# EVOLUTION OF COELOM

SEM – II, CC-III

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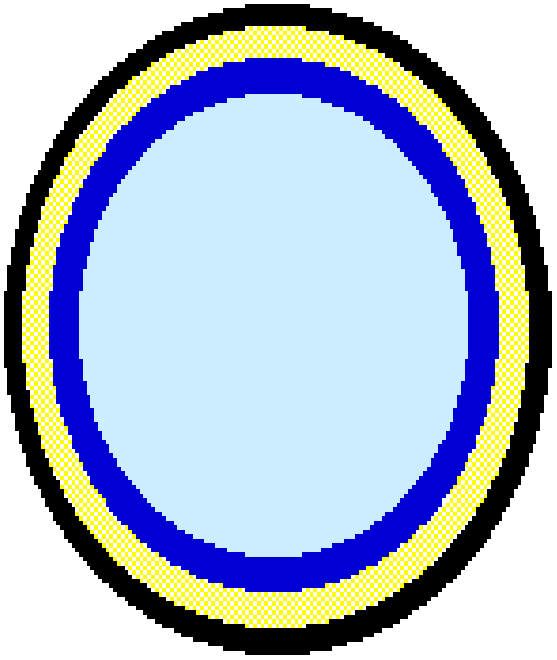
# EVOLUTION OF COELOM

A coelom or true body cavity generally refers to a large fluid filled space lying between the outer body wall and the inner digestive tube.

It arises as a secondary of cavity between two layers of embryonic mesoderm and contains most of the visceral organs.

- In the cnidarians, the space between the ectoderm and endoderm tissue layers is filled with an acellular mesoglea. In the platyhelminthese (flatworms) mesderm fills the space between ectoderm and the endoderm:
- The advantage of the flatworm body plan, is the superior pull muscles can make using solid mesoderm as a leyer, versus gel-like mesoglea.



