CBCS FIRST SEM GENERIC

# UNIT3 :PHYLUM CNIDARIAN GENERAL CHARACTERS AND CLASSIFICATION UPTO CLASSES POLYMORPHISM IN HYDROZOA

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# Introduction

Phylum Cnidaria or coelenterate includes diverse animals like jelly fish, sea anemones, corals and the more familiar Hydra. They are diploblastic eumetazoans with tissue grade of organization.

The cnidarians are characterized by the presence of Cnidocytes, polyp and medusa forms. Cnidarians form a phylum of animal that are more complex than sponges, about as complex as ctenophores (comb jellies), and less complex than bilaterians, which include almost all other animals.

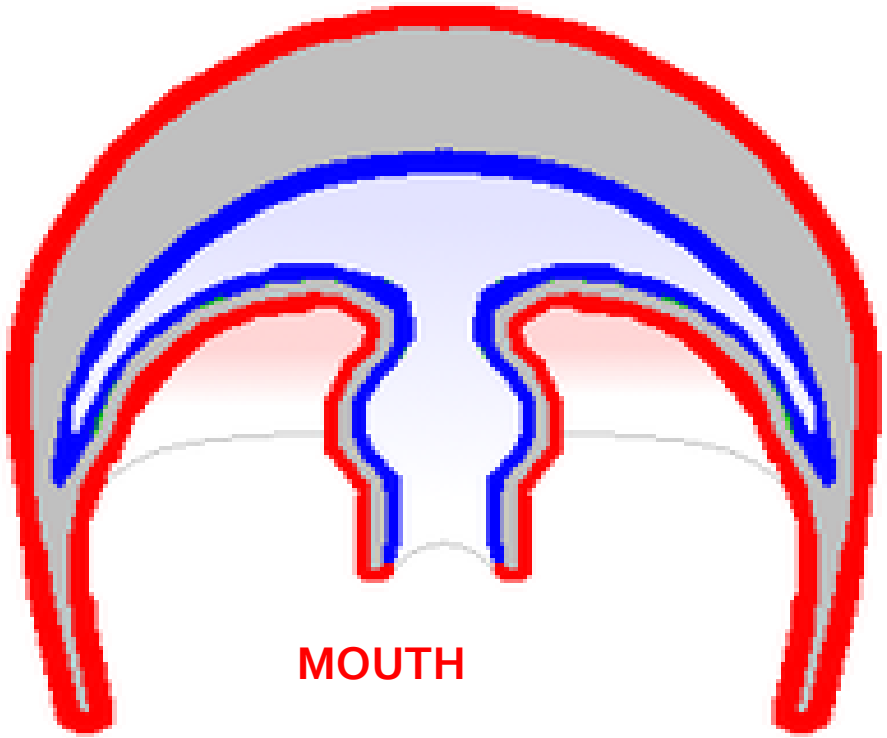
Both cnidarians and ctenophores are more complex than sponges as they have: cells bound by inter-cell connections and carpet-like basement membranes; muscles; nervous systems; and some have sensory organs. Cnidarians are distinguished from all other animals by having cnidocytes that fire harpoon like structures and are usually used mainly to capture prey.

# BASIC BODY FORM:

**Most adult cnidarians appear as either free-swimming medusae or sessile polyps, and many hydrozoans species are known to alternate between the two forms.**

**Both are radially symmetrical, like a wheel and a tube respectively. Since these animals have no heads, their ends are described as "oral" (nearest the mouth) and "aboral" (furthest from the mouth).**

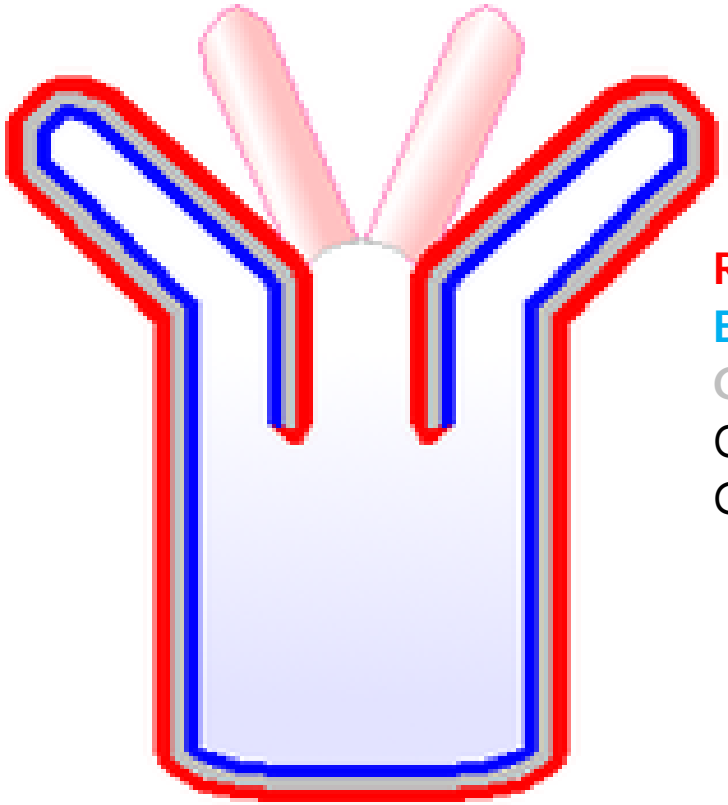
ABORAL END



MOUTH

ORAL END

ORAL END



ABORAL END

RED-EXODERM

BLUE-GESTODERM

GREY-MESOGLEA

OFF WHITE-DIGESTIVE CAVITY

Most have fringes of tentacles equipped with cnidocytes around their edges, and medusae generally have an inner ring of tentacles around the mouth. Some hydroids may consist of colonies of zooids that serve different purposes, such as defense, reproduction and catching prey.

The mesoglea of polyps is usually thin and often soft, but that of medusae is usually thick and springy, so that it returns to its original shape after muscles around the edge have contracted to squeeze water out, enabling medusae to swim by a sort of jet propulsion.

# General Characters of Phylum Cnidaria

- These are mostly marine and a few like hydra live in fresh water
- Many are colonial (Eg: Corals). Some are solitary (Eg: sea anemone)
- They are diploblastic and show tissue grade of organization
- The body is radially symmetric but sea anemones show biradial symmetry

- Polyp and medusa re the two different forms of cnidarians. Polyp is hydroid form which is sessile with mouth-up orientation. Medusa is umbrella or bell shaped with mouth down orientation. It swims by constricting the bell.

- The body wall is composed of an outer epithelium called as epidermis, an inner epithelium called gastrodermis, a gelatinous mesoglea between the outer and inner epidermis. Mesoglea consists of amoeboid cells derived from ectoderm. Mesoglea is thin in polyps. It is thick in medusa, in which it is important in buoyancy.

