PROTOCHORDATA (ACRANIATA)

SUBPHYLUM: UROCHORDATA (TUNICATA)

SUBPHYLUM: CEPHALOCHORDATA

SUBPHYLUM: UROCHORDATA (TUNICATA)

These are the only animals known to produce highly **crystalline cellulose.**

The name of **"Tunicata"** is derived from thr unique integumentary tissue called the **tunic**, which contains the cellulose microfibrils.

Sharing characters with the other members of the phylum Chordata;

- a permanent or temporary notochord
- a central nervpous system in the form of dorsal tube.
- a pharynx provided with gill slits
- post anal tail

The notochord is restricted to the tail and found in the larva

Live in all seas from near shoreline to great depths as **solitary** or **colonial** form.

Colonial forms reach up to 2 meters in length whereas solitary forms range from 1 mm to over 2 cm in length.

Most are sessile as adults

Although some are free-living

LARVA OF TUNICATA (SEA SQUIRT)

- They look like frog tadpole.
- The tail of the larva is cuticula structure and has got a notochord, dorsal hollow nerve cord, segmented striated muscle.
- Organs are found in the head and body.

- There are three glands which secrete mucus (adhesive papillae) on the head and the body that provides attachment to somewhere.
- Digestive system is well developed.
- Pharynx large and short esophageal.
- At the bottom of the pharynx, there is an **endostyle** which is homologous with the **thyroid gland in the vertebrate**.
- has got gill slits, stomach, intestine, and anus.
- has got coelom and circulatory systems.
- The heart is completely formed after metamorphosis.

METAMORPHOSIS

They show a **positive phototactic** and **negative geotactic** behavior and attached themselves to a place by the head

1. The tail which has got chordate feature is lost these properties during degenerative metamorphosis.

2. Tail (partially), notochord, dorsal nerve cord (without body ganglion),segmented muscles are absorbed by phagocytose.

3. Torsion occurs Sexual organs and cells consist of a layer of mesoderm between the stomach and the intestine

ADULT TUNICATA

They have got two opening (siphons): **Ingestion (oral-incurrent siphon**) and **egestion (atrial-excurrent siphon**)
The **inhalant siphon** is used to take in food and water, and the **exhalant siphon** expels waste and water.

Cylindrical body

The body attached the base of the water

NERVOUS SYSTEM
The central nervous system is found in the front of the esophagus in the form of a round ganglion.

DIGESTIVE SYSTEM

- They are filter-feeders (plankton feeders)
- Tunicates have a **U-shaped** digestive system, with the anus emptying directly to the outside.
- Food particles captured by the pharyngeal slits, then passed into the remainder of the digestive system (esophagus, stomach, intestine) situated in the **lower cavity called the epicardium**.
- The digestive system ends with an **anus** that opens back into the **atrial cavity**
- **Waste** exits the body through the **exhalent siphon**.

CIRCULATORY SYSTEM

- The heart is located below the esophagus and within the pericardium.
- They have got **an open circulatory system**.
- They have got some large blood vessels but no tiny capillaries.
- The tunicate heart is periodically reverses the direction in which it pumps the blood

RESPIRATION SYSTEM

The branchial sac (branchail basket) is used **for respiration** as well as **for filtration of food particles.**

Gas exchange occurs across the gill slits and also across various other body surfaces, such as the lining of the atrium.

EXCRETORY SYSTEM

- Tunicates to **not have kidney-like organs** and have a less elaborate excretory system.
- They have **two siphons** through which **water enters** and exits the branchial basket.
- Their blood is **isotonic with sea water** and does not spend power on the adjustment of **osmotic pressure**.