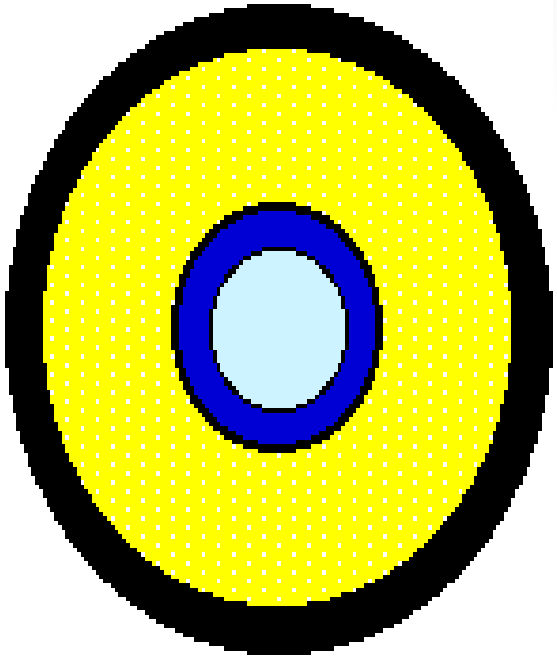
Cnidarian Body Plan

ectoderm

mesoglea

endoderm

gut cavity



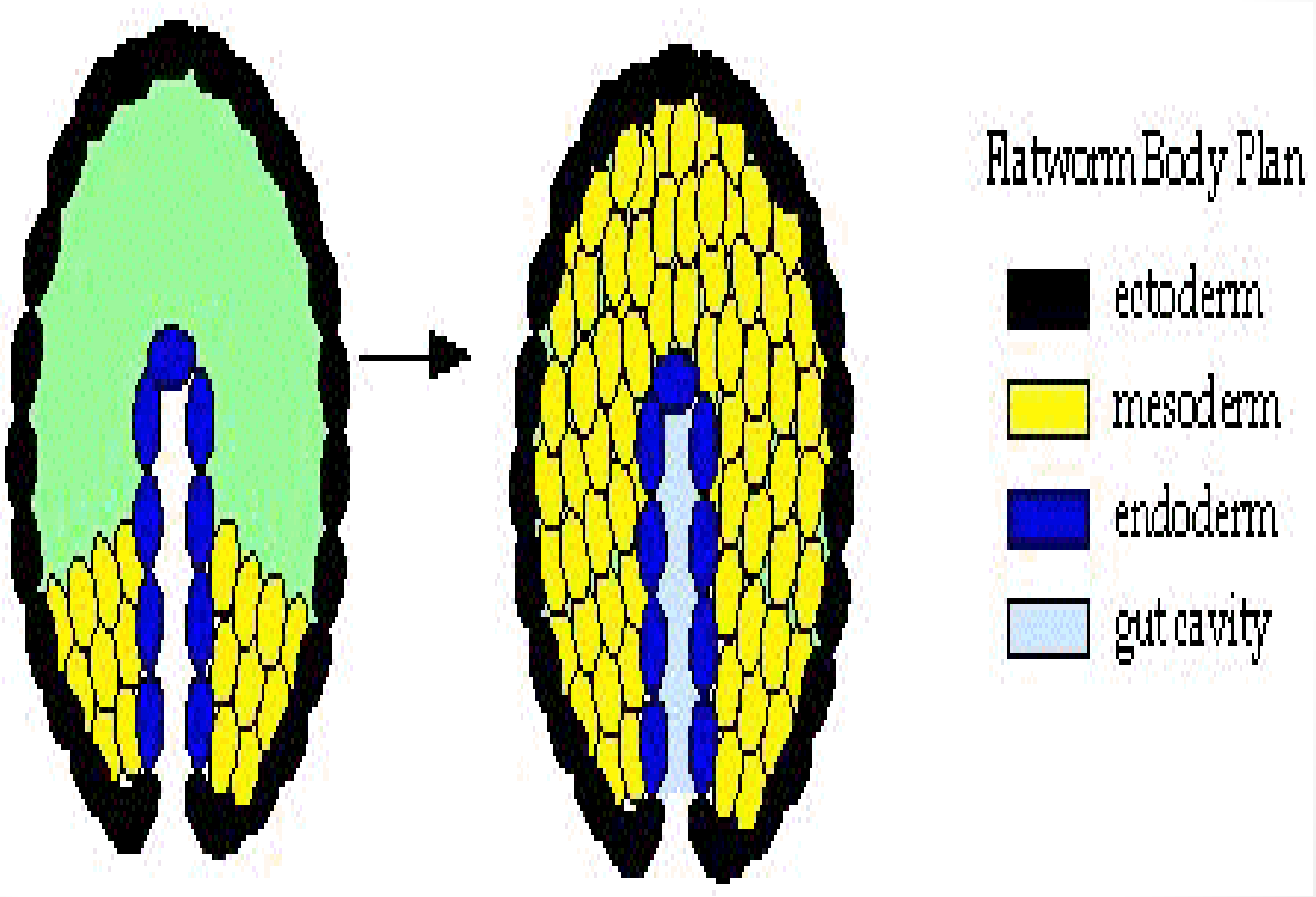
Flatworm Body Plan

ectoderm

mesoderm

endoderm

gut cavity

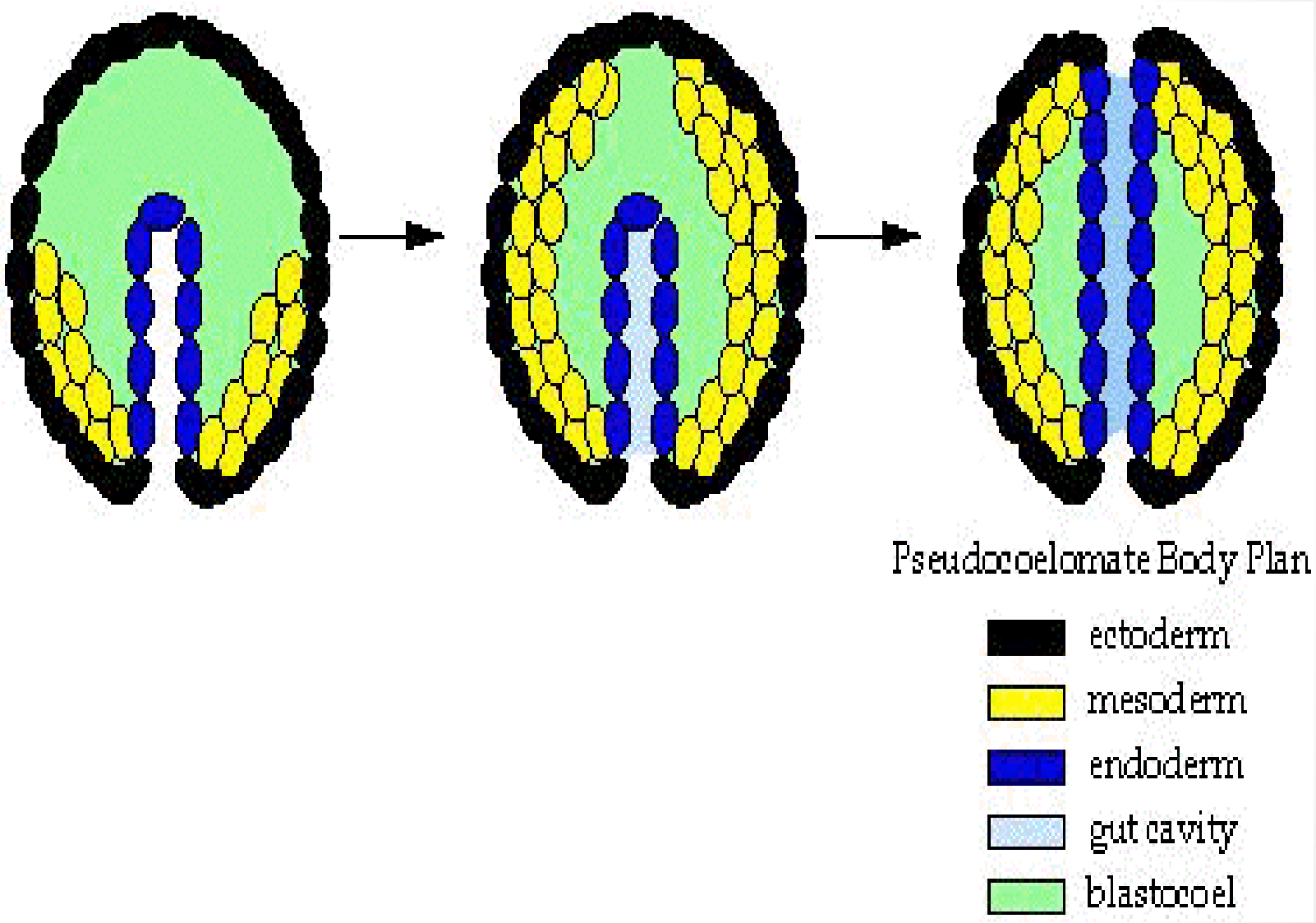

Flatworm Body Plan
ectoderm
mesoderm
endoderm
gut cavity

- Problems:
- 1. Body organs cannot move freely but are embedded in solid mesoderm tissue.
- 2. It is more difficult for materials to move from the gut to the body wall.
- A solution to both problems is to have some sort of body cavity, called a **coelom**, in which the body organs lie bathed in body fluid. Movement of the body wall would not squeeze the organs, organs could grow without being pressed by the body wall, and diffusion of nutrients and wastes would be easier.

- Two types of Body Cavities:
  Pseudocoelom
  True Coelom

- **Pseudocoelom**
- The pseudocoelm is a blastocoel (the space in the blastula) that is retained to adulthood.
- In addition to having a body cavity, organisms with pseudocoeloms also have a complete digestive tract -- separate openings for food to enter and undigested material to leave. This makes digestion and feeding more efficient because the animal can eat before it has finished digesting its previous meal.

  Organisms that have pseudocoeloms are not a monophyletic group (in other words, the pseudocoelom is a homoplasious character that occured more than once).
- Psuedocoelomates contain a variety of small oganisms, including
- Nematodes (roundworms):
  Gastrotrichs
  Rotifers
  and, Kinorhynchs

