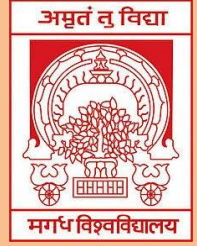




DAUDNAGAR COLLEGE

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Topic

PHYLUM – CNIDARIA

OBELIA

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Obelia (Sea Fur)

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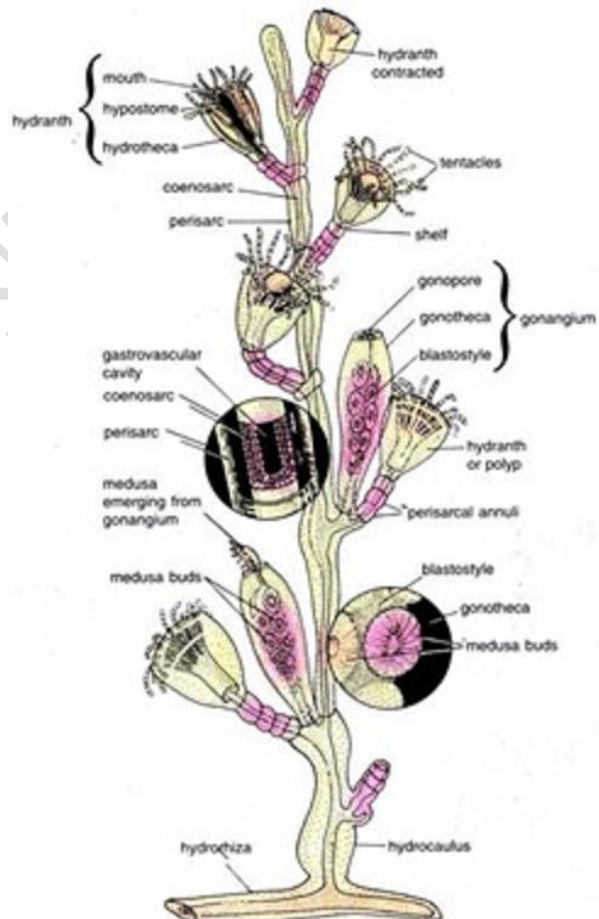


Fig. 32.1. Obelia. A portion of colony.

INTRODUCTION

- ☞ Obelia is a sedentary colonial marine cnidarian which grows upright in a branching tree-like form and has several specialized feeding and reproductive polyps.
- ☞ It is commonly called sea-fur
- ☞ It exists in both asexual, sessile, polypoid stage and sexual, free-swimming medusoid phase.
- ☞ The common species of Obelia are:

- Obelia geniculata (Knotted thread hydroid)
- Obelia longissima (Sessile hydroid)
- Obelia dichotoma (Sea thread hydroid)
- Obelia bidentata (Double toothed hydroid)

HABIT AND HABITAT:

- ☞ Obelia is cosmopolitan in distribution, only exception being the high-arctic and Antarctic seas.
- ☞ They grow in shallow water, in intertidal rock pools and are usually found up to 80-100 meters of depth from the water's surface.
- ☞ The medusa stage of Obelia species is commonly found in coastal and offshore plankton around the world.
- ☞ The colonies of Obelia are often found as a delicate fur-like growth on the rocks, stones, mollusc shells, sea weeds, wooden pilings and wharves.
- ☞ Obelia geniculata normally grows on kelp fronds,

MORPHOLOGY

- ☞ Obelia is a very small marine hydroid.
 - ☞ It looks like a small branching tree exhibiting whitish or brown colour.
 - ☞ The height of Obelia varies from 2 cm more.
 - ☞ The **body of Obelia** consists of two kinds of filaments, horizontal **hydrorhiza** and vertical **hydrocaulus**.
- Fig. : Colony of *Obelia geniculata*

A. Hydrorhiza (Root of a hydroid)

- Hydrorhiza is the basal part of the colony consisting of tubular processes called stolons.
- It encrust over the surface of substratum and helps in the attachment of the colony.