REPRODUCTION SYSTEM

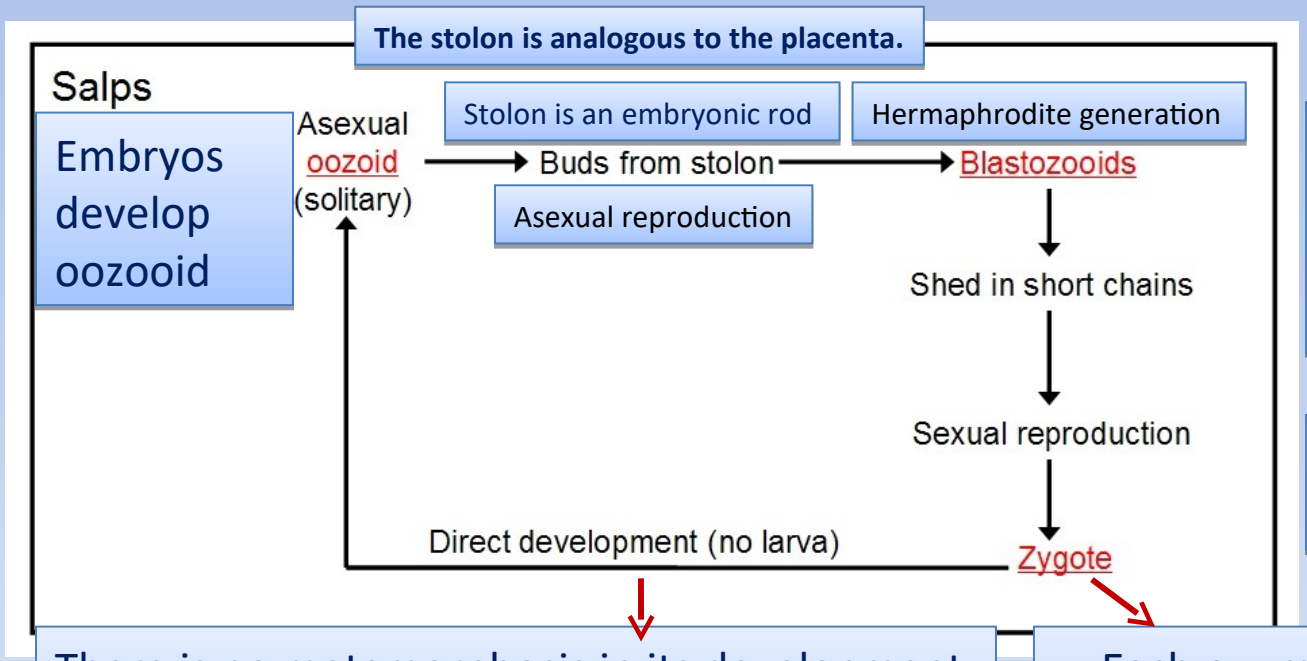
- Tunicates have the ability to perform **asexual** and **sexual reproduction**.
- **Asexual reproduction** only takes place in the **colonial species** and occurs by means of **budding**. The bud is called a **blastozooid** and comes from an **oozooid**, which is a zooid developing from a **fertilized egg** .
- Tunicates are hermaphrodites, however, eggs and sperm can not self-fertilize because they are not mature at the same time.

- Fertilization is **internal of those living in colonial** and **external of those living in solitary**.
- Free-swimming **tunicates** metamorphose without attachment.
- During the budding of Tunicata, various tissues and organs occur with **blastogenesis.**
- **Blastogenesis:** The internal organs are form only ectoderm, only endoderm or only mesenchymal cells.
- **Embryogenesis:** Firstly endoderm, ectoderm and mesoderm are formed. Then certain organs develop from them.

- Different reproductive cycles are seen in *Salpa* and *Doliolum* (Class: Thaliacea) which are living solitarily.

Reproductive Cycle in *Salpa*

- They do not have sex organs and occur as individuals chained with **budding**.