- The body wall contains stinging cells called as cnidocytes. Hence the name cnidaria. Each cnidocyte cell contains a fluid filled membranous capsule called cnida. Cnidocytes help in defence and capture of prey.

- The blind sac-like central cavity is called coelenterons or gastro vascular cavity. Hence the name Coelenterata. It opens out by mouth surrounded by tentacles. Mouth serves for ingestion as well as for egestion.

- In medusa form the coelenterons is specialized into stomach, radial canals and ring canal. Coelenterons helps in digestion and circulation.
- Digestion is first extracellular in the coelenterons and then intracellular in the nutritive muscular cells of gastrodermis.

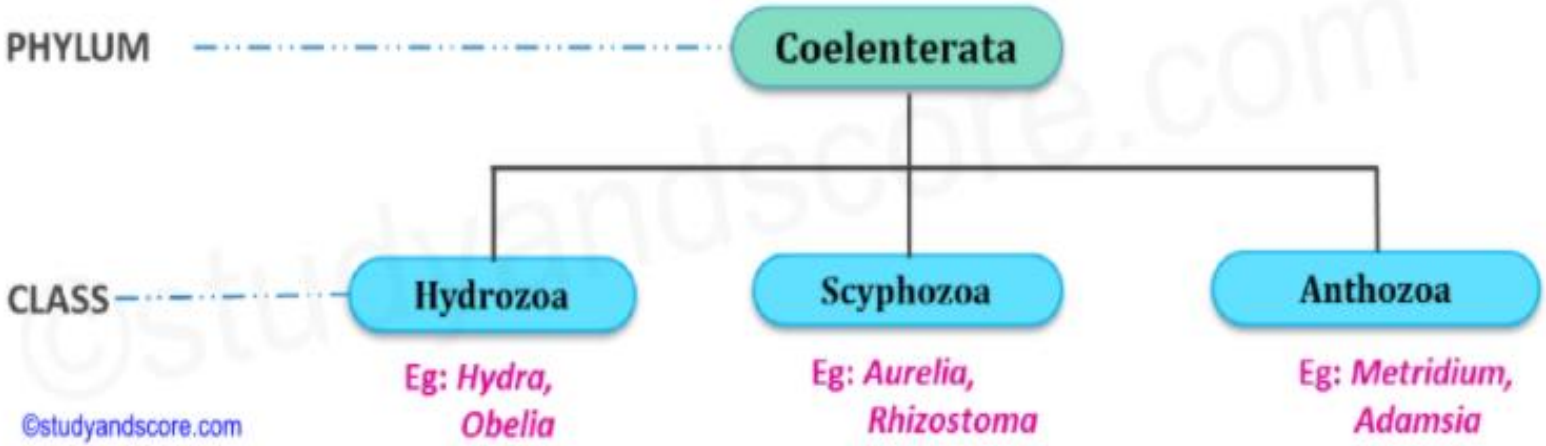
- Exchange of respiratory gases and elimination f the excretory wates occurs by diffusion through the body wall.

- Neurons are interconnected to form a pair of nerve nets, one in epidermis and the other in the gastrodermis. The two nerve nets are joined by neurons that cross the mesoglea. Nerve impulse conduction is diffuse conduction. Nerve impulse can travel in any direction. Besides nerve nets, medusae have nerve rings and ganglia around the margin of the bell.
- Sensory structures like statocysts occur in the medusoid form

- Asexual reproduction takes place by budding, fission and fragmentation.
- Cnidarians are generally unisexual but some are bisexual. Fertilization is external. Cleavage is holoblastic. Development is indirect and includes a free swimming ciliated larval stage called planula.
- In species having polyp and medusa phases, the alternation of asexually reproducing polyp form and sexually reproducing medusa form is called as metagenesis.
- Cnidarians have remarkable power of regeneration.

# Classification of Phylum Cnidaria

## Phylum Coelenterata/Cnidaria includes about 10,000 known species. It is classified into three classes namely Hydrozoa, Scyphozoa and Anthozoa.




The following are the general characters of each of them,

# Class I: Hydrozoa (Gr. Hydros=water, zoon=animal)

- These are mostly marine animals but some may also live in fresh water.
- They are chiefly colonial. Some forms may also appear solitary.
- Medusa stage is absent in few animals. Sometimes both polyp and medusa stages are present in few animals of this class. Medusa is craspedote (presence of velum)
- Coelenteron of the polyps of this class is undivided
- Mesoglea is acellular
- Cnidocytes are restricted to the epidermis
- Gonads also occur in the epidermal region
- Their colonies are polymorphic with different types of zooids like gastrozooids (feeding type), dactylozooids (defensive type) and gonozooids (reproductive type)

# Class II: Scyphozoa (Gr. skyphos=cup, zoon=animal)

- All the animals belonging to this class are marine in nature
- Medusa stage is predominant in this class. Medusa is acraspedote (No velum)
- Mouth is surrounded by four oral arms.
- Mesoglea is cellular and contains amoebocytes
- Cnidocytes occur in the epidermis and also in the gastrodermis region
- Gonads occur in the gastrodermal region.
- Polyps are solitary or may also exist in colonies. Polyp stage is syphistoma (body is divided by septa). This syphistoma produces juvenile medusa called as ephyrae by the process of strobilation. Finally this ephyra grows into the sexual adult medusa.
- This class includes Jelly fish

# Class III: Anthozoa (Gr. anthos=flower, zoon=animal)

- All the animals of this class are marine
- They may be solitary or colonial
- All are sedentary polyploid forms. The medusa stage is absent
- Mouth is oval and is surrounded by a whorl of tentacles resembling a flower like structure. Hence the name of the class.
- The mouth leads into tubular pharynx called stomodaeum that in turn opens into coelenteron. Coelenteron is divided into radial compartments by vertical septa called as mesenteries.
- Cnidocytes occur in epidermal as well as gastrodermal region
- Gonads occur in the gastrodermis.

# Hydrozoan Anatomy

The class Hydrozoa contains species that include the siphonophores and hydroids. Unlike the anthozoans, many Hydrozoa alternate between polyp and medusa forms. However, the polyp form normally dominates in the hydrozoan life cycle. The medusa form is generally small and short-lived.

Its primary function is to carry out sexual reproduction and to allow the species to disperse to different locations. Hydrozoa are classified based on the presence of a membrane called the velum that lines the inside edge of the bell in the medusa forms.

The hydrozoan species Portugese Man O' War. Note the air bladder at the top of the animal and the long feeding tentacles hanging below.

Hydrozoa of the order Siphonophora are fascinating creatures. These animals can form large, sophisticated colonies of interconnected and interdependent individual polypoids and medusoids called zooids.

The term zooid refers to the fact that the individual can usually only function as part of the whole colony. This is because the colony often divides up tasks with some individuals becoming specialized for certain functions.