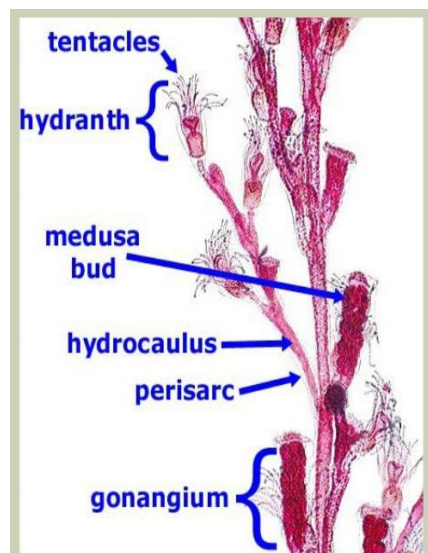


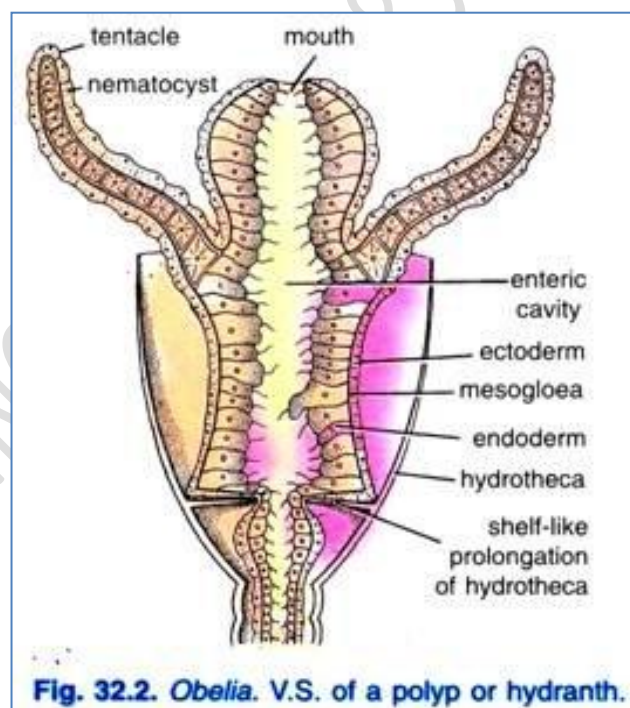
Fig. : Outline structure of *Obelia* : showing alternate branches with zooids

B. Hydrocaulus (Stem of a hydroid)

- A few small vertical filaments, 2-3 cm long, arise from the hydrorhizas. These are called hydrocauli (Sing., Hydrocaulus).
- Each hydrocaulus branches alternately, each of which terminates into a polyp. The polyps collectively are termed as zooids.
- These zooids are nutritive in function and help in feeding. These are called gastrozooids.
- The axils of proximal branches bear cylindrical reproductive zooids. These are termed as gonozooids, blastozooids or blastostyles.

LIVING TISSUE OF OBELIA - COENOSARC

- ☞ Whole colony of Obelia; hydrorhiza, hydrocaulus and zooids; contain living tissue, called coenenchyme or coenosarc.
- ☞ The coenosarc is diploblastic comprising of two layers;
 - outer epidermis and
 - inner, gastrodermis.
 - A middle non-cellular layer of mesoglea is present in between epidermis and gastrodermis.
- ☞ A narrow canal, called coenosarc canal runs through whole colony of Obelia which is continuous with the gastrovascular cavity of the zooids.
- ☞ The continuity of the canal system helps to transport the digested food throughout the colony.



A. EPIDERMIS

- The epidermis is thin and made up of typical cells of Cnidaria. These include; epithelio-muscular cells, mucus-secreting cells, interstitial cells, nerve cells and nematoblasts.
- The nematocysts are basitrichous isorhizas. These consist of an oval capsule, a long thread bearing spines and open at the tip.

B. GASTRODERMIS:

- It forms the lining of gastrovascular cavity and consists of endothelio-muscular cells, nutritive cells, gland cells and nerve cells.