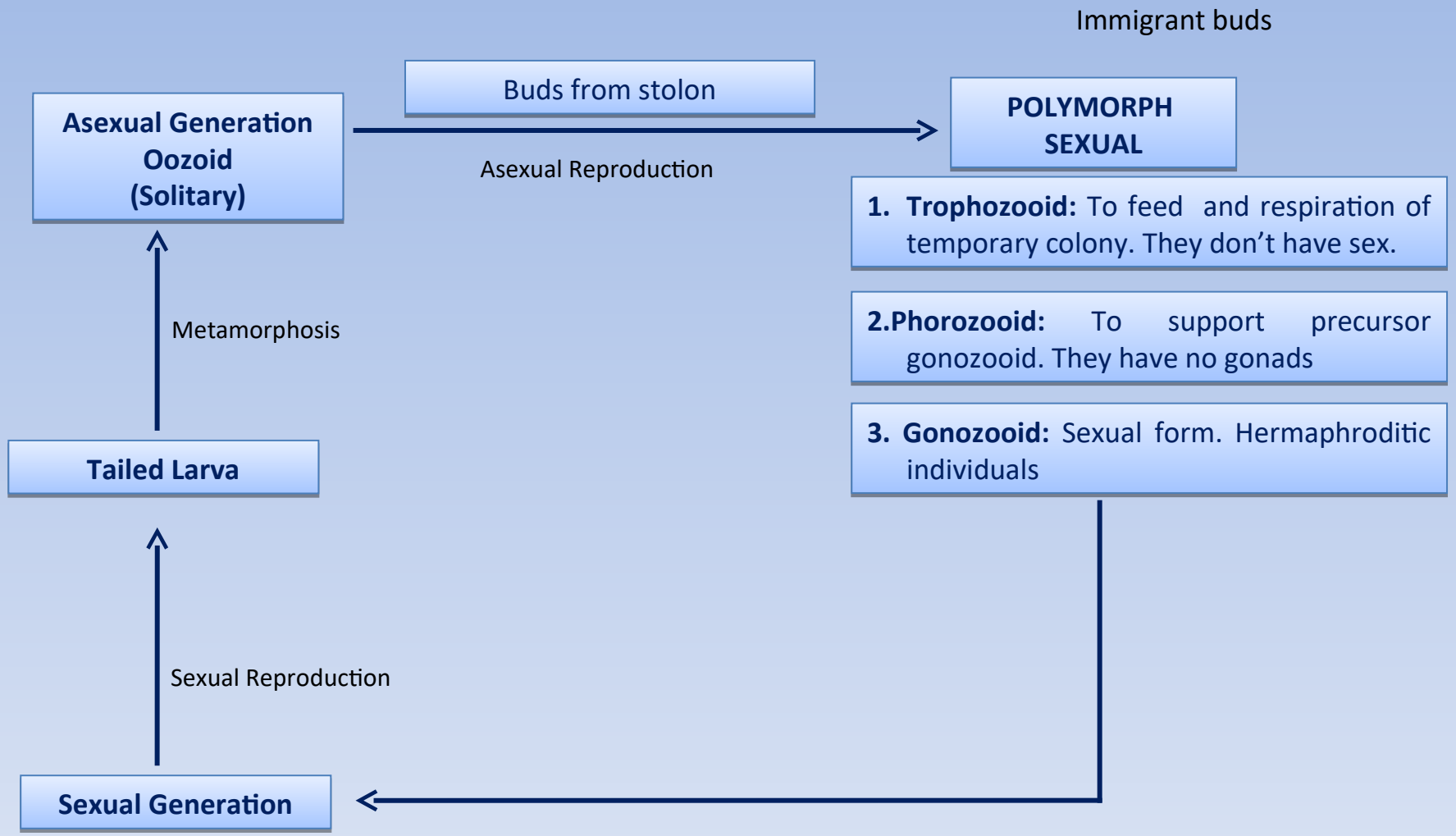
The 50-100 individuals break off the chain and **form Blastozooids** which reproduce sexually.

First the ovary, then the testes develop.

There is no metamorphosis in its development. There is an alternation of generations between sexual and asexual reproduction which is called **metagenesis**

Each ovum consists of an embryo

Reproductive Cycle in *Doliolum*



METAGENESIS + METAMORPHOSIS

IMPORTANCE

- Rarely eaten by humans
- An important link in the food chain.
- Contain some unusual chemicals, and some of these may prove useful as drugs.
- Some tunicates are fouling organisms that grow on ships' hulls.
- Their main interest to humans is in providing clues to the possible ancestry of vertebrates.

CLASSIFICATION

SUBPHYLUM: UROCHORDATA-TUNICATA

CLASS: ASCIDIACEA (SEA SQUIRTS)

- Marine and benthic forms which vary greatly in size and form.
- The individuals are solitary or colonial.
- Adults become usually sessile after metamorphosis of the larval stage
- Colonial ascidians are produced by asexual budding.

CLASS: APPENDICULARIA (LARVACEA)

- The members of the class are minute free-swimming pelagic forms with a highly developed tail.
- The tail is supported by notochord and large striped muscle cells.
- The tunic is not persistent
- The nerve cord is persistent.
- The atrium is lacking.

CLASS: THALIACEA

- The members of this class vary greatly in size. The adult form is devoid of notochord and tail.
- Distinct alternation of generations is present in the life-cycle.
- The tunic is thin and transparent.
- The pharynx is provided with two large or many small stigmata.

SUBPHYLUM: CEPHALOCHORDATA (LANCELET)

- The **notochord** extends from the tip of the nose to the tail and **maintains its presence throughout the entire life.**
- **They are considered as transition groups between primitive chordates and vertebrates.**

- They have not got Cranium (Acrania group)
- They live on the sandy sediments of coastal waters.
- Fins are not well developed. They haven't got paired fins.
- Most of their lives are buried in the sand with the head part outside.

