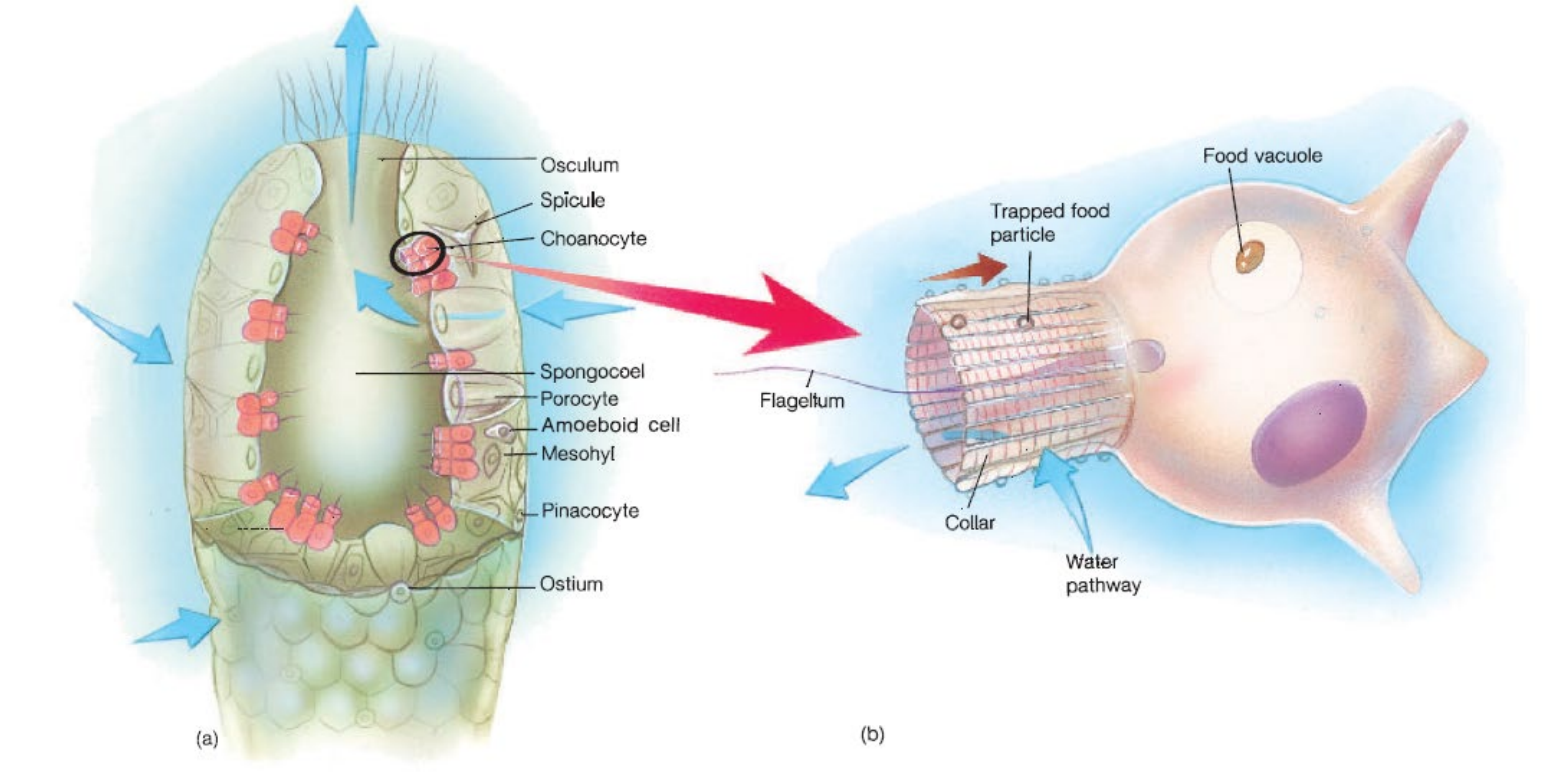



***The endoderm is formed by a layer of cells or choanocytes, very similar to the cells of choanoflagellates.**

**Choanocytes have two functions: to circulate water through the movements of the flagellum and to phagocytize food particles.**

# Chapter 2 : Diploblastic Metazoans

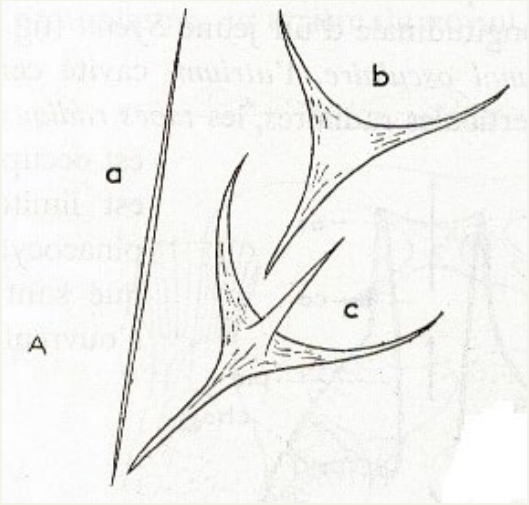
***Cells of ectodermal origin:**

**-The sclerocytes secrete the spicules, the skeleton of the sponge.**

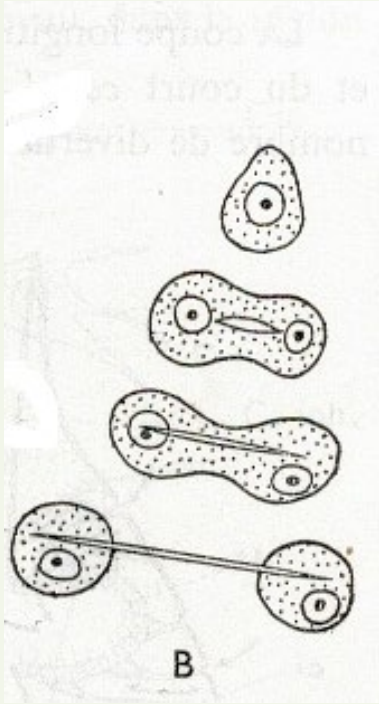
**-The spongocytes secrete spongin, an elastic substance composed of fibrillar scleroproteins related to collagen.**

**-The Porocytes are excavated by an intracellular canal and form the inhalant pores.**

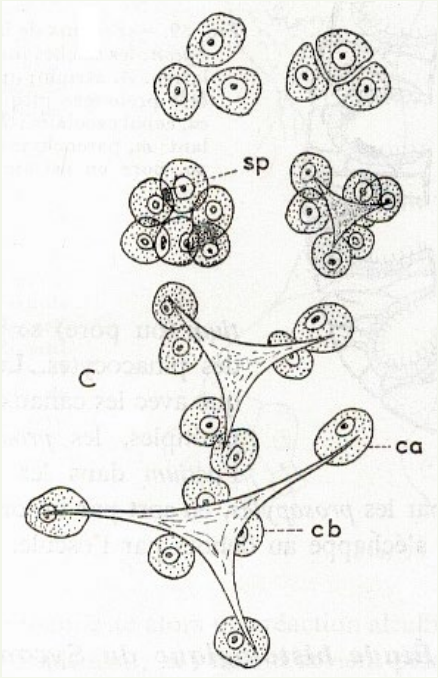
# Chapter 2 : Diploblastic Metazoans




**Three types of spicules**
**a) Mon-axis spicule**
**b) Tri-axis spicule**
**c) Tetra-axis spicule**




**Formation of a mono-axis spicule from a one sclerocyte**




**Formation of a tri-axis spicule from a three sclerocytes**

**Endodermal origin cells:**

**- Collencytes are star-shaped cells whose extensions anastomose and form a network containing other cell types.**

**- Nerve cells form a diffuse network connecting the ectoderm and the endoderm: they emit long extensions, some of which are branched, resembling dendrites or axons.**

**- The Archeocytes, large and embryonic in nature, can give rise to Gonocytes and contractile Myocytes, especially present in siliceous Sponges.**

## 1.2. – Reproduction of Sponges

All sponges are capable of both sexual and asexual reproduction.

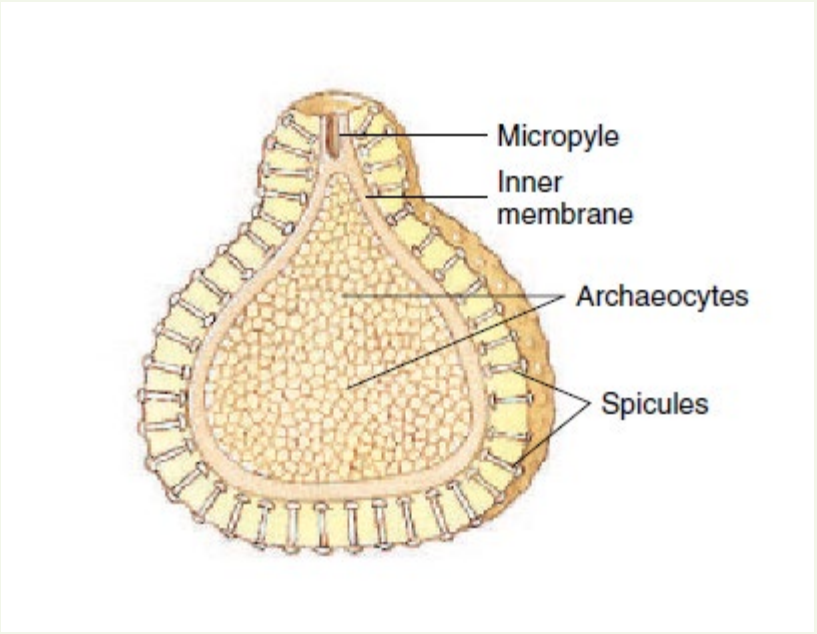
Most sponges are monoecious (both sexes occur in the same individual) but do not usually self-fertilize because individual sponges produce eggs and sperm at different times.

# Chapter 2 : Diploblastic Metazoans

## 1.2. – Reproduction of Sponges

### 1.2.1. – Asexual reproduction

Sponges reproduce asexually by forming external buds that detach or remain to form colonies. In addition to external buds, which all sponges can form, freshwater sponges and some marine sponges reproduce asexually by the regular formation of internal buds called gemmules.



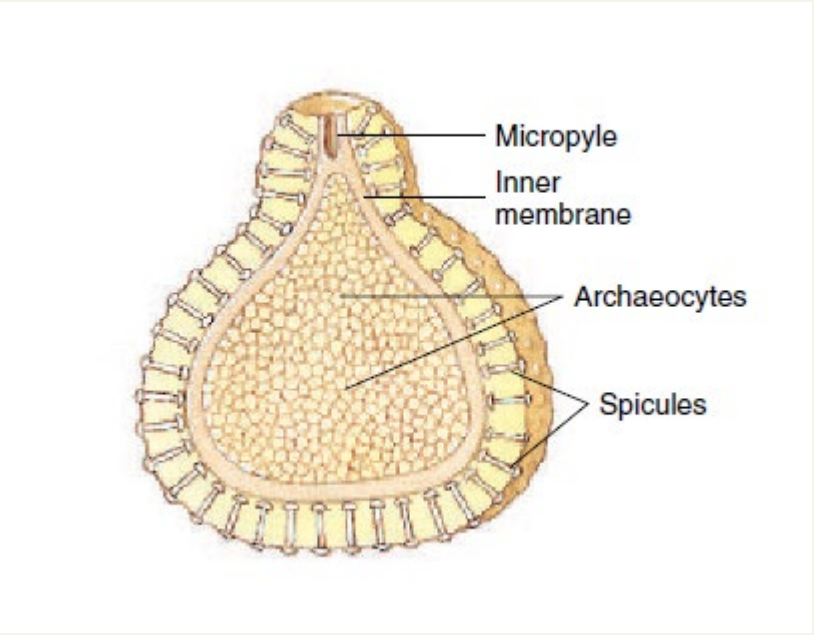

Section through a gemmule of a freshwater sponge (Spongillidae)

# Chapter 2 : Diploblastic Metazoans

## 1.2. – Reproduction of Sponges

### 1.2.1. – Asexual reproduction

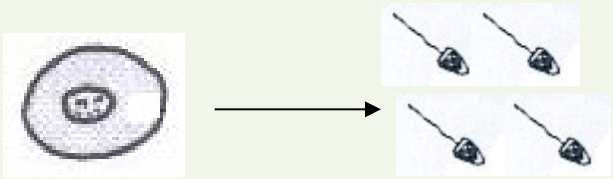
These dormant masses of encapsulated archaeocytes are produced during unfavorable conditions. They can survive periods of drought and freezing and more than three months in the absence of oxygen. Later, with the return of favorable conditions for growth, archaeocytes in the gemmules escape and develop into new sponges.




Section through a gemmule of a freshwater sponge (Spongillidae)

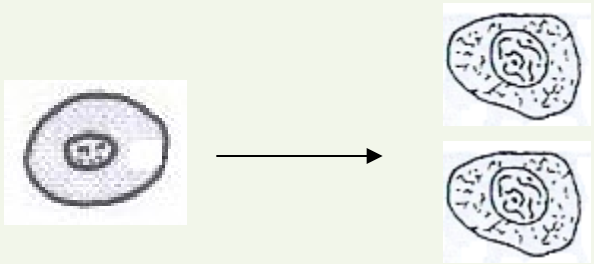
## 1.2.2. – Sexual reproduction

### a) Spermatogenesis



### b) Oogenesis

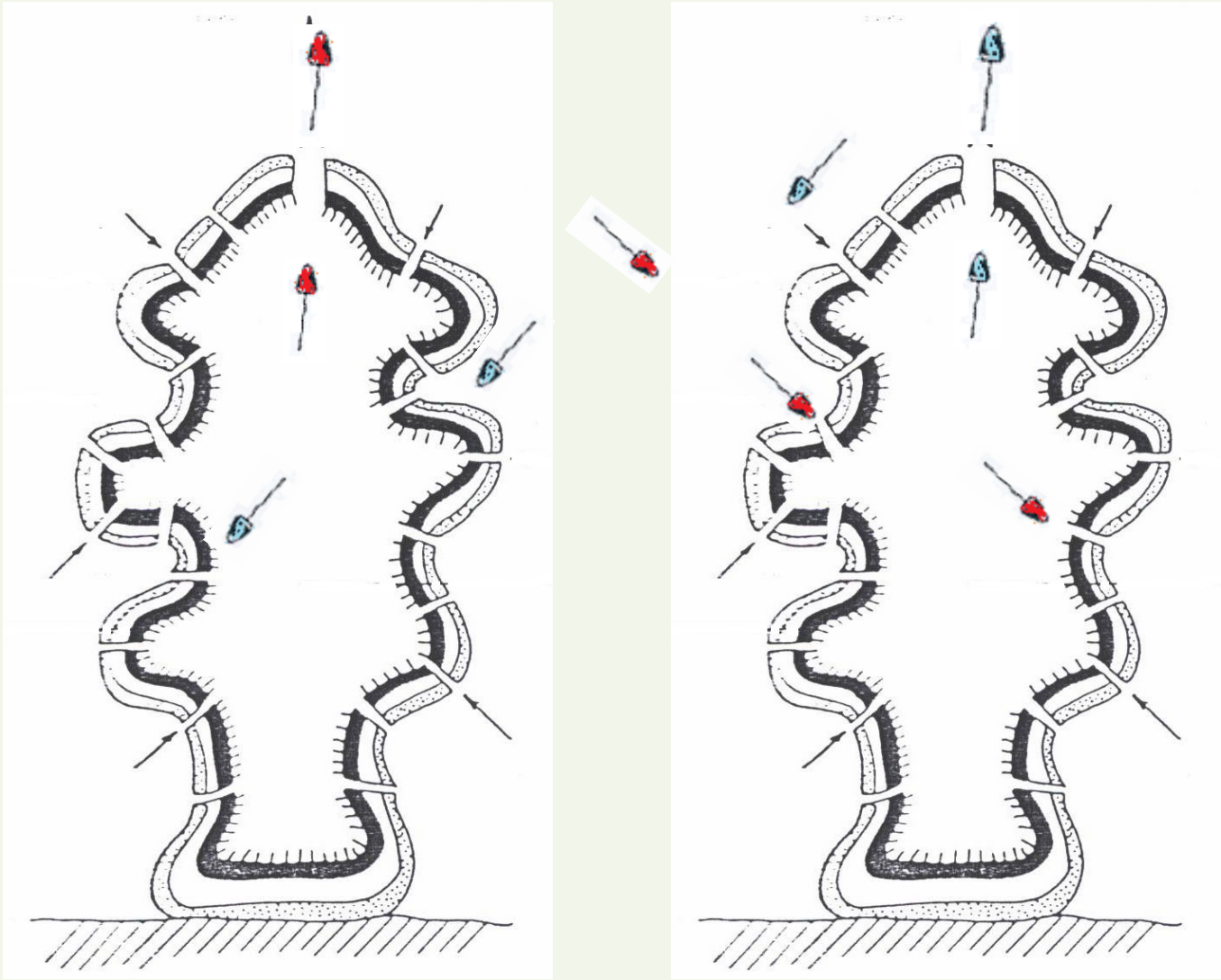
Some archaeocytes divide and give rise two oogonia.



**c) The Fertilization**

**The fertilization is indirect type. Siliceous sponges are hermaphrodites (monoecious, ambisexual), while calcareous sponges are gonochoric (separate sexes).**

# Chapter 2 : Diploblastic Metazoans

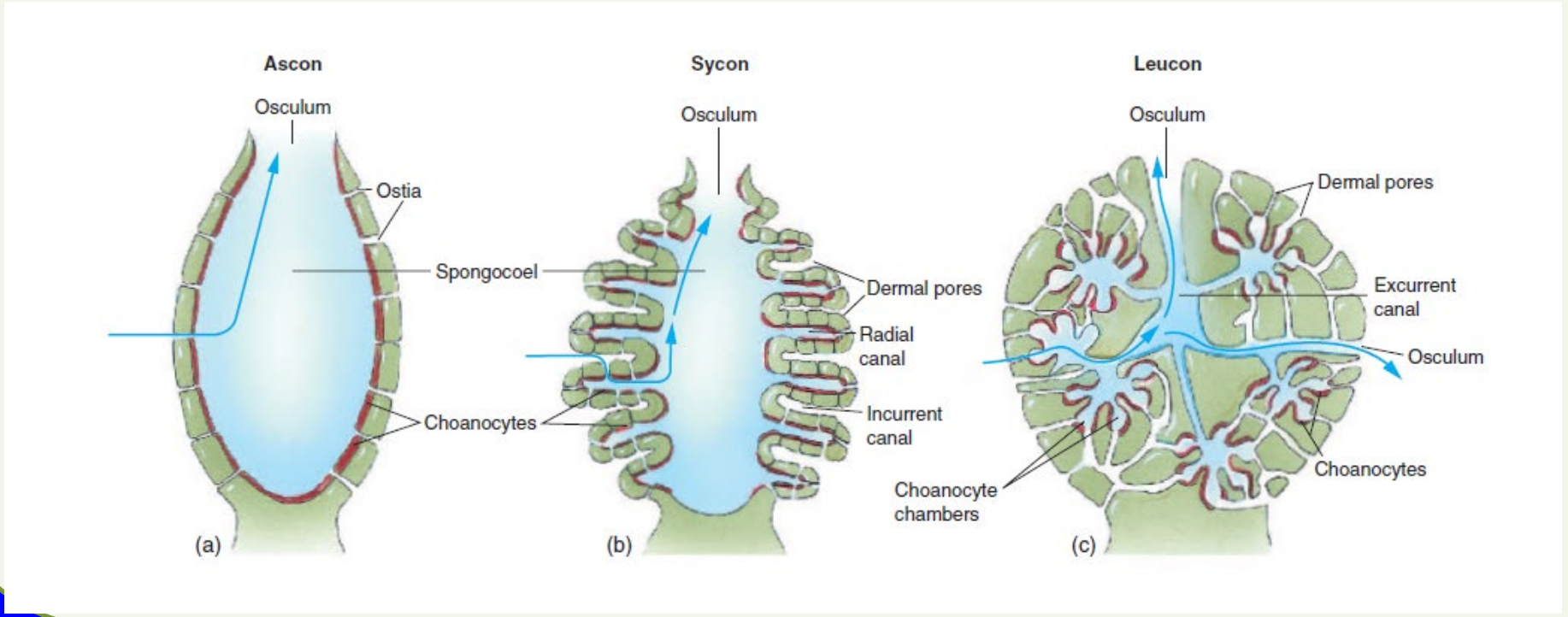


# Chapter 2 : Diploblastic Metazoans

**Class 1 : Calcarea**

**Order 1 : Homocoeles (Ascon)**

**Order 2 : Heterocoeles (Sycon et Leucon)**



# Chapter 2 : Diploblastic Metazoans

***Order 1 : Homocoeles (Ascon) Choanocytes line the spongocoel, and their flagellar movements draw water into the spongocoel through the ostia. Water exits the sponge through the osculum, which is a single, large opening at the top of the sponge.**