C. PROTECTIVE COVERING – PERISARC

- Entire colony of Obelia is surrounded by a protective covering, called perisarc. It is non-cellular, tough, transparent, yellowish-brown and cuticular in nature and is called perisarc or periderm.
- It makes the vertical part of the colony firm and rigid. Perisarc is secreted by the epidermis and is separated from the coenosarc by a thin fluid-filled space.
- However, the coenosarc and perisarc are in contact making the colony more rigid.

- At some points, the perisarc is arranged in flexible rings called annuli. These allow the swaying movements due to the force of water currents.
- The perisarc of hydranth is termed as hydrotheca and that of gonozooid is called gonotheca.

MORPHOLOGY OF A GASTROZOOID

- ☞ Gastrozoid of Obelia is a feeding polyp. Its function is to feed the whole colony.
- ☞ Gastrozoid is a tubular and diploblastic zoid with a central gastrovascular cavity continuous with the coenosarc canal.
- ☞ The polyp is attached to the hydrocaulus by a hollow stalk while its distal end is produced into a conical elevation called manubrium or hypostome.
- ☞ The apical portion of the manubrium bears a terminal mouth encircled by numerous long, solid tentacles, often 24, loaded with nematoblasts.
- ☞ The perisarc of gastrozoid, called hydrotheca, is transparent and cup-shaped invaginated as a platform or shelf at the base of the gastrozooids for polyp to rest.
- ☞ The gastrozoid and hydrotheca collectively form **hydranth**.
- ☞ In case of any emergent situation, the polyp can withdraw itself into the hydrotheca and the tentacles fold over the manubrium covering the mouth. The presence of shelf prevents the polyp to retract into the hydrocaulus.
- ☞ The annuli of the perisarc present around the stalk of polyp allow the swaying movements due to the force of water current.

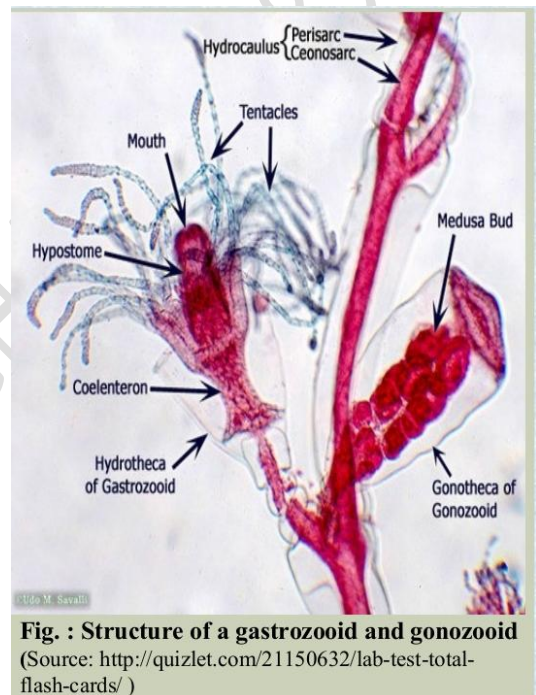


Fig. : Structure of a gastrozoid and gonozooid
(Source: <http://quizlet.com/21150632/lab-test-total-flash-cards/>)

Fig. : Structure of a gastrozoid and gonozooid (Source: <http://quizlet.com/21150632/lab-test-total-flash-cards/>)

MORPHOLOGY OF A GONOOZOID (polyp stage)

- ☞ The gonozooids, also called **blastozooids** or **blastostyles** are cylindrical rod-like reproductive bodies present in the axils of hydrocaulus and stalk of gastrozooids.
- ☞ Gonozooids are less in number than gastrozooids as these are present only in the proximal part of the colony. It has a reduced gastrovascular cavity and is devoid of mouth and tentacles. It, thus, cannot feed and receives food digested by the gastrozooids and transported through the gastrovascular cavity.
- ☞ Like other parts of the colony, gonozooids are also enclosed in a perisarc, called **gonotheca**. It is constricted distally and constricted by annuli proximally. The apical part of the gonotheca has an opening called **gonopore**.
- ☞ Gonozooid produces numerous small medusae or gonophores by the asexual process of budding.