MORPHOLOGY

- A mature *Amphioxus* has a slender, laterally compressed, translucent animals.
- About 3-7 cm in length
- Their skin does not contain pigment, so myotomes are easily seen.
- No head, eyes, noses, ears and jaws.
- Their myotomes are “V” shaped
- Approximately 20 oral tentacules (cirri) found around the mouth against excitations
- Numerous gill slits are opened to the atrium
- Clear tail zone

LOCOMOTION

- There are 50-85 V-shaped myotomes in the body.
- They are separated by myoseptum from each other.
- The contraction of myotomes allows the body to move and bury head in the sand
- Notochord serves as a support to the body and creates a surface area to connect the muscles.
- There are no paired fins that determine swimming direction and stay in balance.
- Metapleural skinfolds serve as the double fins, and also protects the body while being quickly buried in the sand.

DIGESTIVE and EXCRETORY SYSTEM

DIGESTIVE SYSTEM: Food is taken with water.

1. Water enters the mouth, driven by cilia in the buccal cavity and pharynx
2. Then passes through numerous pharyngeal slits.
3. Moved by cilia into the gut. In pharyngeal slits, food is trapped in mucus secreted by the endostyle
4. The smallest food particles are seperated from the mucus and passed into the hepatic cecum. In here they are phagocyctized and digested intracellulary.

EXCRETORY SYSTEM: Filtered water passed first into an atrium, then leaves the body by an atriopore (equivalent to the excurrent siphon of Tunicate)**ç They have got flame cell for excretion.**

CIRCULATORY and RESPIRATORY SYSTEM

CIRCULATORY SYSTEM

Closed circulatory system is complex for so simple a chordata

- Blood is pumped forward in the **ventral aorta** by peristaltic-like contractions of the vessel wall.
- Then blood is collected in veins which return to it to the ventral aorta
- Then passed upward through branchial arteries in the pharyngeal bars to paired dorsal aortas
- In there, blood is distributed to body tissues by **microcirculation**

RESPIRATIORY SYSTEM:

- Erythrocytes and hemoglobin are lacking; so their blood play little role in the respiratory gas transport.
- **There are no gills specialized for respiration; gas exchange occurs over the surface of the body.**
- **There is no heart,** but the flow pattern is remarkably similar to that of fishes.

NERVOUS SYSTEM and SENSE ORGANS

- Centered around a hallow nerve cord lying above the notochord
- Pairs of spinal nerve roots emerge at each muscle segment
- Sense organs are simple, including an anterior, unpaired ocellus.
- Ocellus act as a photoreceptor
- The anterior end of the nerve cord is not enlarged into the characteristic vertebrate brain.

REPRODUCTIVE SYSTEM

- Sexes are separate.
- There are about 25 pairs of sac-like gonads as reproductive organ.
- Gamets are released in the atrium
- Pass through the atriopore to the outside where fertilization occurs (External Fertilization)

PRIMITIVE FEATURES OF *AMPHIOXUS* (BRANCHIASTOMA)

- Trapped foods with cilia and attached with endostyle
- Epidermis consists of a layer of cells
- Segmented myotomes throughout the body with “V” shaped
- The brain has not developed.
- There is no head.
- Paired fins and developed sensory organs are lack.
- There is no heart
- Sex organs are segmental and do not have channels
- Digestive system is simple
- Ocellus is found as photoreceptor

DEVELOPED FEATURES OF *AMPHIOXUS* (BRANCHIASTOMA)

- There is an **atrium**
- Gill slits (pharngeal slit) cover a very large part of the body
- Embryonic development is completed in a very short time
- **Notokord** is taken part throughout the whole body
- Respiration is done with the front part of the digestive system
- **Hallow nerve cord** on notochord
- **Closed circulatory system**

IMPORTANCE

- Their significance has to do with their place in evolution, as invertebrates transitional to vertebrates providing clues for the history of human lineage.
- **SO,** Amphioxus-Cephalochordata have a structure that illustrates the characteristic features of chordates in simple form.

CLASSIFICATION

SUBPHYLUM: CEPHALOCHORDATA

CLASS: LEPTOCARDIA

Genus: *Amphioxus-Branchiostoma*

Gonads lie on each side of the body. They inhabit the tropical and sub-tropical seas.

Genus: *Asymmetron*

Gonads lie only on the right side. They inhabit the tropical seas.

FOSSILS: The oldest known Cephalochordates is **Pikaia**, recorded from the **Burges Shales of Canada, about the middle Cambrian period**.

The anatomical characteristic features are more or less same as Branchiostoma except a pair of sensory tentacles that are found at the end of the body.