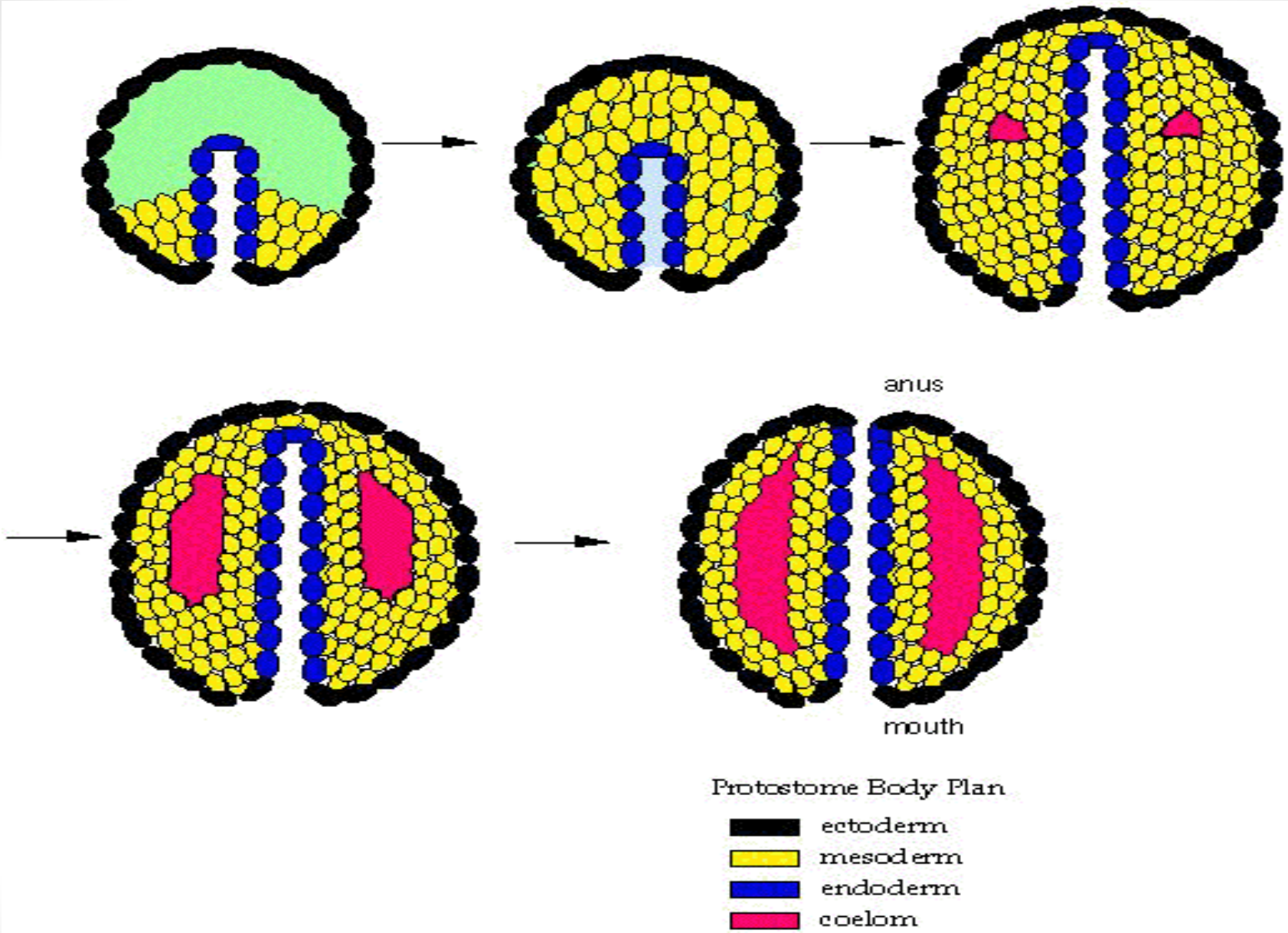

Pseudocoelomate Body Plan
ectoderm
mesoderm
endoderm
gut cavity
blastocoel

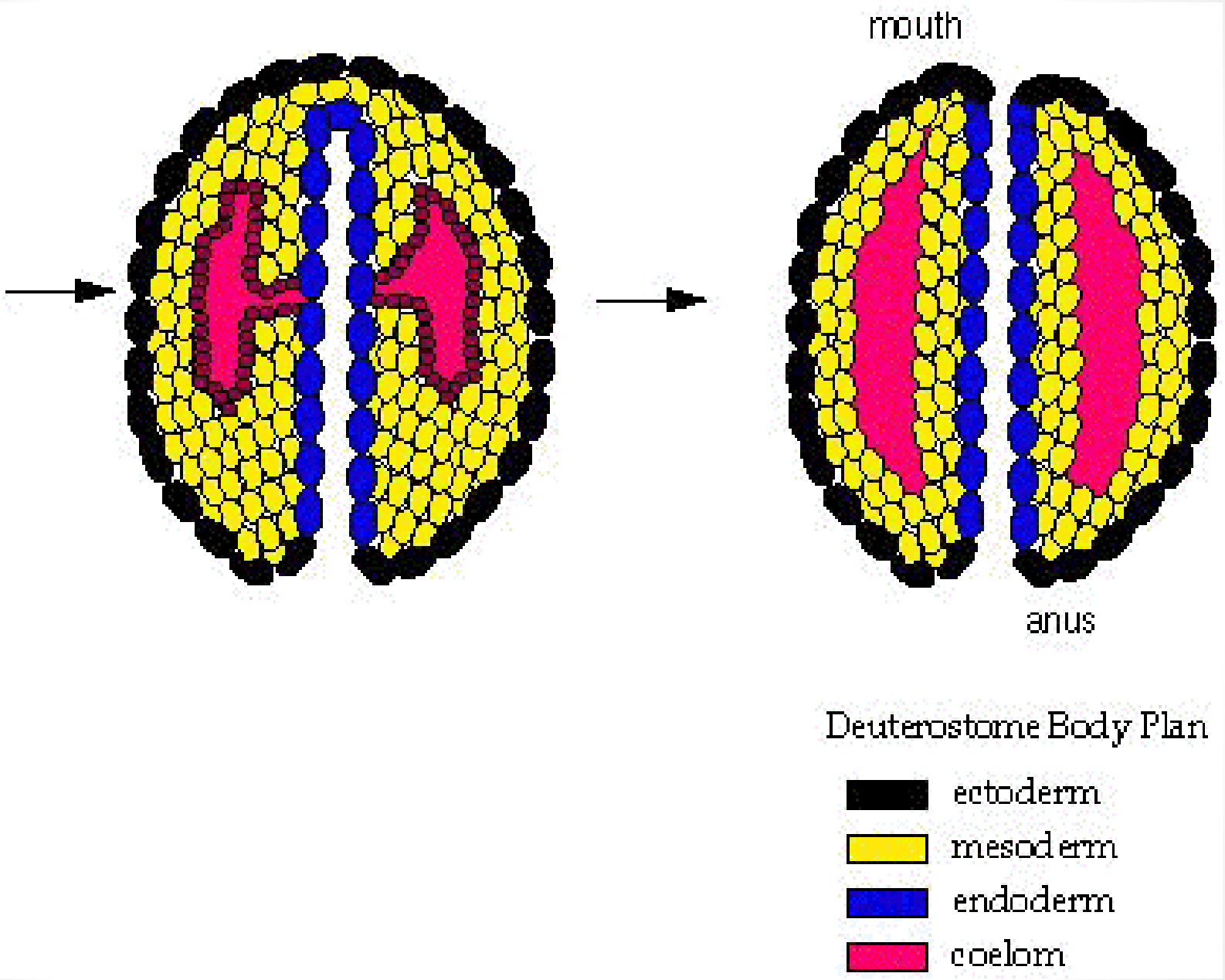
- Two kind of True Coeloms
  1. Schizocoelom
  2. Enterocoelom