***Order 2 : Heterocoeles (Sycon et Leucon) The atrium is lined with pinacocytes and the choanocytes are pushed into vibratile chambers.**

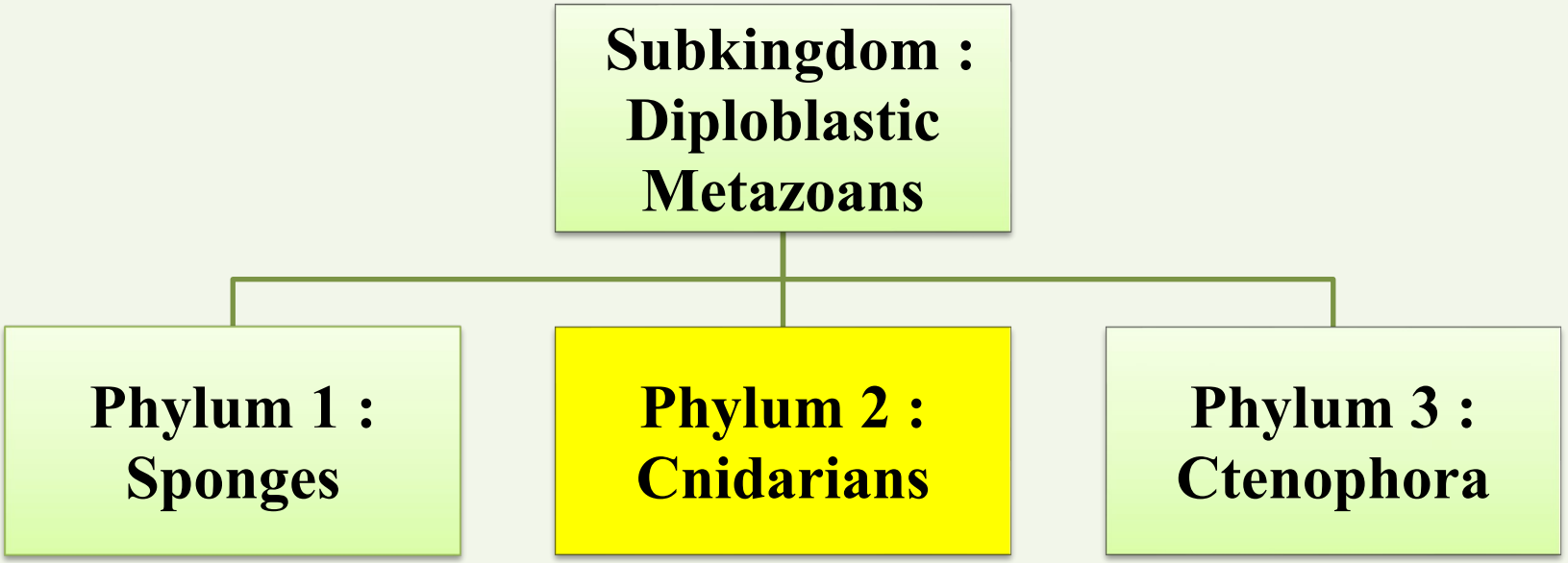
# Chapter 2 : Diploblastic Metazoans

Grantia compressa *est une petite éponge calcaire (ici à sa taille réelle), à structure simple, qui vit en Bretagne sous les surplombs à très basse mer.*

***Spongia officinalis***

*Des éponges massives, souvent brillamment colorées comme cette Clathria, vivent sur les pentes des récifs coralliens.*

# Chapter 2 : Diploblastic Metazoans



# Chapter 2 : Diploblastic Metazoans

## 2. – Phylum 2 Cnidarians

- Aquatic animals, almost all marine. Bearing cnidoblasts (stinging cells: cnid = nettle) very abundant along their tentacles and in the ectoderm.

- Cnidarians are diploblastic Metazoans whose ectoderm and endoderm are separated by an acellular layer: the mesoglea.

- Characterized by their single digestive cavity that communicates with the outside through the mouth.

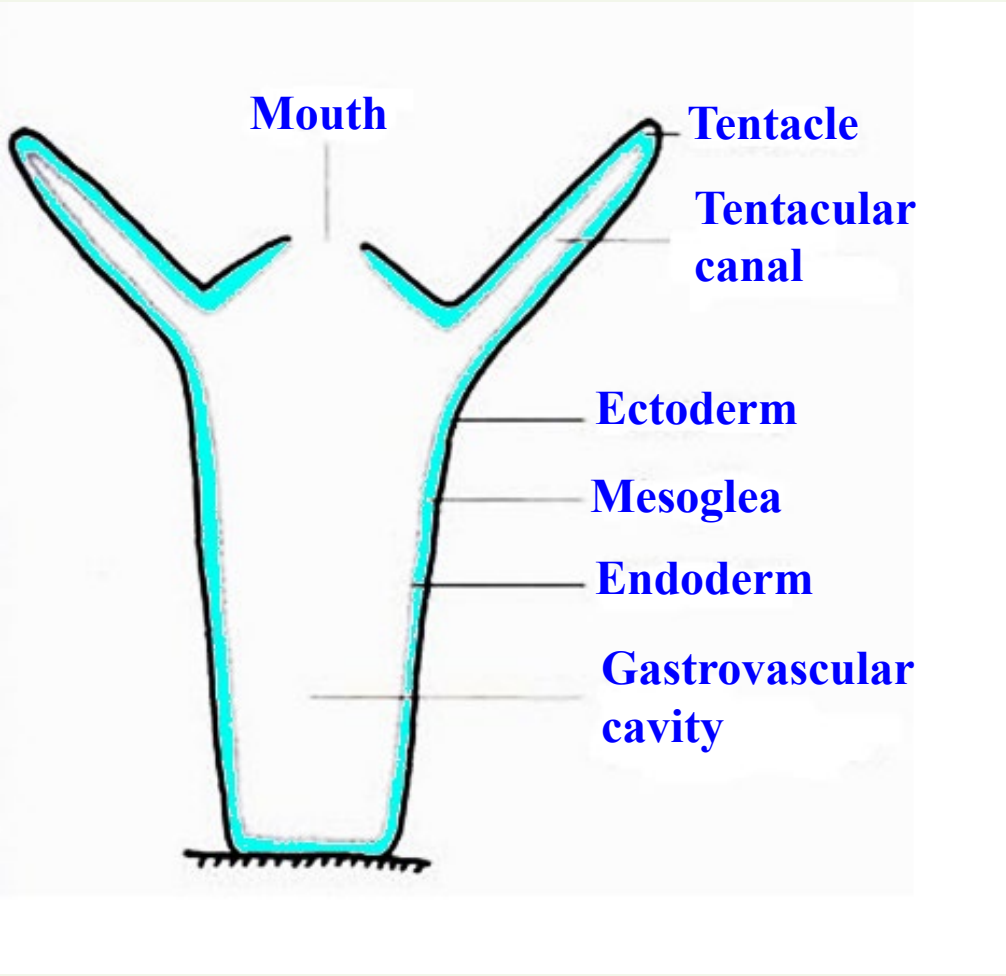
- Can exist in two different forms: the fixed form or polyp, and the free form or medusa.

# Chapter 2 : Diploblastic Metazoans

## 2. – Phylum 2 Cnidarians

### 1.1. – Anatomy of polyp phase

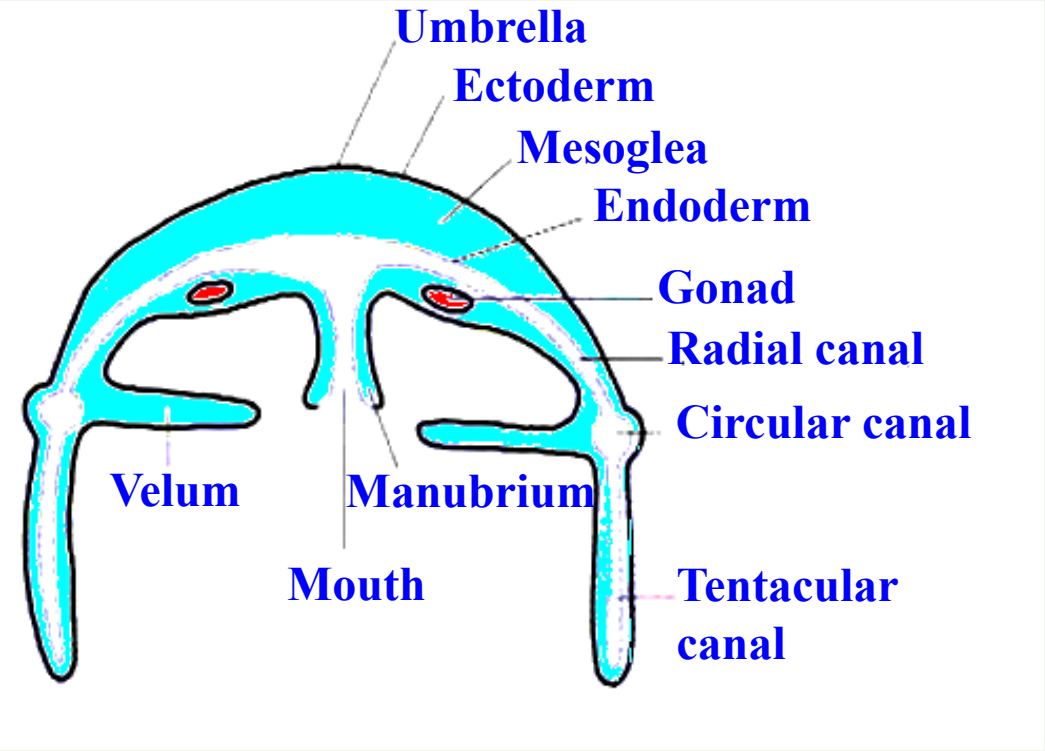
A polyp is a small sac whose opening, the mouth, is surrounded by a crown of tentacles into which the gastrovascular cavity extends. The mesoglea is thin in the polyp.



## 1.2. – Anatomy of medusa phase

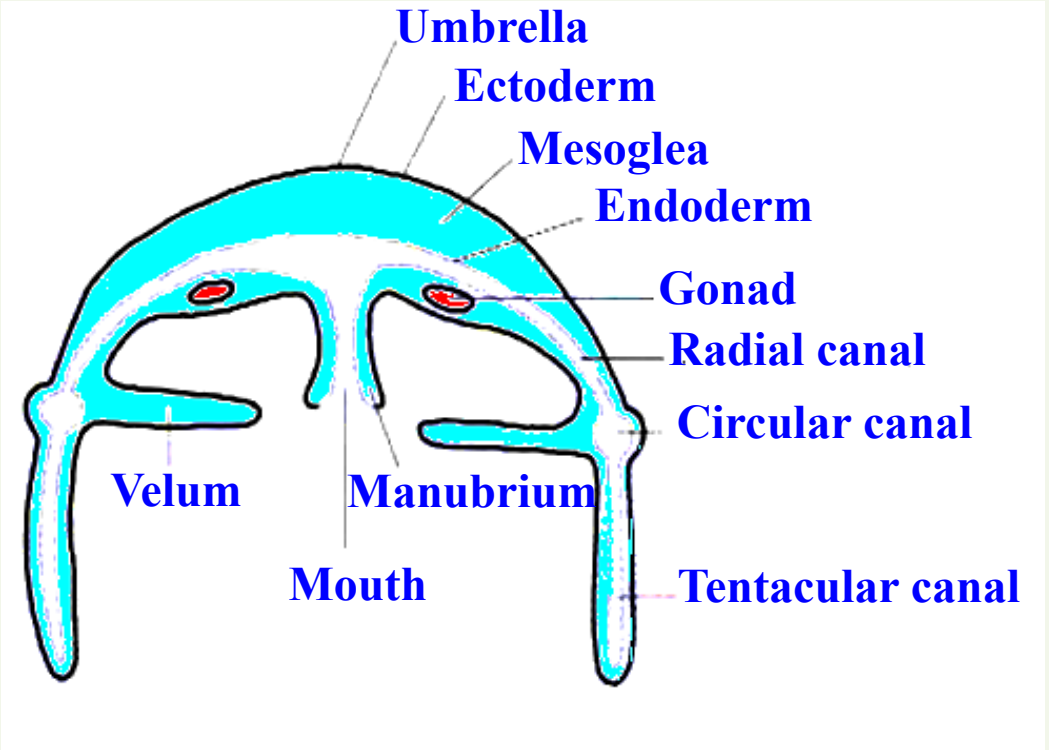
- The Aboral face or the one opposite the mouth is strongly widened and takes on a convex shape: it is the Umbrella.

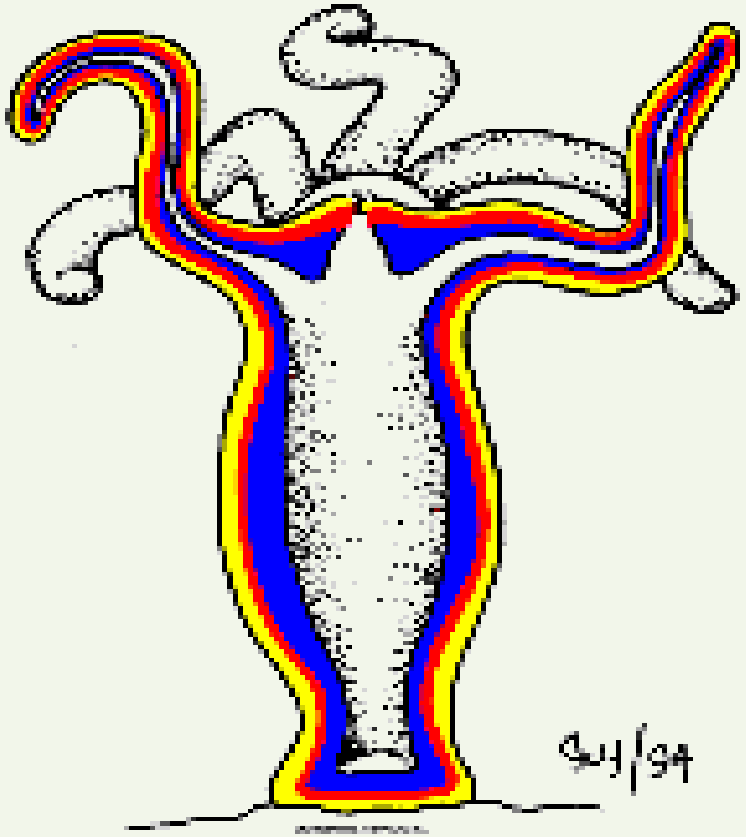
- The oral face is concave, the mouth opens at the end of a pseudotromp called Manubrium.



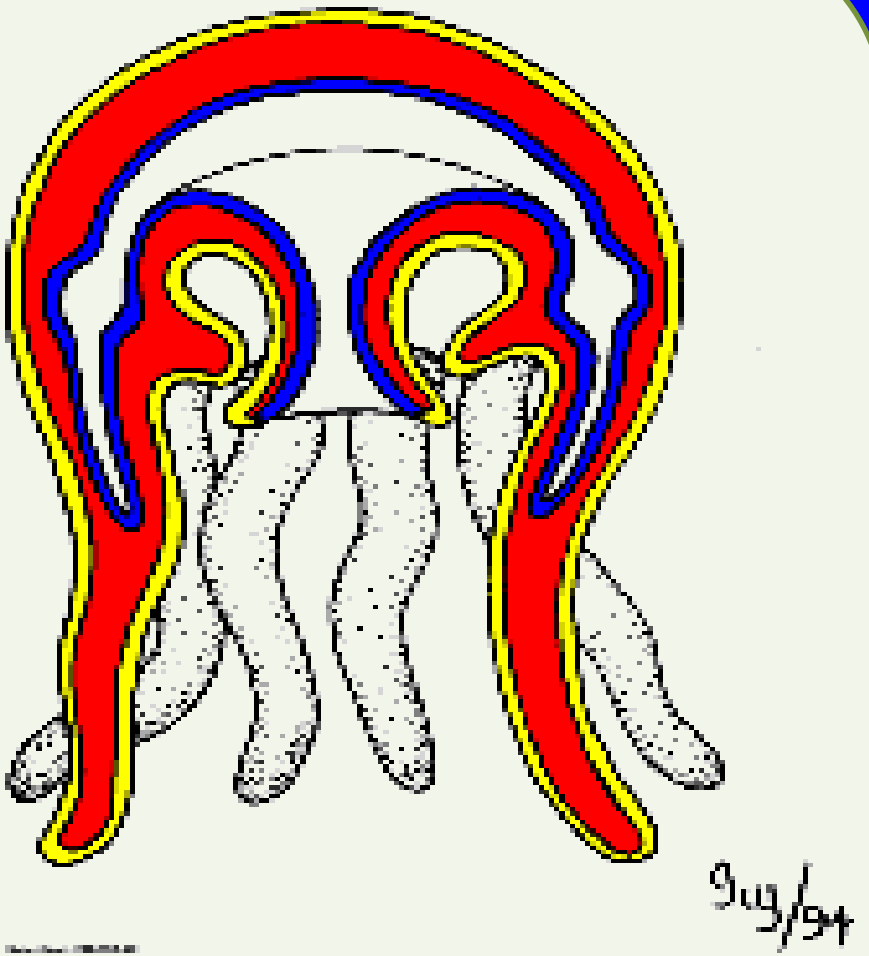
## 1.2. – Anatomy of medusa phase

- This mesoglea, thick in the bell, reduces the gastrovascular cavity to a network of canals that extend from the manubrium to the tips of the tentacles.