Zooids specialized for a particular function usually lose the ability to perform other functions. For example, nectophores are medusoid zooids that function to move the colony through the water.

Nectophores however, cannot feed. They are dependent on specialized feeding polyps within the colony to absorb and deliver nutrients. This is a distinguishing feature of the hydrozoans. Although some jellyfish also form colonies, it is neither as prevalent nor as sophisticated among species within the Scyphozoa and Cubozoa classes as it is in the Hydrozoa class.

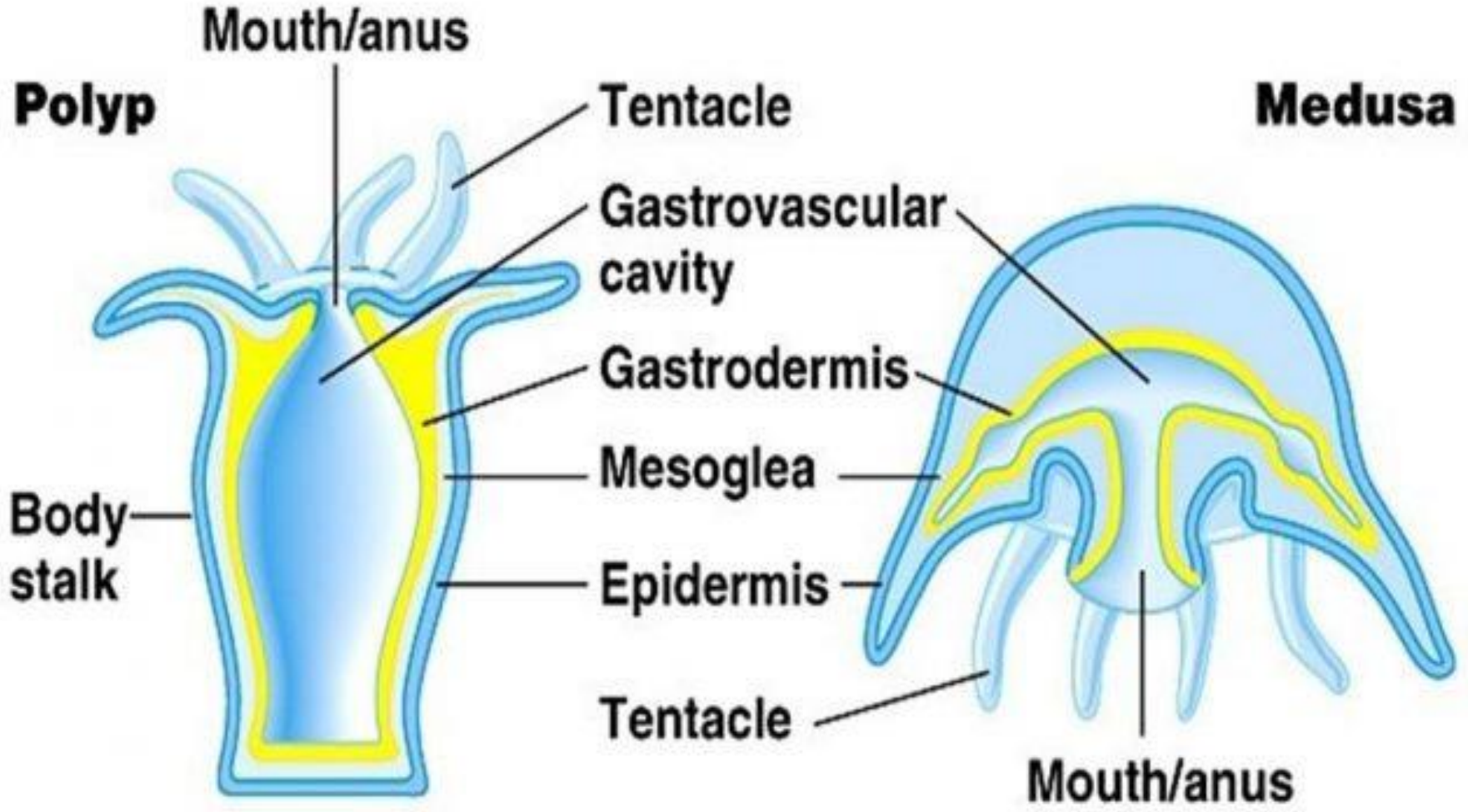
# Types of colonics in siphonophora

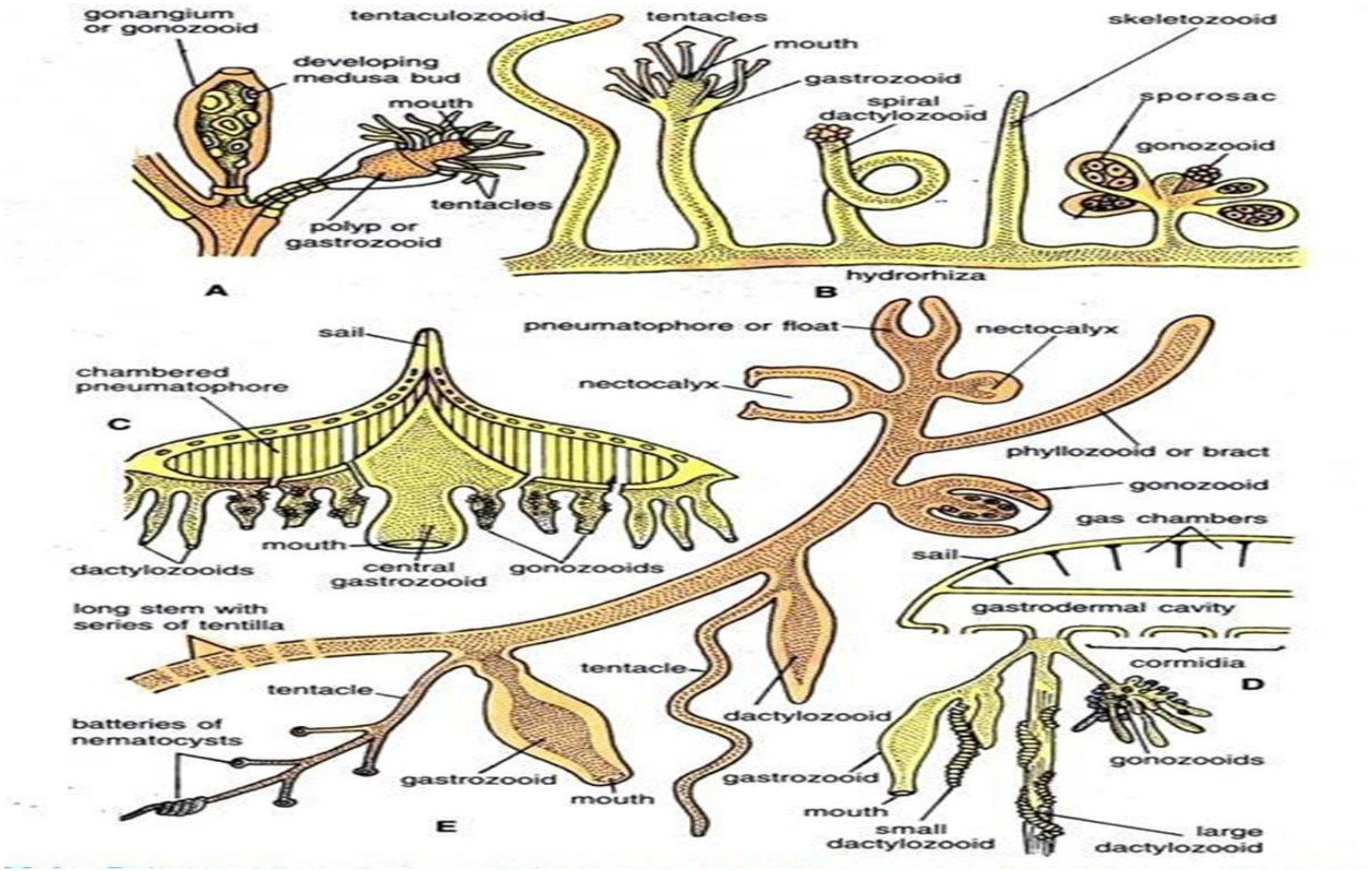
Hydrozoa belonging to the orders siphonophora and chondrophora are exclusively marine, planktonic or pelagic and polymorphic colonies. The colonies are usually delicate, transparent and beautiful The zooids in each colony are attached to the coenosarc or coenosome and their arrangement exhibits diversity in different colony. Because of great diversity of colonics in siphnophora and chondrophora can be illustrated only by some examples of the colonies such as Halistemma, Physalia and Porpita.

