

**SEGMENTAL ORGANS IN
ANNELIDA (COELOMODUCTS
AND NEPHRIDIA)**

- In annelids are found certain tubes called **segmental organs**, as they are repeated in successive segments. •
- These tubes serve to convey the excretory and reproductive products from coelom to the exterior.
- Segmental organs are primarily divided into two types :
 - (1) **coelomoducts** derived from mesoderm, and
 - (2) **nephridia** derived from ectoderm.

[1] Coelomoducts

- Coelomoducts are normally wide tubes of mesodermal origin, developed as evaginations from coelom to the exterior.
- Typically, a coelomoduct opens, to the exterior by a **genital pore** and into coelom by a relatively large ciliated funnel, the **coelomostome**.
- It is easily distinguished from the small ciliated funnel or **nephrostome** of the nephridium.

- Coelomoducts primarily function as **gonoducts** and are confined to only a few reproductive segments.
- In the Oligochaeta (earthworms), the reproductive funnels and ducts, both male and female, are coelomoducts.
- However, in some forms, the coelomoducts may secondarily function as excretory organs.
- The uriniferous tubules of vertebrate kidney are coelomoducts.


[2] Nephridia

- Nephridia are also segmentally arranged coiled tubes of ectodermal origin developed as invaginations from ectoderm into coelom.
- They communicate with the exterior through laterally placed small apertures called nephridiopores.
- Internally, they may end blindly (protonephridia) or may open by small ciliated funnels, or nephrostomes, into coelom (metanephridia).



- Nephrostomes may open into coelom of the same segment in which the nephridia lie, or of the segment just in front.
- Nephridia are primarily excretory in function but may secondarily serve to convey the genital products to the exterior.
- Polychaete excretory organs are either protonephridia or metanephridia.

1. Protonephridia.

- The 'closed' or protonephridium seems to be more of the primitive type.
- It terminates in the coelom as a blind tube. 
- Protonephridia, made of a few syncytial cells with an intracellular blind ending tubule, always develop in the larval polychaetes, irrespective of the kind of adult nephridia.
- The closed end or other parts of the tube are provided with peculiar specialized excretory tube cells or solenocytes.

- These are similar to the flame cells of Platyhelminthes and Rotifera.
- Solenocytes may occur singly or in groups.
- A solenocyte is a rather to the rounded ciliated cell connected to the protonephridium by a thin tube, the lumen of which encloses a long, vibratile flagellum.
- Excretory fluid enters through the walls of nephridial tubules which are internally ciliated.
- This fluid is driven into the lumen of nephridium by flagellum and forced to the exterior through nephridiopore.
- Protonephridia are found in some adult polychaetes such as *Vanadis*, *Phyllodoce*, *Tomopteris*, *Glycera*, *Nephtys*, etc.

2. Metanephridia.

- The 'opened' or metanephridia are far advanced and found in the majority of polychaetes (Meanthes), all the oligochaetes (Lumbricus) and leeches.
- Instead of solenocytes, the inner end of metanephridium opens into the coelom by a ciliated funnel or nephrostome.
- The other end opens to the exterior through the nephridiopore.

- A metanephridium is thus open at both ends.
- A typical metanephridium occurs in *Nereis*, those of other polychaetes differ only in minor details.
- Archannelida usually possess one pair of nephridia which may be protonephridia (*Dinophilus*) or metanephridia (*Polygordius*, *Protodrilus*).
- Principal nitrogenous waste in polychaetes is ammonia.
- Excretory wastes diffuse from coelomic fluid or blood into the lumen of nephridial tubule and discharged to outside through nephridiopore.

(a) Micro and Meganephridia

- Nephridia may be micronephridia or meganephridia on the basis of their size and number.
- Micronephridia or meronephridia are smaller in size, sometimes microscopic, and are numerous in each segment.
- They are networks of fine tubes lying on the body wall and septa in each segment.
- All the nephridia of Pheretima are micronephridia.

- Meganephridia or holonephridia are larger in one pair per segment.
- They usually extend over two segments and their nephrostomes open into the segments next in front. They are represented in Polychaeta and Hirudinea.
- In Neanthes, Neris and Hirudo, they are typical metanephridia with internal ciliated funnels.
- But in Hirudinaria a ciliated funnel or nephrostome is lacking due to its modification into ciliated organ.
- The two kind of nephridia may exist in the same worm and even in the same segment, as in Megasclex.
- In Serpula and some other tubicolous worms, a division of labour exists.
- Nephridia in the anterior region of body are large and excretory in function, while those in the posterior region are small and serve as gonoducts.

(b) Exo and enteronephridia.

- Nephridia are termed **exonephric** or **ectonephric** when they directly open to the exterior through nephridiopores, such as the meganephridia of Nereis, Hirudinaria and Lumbricus, and integumentary micronephridia of Pheretima.
- They termed **enteronephric** when they lack nephridiopores and open into the excretory canals or alimentary canal, as septal and pharyngeal nephridia of Pheretima.

(III) NEPHROMIXIA

- In oligochaeta, Hirudinea and the more primitive Polychaeta, nephridia and coelomoducts are separate.
- In some Polychaeta, coelomoducts do not remain independent but become fused, partially or wholly with the nephridia forming compound segmental organs or nephromixia.
- They consist both ectoderm and mesoderm and used both as genital as excretory duct.
- Nephridia and the coelomoductus show various degrees of combination.
- Either they share only the same external opening, or their fusion may be more intimate so that they share most of the same duct.

1. Protonephromixium.

- Coelomoduct is united with a protonephridium.
- It conveys both reproductive and excretory products to the exterior.
- Protonephromixia occur in Phyllodoce.

2. Metanephromixium.

- Coelomoduct is grafted on to a metanephridium.
- A good example is seen in Hesione.

3. Mixonephridium.

- Coelomoduct and nephridium are intimately fused to form a simple composite organ.
- Its funnel is formed by coelomoduct and its duct by nephridium.
- Mixo-nephridia occur in *Arenicola* where they are restricted to the 6 segments of the second terna of the divided body.
- Each organ has a frilly funnel as an internal opening, a rich supply of blood vessels, and the gonad tissue in close proximity.

4. Ciliated organs.

- In Some forms, Coelomoducts are reduced to ciliated organs.
- In *Nereis* they are attached to the dorso-lateral longitudinal muscles and are known to open externally.
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