- **True Coelom**

A true coelom is lined on all sides by mesoderm which gives rise to muscles that surround the gut as well as underlying the body wall. This allows more efficient digestion because food can be pushed through the digestive tract by muscles.

Schizocoeloms are found in animals known as PROTOSTOMATES
Enterocoeloms are found in animals known as DEUTEROSTOMATES
Schizocoelom:


anus
mouth
Protostome Body Plan
ectoderm
mesoderm
endoderm
coelom


mouth
anus
Deuterostome Body Plan
ectoderm
mesoderm
endoderm
coelom

- **Why is the evolution of the coelom significant?**
- a. more food could be stored within it.
  b. more wastes would be stored before excretion.
  c. it enabled development of more complex organ systems.
  d. eliminated the need for a circulatory organ.
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- **Evolutionary considerations**
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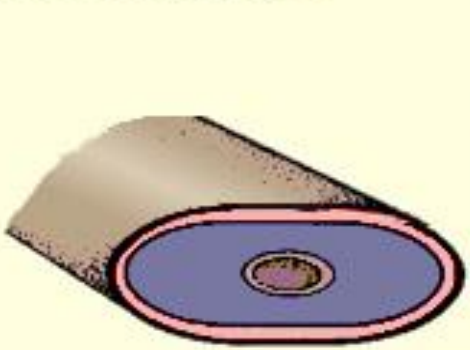
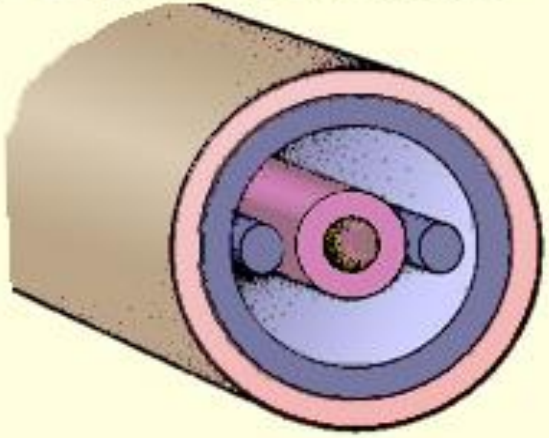
- The coelom was an effective way of solving some of the problems of increased body size. Small organisms did not need special organs for overcoming the distance involved in moving all sorts of things used and produced by specialized organs. Diffusion through fluids and tissues could take care of the problem. But as size increased, direct diffusion was inadequate for moving things more than a few cells distance. So to get adequate oxygen to tissues, some became flatter as they grew.