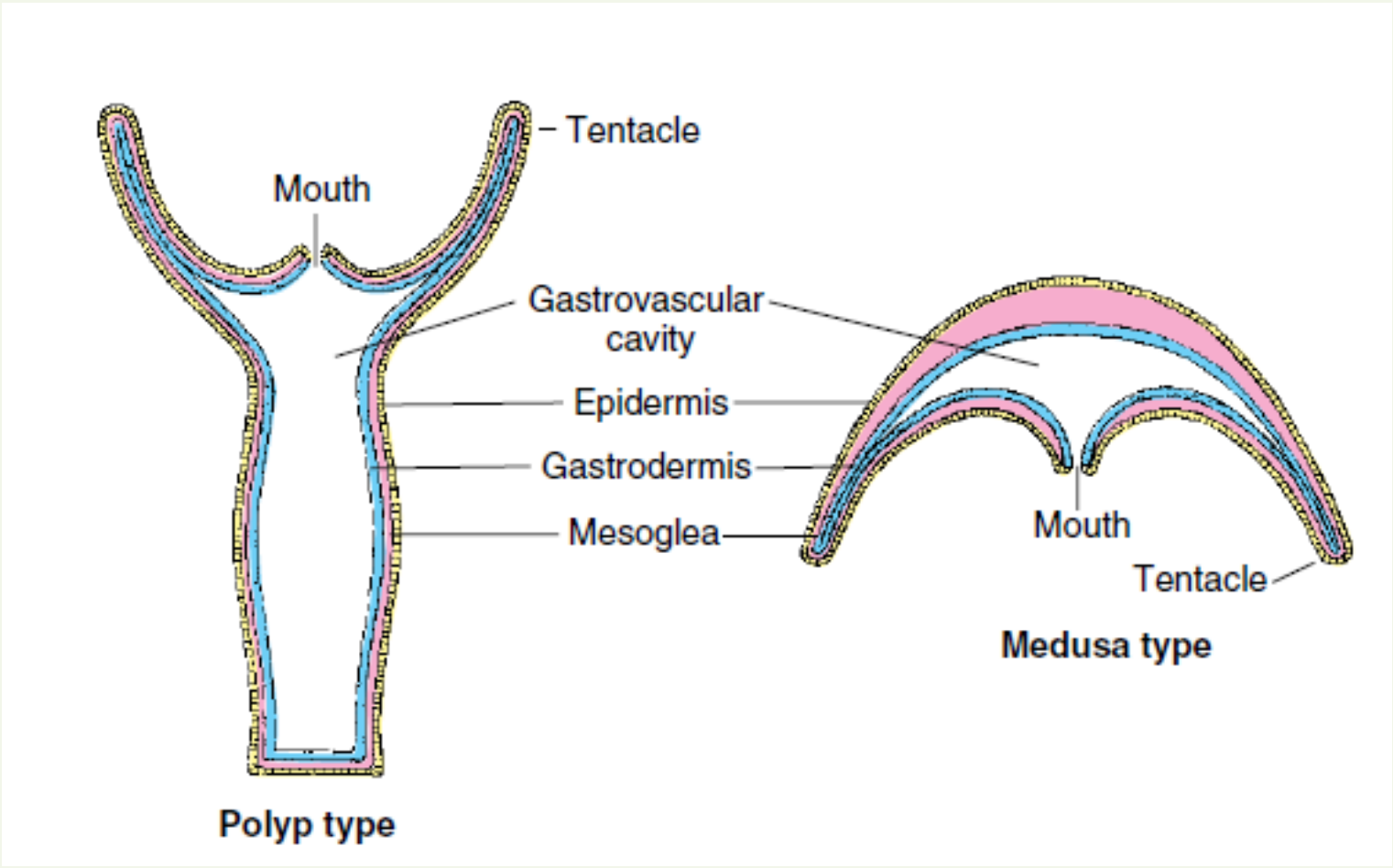


Polyp



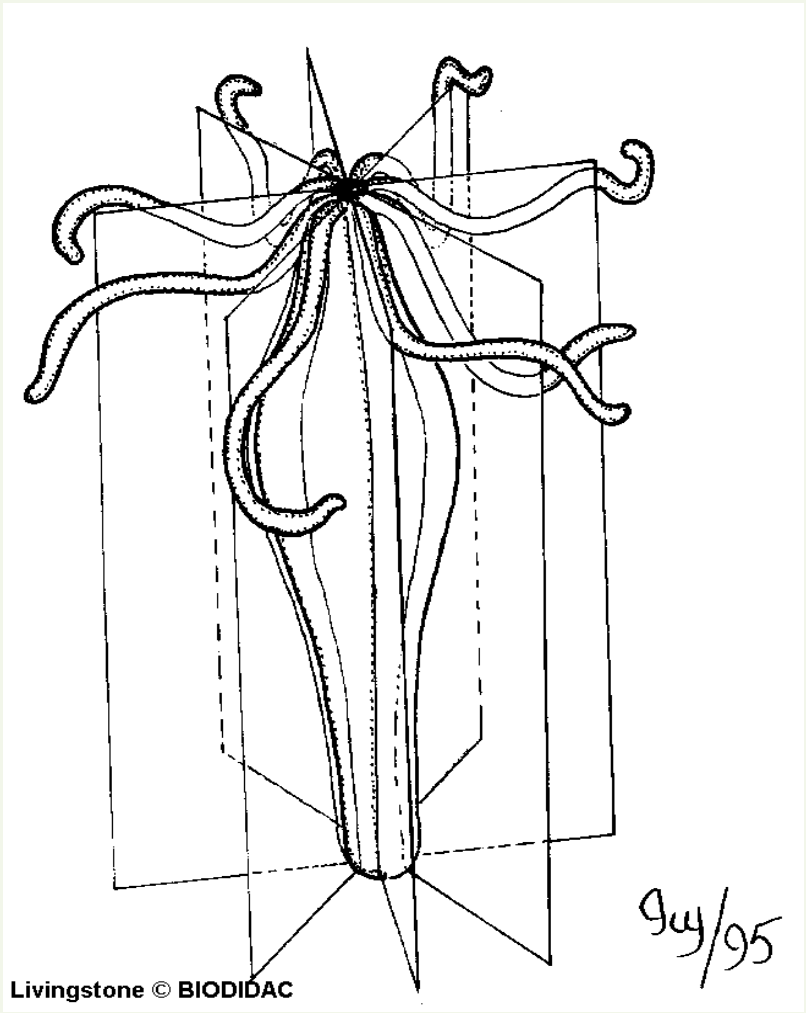
Medusa

- Ectoderm
- Mesoglea
- Endoderm




**Comparison between the polyp and medusa types of individuals**

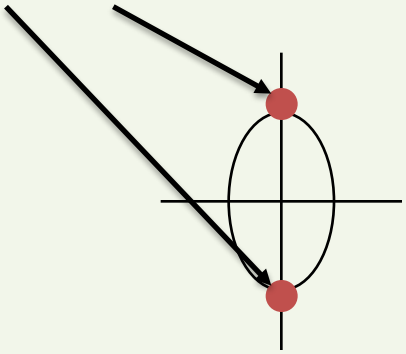
# Radial symmetry

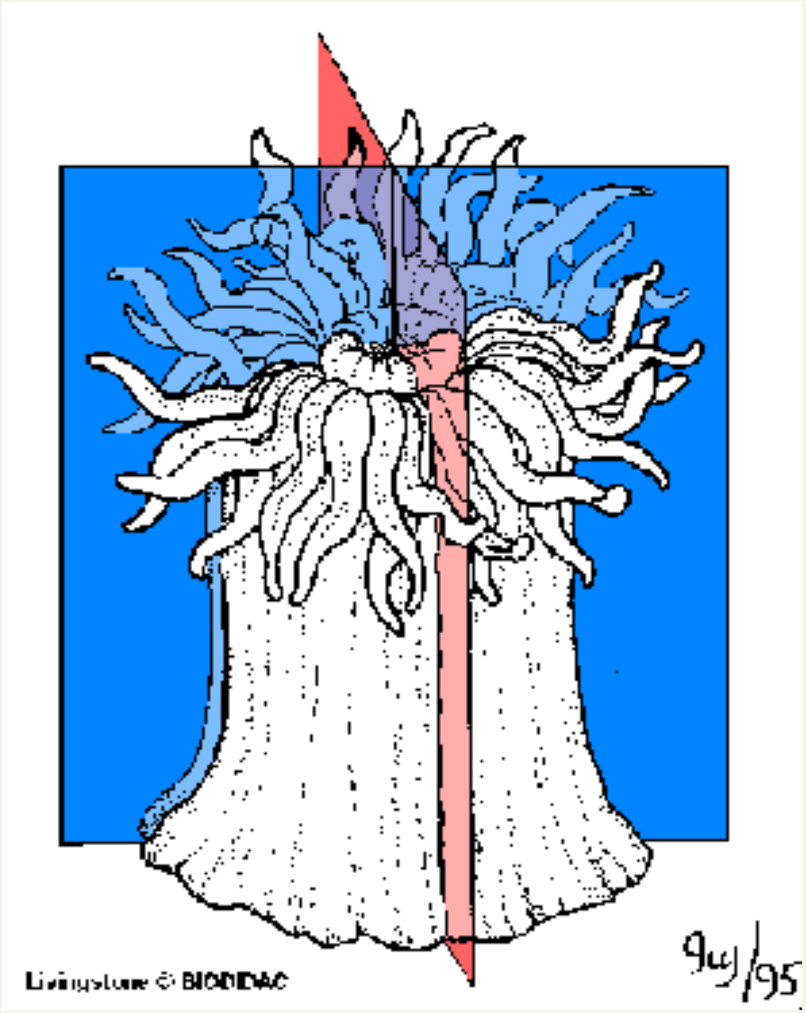



# Biradial symmetry
(Cnidaria - Anthozoa)

- **Biradial symmetry due to the presence of siphonoglyphs.**

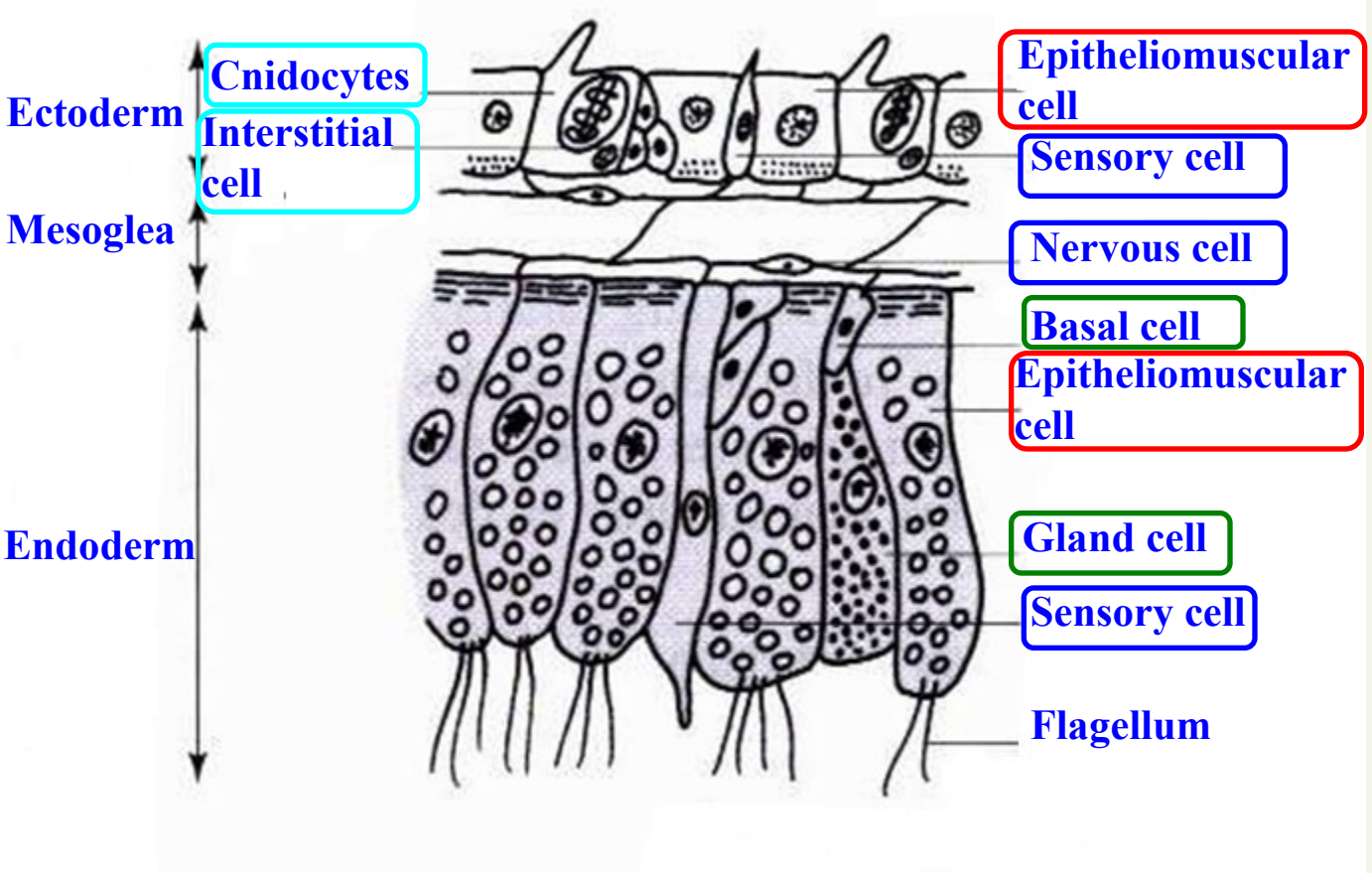
**Siphonoglyphs**





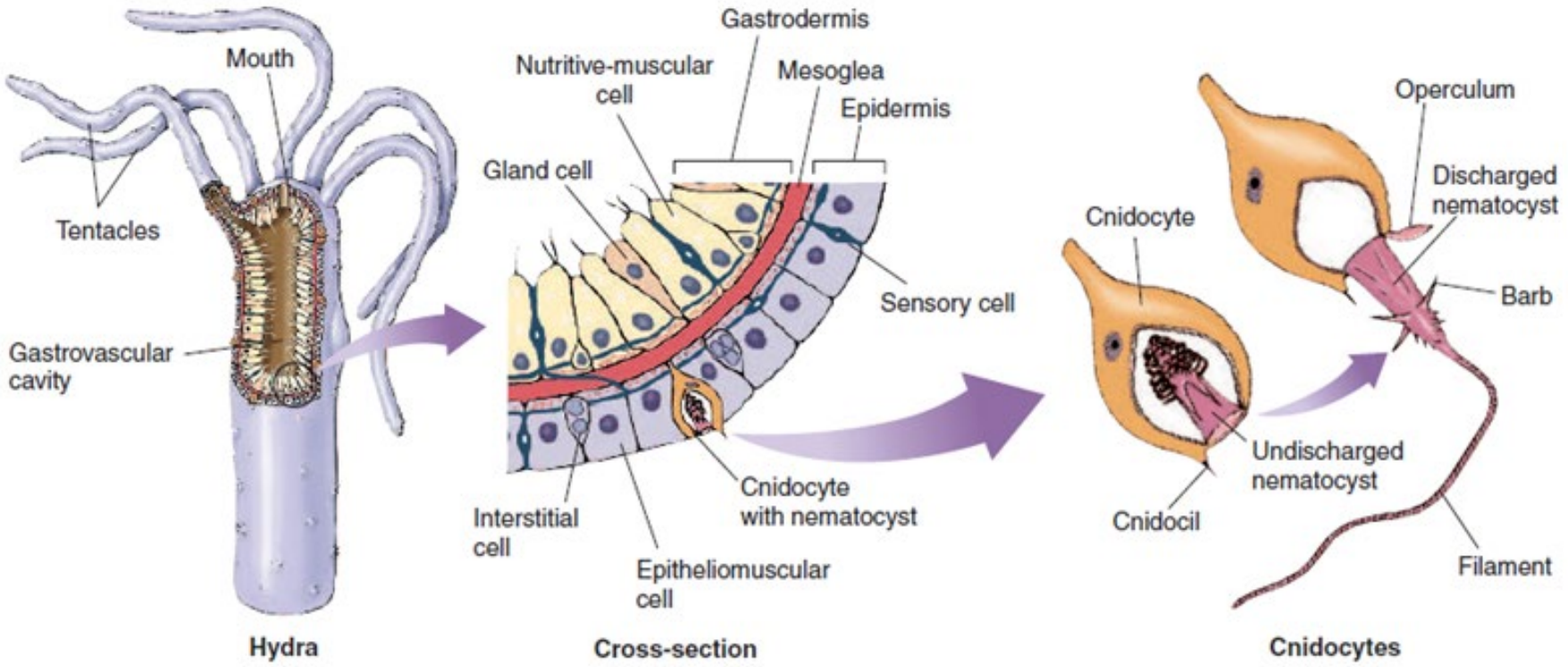
# Chapter 2 : Diploblastic Metazoans

## 2. – Histologic structure



# Chapter 2 : Diploblastic Metazoans

## 2. – Histologic structure




**figure**

At right, structure of a stinging cell. Center, portion of the body wall of a hydra. Cnidocytes, which contain the nematocysts, arise in the epidermis from interstitial cells.

***Myoepithelial cells: These cells belonging to the ectoderm or endoderm are also called epithelial-muscle cells.**

***Nerve cells: These cells form two nerve plexuses, one located at the base of the ectoderm and the other at the base of the endoderm. They transmit information to sensory cells distributed in both layers.**

# Chapter 2 : Diploblastic Metazoans

*<u>Specific ectodermal cells:</u>

**Interstitial cells: These are small embryonic-like cells that produce germ cells and are capable of differentiating to replace other cells: the Cnidoblasts.

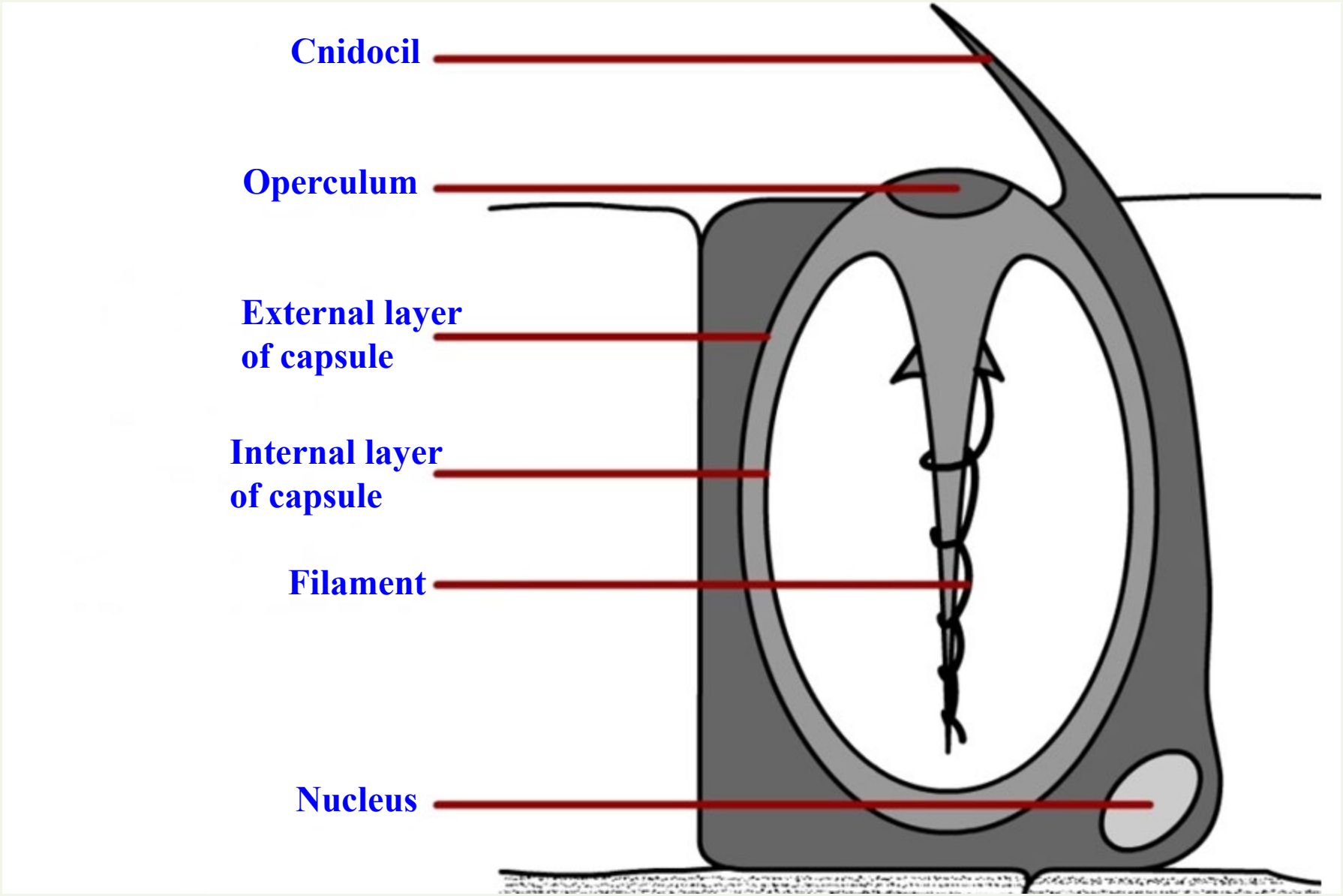
**Cnidoblasts:** These are the characteristic cells of Cnidarians. They are abundant in the tentacles, stinging, and serve to capture prey.

