

EVOLUTION OF COELOM

Introduction: The coelom is the main body cavity in most animals, positioned inside the body and surrounded by mesoderm on all its surfaces.

Development: During the development of the embryo, coelom formation begins in the gastrulation stage. The developing digestive tube of an embryo forms as a blind pouch called the archenteron.

- A. **Schizocoely:** In Protostomes, the coelom forms by a process known as schizocoely. The archenteron initially forms, and the mesoderm splits into two layers: the first attaches to the body wall or ectoderm, forming the parietal layer and the second surrounds the endoderm or alimentary canal forming the visceral layer. The space between the parietal layer and the visceral layer is known as the coelom or body cavity.
- B. **Enterocoely:** In Deuterostomes, the coelom forms by enterocoely. The archenteron wall produces buds of mesoderm, and these mesodermal diverticula hollow to become the coelomic cavities. Deuterostomes are therefore known as enterocoelomates. Examples of deuterostome coelomates belong to three major clades: chordates (vertebrates, tunicates, and lancelets), echinoderms (starfish, sea urchins, sea cucumbers), and hemichordates (acorn worms and graptolites).

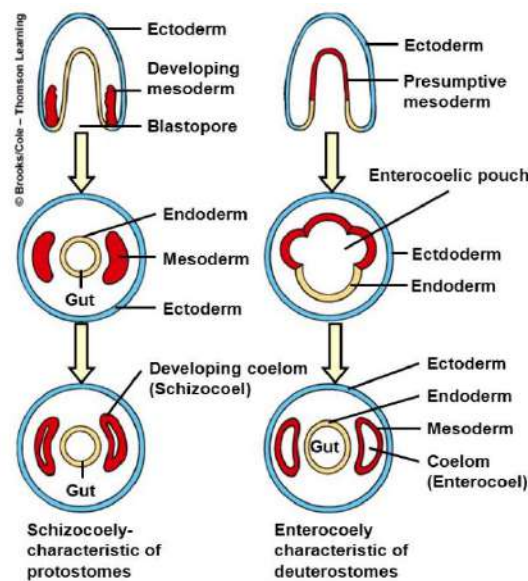


Table 5.3 : Differences between Protostomia and Deuterostomia

Characters	Protostomia	Deuterostomia
Blastopore gives rise to	Mouth	Anus
Formation of coelom	Schizocoel	Enterocoel
Cleavage type	Spiral determinate	Radial indeterminate
Larval type	Trochophore larva	Pluteus larva
Mesoderm formation	From 4d cells	From other cells

Origin and Evolution of Coelom: The evolutionary origin of the coelom is uncertain. Initially two theories were proposed :

- A. **The acoelomate theory:** which states that coelom evolved from an acoelomate ancestor.

B. **The enterocoel theory:** which states that coelom evolved from gastric pouches of cnidarian ancestors.

This is supported by research on flatworms and small worms recently discovered in marine fauna.

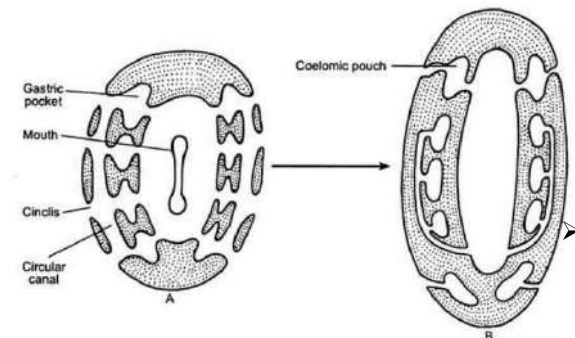
Later, Clark (1964) discussed four different theories to regarding origin and evolution of Coelom.

A. Enterocoel theory— First proposed by Lankester in 1877, supported by Lang (1881), Sedgwick (1884)

B. Gonocoel theory - (Hatschek, 1877, 1878), Bergh (1885), Meyer (1890), Goodrich (1946)

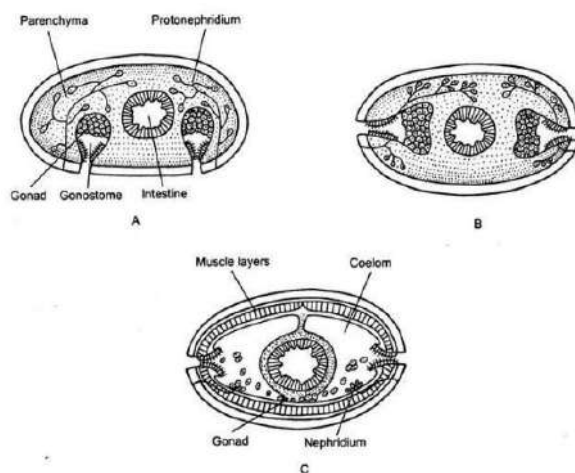
C. Nephrocoel theory - (Lankester, 1874, Snodgrass, 1938)

D. Schizocoel theory - (Clark, 1964)



A. Enterocoel theory: This theory argues that the coelom evolved from the gastric pouches of some cnidarians ancestors such as anthozoans or scyphozoans. These gastric pouches separated out from the main gastric cavity to form the coelomic pouches.

This theory proposes that all bilateral animals are basically coelomate and that acoelomate forms like flatworms are secondarily derived from coelomate ancestors by the loss of the cavity. The enterocoelous mode of coelom formation in the embryogeny of echinoderms, hemichordates and chordates is the main supporting evidence of this theory.



B. Gonocoel theory: It regards the coelom as the cavity of an expanded gonad and its origin is based on the common association between the gonads and the coelomic epithelium. Bergh believed that coelom initially arose in a segmented condition by enlargement and cavitation of the gonads after the release of gametes. One of the main drawbacks of this theory is that it closely links the origin of coelom with the origin of metameric segmentation and hence it is difficult to account for the unsegmented coelomates. There is no evidence that the unsegmented coelomates have

originated from the segmented ancestors. This theory has no embryological support because gonads do not arise before the coelom.

C. Nephrocoel theory: Proposed by Lankester in 1874. The coelom originated as an expanded nephridia. This theory however, was never taken seriously because protonephridia has been described in coelomates and also excretory organs are absent in some coelomates like echinoderms.

D. Schizocoel theory: According to this theory, the coelomates evolved from an ancestral acoelomate like flatworms by hollowing out of the parenchymal cells of the mesenchyme. Some of these cells formed the peritoneum. According to this theory, the acoelomate body plan is primary and ancestral to the coelomate plan.

- The acoelomate flatworms, thus, form the basic group in the evolution of bilateral animals. The schizocoel mode of coelom formation in the embryonic development of annelids and molluscs would

claim as supporting evidence of this theory. However, the evolution of coelom is not related to gonads or endodermal pouches of lower forms.

Functions of Coelom

- i. A coelom can absorb shock or provide a hydrostatic skeleton.
- ii. It can also support an immune system in the form of coelomocytes that may either be attached to the wall of the coelom or may float about in it freely.
- iii. The coelom allows muscles to grow independently of the body wall — this feature can be seen in the digestive tract of tardigrades (water bears) which is suspended within the body in the mesentery derived from a mesoderm-lined coelom.

Coelomic fluid

Definition: The fluid inside the coelom is known as coelomic fluid. This is circulated by mesothelial cilia or by contraction of muscles in the body wall which are themselves of mesin.

Significance: The coelomic fluid serves several functions: it acts as a hydroskeleton

- i. it allows free movement and growth of internal organs
- ii. it serves for transport of gases, nutrients and waste products around the body
- iii. it allows storage of sperm and eggs during maturation; and it acts as a reservoir for waste.