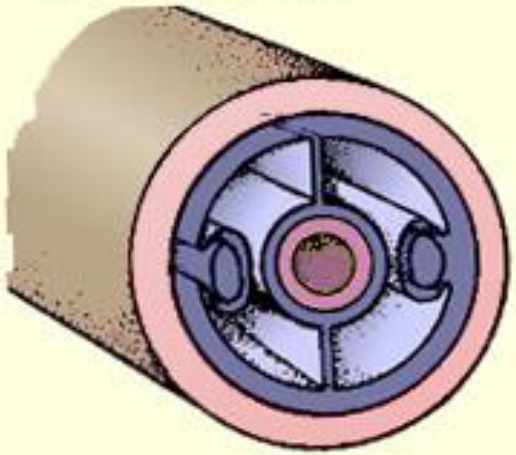
Acoelomate

Pseudocoelomate

Coelomate







body wall

ectoderm

mesoderm

endoderm

cavity

- Others (acoelomates) filled underlying spaces with jelly-like material that was nearly inert metabolically. Others (pseudocoelomates) could get larger and have organs in the pseudocoel with enough fluid filling it to give them some escape from distortions with movement. Also the fluid could move around and serve some of the transport role of a circulatory system.
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- Still other acoelomates had branches of the digestive system reaching to all regions of the body so movements of fluid in the gut could perform some of the vascular functions. Hence, that type of development of the digestive system was called a gastro-vascular type of body cavity.
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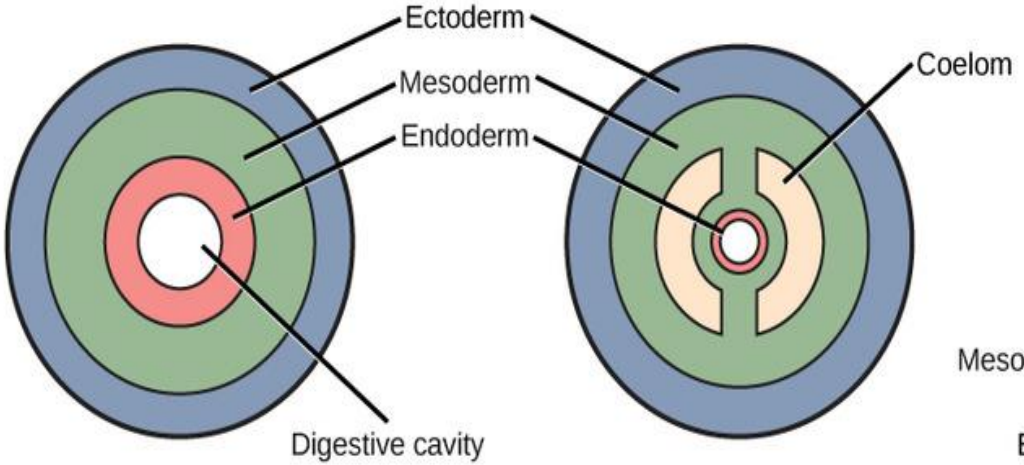
Flatworm: *Pseudobiceros bedfordi*

Annelid: *Glycera*

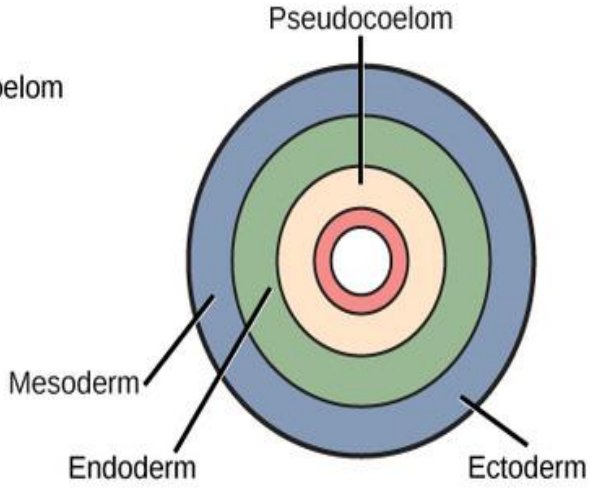
Nematode: *Heterodera glycines*




(a) **Acoelomate** (flatworms)




(b) **Eucoelomate** (annelids, mollusks, arthropods, echinoderms, chordates)




(c) **Pseudocoelomate** (roundworms)

- So coelom development was important when accompanying blood vascular system, respiratory, excretory, and endoskeletons needed for greatly increased size.  Of course there were other developments of importance.  One was the skin was no longer a single layer of cells or other simple covering; in the skin of vertebrates the epidermal layer is now serviced and supported by a dermal layer supplied with blood vessels and nerves.
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## Views Regarding the Coelom Formation:

Regarding the origin of coelom there are four basic theories which have been discussed in details by Clark (1964).

