BIO 221
Invertebrate Zoology I
Spring 2010

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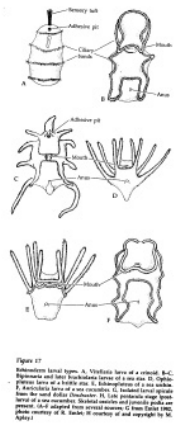
http://www4.nau.edu/isopod

Lecture 18

Larval Development

1. Often presented as a progression of stages
   a. Representative stages exist in various groups.
   b. Need not represent the actual progression.



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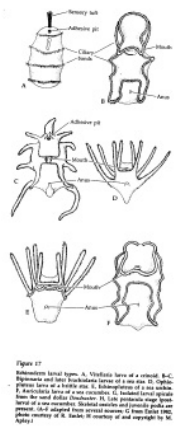
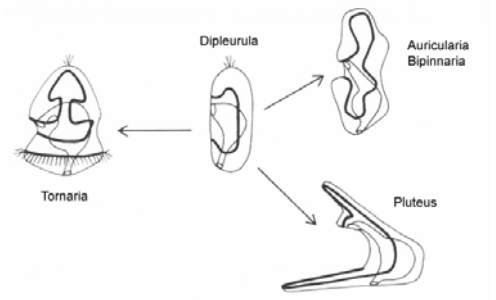


Dipleurula

1. hypothetical ancestral larval type thought to have given rise to echinoderms.



Dipleurula

2. Characteristics

a. Mouth, anus, band of cilia.

b. Bilateral symmetry

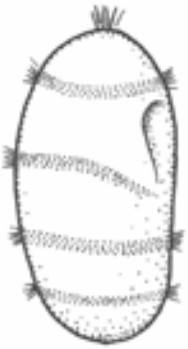
3. Resembles somewhat the "vitellaria" (doliolaria) larva of crinoids.

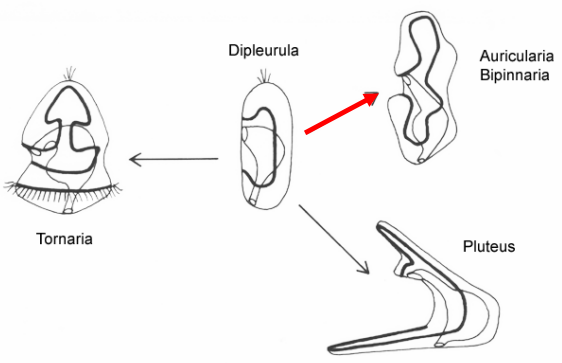
Dipleurula

Doliolaria

A barrel-shaped stage with a series of 4 or 5 circumferential bands.

Usually nonfeeding (lecitotrophic).



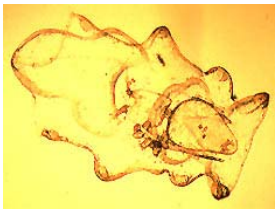


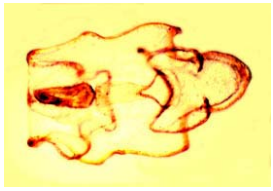
Auricularia

1. Larval form of sea cucumbers.

2. Ciliary band becomes convoluted as the larva grows.

As the larvae swim, food particles are directed towards the mouth.

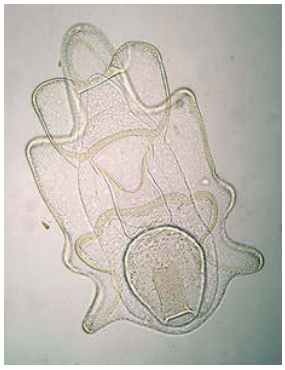




Bipinnaria

1. Ciliary bands separate, elongate to further define arms.

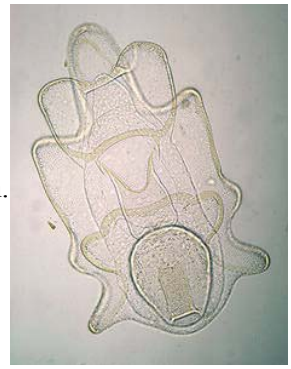
a. Often more "arms" than expected from pentaradial symmetry.