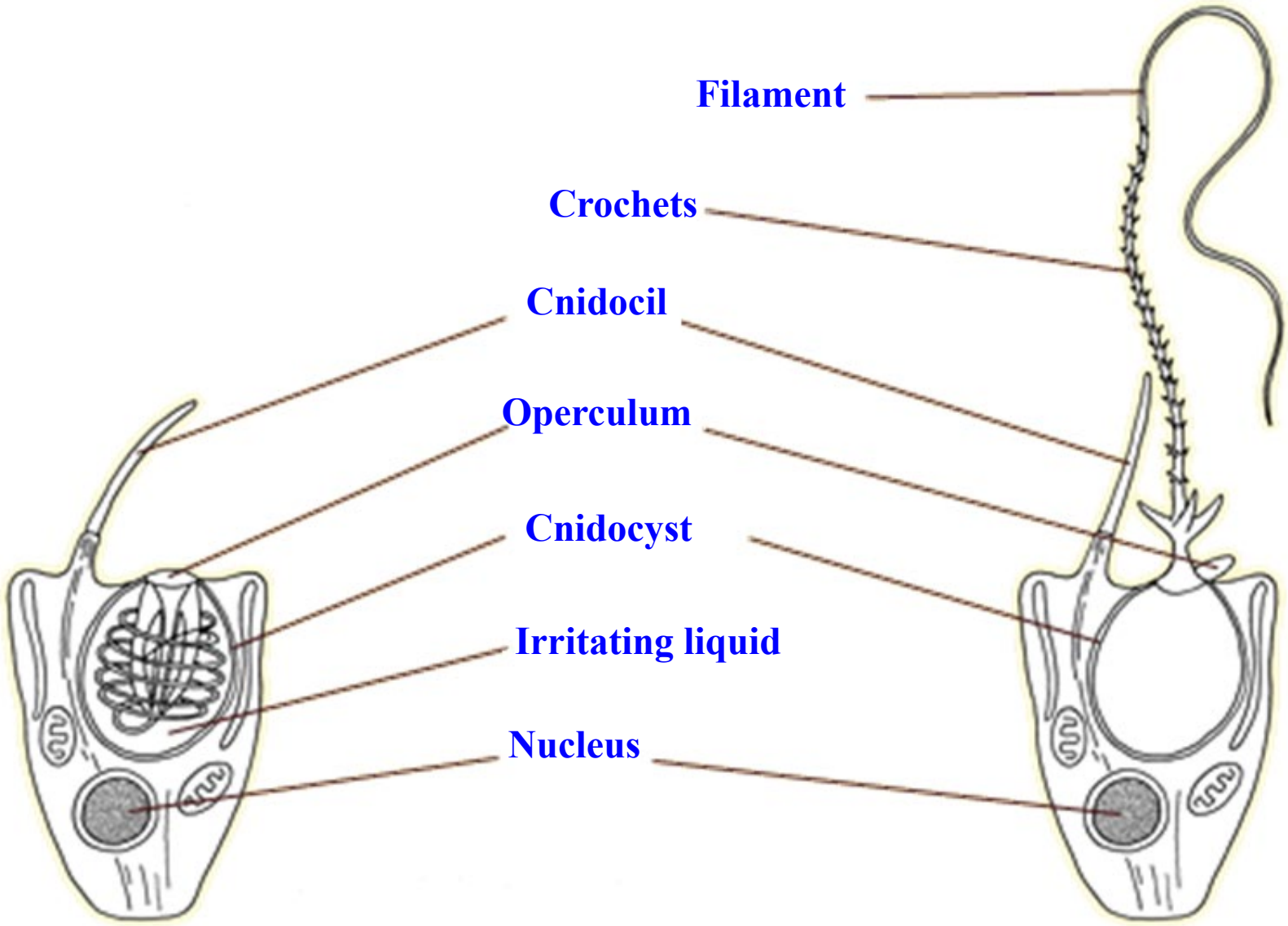
*Specific endodermal cells:

**Glandular cells: These cells have two to five flagella and possess phagocytic activity. Between the myoepithelial cells, there are glandular cells whose enzymes are released into the gastrovascular cavity and partially digest food particles before their phagocytosis.

**Basal cells: These cells are embryonic in nature, stem cells of glandular cells, and located at the base of the endoderm.

***Cnidoblasts: These are the characteristic cells of Cnidarians. They are abundant in the tentacles, stinging, and serve to capture prey.**


Cnidocil
Operculum
External layer of capsule
Internal layer of capsule
Filament
Nucleus




Cnidoblast

Cnioblast with a discharged nematocyst

# Chapter 2 : Diploblastic Metazoans

## 3. – Reproduction

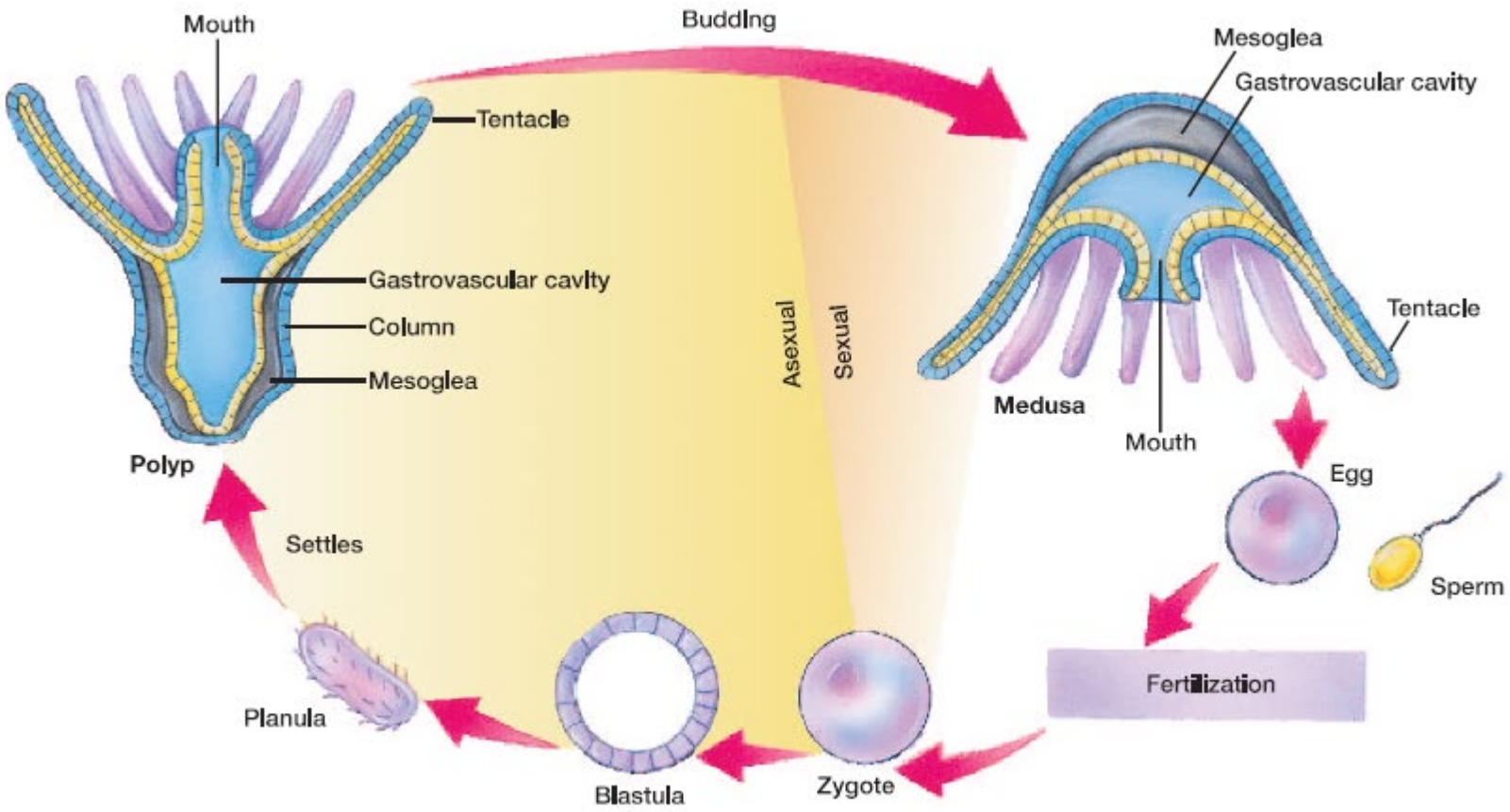



**Figure: Generalized Cnidarian Life Cycle**

# Chapter 2 : Diploblastic Metazoans

## 3. – Reproduction

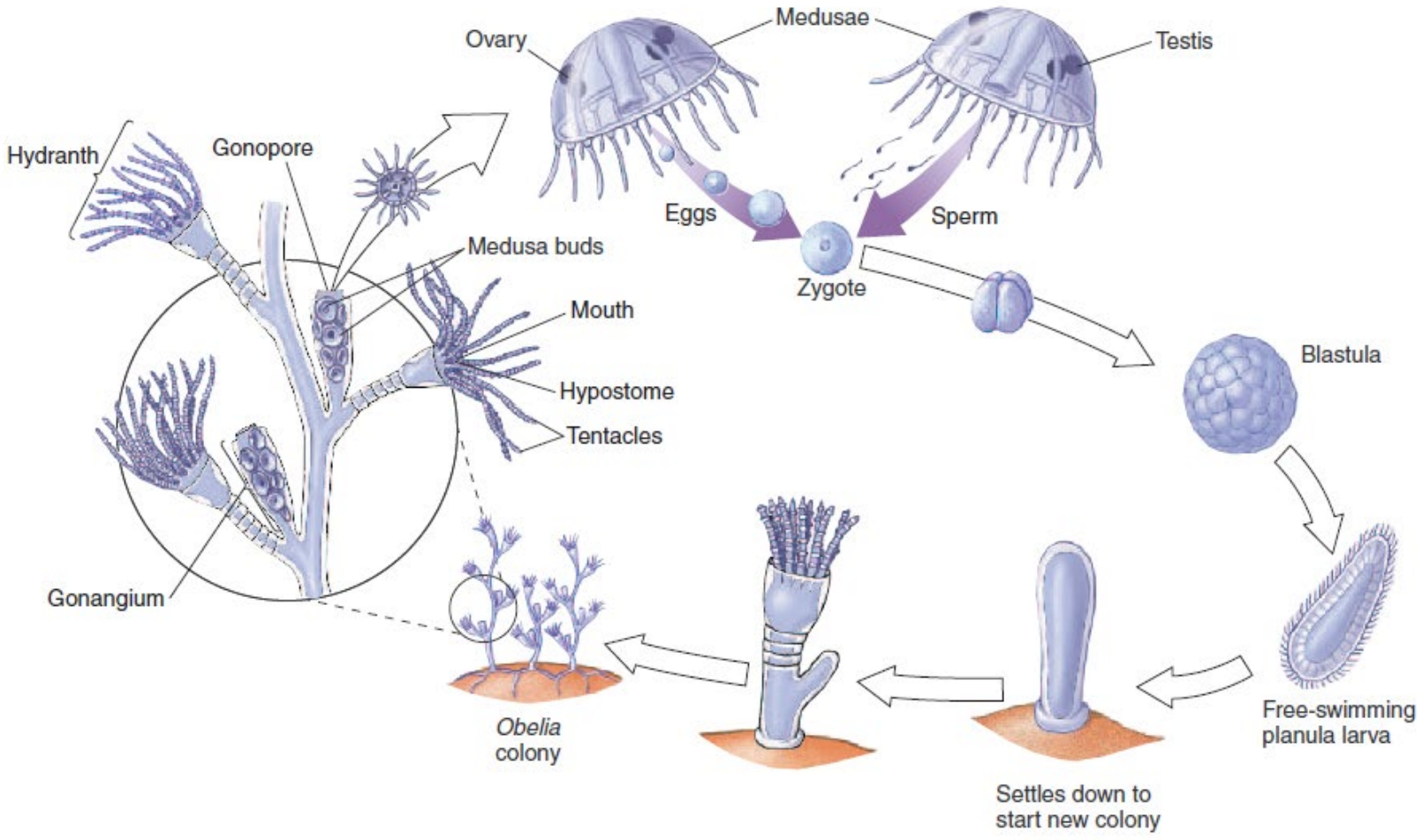



**Figure: Life cycle of *Obelia*, showing alternation of polyp (asexual) and medusa (sexual) stages**

# Chapter 2 : Diploblastic Metazoans

***The life cycle of cnidarians consists of two alternating phases:**

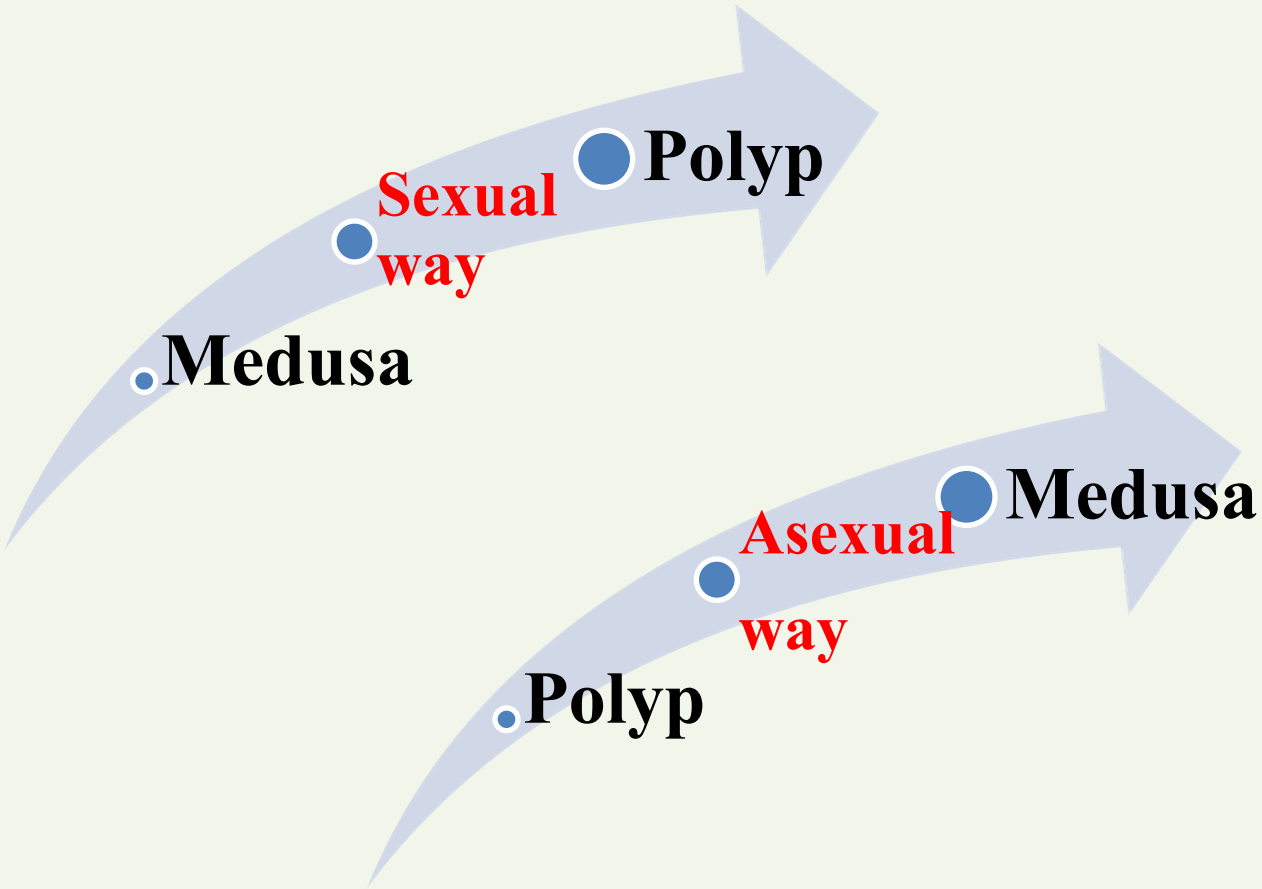
**-The polyp phase, asexual, which through budding or strobilation gives rise to swimming and sexual jellyfish;**

**- The medusa phase which produces reproductive cells that, after fertilization, give rise to a ciliated larva or planula. This planula, after a few days, settles on the bottom to form a polyp, the first element of a future colony.**

## 3. – Reproduction

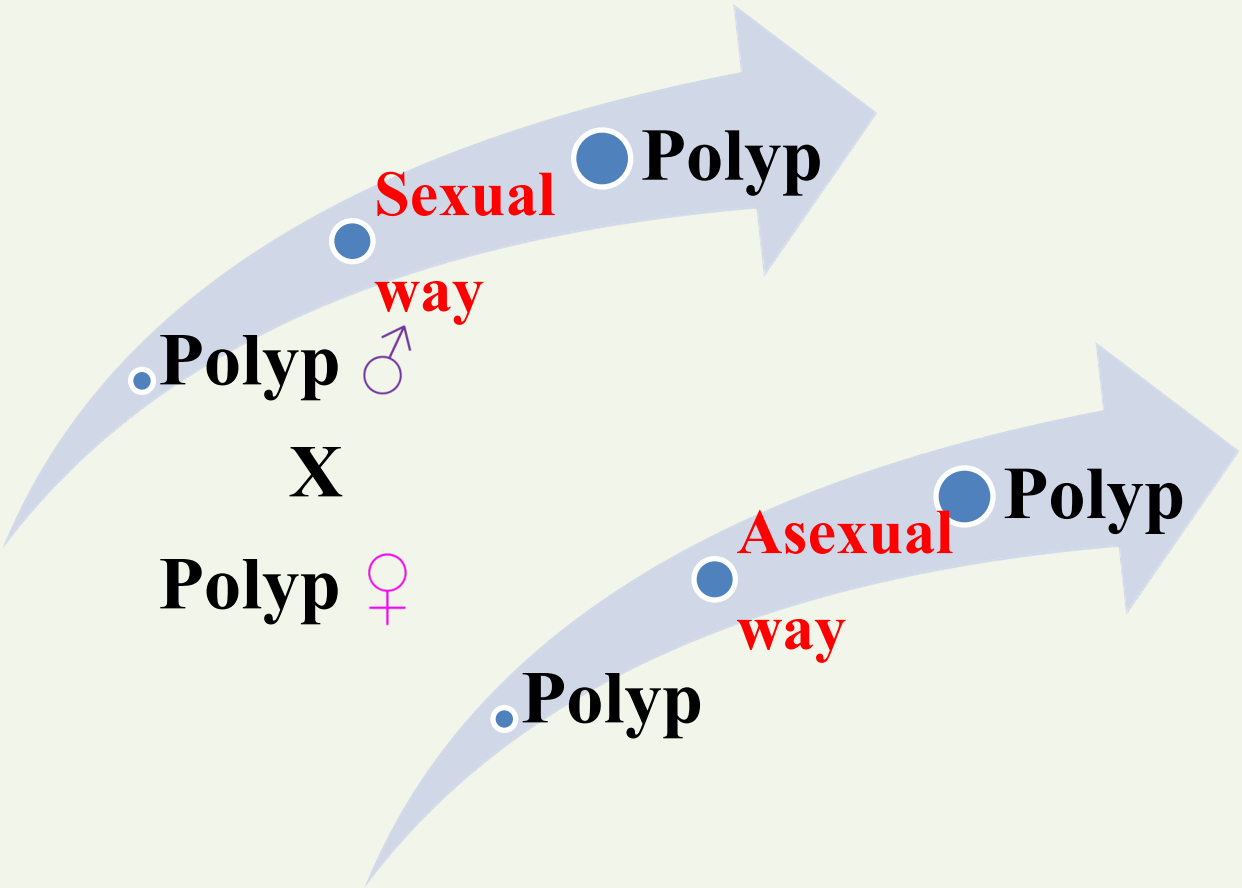
**Among Cnidarians present in both polyp and medusa forms:**