# POLYMORPHISIM IN HYDROZOA

**Polymorphism (Gr., poly = many; morphe = form)** is the occurrence of several different types of individuals or zooids in a single species during its life cycle or as members of the colony, the members perform different functions so that there is a division of labour amongst the members.

Coelenterata are noted for their polymorphism, but the various types are reducible to either a polypoid or medusoid type. The polyp and medusa occur in a number of morphological variations. However, polymorphism may be defined as the representation of a single organism by more than one kind of individuals or zooids which differ in their form and function.

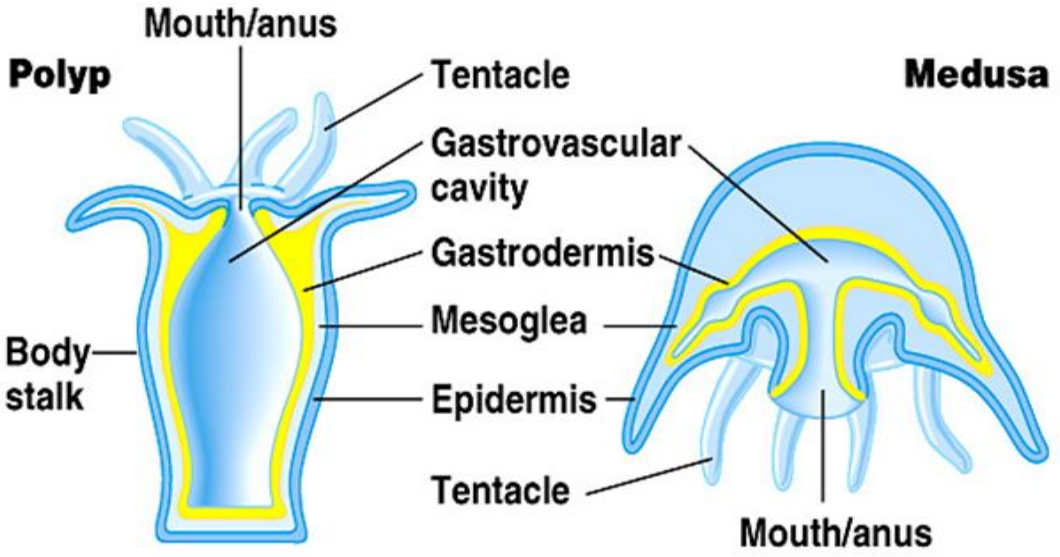

Polyp
Mouth/anus
Tentacle
Gastrovascular cavity
Gastrodermis
Mesoglea
Epidermis
Body stalk
Medusa
Tentacle
Mouth/anus




Polymorphic colonies of Hydrozoa. A—*Obelia* ; B—*Hydractinia* ; C—*Velella* ; D—*Physalia showing a single cormidium*; E—Generalised calycophoran Siphonophora showing a single cormidium.

Polyp: A polyp has a tubular body with a mouth surrounded by tentacles at one end. Other end is blind and usually attached by a pedal disc to the substratum.

Medusa: A medusae has a bowl or umbrella shaped body with marginal tentacles and centrally located mouth or manubrium




(a) Sea anemone: a polyp

(b) Jelly: a medusa

# Patterns of polymorphism

Degree of polymorphism varies greatly in different groups of hydrozoa.

Dimorphic: Simplest and commonest pattern of polymorphsm is exhibited by many hydrozoan colonies like Obelia, Tubularia etc.,

They have two types of individuals or zooid namely:

Gastrozooids or hydranths are connected for feeding

Gonazooids or blastostyles with asexual budding forming sexual medusae or gonophores.

This phenomenon is termed as dimorphism.

2. Trimorphic: Besides gastrozooids and gonozooids they also possess a third type individuals the dactylozooids.

3. Polymorphic: Animals having more than three types of individuals are called polymorphic. some what greater degree of polymorphism is found in the encrusting colony of Hydractinia with five types of polyps each performing a specialized function.

Gastrozooids - feeding
Dactylozooids - protection.
Tentaculozooids - Sensory cells
Skeletozooids - Spiny projections of chitin
Gonozooids - Reproductive individuals.