- ☞ Mature medusae detach from the gonozooids and escape into the surrounding water through the gonopore.
- ☞ The gonozooids, gonophores and gonotheca collectively form **gonangium**.

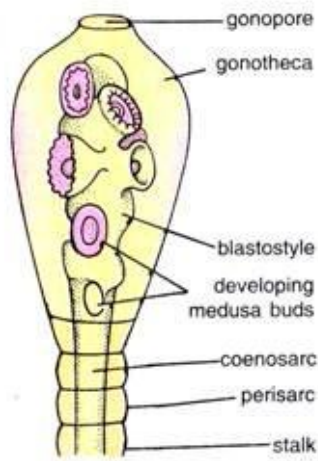


Fig. 32.3. *Obelia*. A gonangium.

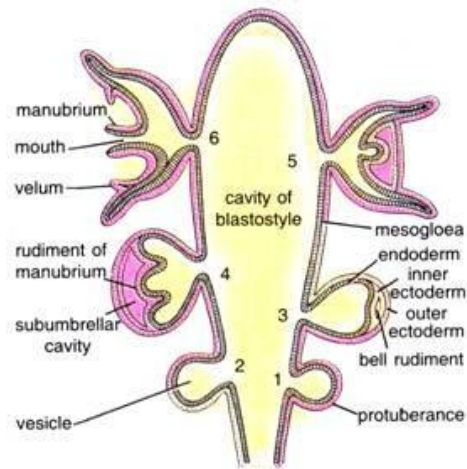


Fig. 32.8. *Obelia*. Stages of the development of medusa from a blastostyle.

MORPHOLOGY OF A MEDUSA

- ☞ Medusa of *Obelia* is **radially symmetrical**, **umbrella-like zoid** which measures approximately 6-7 mm in diameter.
- ☞ The outer surface of medusa is **convex** and known as **ex-umbrellar surface**, while the inner **concave** surface is called **sub-umbrellar surface**.
- ☞ A short manubrium containing a quadrangular mouth at its distal end hangs from the centre of the sub-umbrellar surface.
- ☞ The **medusa is craspedote type** as its edge is produced inwards into an insignificant rudimentary velum.
- ☞ The margins of the medusa bear initially 16 short, contractile tentacles; which gradually increase in number.
- ☞ The **mouth** open into a short **gullet** which leads to a wide expanded **stomach** from which arise four narrow, radial canals which mark the **four principal per-radial**. The radial canals extend till the margin of the umbrella and open into a circular canal running parallel to the margin.

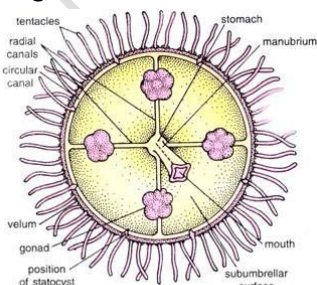


Fig. 32.4. *Obelia*. Medusa in oral view.

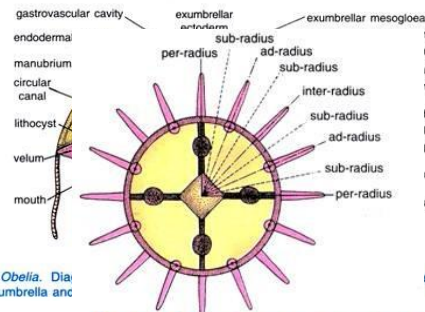


Fig. 32.6. *Obelia*. Dia- umbrella anc

Fig. 32.7. *Obelia*. Medusa showing radial symmetry and various orders of radii.

- ☞ The radius bisecting two per-radial is called inter-radius (four in number) and that bisecting per-radius and adjacent inter-radius is termed as **ad-radius** (eight numbers).