***Obelia geniculata***



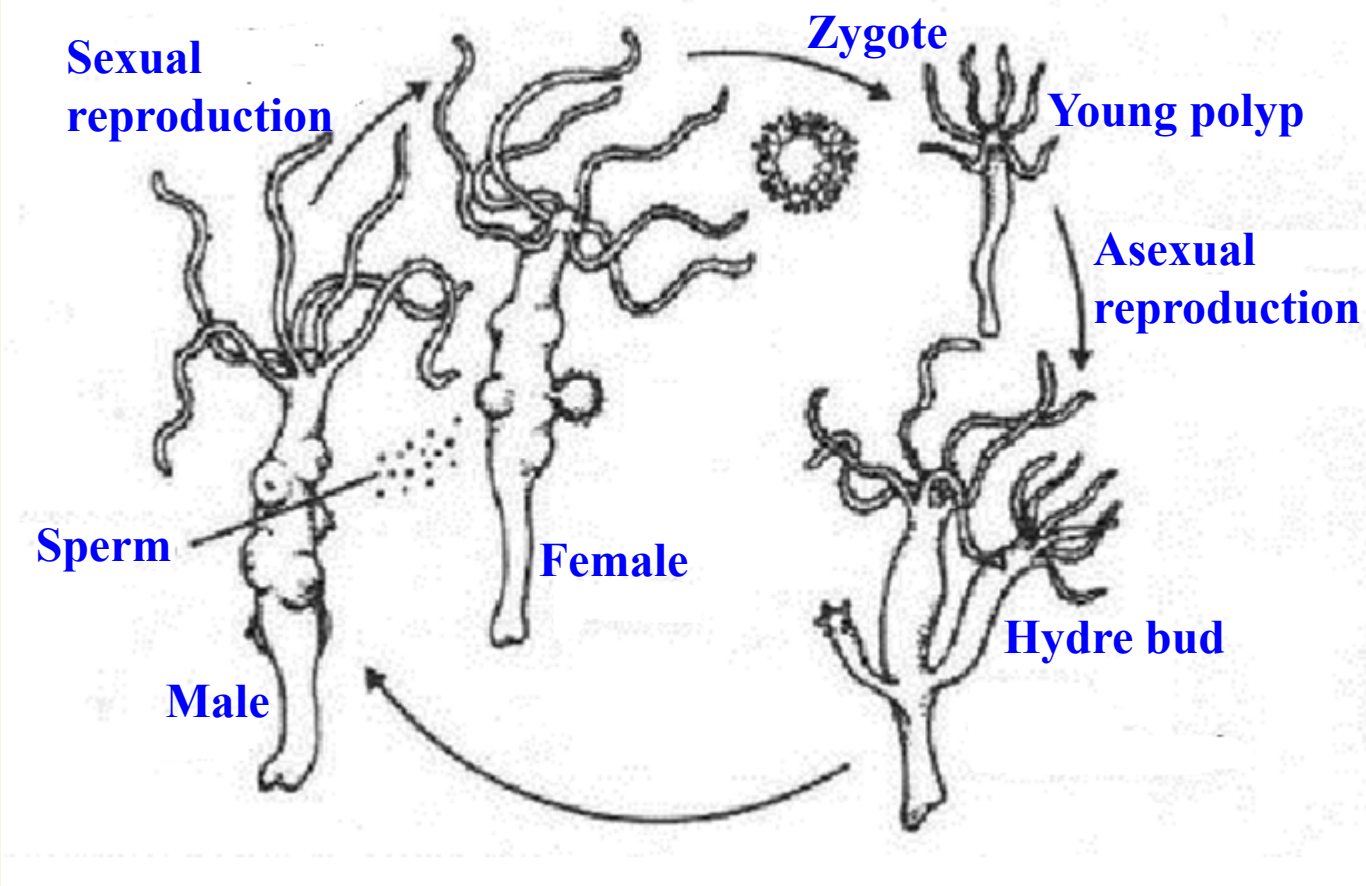
## 3. – Reproduction

**Among Cnidarians present in polyp form only : *Hydra viridis.***

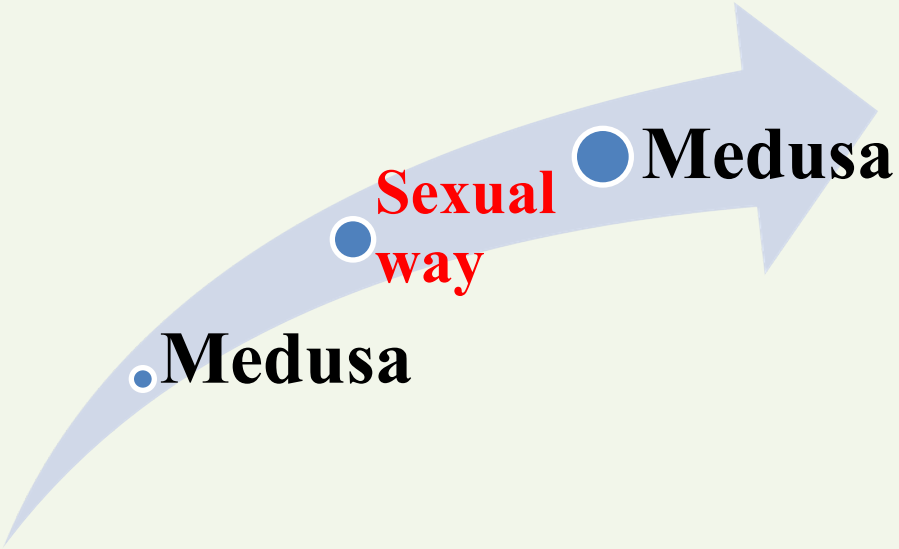


## 3. – Reproduction

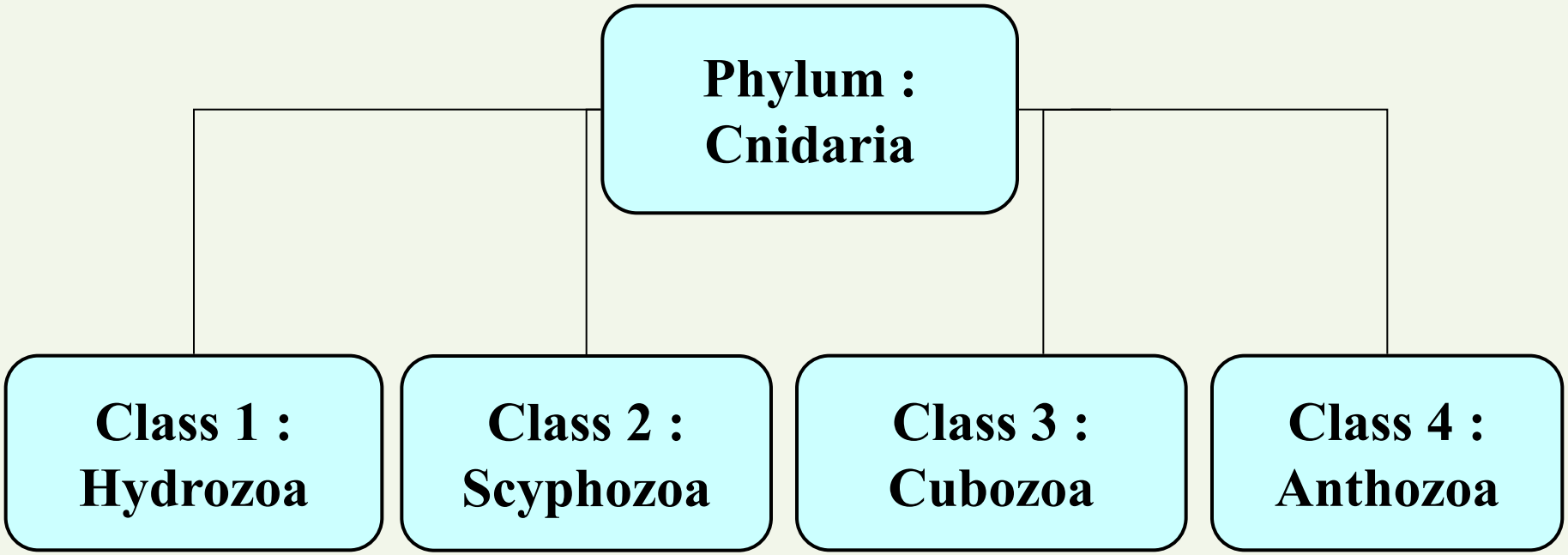
**Among Cnidarians present in polyp form only : *Hydra viridis.***

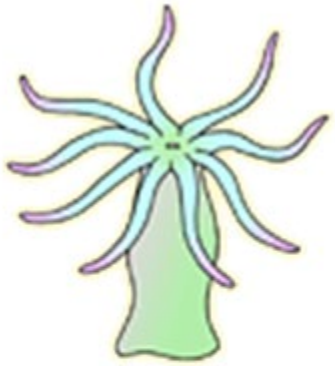


**Among the Cnidarians present only in the medusa form *Aurelia aurita*: the polyp becomes a larval stage (Scyphistoma), the jellyfish form through strobilation, giving rise to ephyra larvae, which grow to become adult jellyfish.**



# Chapter 2 : Diploblastic Metazoans





**Fixed solitary polyp**

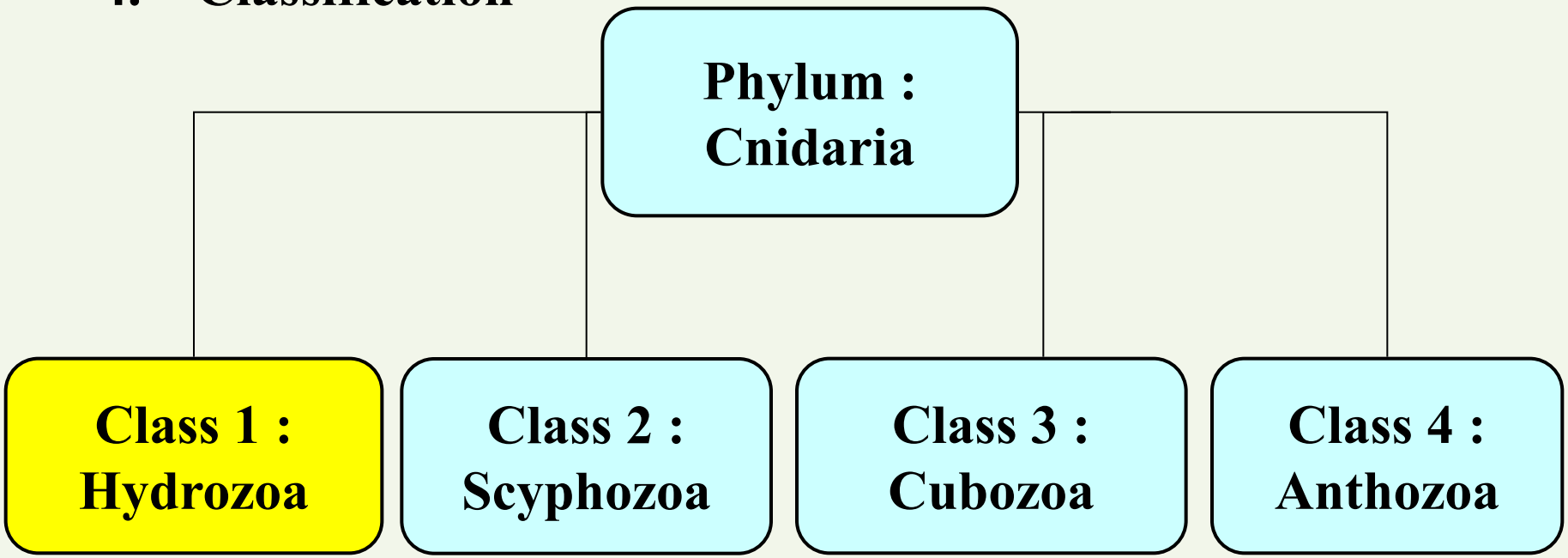
**Fixed colonies polyp**

**Pelagic solitary medusa**

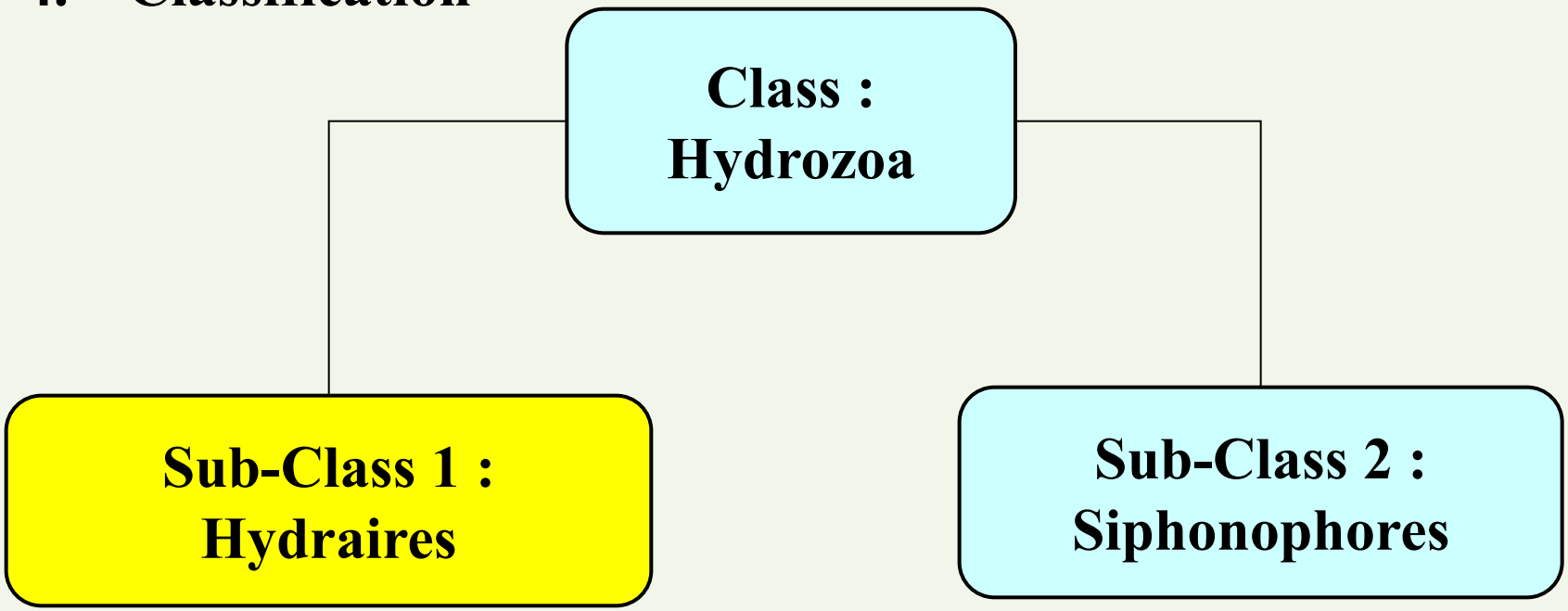
**Pelagic colonies**

# Chapter 2 : Diploblastic Metazoans

## 4. – Classification

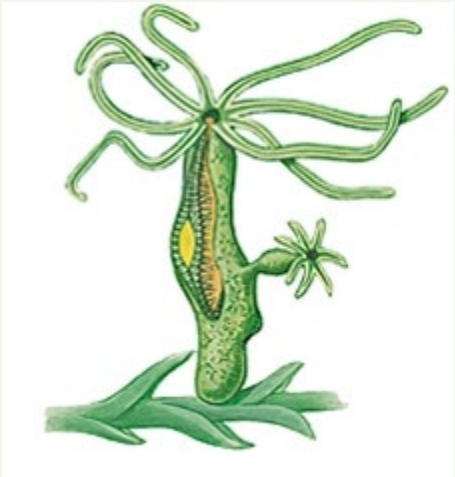


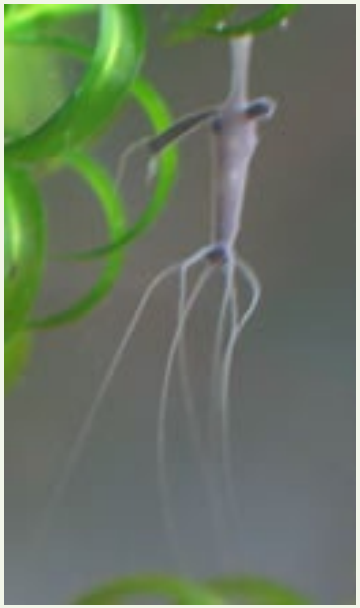
## 4. – Classification



# Chapter 2 : Diploblastic Metazoans

## 4.1. Class 1 Hydrozoa

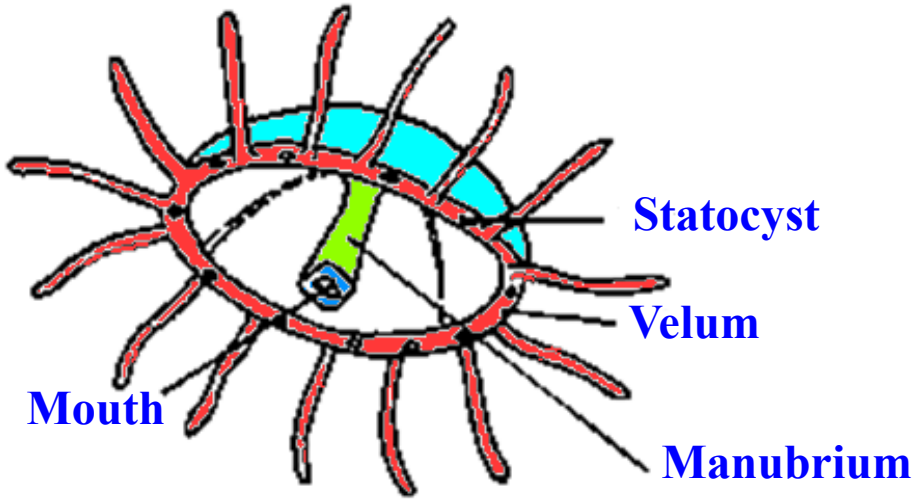




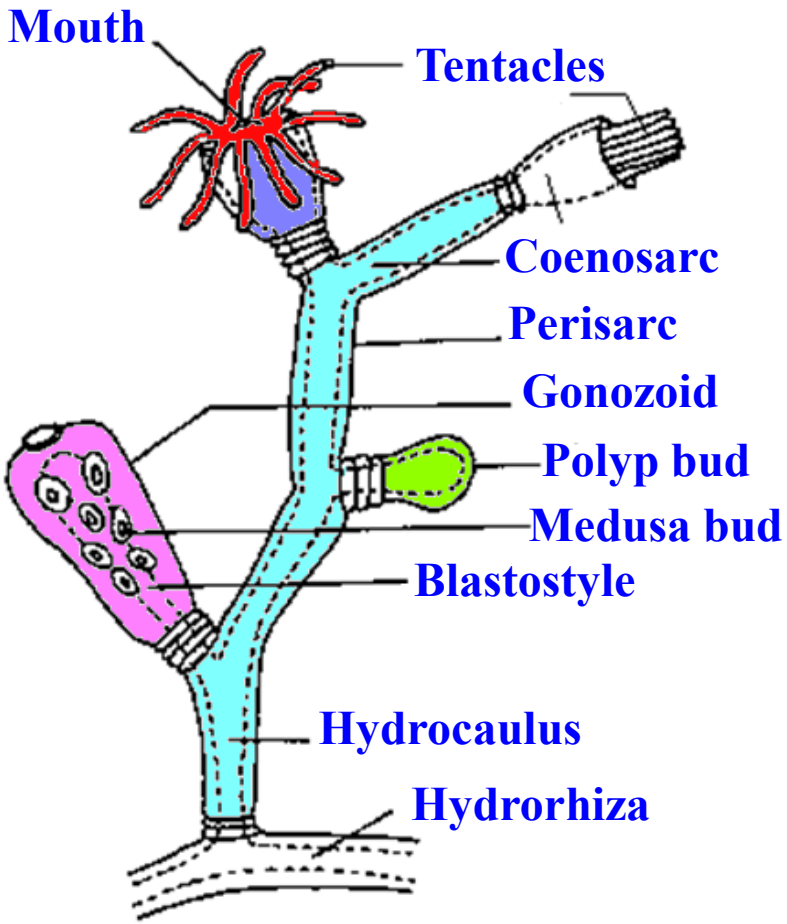
***Hydra viridis*** **(Class : Hydrozoa, Sub-Class : Hydras)**