# POLYPOID ZOOIDS ARE :

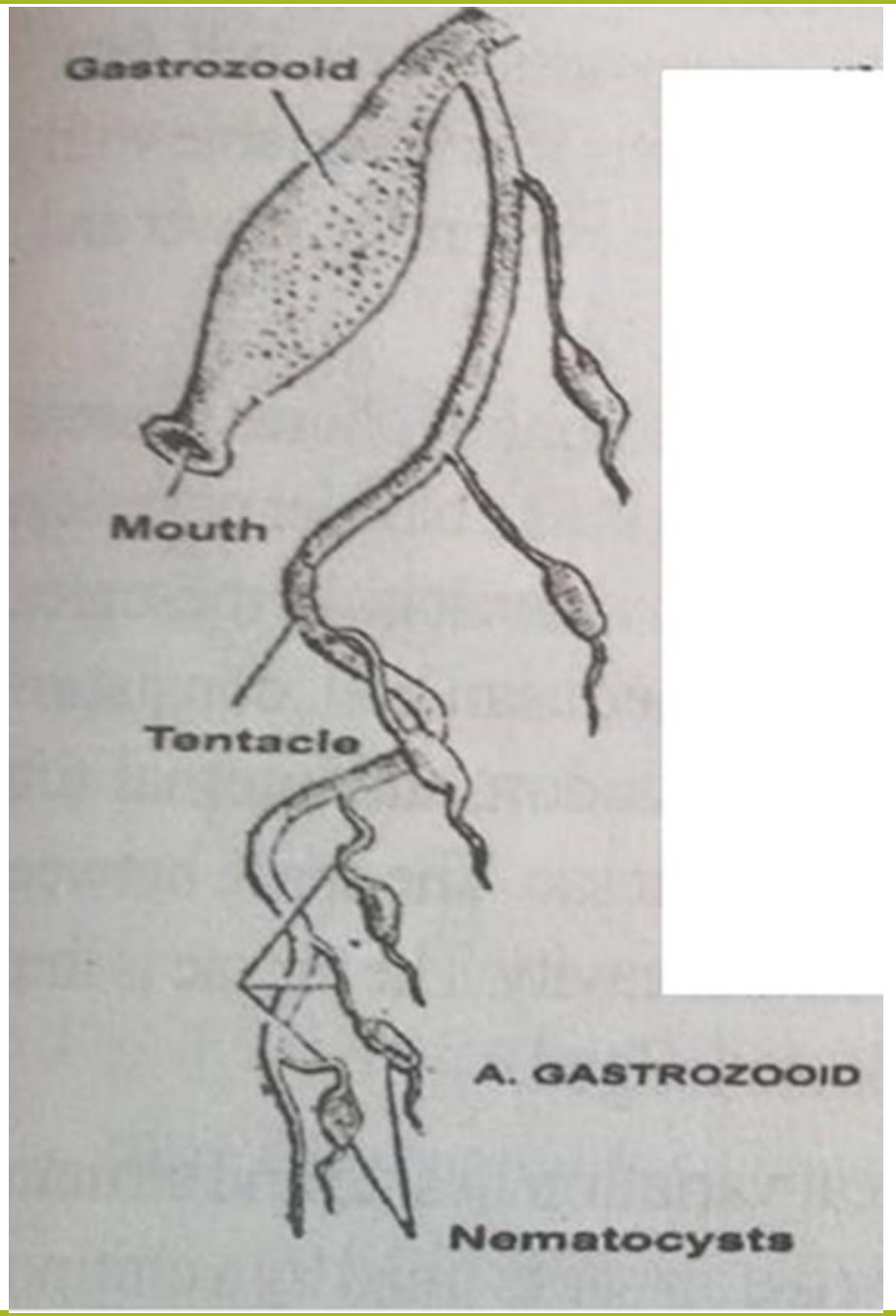
Gastro zooids
Dactylo zooids
Gono zooids

## . Gastrozooids :

The nutritive polyps are called gastro-zooids.

They alone take up nutrition in the colony.

A mouth is present at the tip of the hypostome. Near the base of a gastrozooid usually a single, long and contractile tentacle arises. It shows batteries of nematocysts. Lateral branches are present called tentilla. Gastrozooids catch the prey and digest it. The digested food is thrown into the coenosarcal canal.



In Pennatula the gstrozooids modified in to nectocalyx which are like buds on the body and helps in driving the water.

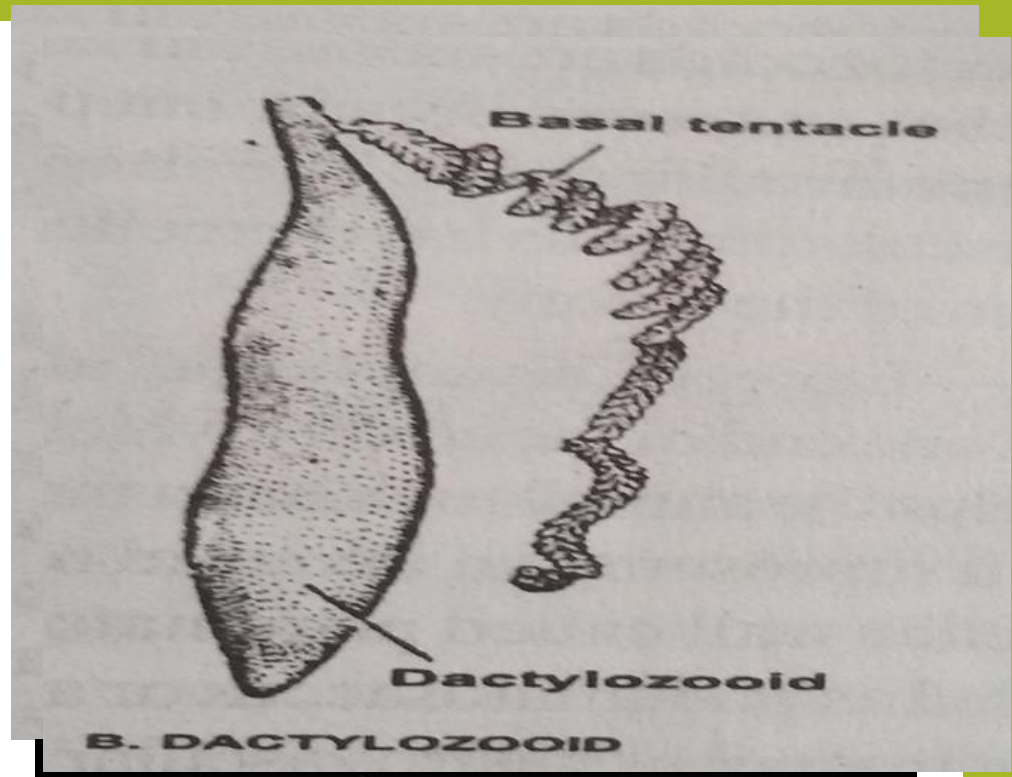
In Renella nectocalyx are in bunches some times called as  pseudonecocalyx.