- ☞ The tentacles present at the end of these radii are named accordingly, such as per-radial tentacles; inter-radial tentacles and so on.
- ☞ Whole system of canals is lined by inner layer of gastrodermis and both the ex-umbrellar and sub-umbrellar surfaces are covered by epidermis.
- ☞ **Nervous system** consists of **two diffused nerve nets** which are concentrated around the margins of the umbrella and form two circular nerve rings.
- ☞ Eight receptor organs, called statocysts, are present at the bases of ad-radial tentacles. These are the **organs of balance, muscular co-ordination** and **equilibrium**.
- ☞ Medusa possesses **four gonads** on the sub-umbrellar surface. These are **per-radial** in position and each of these is present in the middle of each radial canal.
- ☞ These are **dioecious, male and female medusae being separate individuals.**

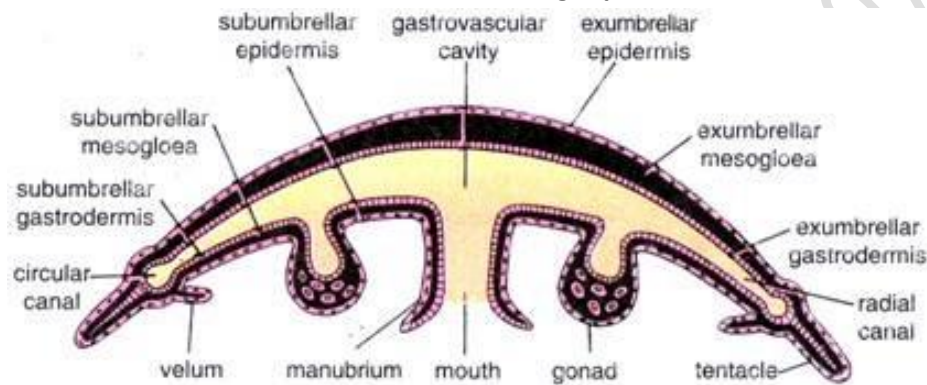


Fig. 32.10. Obelia. V.S. of medusa showing gonads.

LOCOMOTION IN OBELIA

A. Movement in Polyps

- ☞ The **polypoid colony** of Obelia is **sessile** and **attached to the substratum**. It **does not move** from place to place.
- ☞ However, polyps exhibit **certain movements under the force of water currents** due to the presence of **annuli in the perisarc**.
- ☞ The polyps can also undergo **contraction and extension** because of the presence of longitudinal and circular muscles in their body wall.

B. Locomotion in Medusa

- ☞ **A.) Hydro propulsion: Medusae are free swimming forms.** They generally swim in the water by **jet propulsion** method.
 - The **contraction and expansion of bell muscles** alternatively closes and opens the bell which forces water out of the sub-umbrellar cavity downwards and propels the body in upward direction.
 - The contraction of the epidermal muscle tails of the sub-umbrellar surface helps in the closure of the bell cavity while the opening of the bell is brought about by elastic mesogloea and contraction of the muscle tails in the middle of upper surface.
 - This kind of jet propulsion method is called hydro propulsion.

- ☞ **b) Passive drifting:** Medusae also **drift and float passively** in sea water under the force of strong water currents and wind. **Thick mesoglea** of medusae provides them **buoyancy and helps in floating**.

NUTRITION IN OBELIA

Nutrition in Polyps

- ☞ The **gastrozooids are the nutritive zooids** of the Obelia colony.
- ☞ They are primarily carnivorous and feed upon small crustaceans, tadpoles, worms, insect larvae, etc.
- ☞ The gastrozooids capture the food with the help of **nematocysts present on the tentacles**.
- ☞ The food is pushed into the gastrovascular cavity through the mouth where the proteolytic enzymes secreted by the gastrodermal gland cells partially digest the food.
- ☞ The semi-digested food is engulfed by the food vacuoles of the nutritive cells for complete digestion. Thus, **digestion is both extracellular and intracellular**.
- ☞ The digested products of the food are distributed throughout the body by **cell-to-cell diffusion** helped by beating of flagella of gastrodermal cells; **the gastrovascular cavity** thus serving for both **digestion and transportation of food**.
- ☞ The undigested food material is **egested through the mouth** of the gastrozooids.