# Chapter 2 : Diploblastic Metazoans

## Class : Hydrozoa, Sub-Class : Hydras

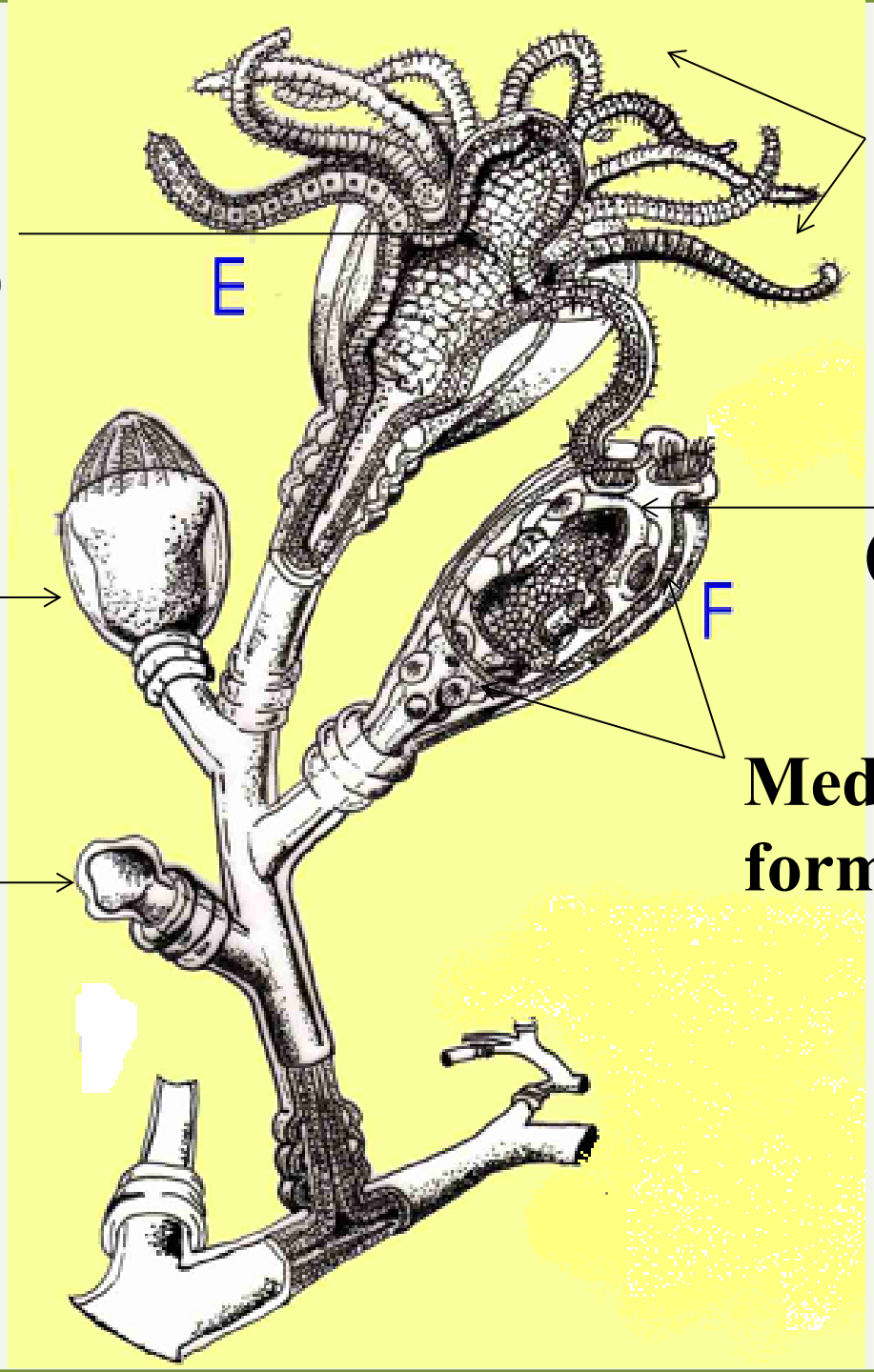



Medusa

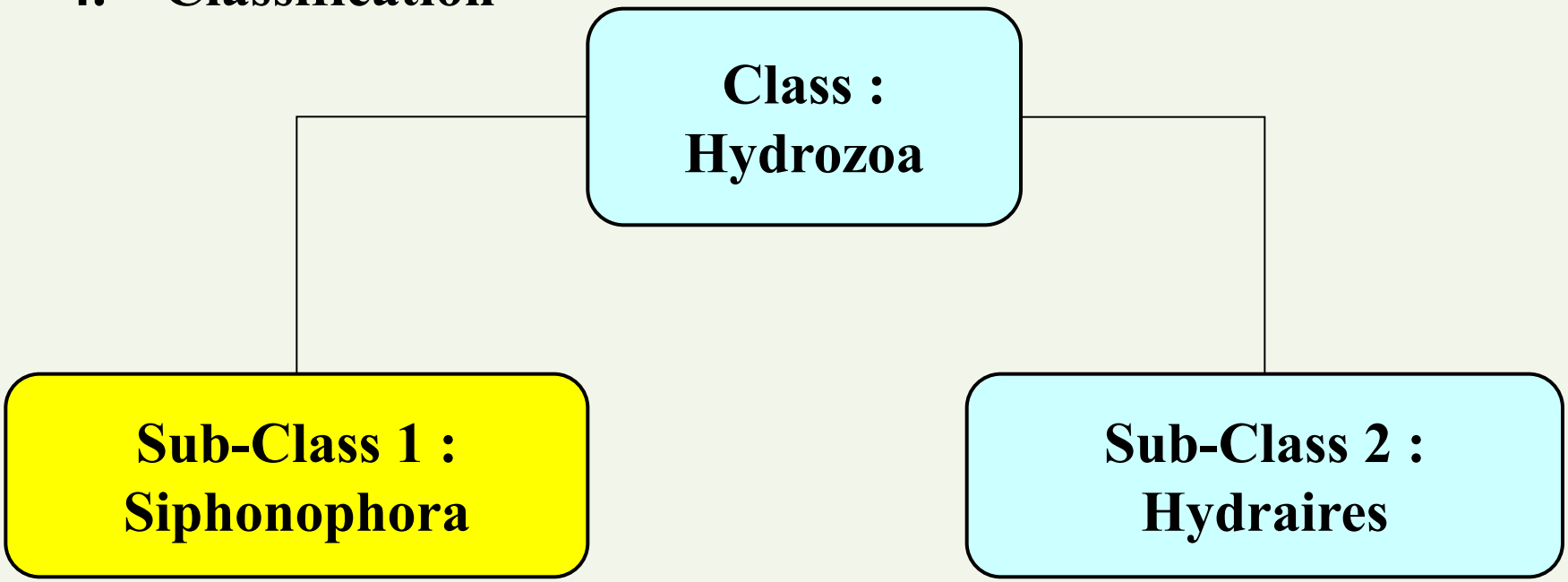



Colonies of polyp

***Obelia geniculata***


Gastrozoid
(Nourisher)
Tentacles
E
Gonozoid
(reproductor)
Dactylozoid
(defensive)
F
Medusa in
formation
Bud

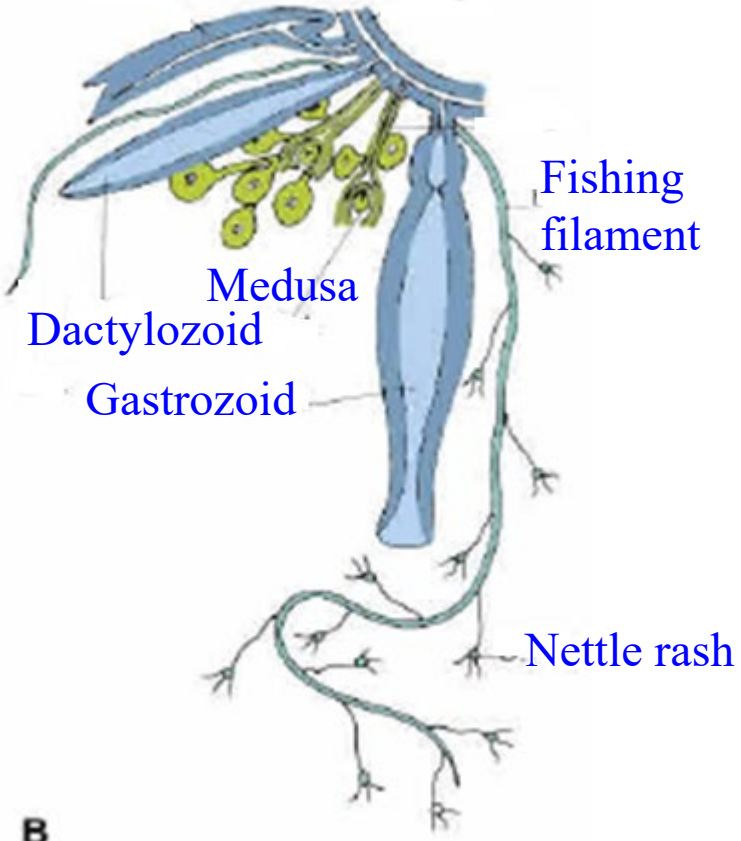
## 4. – Classification



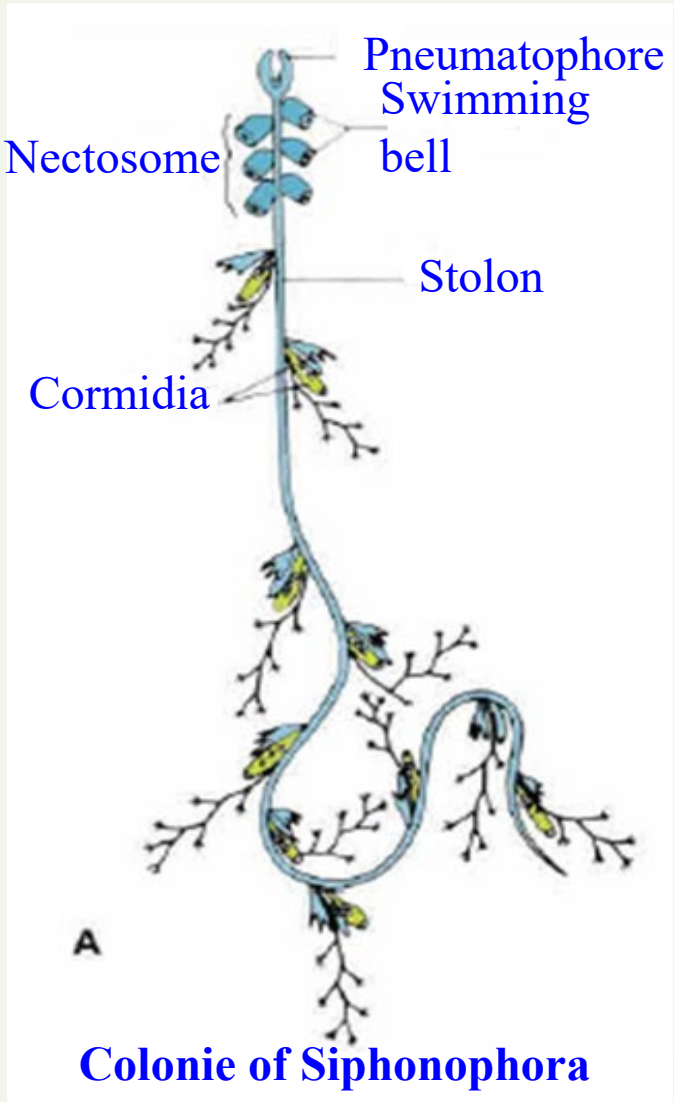
# Chapter 2 : Diploblastic Metazoans

**Class : Hydrozoa, Sub-Classe : Siphonophora**

**Pelagic (floating) colonies, composed of similar units: the cormidia, permanent or detachable.**

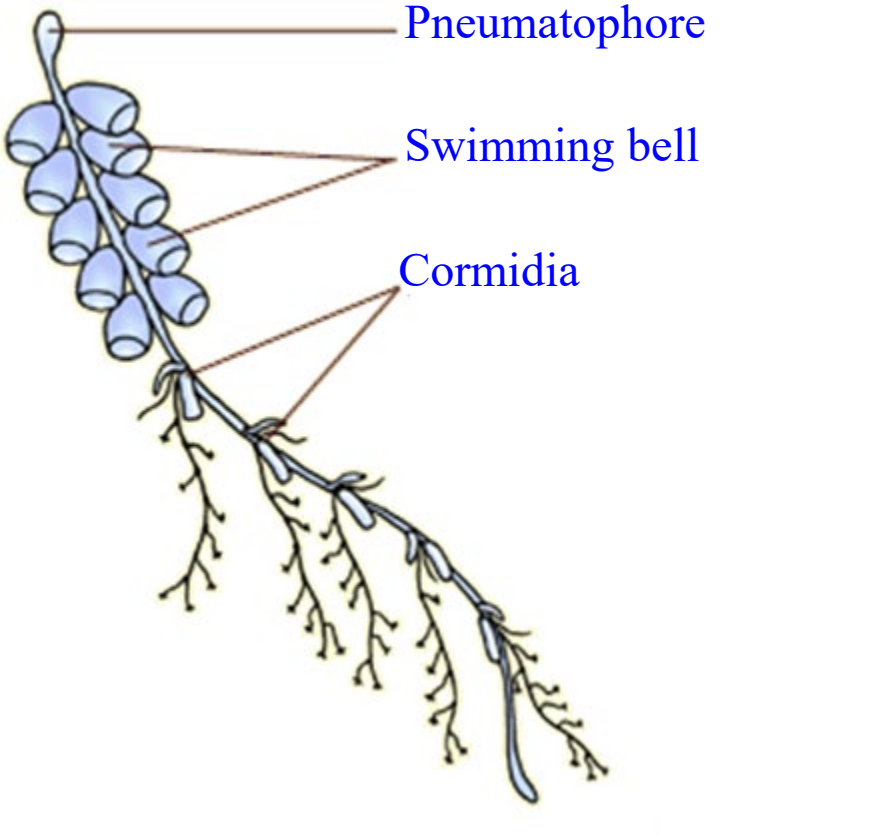


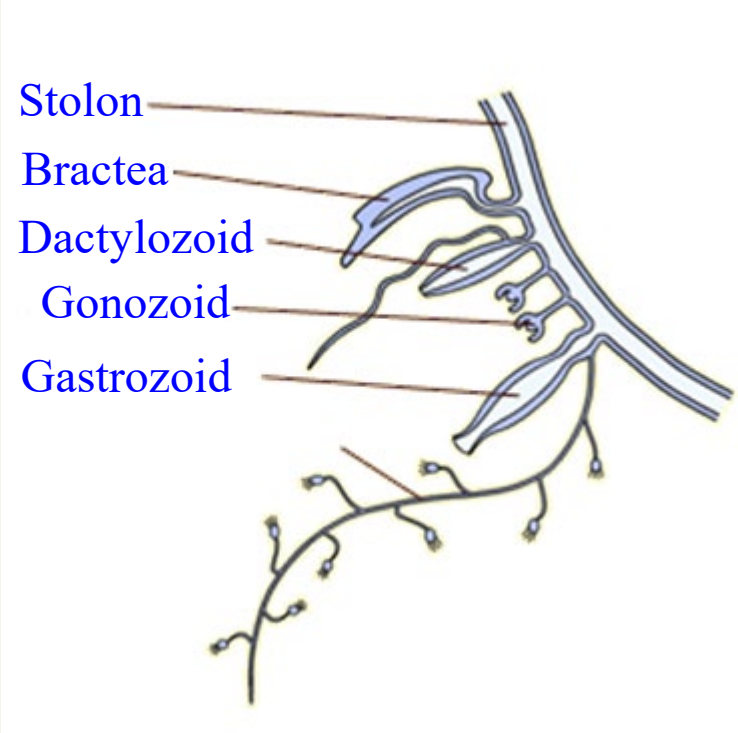

**Organisation of cormidia**




**Colonie of Siphonophora**

# Chapter 2 : Diploblastic Metazoans




## Siphonophora

# Chapter 2 : Diploblastic Metazoans

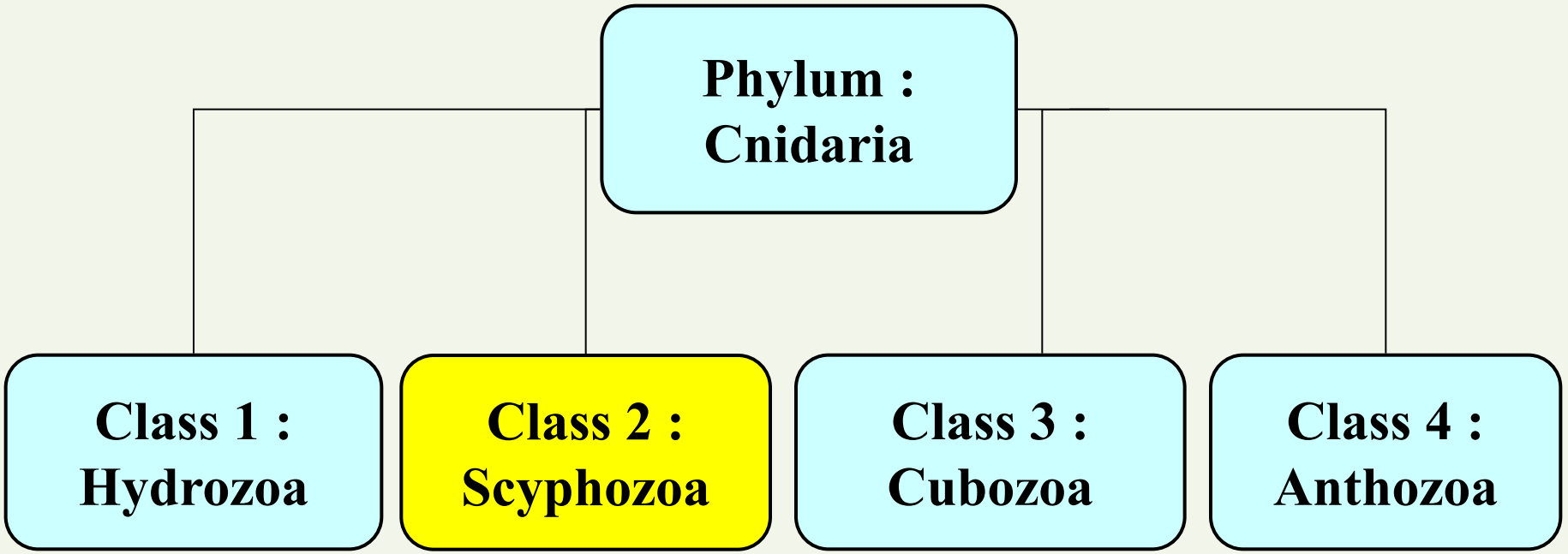
***A cormidia = ∑ polyps with distinctly different shapes and roles.**

***The gastrozoids with a nourishing role and whose cavity serves as a stomach are equipped with a fishing filament filled with cnidoblasts.**

***The Dactylozoids with an elongated palpus have a defensive role.**

***The gonozooids are the reproductive individuals. They are protected by flattened polyps, the bracts.**

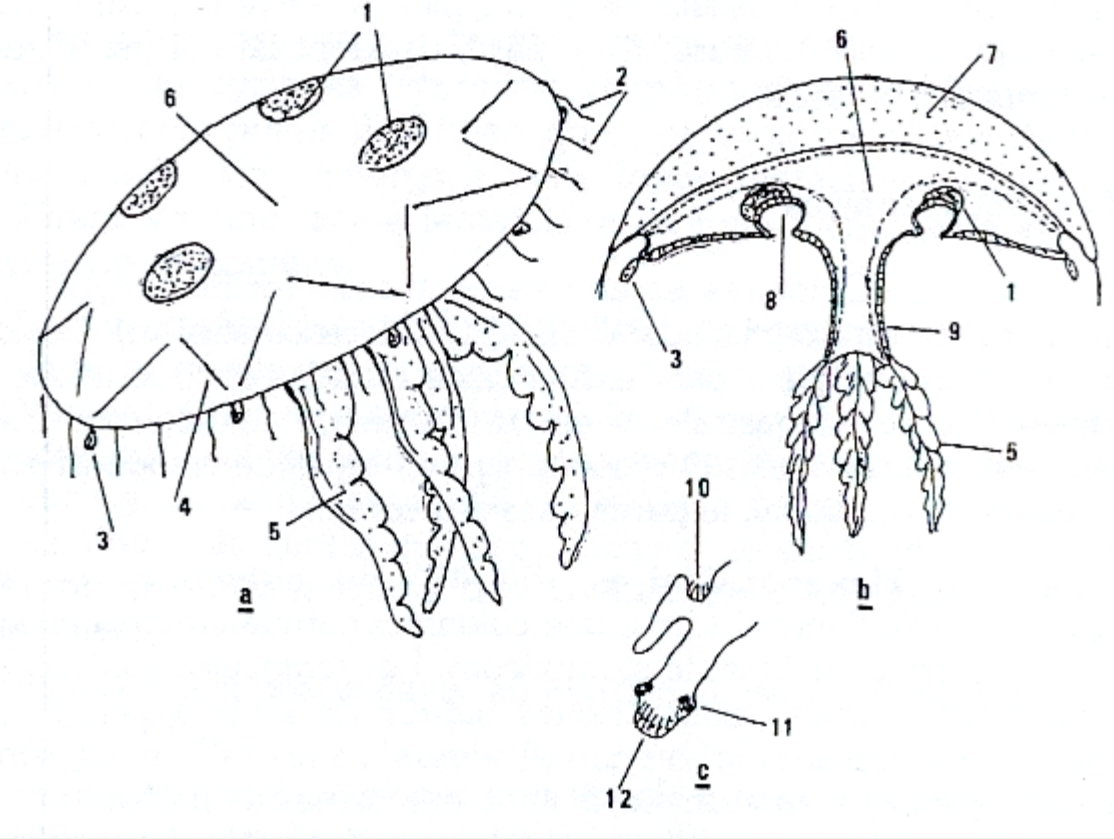
# Chapter 2 : Diploblastic Metazoans



# Chapter 2 : Diploblastic Metazoans

## 4.2. – Class 2 Scyphozoa

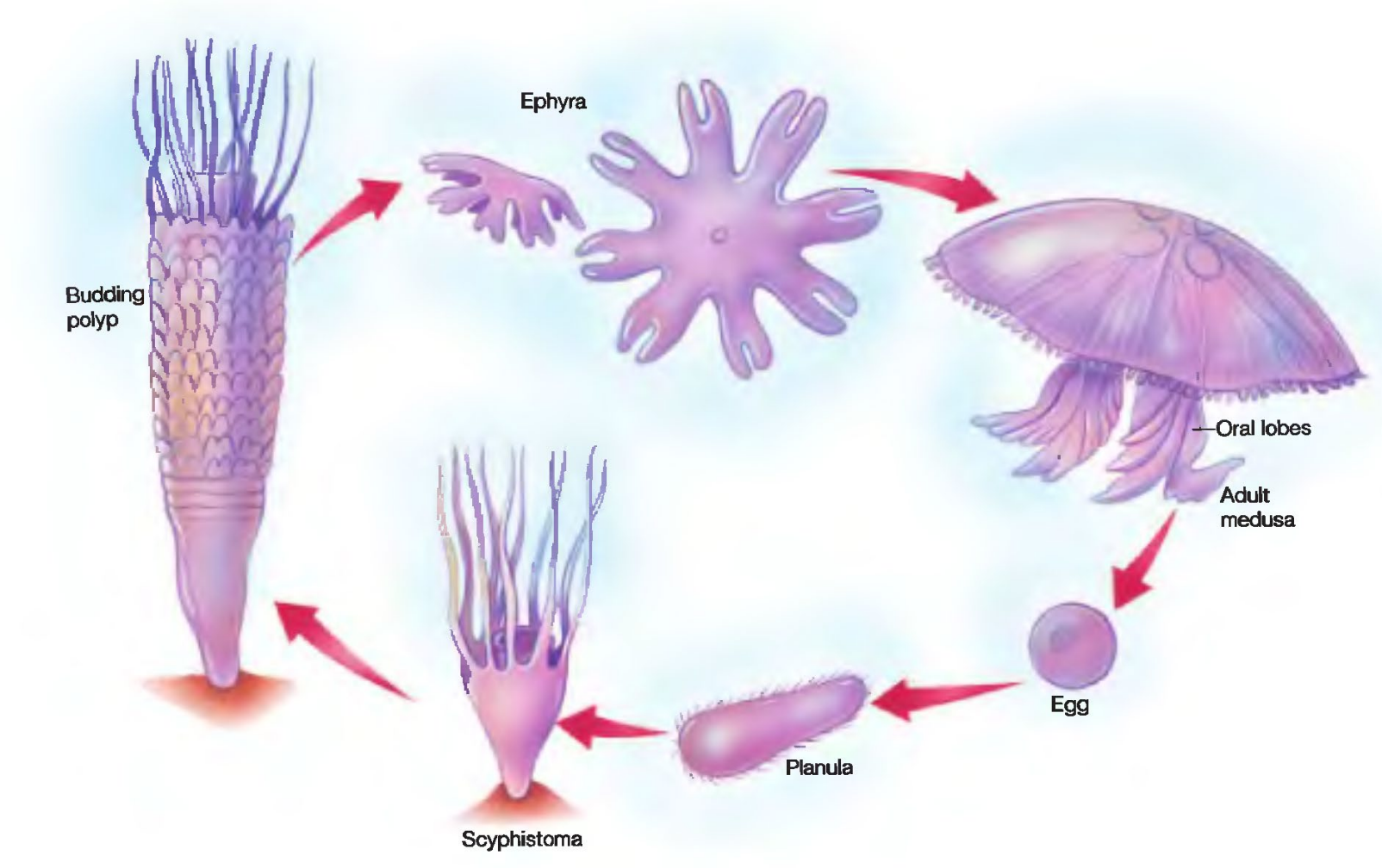
*It is the class of Acalephs or acraspedote jellyfish (jellyfish without a velum = acraspedotes) of large size. The symmetry of these animals is quaternary.