- **1. Enterocoel theory— First proposed by Lankester in 1877, supported by Lang (1881), Sedgwick (1884):**
- This theory states that the coelom may have originated by evagination as pouch-like structures in the wall of embryonic archenteron. This type of coelom formation occurs in many existing enterocoelous animals.
- This concept was proposed by Lankester in 1877. Sedgwick (1884) suggested that the gastric pouches of anthozoans (Cnidaria) became separated from the main gastric cavity (gastrovascular cavity) and were transformed into coelomic pouches.

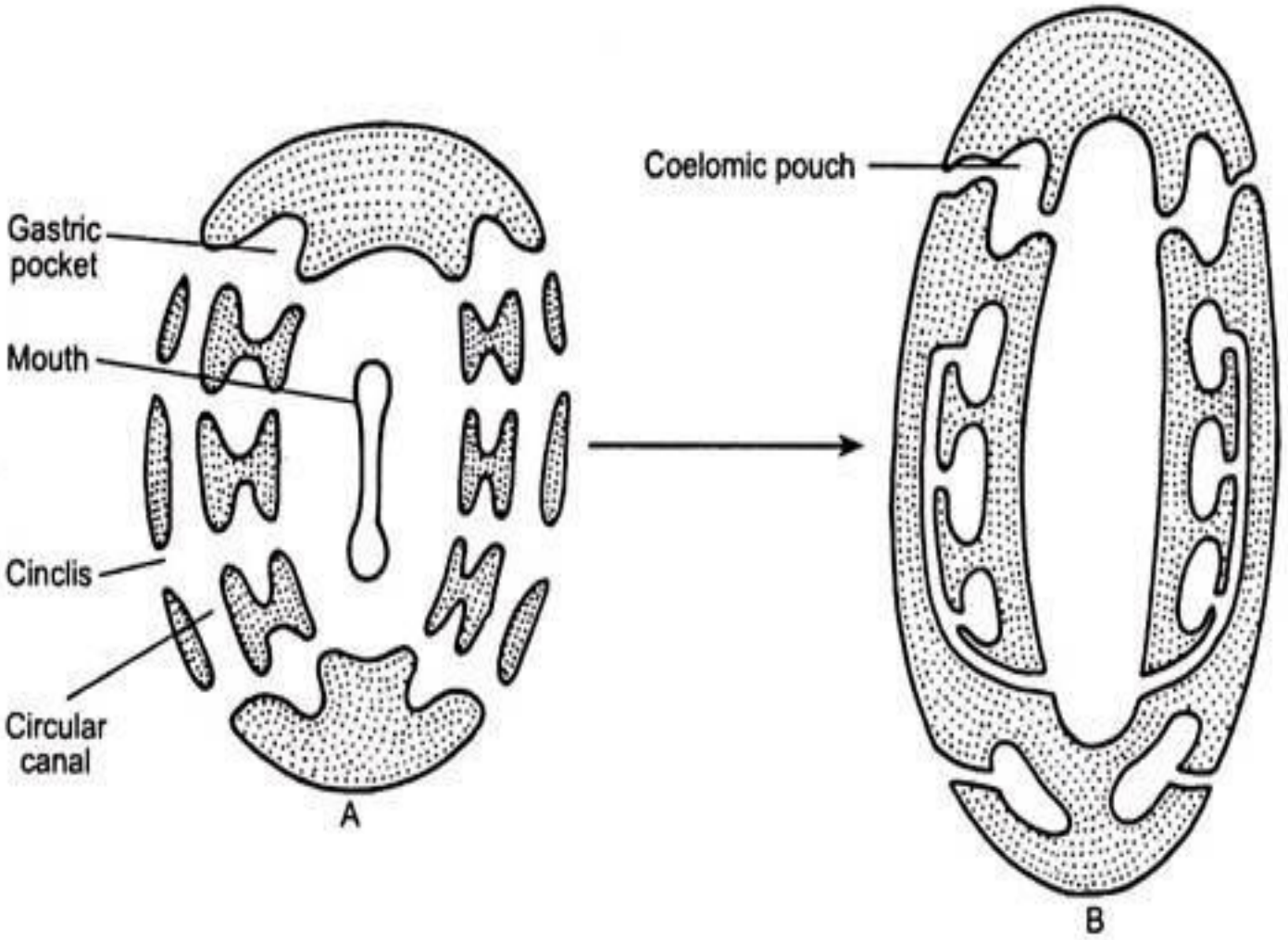


**Fig. 17.52:** Digrams showing the enterocoel theory of coelom formation. A. Diagramillustrating the gastric pockets of an anthozoan animal. B. Fig. shows the coelomic pouches after transformation of the gastric pockets of anthozoans.