Bipinnaria

2. Larva is usually *planktotrophic* - feeds by ciliary action which beats plankton to mouth.

3. Cilia are also locomotory.



Brachiolaria

1. Three small projections form at anterior end.

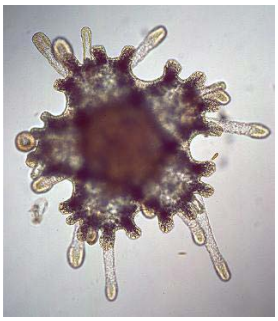
a. Usually allows larva to settle and begin metamorphosis.

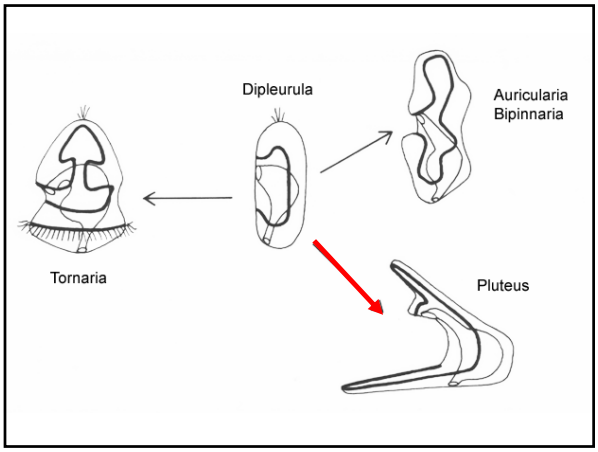
Brachiolaria

2. *Adult rudiment* often forms within larval shell.

a. Eventually emerges to release postlarva.

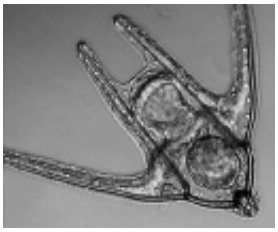
b. Postlarvae have names particular to classes.





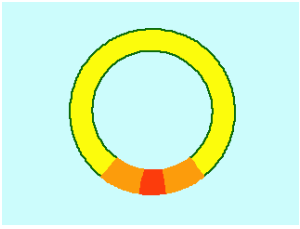
Pluteus

1. Larva of ophiuroids and echinoids with long extensions of arms.
2. Often remain in plankton for long periods (planktotrophic).



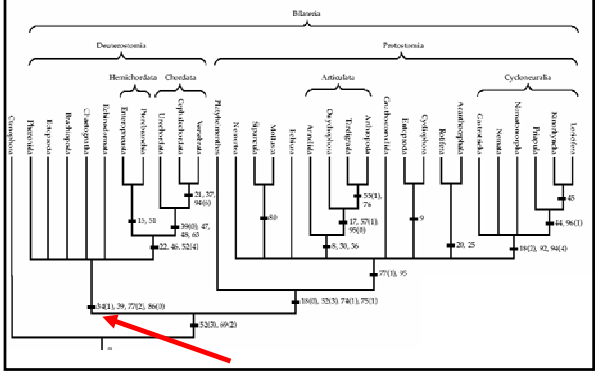
Blastula to Pluteus

Yellow is ectoderm, orange is endoderm, red is primary mesenchyme cells and skeleton, orange "dots" are secondary mesenchyme cells. Process from "blastula" to "pluteus" takes about 48 hours.



Note: Anus is formed before the mouth.

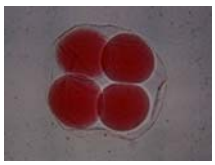
More Deuterostomia

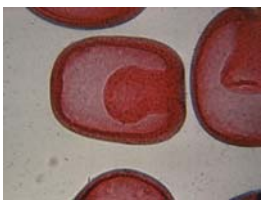


Deuterostomia

1. Synapomorphies:

a. 34(1) – mesoderm derived from archenteron by enterocoelic pouching





Deuterostomia

1. Synapomorphies:

b. 39 – tri partite coelom (anterior, middle and posterior compartments)

Deuterostomia

1. Synapomorphies:

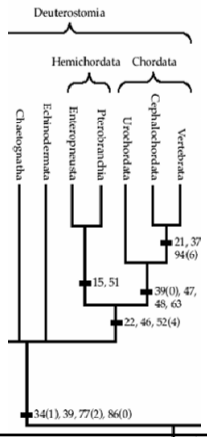
c. 77(2) – internal body cavity lined by peritoneum (mesodermally derived).