Nutrition in Medusa

- ☞ The process of feeding in medusa is **similar to that in polyps**.
- ☞ Medusa is **strictly carnivorous** and captures food with the help of tentacles beset with nematocysts.
- ☞ As in polyps, the food is digested both extracellularly and intracellularly but **exclusively in stomach**.
- ☞ The **digested food is distributed** to whole body through the network of **radial and circular canals present in medusa**.

RESPIRATION IN OBELIA

- ☞ Obelia **does not have any respiratory organs** and the **gas exchange takes place by diffusion through the general body surface**. Oxygen diffuses directly from the surrounding water into the epidermal cells and carbon dioxide is diffused out.
- ☞ The diffusion of gases can also take place during circulation of water in the gastrovascular cavity of polyp or medusa as there is a continuous influx of water.
- ☞ Here, exchange of gases takes place **between water and the gastrodermal cells** from where oxygen diffuses to each cell of Obelia.

EXCRETION AND OSMOREGULATION IN OBELIA

- ☞ Obelia **does not have** special excretory or osmoregulatory organs.
- ☞ It excretes nitrogenous waste in the **form of ammonia** that **diffuses** through the body wall.

- ☞ Excess water is thrown out of the gastrovascular cavity through the mouth. Thus, **mouth** being the single opening functions as a **contractile vacuole** also.

SENSE ORGANS – STATOCYST

- ☞ **Polyps of Obelia** are **sessile zooids** and they **do not require any sense organs**. However,
- ☞ **medusae** are **free-swimming zooids** and while swimming, their body may tilt and lose balance. Thus, they **possess balancing organs, statocysts** with the help of which they can regain their position.
- ☞ **Structure A statocyst** is a fluid-filled sac lined by sensory epithelial cells. The basal part of the cells is connected to the nerve cells while the inner ends bear sensory processes. The cavity of statocyst contains a round particle of calcium carbonate, called **statolith or otolith**. The particle is movable and is secreted by a large cell, lithocyte.
- ☞ **Function The statocysts help in balance and equilibrium of medusa**. While swimming, if the medusa tilts, the movable particle of statolith rolls over the tilted side and presses against the sensory processes. The stimulated cells transmit the nerve impulse to the **nerve ring** which is connected to the muscle tails.
- ☞ The nerve impulse causes the rapid contraction of the muscle tails of the stimulated side regaining the original position of medusa.

REPRODUCTION IN OBELIA

The **life cycle of Obelia** includes **both polyp and medusa stages**. **Polyp is an asexual form and reproduces by asexual** means while **medusa is a sexual zooid and reproduces sexually**.

a) Asexual Reproduction - polyps

- ☞ The **polyps reproduce asexually by the process of budding**.
- ☞ The hydrocaulus gives rise to a number of **gastrozooids** and as the colony matures, **blastostyles bud** from the axils of proximal gastrozooids and hydrocaulus.
- ☞ **Each blastostyle** produces a **large number of medusa buds** in **spring and summer**.
- ☞ These medusa buds gradually **develop and mature**. When fully formed, **they detach** from the blastostyles and **escape into the water through the gonopore**.

Fig. : Development of medusa buds in Obelia Source:

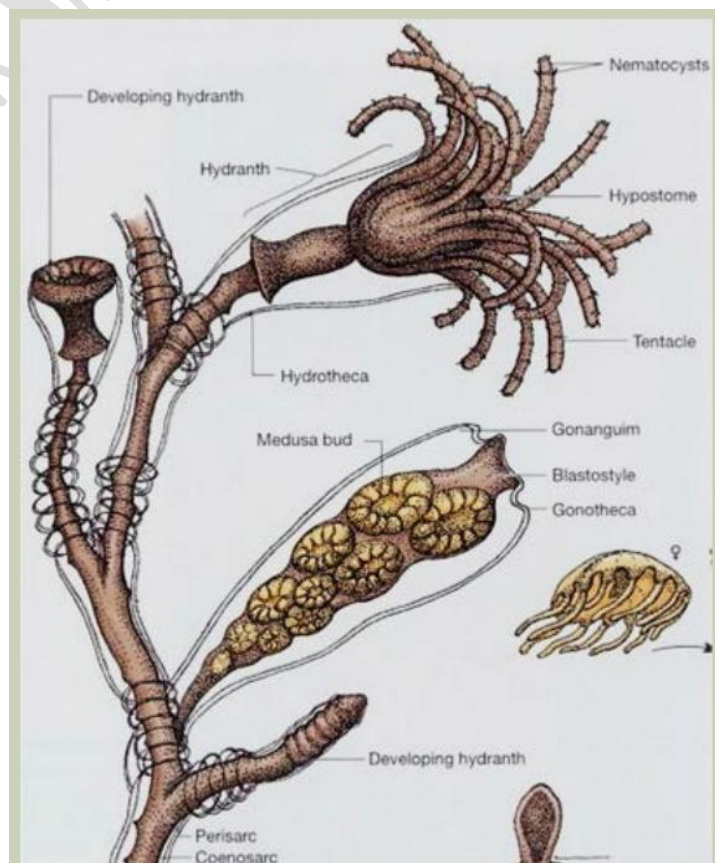


Fig. : Development of medusa buds in Obelia

<http://quizlet.com/21150632/lab-test-total-flash-cards/>

B) Sexual Reproduction - Medusa

- ☞ The **sexual reproduction** in Obelia takes place in the **medusa stage**; the **male and female medusa being separate.**
- ☞ The **medusae produce ova and sperms** and release them into **the water where fertilization** takes place.
- ☞ Sperms may also enter the female medusa along with the water current and **fertilization** may take place **inside the body of female medusa.**
- ☞ **Development of Fertilized Egg:-** The fertilized egg undergoes complete and equal cleavage resulting in the formation of solid ball of cells, called **morula**. Morula develops a central cavity, **blastocoel** surrounded by loosely arranged blastomeres. This hollow blastula is termed as **coeloblastula**.
- ☞ Gradually, the new cells cut off from the blastomeres and start migrating in the blastocoel from one end of the coeloblastula. Slowly, entire blastocoel is filled with the cells and hollow blastula converts into **solid gastrula**, called **stereogastrula by delamination**.
- ☞ The outer surface of the embryo becomes ciliated forming a **ciliated larva, planula larva.** It is double layered ovoid larva, consisting of outer ciliated ectoderm and inner solid mass of endodermal cells. It **actively swims** in the water and helps in the dispersal of species.
- ☞ After a short period of time, the **larva settles down** and attaches itself to the substratum by one of its ends.
- ☞ The attached end forms a **basal disc** while a **mouth surrounded by tentacles** is formed at the **distal end**.
- ☞ This sessile stage is termed as **hydrula stage** as it resembles a hydra.
- ☞ Gradually, **hydrula undergoes asexual reproduction repeatedly** and converts into an **adult Obelia colony**.