**Scyphozoa (acraspedote medusa)**
(1) gonad, (2) Marginal tentacles, (3) Rhopalium, (4) partition, (5) Oral tentacles, (6) Gastrovascular cavity, (7) Mesoglea, (8) subgenital cavity, (9) Manubrium, (10) Sensory (olfactory) lappet , (11) Ocellus, (12) Statocyst.

# Chapter 2 : Diploblastic Metazoans

## 4.2. – Class 2 Scyphozoa




*Aurelia* Life cycle

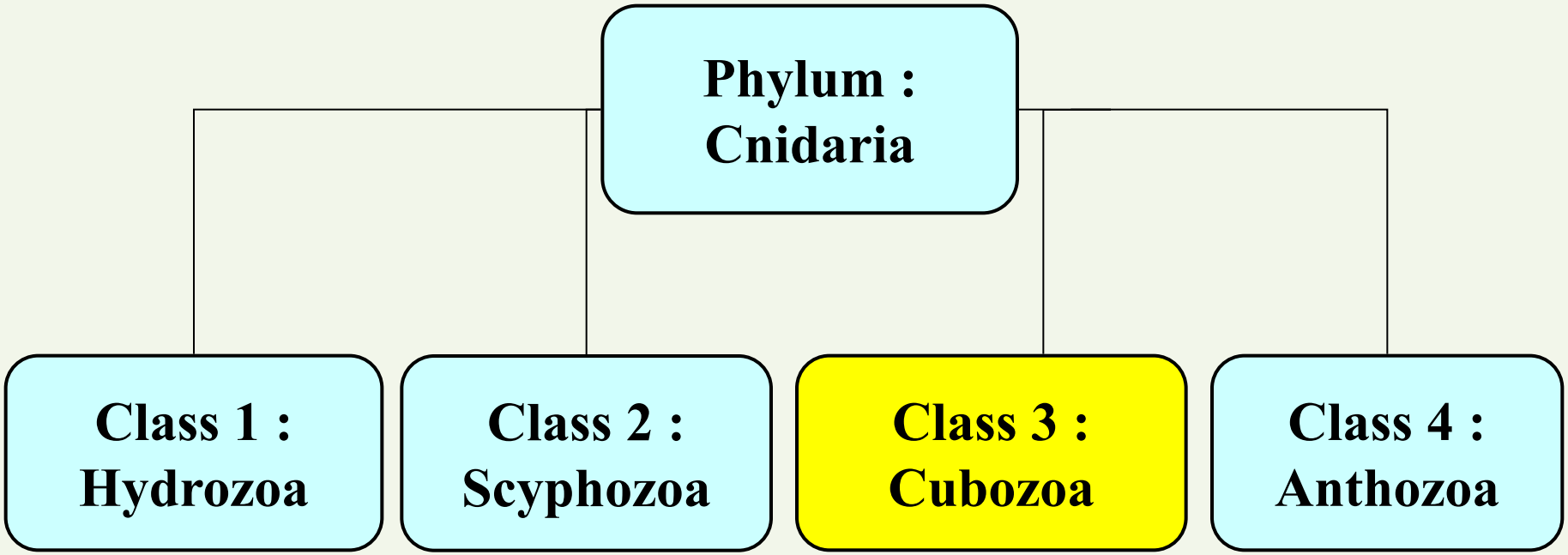
# Chapter 2 : Diploblastic Metazoans

## 4.2. – Class 2 Scyphozoa

*Pelagia noctiluca*


Gilles CAVIGNAUX

# Chapter 2 : Diploblastic Metazoans

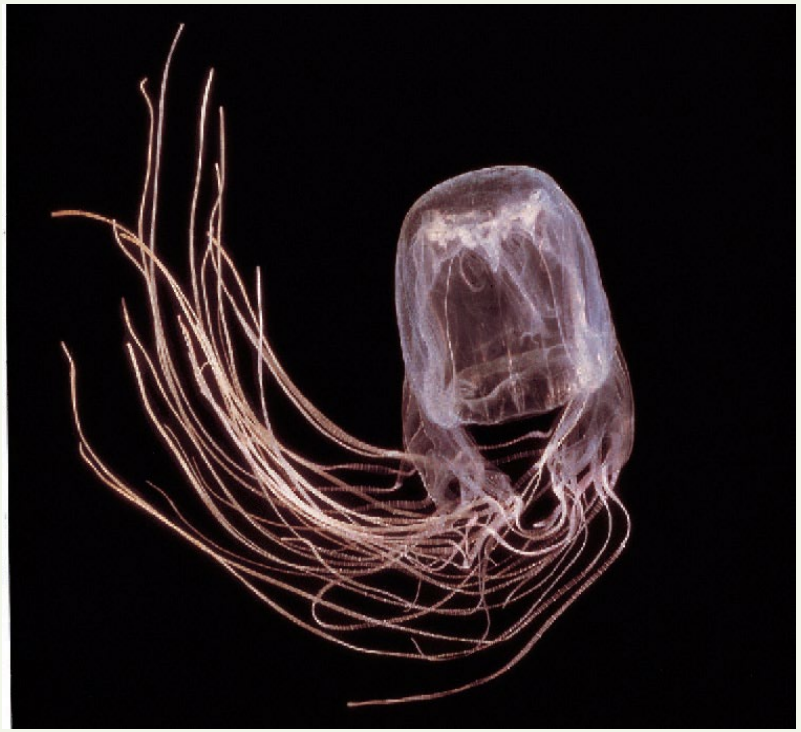


# Chapter 2 : Diploblastic Metazoans

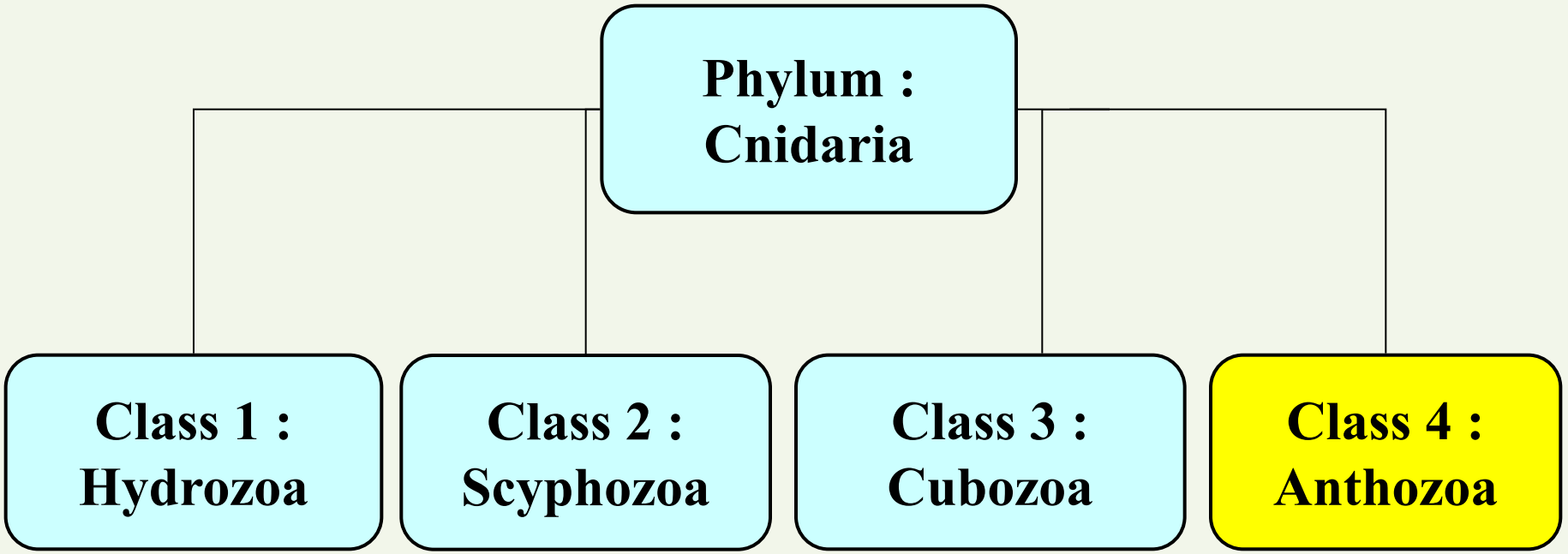
## 4.3. – Class 3 Cubozoa

These are small, acraspedote jellyfish known as Sea Wasps. The shape of their bell is angular, hence their name.

They live in tropical seas and swarm the Australian Great Barrier Reef, where they cause fatal accidents for swimmers who are unfortunate enough to encounter them.



# Chapter 2 : Diploblastic Metazoans



# Chapter 2 : Diploblastic Metazoans

## 4.4. – Class 4 Anthozoa (Antho : flowers; zoa : animal)

These animals exist only in the polyp form, they are solitary or colonial. Their gastric cavity is subdivided by radial partitions.

### 4.4.1. – Sub-Class 1 Octocorallians (Figure)

- Each polyp has eight pennate tentacles covered with papillae.

- The pharynx is elongated and sloped with a ciliated groove called Siphonoglyph that indicates the ventral side: they thus exhibit radial and bilateral symmetry. They have 8 gastric partitions.

# Chapter 2 : Diploblastic Metazoans

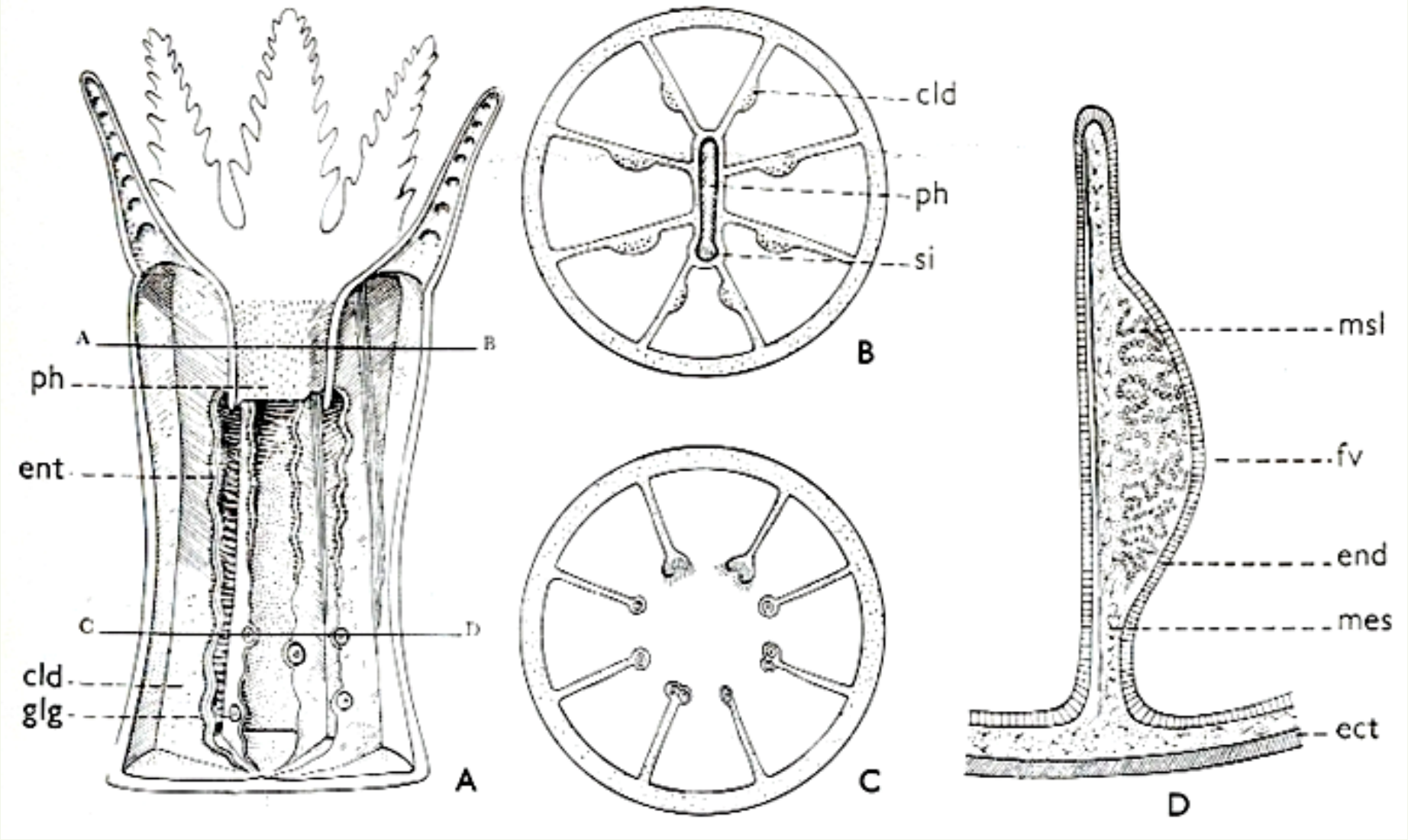
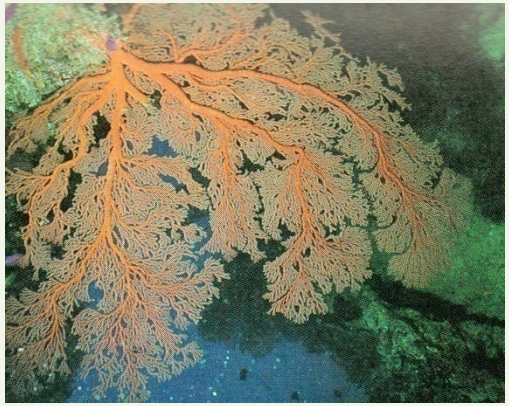
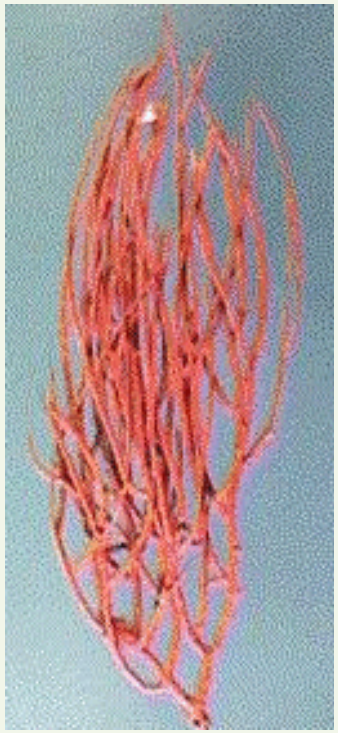



**Figure: Octocorallian polype**

ect: ectoderm, end: endoderm, ent: enteroid, glg: genital gland, mes.: mesoglea, ph: pharynx, si: siphonglyph. **B:** Cross section A-B, C: Cross section C-D, **D:** Cross section of septum.

# Chapter 2 : Diploblastic Metazoans





Gorgonides : *Gorgona ventalina*. A. Vue générale de la colonie.

## 4.4.2. – Sub-Class 2 Hexacorallians (Figure)

*There are solitary forms among these animals, the Actiniae, and colonial forms, the Madrepore.

*Smooth tentacles correspond to a multiple of 6.

*Gastric partitions equal to a multiple of 6.

*2 siphonoglyphs: 1 ventral and 1 dorsal.

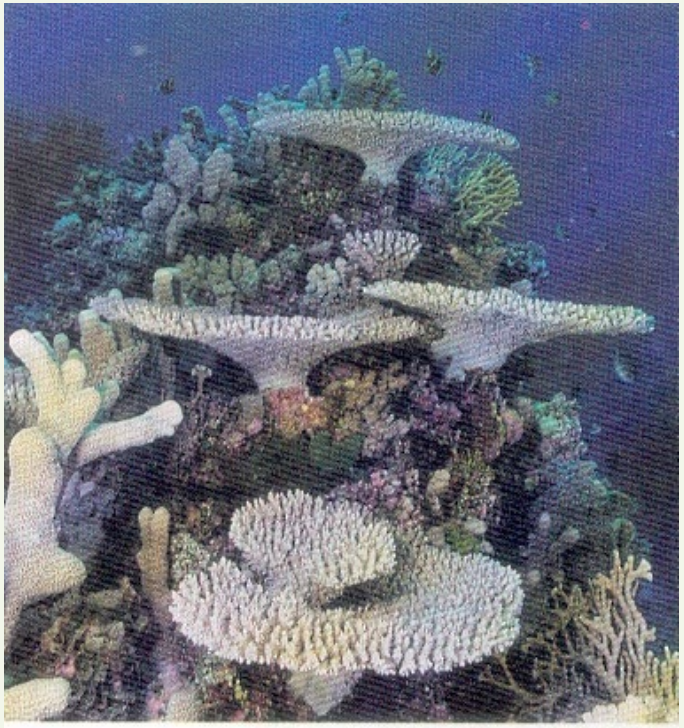
## 4.4.2. – Sub-Class 2 Hexacorallians (Figure)

**The solitary Actiniae (predatory species), of which the type is *Actinia equina*.**

**Solitary Anemone**
***Actinia equina***

# Chapter 2 : Diploblastic Metazoans

- The  Madrepore live in colonies.