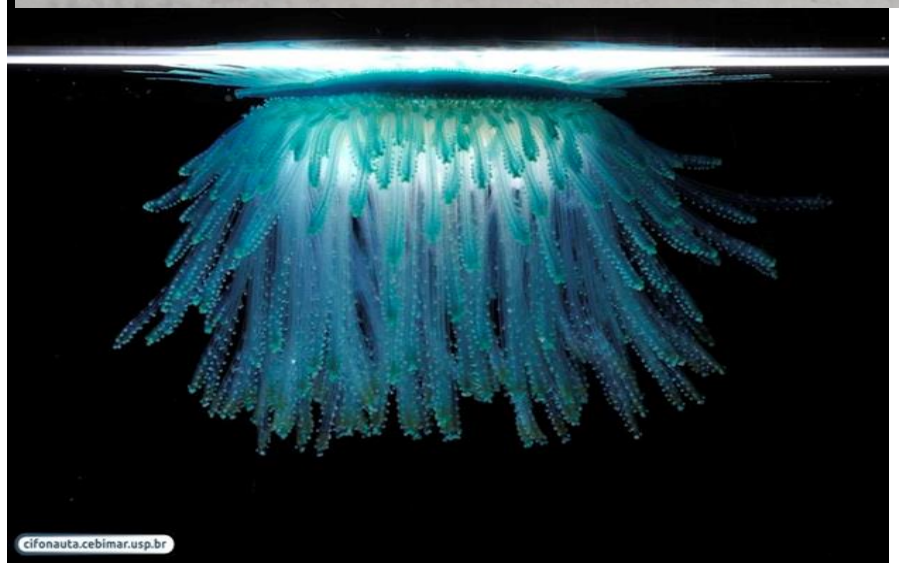
In Millipora many gastropores protrude out from the polyp. Each polyp with 4-6 tentacles and cnidoblast buds .

## 2. Dactylo zooids :

They are called Palpons, feelers or tasters.
They resemble the gastrozooids.
They do not show mouth. Their basal tentacle is un branched.

In Physalia, the tentacle is very long.
In velella and Porpita the margin of the colony bears long and hollow tentacles.
These zooids are protective in function.
They bear batteries of nematocysts.



# MEDUSOID FORMS :

Pneumatophores :

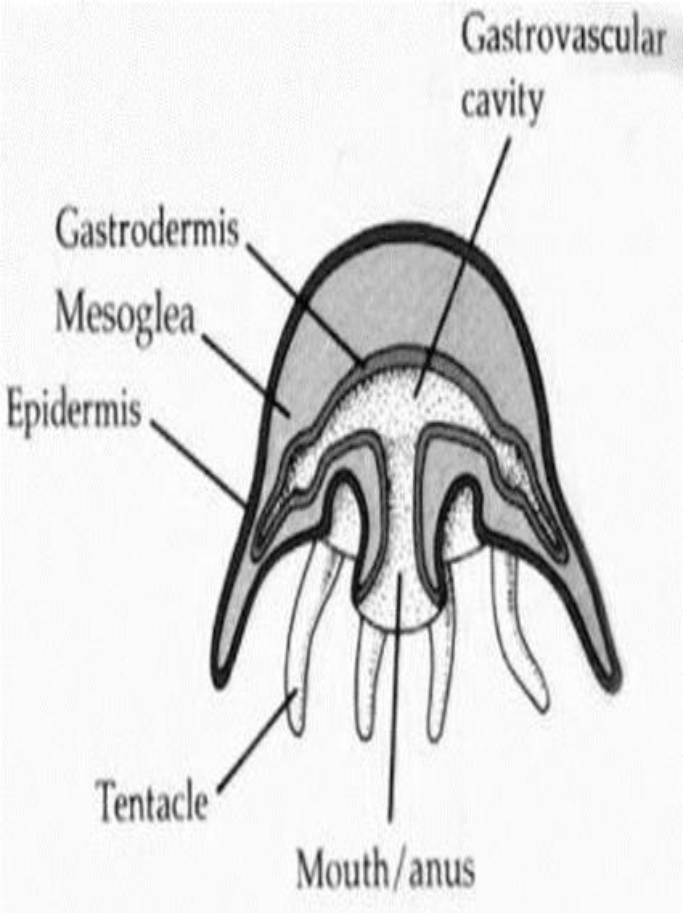
Nectopore or Nectocalyx or swimming zooid:

Bracts :

Gonophores :

# MEDUSOID FORMS

Pneumatophores : It functions as a float. It is an inverted medusan bell. The walls are two layered and highly muscular. The epidermal lining becomes glandular to form a gas gland. The gas gland secretes gas into the air-sac




1)The pneumatophore is small in Halistemma.

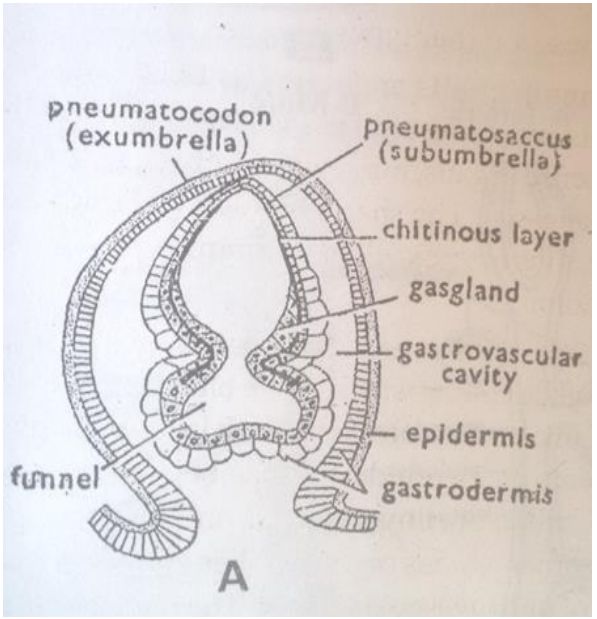
2)The pneumatophore is very large in Physalia.

3)It is disc-shaped in porpita.

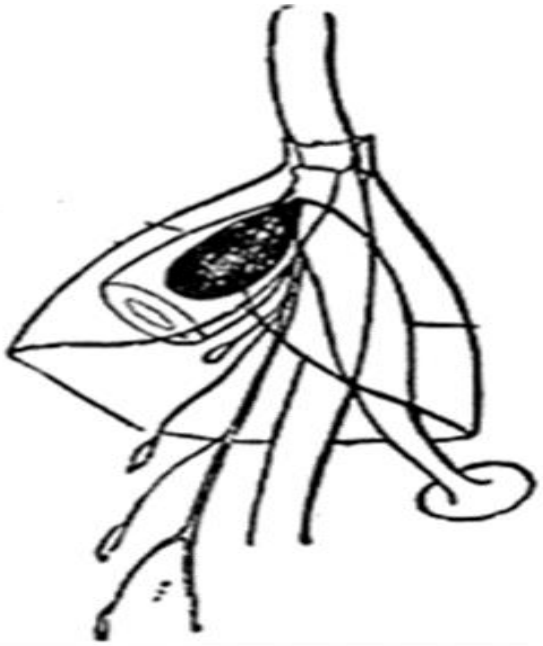
In Agalma the air sac is lined by a chitinous layer secreted by the Epidermis which is also forms a funnel shaped tricher or funnel. The epidermis forme two layers and the gas gland secretes the gas.