- **2. Gonocoel theory (HatSchek, 1877, 1878), Bergh (1885), Meyer (1890), Goodrich (1946):**
- The origin of coelom in favour of gonocoel theory is that first coelomic cavities arose from the mesodermally derived expanded gonadal cavities and the cavities persisted after the release of gametes. For example, the gonads of tricladid flatworms are arranged in a linear order and the segmental coelom of annelida may have developed from this tricladid.

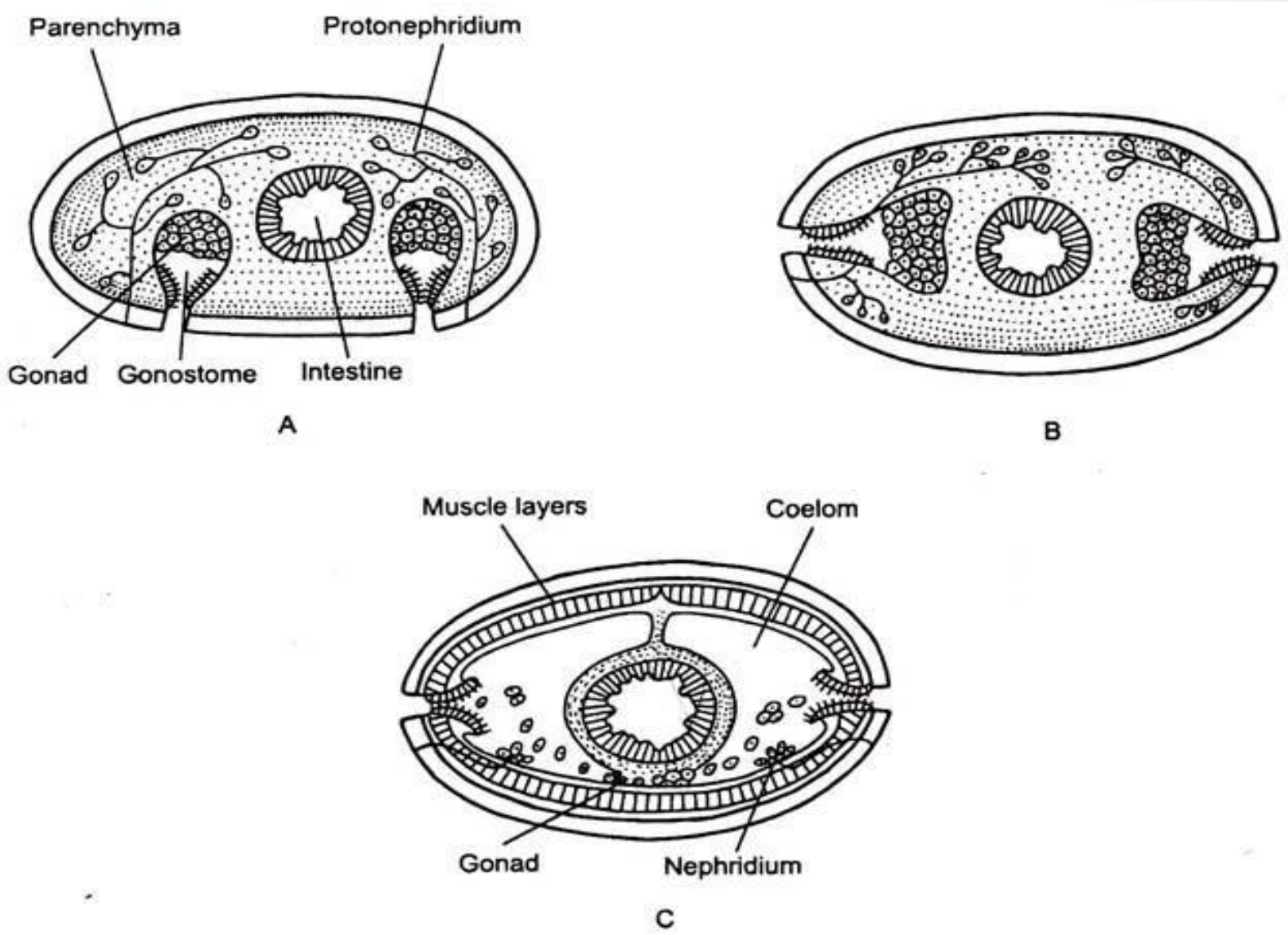


**Fig. 17.53:** Diagrams showing the gonocoel theory of coelom formation.

- **3. Nephrocoel theory (Lankester, 1874, Snodgrass, 1938):**
- The theory states that the coelom originated from the expanded nephridia of flatworms. The chief objection of this theory is that the protonephridia have not recorded in all coelomates, even the echinoderms do not have excretory organs.
- **4. Schizocoel theory (Clark, 1964):**
- The theory states that the coelom could have evolved by the splitting of mesodermal plates.