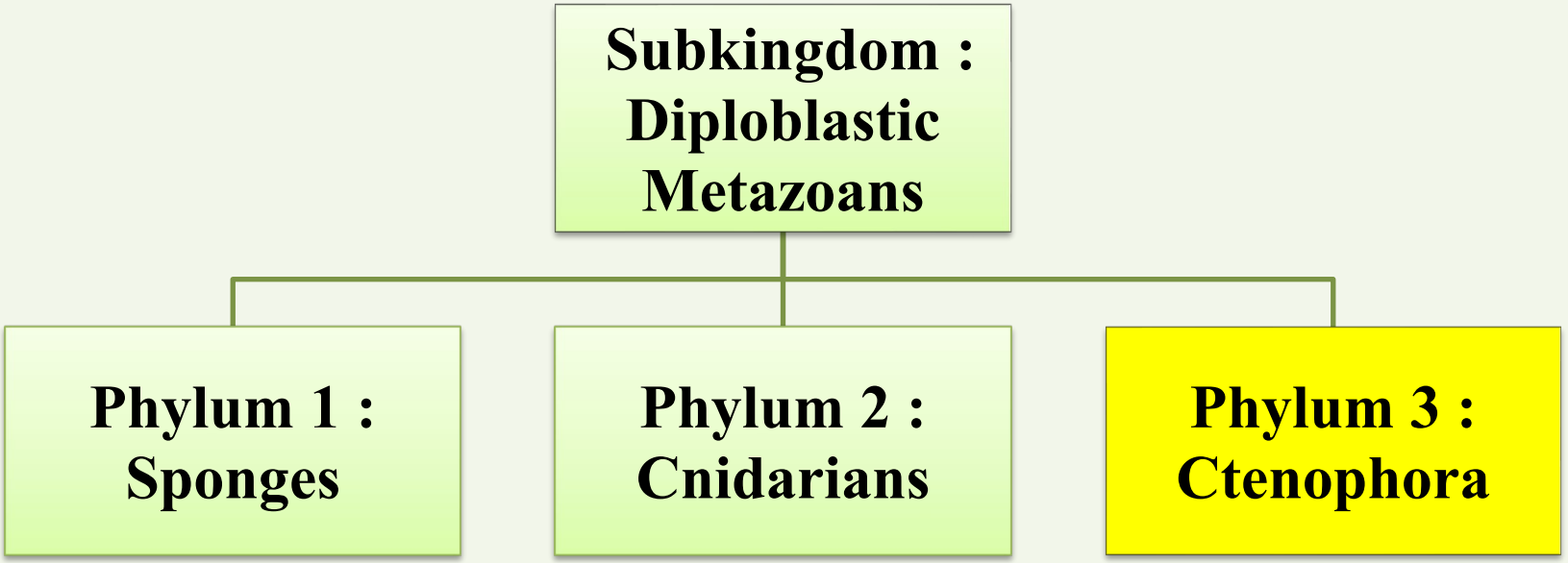


# Chapter 2 : Diploblastic Metazoans

**Table summarizing the characteristics of each class :**

| | Hydrozoa | Scyphozoa | Anthozoa |
|---|---|---|---|
| Symetry | Quaternary | Quaternary | 6n or 8 + biradial symetry |
| Cycle | Alternation polyp-medusa | Medusa only | Polyp only |
| Cavity | Simple | 4 partitions | 6n ou 8 partitions |
| Medusa | Velum | Without velum | Absent |

# Chapter 2 : Diploblastic Metazoans



## 3. – Phylum 3 Ctenphora (Ctenos : comb; phoros : to bear)

**Characteristics of the phylum Ctenophora include:**

1. **Diploblastic, tissue-level organization;**

2. **Biradial symmetry;**

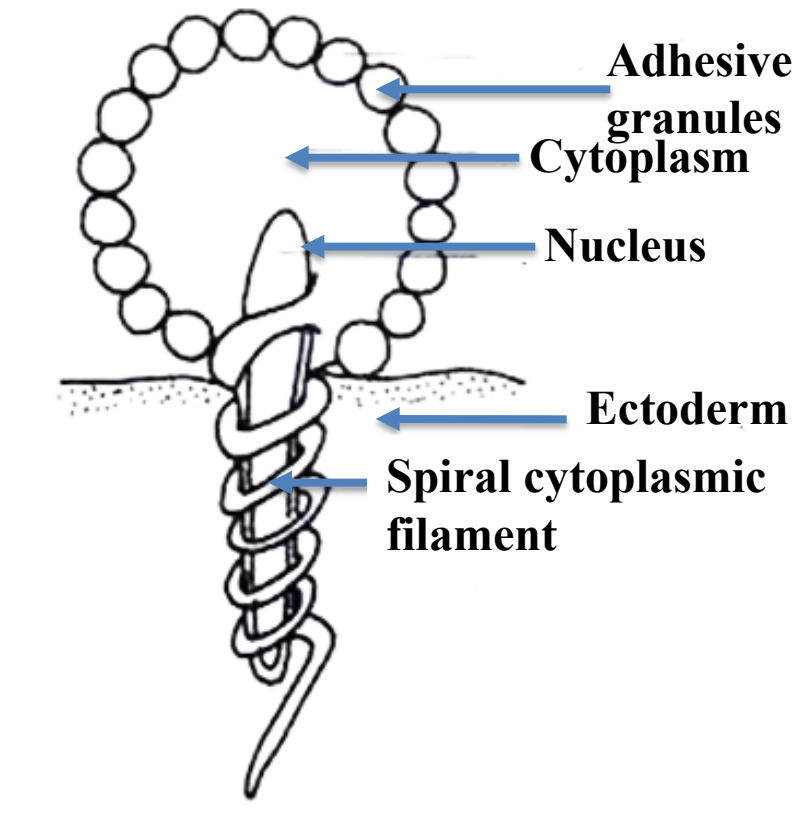
3. **Gelatinous mesoglea between the epidermal and gastrodermal tissue layers;**

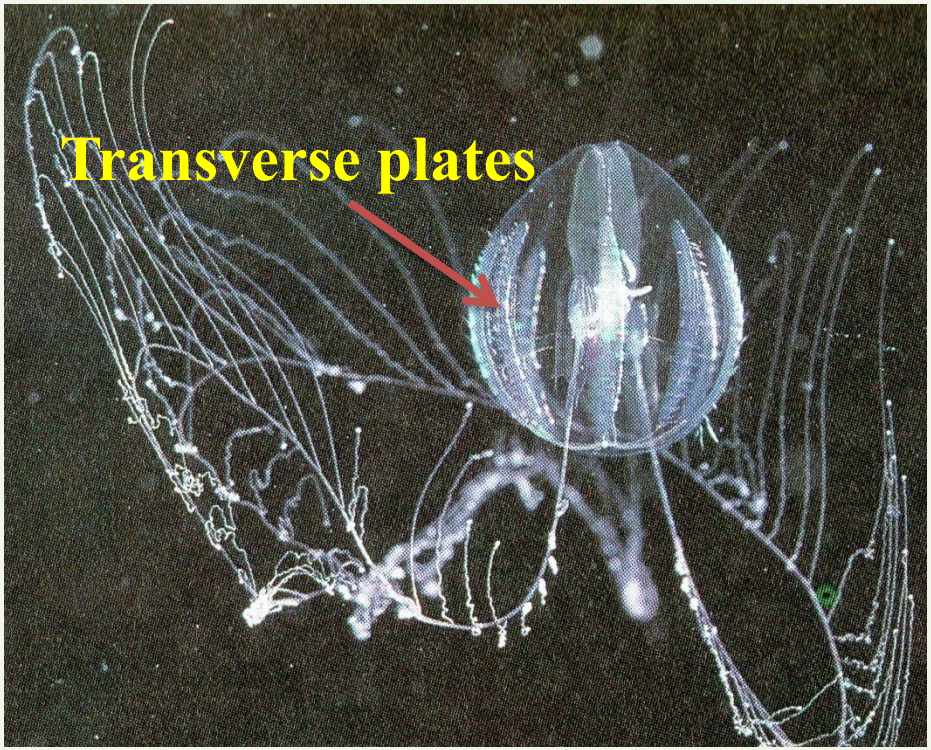
4. **Gastrovascular cavity;**

5. **Nervous system in the form of a nerve net;**

6. **Marine individuals, transparent, carnivorous, slitary, hermaphrodites.**

# Chapter 2 : Diploblastic Metazoans



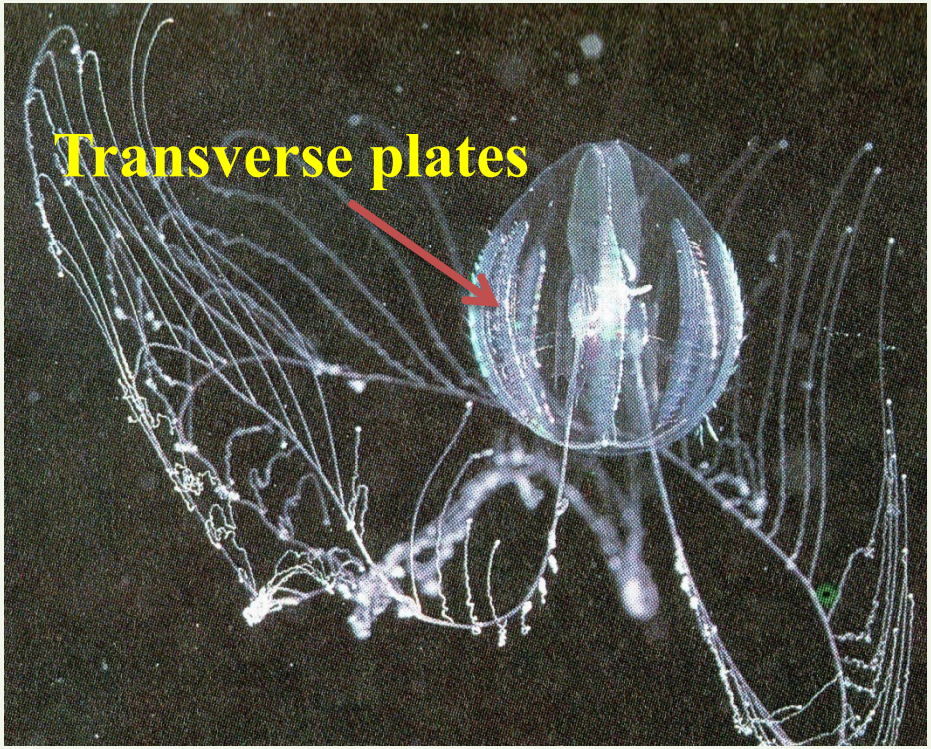




## Structure of Colloblast

The surface of the tentacles bears specialized glue cells called colloblasts, which secrete a sticky substance that facilitates catching small prey.

# Chapter 2 : Diploblastic Metazoans

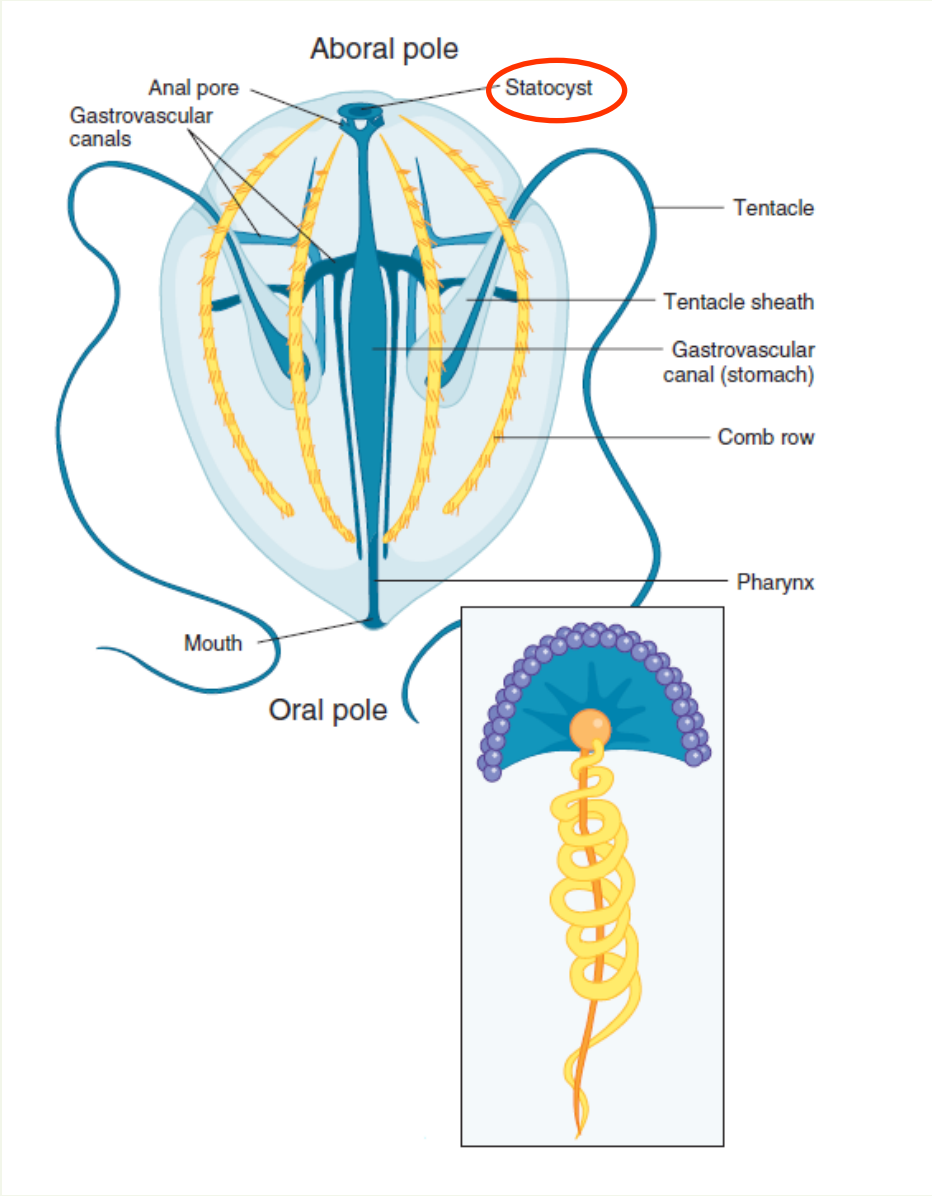
Structure of Colloblast




Its surface bears eight longitudinal rows of transverse plates bearing long fused cilia and called comb plates. The beating of the cilia in each row starts at the aboral end and proceeds along the rows to the oral end, thus propelling the animal forward.

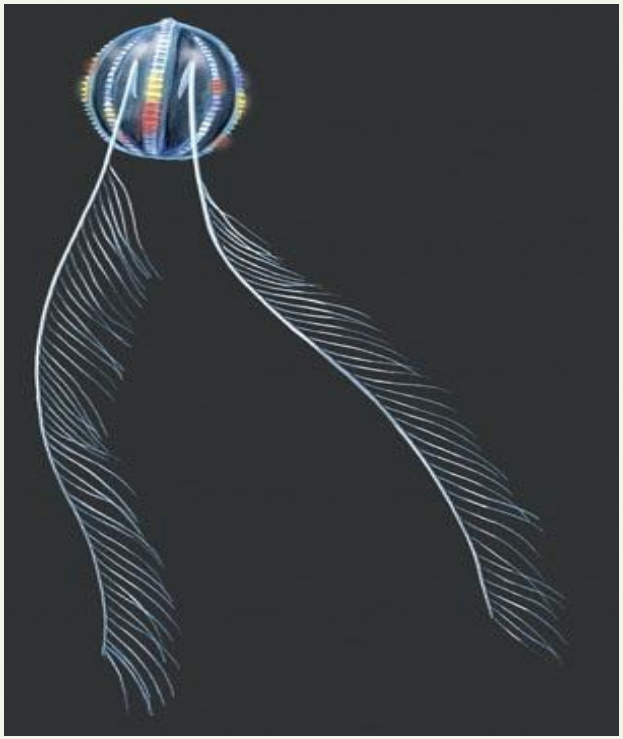
# Chapter 2 : Diploblastic Metazoans

**The sense organ at the aboral pole is a statocyst, or organ of equilibrium.**



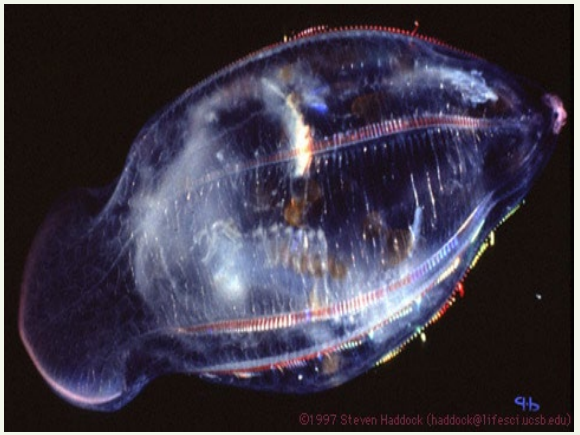
# Chapter 2 : Diploblastic Metazoans

## Systematic of Ctenophora :

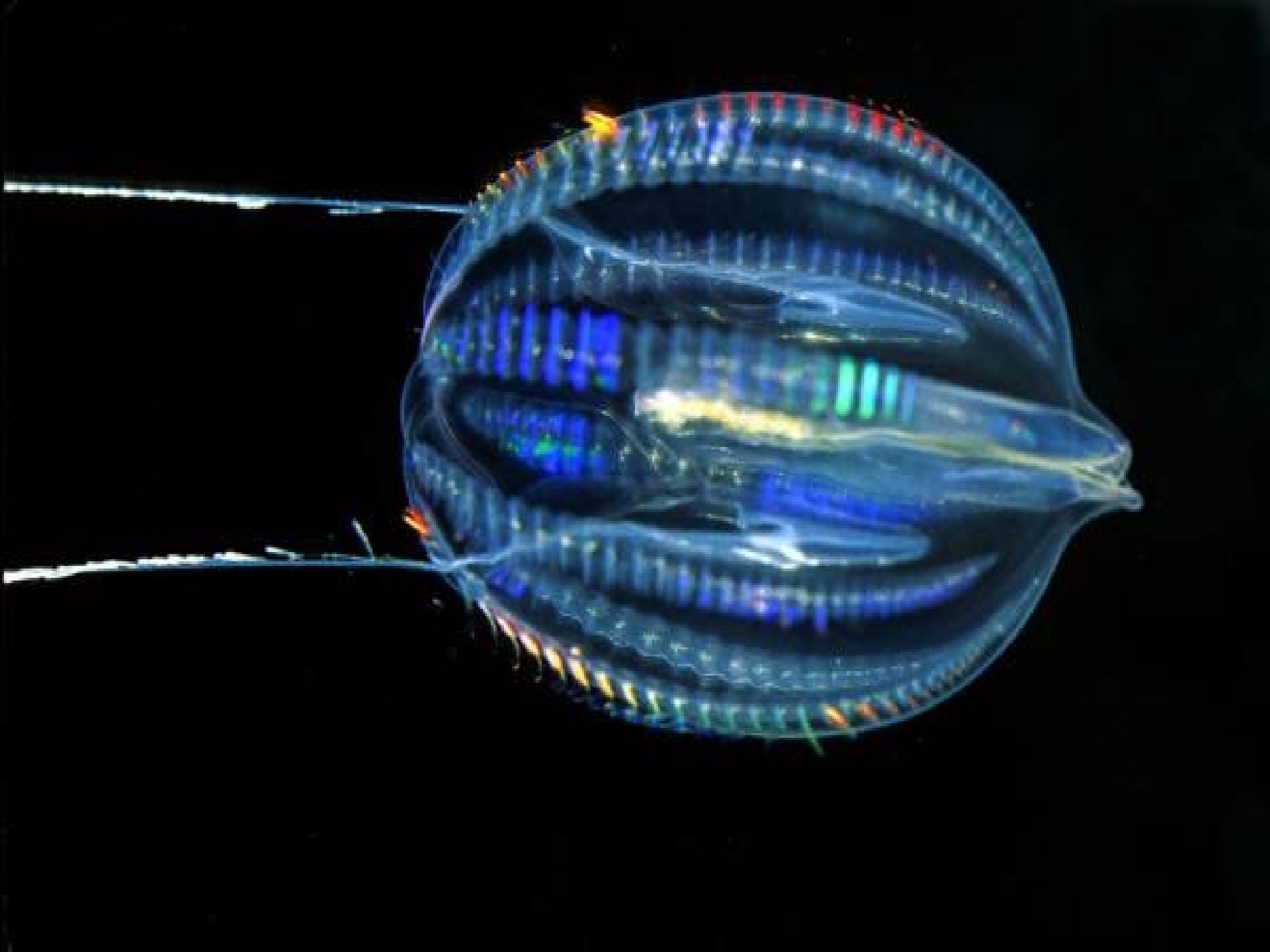


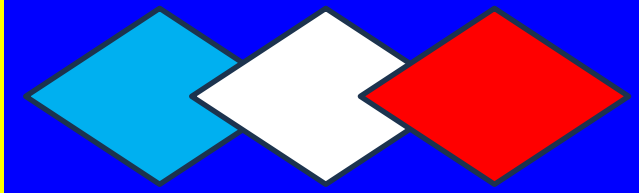
Class 1 : Tentaculata :

With tentacles




Classe 2 : Atentaculata : Without tentacles





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