## Nectopore or Nectocalyx or swimming zooid:

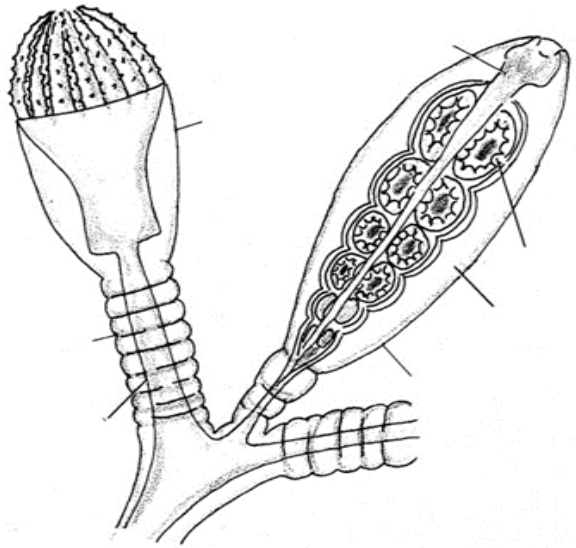
Nectocalyces or nectophores are bell-shaped medusoids with a velum, radial canals and circular canal, they have no mouth, manubrium, tentacles or sense organs, A nectocalyx is muscular and brings about locomotion of the colony by swimming. It is also referred to as nectophore or nectozooid



3.Bracts : They are also known as hydrophyllia. They are leaf like, helmet shaped.
They serve to cover and protect other zooids of the colony.