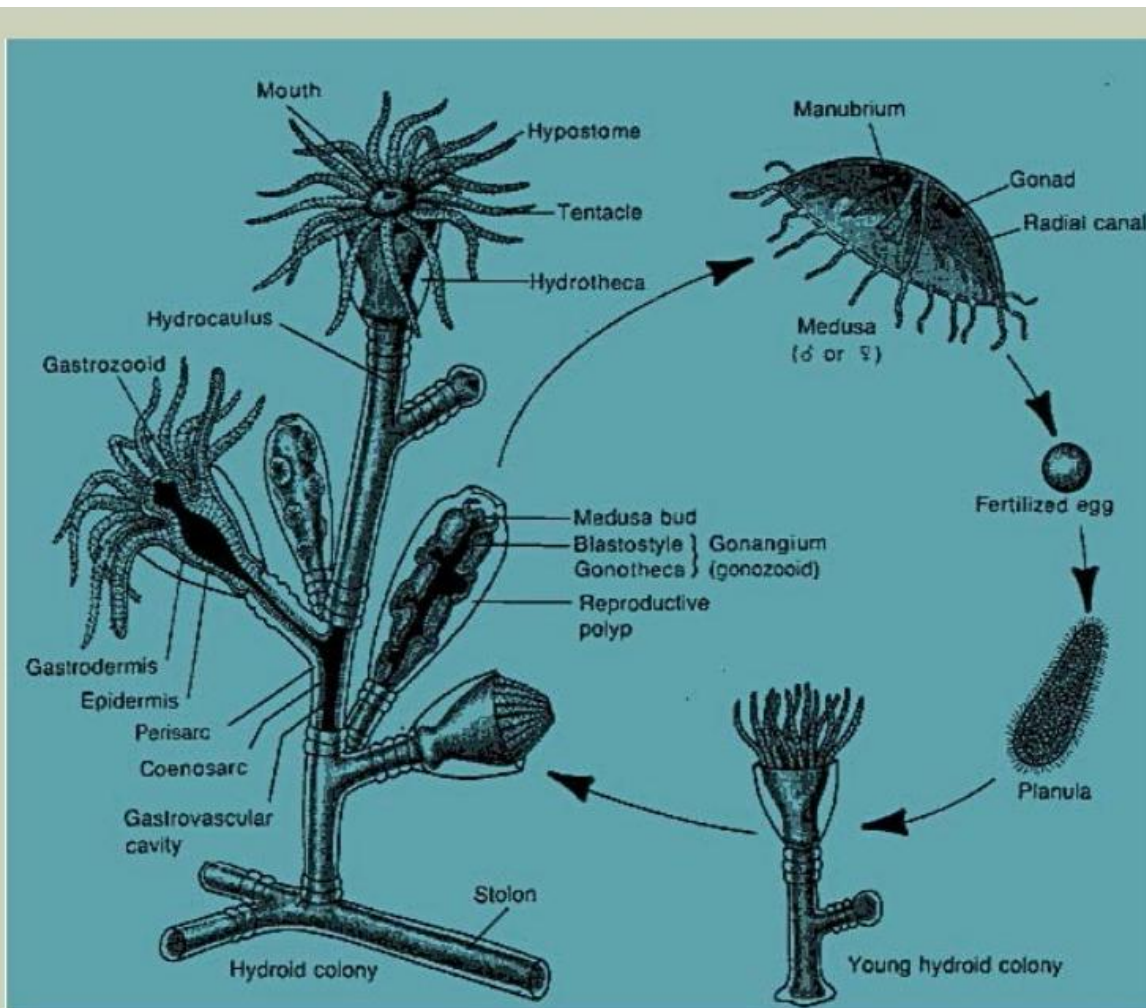


Fig. : Detailed view of the life cycle of *Obelia*

Source: <http://palaeos.com/metazoa/cnidaria/hydrozoa.htm>

METAGENESIS

- ☞ The **life cycle of Obelia** represents a remarkable example of **alternation of generation** where the **asexual and sessile phase of Obelia (polyp)** reproduces asexually by budding and gives rise to **sexual and free-swimming medusa**.
- ☞ The **asexual and free swimming medusa reproduces sexually and forms new polyps**.
- ☞ Thus, a **diploid asexual hydroid phase alternates with another diploid sexual medusoid phase**.
- ☞ This phenomenon of **alternation between two diploid phases** is termed as **metagenesis**.

Fig. : Detailed view of the life cycle of Obelia Source: <http://palaeos.com/metazoa/cnidaria/hydrozoa.htm>

POLYMORPHISM

- ☞ Thus, the **life cycle of Obelia** includes **three distinct types of zooids**;
- ☞ a) **Nutritive polyps – hydranths**
- ☞ b) **Asexual reproductive polyps – blastostyles**

- c) **Sexual reproductive polyps – medusa**
- This phenomenon, where **Obelia** is represented by structurally and functionally different individuals, is called **polymorphism**.
- Initially the colony of **Obelia** is represented by only two forms, **gastrozooids** and **blastozooids** and is called **dimorphic**.
- Later, when **gonophores** develop on the **blastozooids** is formed by the process of budding, the colony is considered **trimorphic** represented by **three kinds of zooids**.