4. Gonophores : Bearing gonads, male gonads produce sperm and female gonad produce ova



Gonophore…obelia

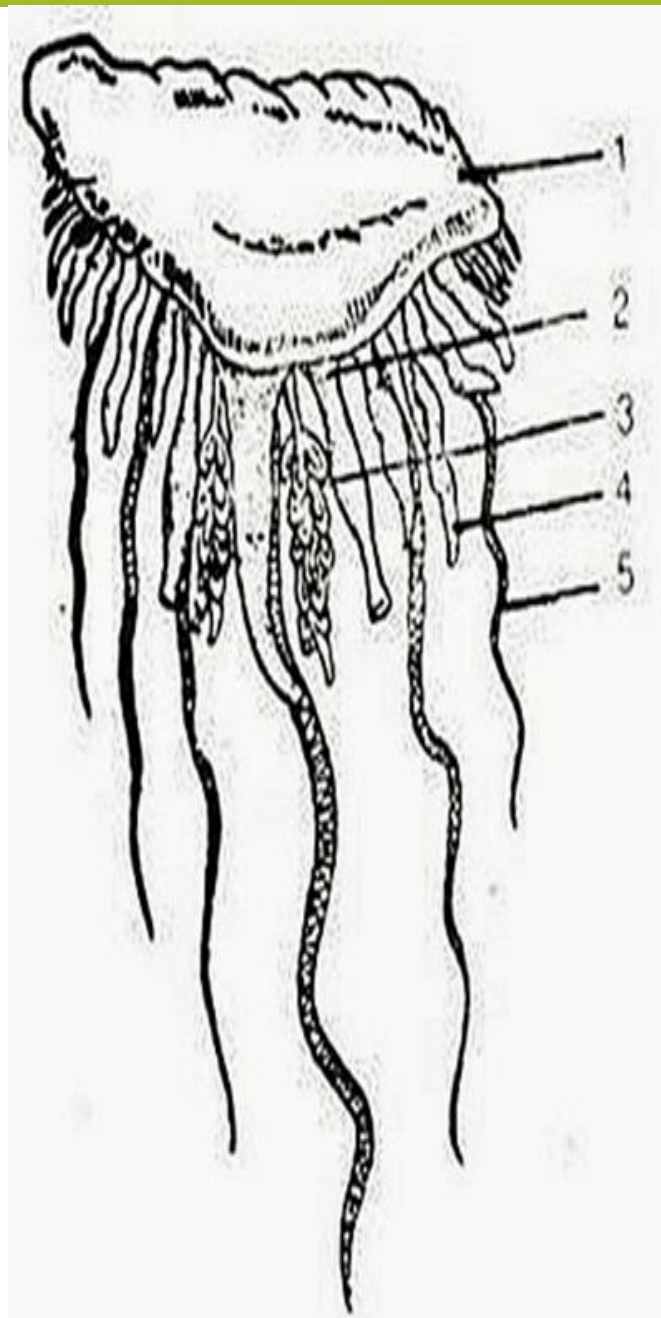
# Notable polymorphic colonies

**Hydrozoans exhibit remarked development of Polymorphism. Some of them are Physalia, Halistemma, Porpita**

**Physalia:** Is commonly called as Portuguese man of war. This is a free floating pelagic colonial form.

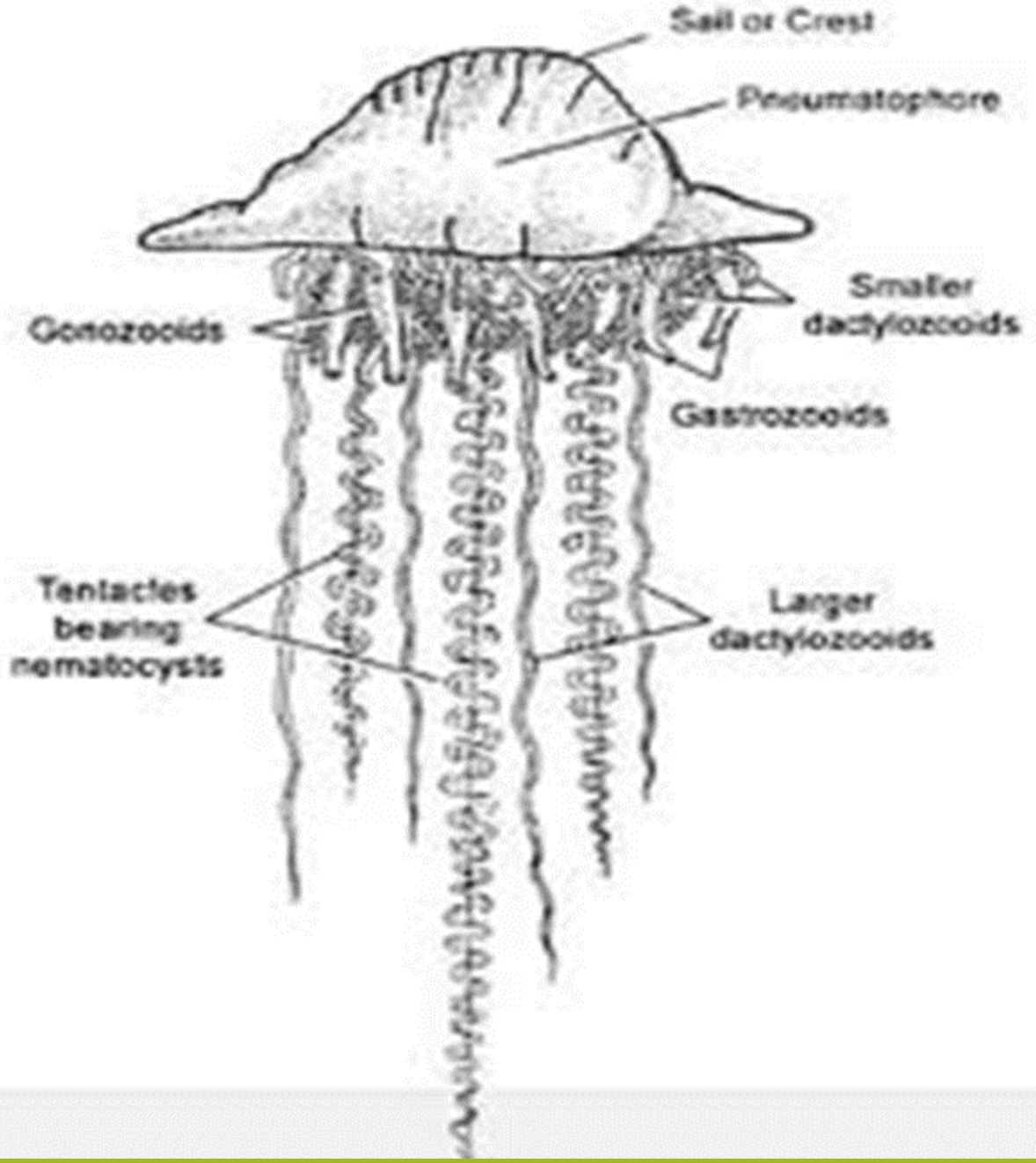
The medusa is modified in to a big pneumatophore or float which floats above the water. The underside of the float has cormidia. Each cormidium consists of a small dactyl zooids with a long slender tentacle, a large dactylozooid with an enormous nematocyst bearing fishing tentacles.

A branched gonozooid with male and female gonophores is present.




# PHYSALIA

1. PNEUMATOPHORE
2. GASTROZOOID
3. GONOZOPID
4. DACTYLOZOOID
5. TENTACLE



Porpita: It has medusoid disc like large pnematohore and chitinous shell with many concentric gas chambers. On the ventro-central region is a single large gastrozooid which is surrounded by clusters of small gonozooids which bear sexual medusae. On the edge of it tantacle like dactylozooids armed with nematocysts.

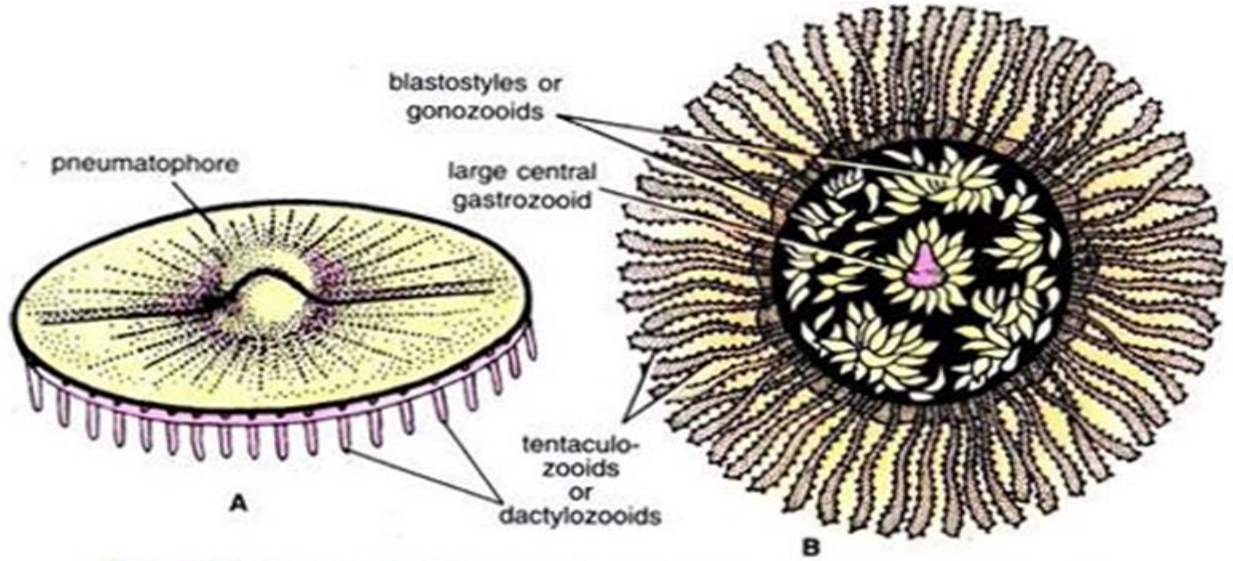




Fig. 35.6. *Porpita*. A—Colony in dorsal view; B—Colony in ventral view.

# ORIGIN OF POLYMORPHISM

There are many theories to explain the origin of polymorphism in coelenterates.

Poly-organ theory: This theory was proposed by Huxley (1859), Eschscholtz (1829), E. Metschnikoff (1874) and Muller (1871).

According to this theory, a polymorphic colony is supposed to be a single medusoid zooid; its various components are regarded to be the modified organs of this medusoid zooid. The various parts of the zooid, i.e., manubrium, tentacles, umbrella, etc., multiply independently from one another and they have assumed different forms to perform different functions.

Poly-person theory: This theory was first proposed by Leuckart (1851), Vogt (1848), Gegenbaur (1854), Kolliker (1853), Claus (1863) and later strongly supported by E. Haeckel (1888), Balfour (1885) and Sedgewick (1888).

According to this theory colony is not a single individual but various parts of the colony are modified individuals which have changed their structure due to division of labour. They have all modified from the primitive zooid which was a polyp.

# Medusa theory:

This theory was proposed by Haeckel (1888) as a compromise between the above theories. The theory says that the siphonophores formed from gastrula was a medusoid individual, from which zooids or persons appeared by budding from the subumbrella

# SIGNIFICANCE OF POLYMORPHISM

The phenomenon of polymorphism is essentially one of division of labour in which specific functions are assigned to different individuals. Thus, polyps are modified for feeding, protection and asexual reproduction, while medusae are concerned with sexual reproduction. This distribution of functions among diversified individuals and their subsequent modifications in coelenterates may have resulted from their initial simple organization and lack of organ specialization. Polymorphism gave the colonies competitive edge in protection and food gathering and eventual survival. polymorphism: colonies of some species have morphologically differing individuals each specialized for certain roles e.g. feeding, reproduction & defense etc.

# Thank you