Deuterostomia

1. Synapomorphies:

86(0) – anterior body cavity unmodified as a proboscis, trunk, collar (as in hemichordates).

Phoronopsis californica



Deuterostomes:

Chaetognatha

Echinodermata

Hemichordata

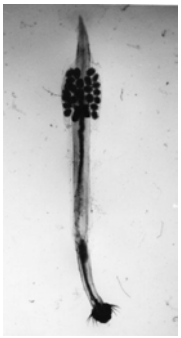
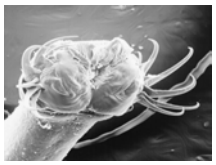
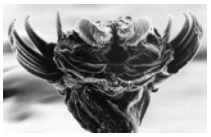
Chordata

Phylum Echinodermata



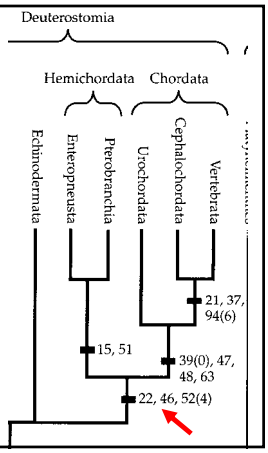

Phylum Chaetognatha

1. Also known as “arrow worms” – small, highly voracious predators
2. Will not be considered in great detail.

Hemichordates and Chordates

1. Highly specialized groups with clear relationships to each other



Hemichordates and Chordates

2. Synapomorphies:

a. 22 – epithelia that binds to iodine

b. 46 – pharyngeal gill slits

c. 52(4) – nervous system concentrated *dorsally*

Hemichordates and Chordates

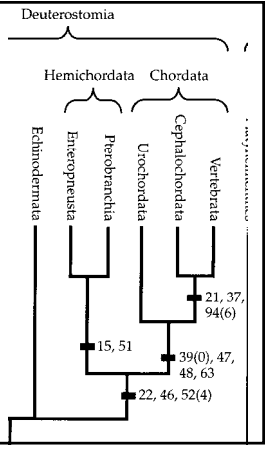
Class Enteropneusta

Class Pterobranchia

Subphylum Urochordata

Subphylum Cephalochordata

Subphylum Vertebrata



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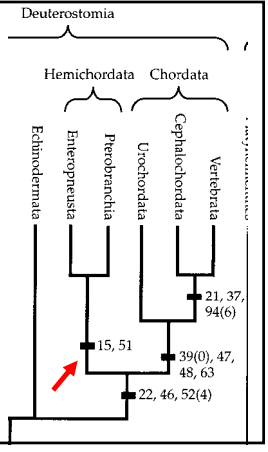

Phylum Hemichordata

1. Marine filter feeders
2. Synapomorphies

a. 15 – preoral gut diverticulum that supports anterior body - stomochord

b. 51 –glomerulus as excretory organ.

3. Classes:

a. Enteropneusta

b. Pterobranchia

Phylum Hemichordata

Hemichordates and Chordates

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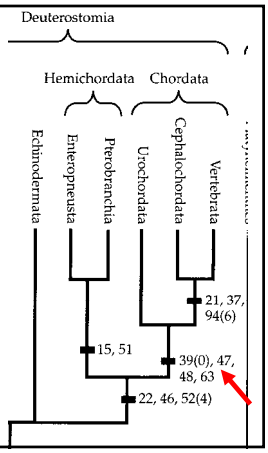

Phylum Chordata

1. Ancestrally marine, sessile filter feeders with motile larvae
2. Synapomorphies:

a. 39(1) – tripartite body cavity (again)

b. 47 – notochord

c. 48 – endostyle (becomes thyroid gland in vertebrates)

d. 63 – muscular, locomotory tail (in larvae in urochordates)

Phylum Chordata

1. Representative Subphyla:

a. Urochordata – sea squirts and other ascidians

b. Cephalochordata - lancelets

c. Vertebrata – vertebrates

Hemichordates and Chordates

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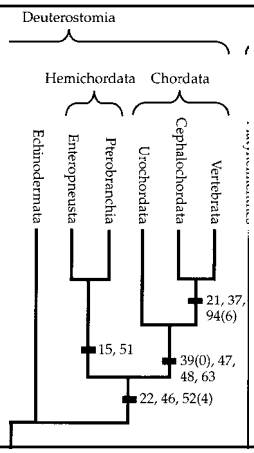

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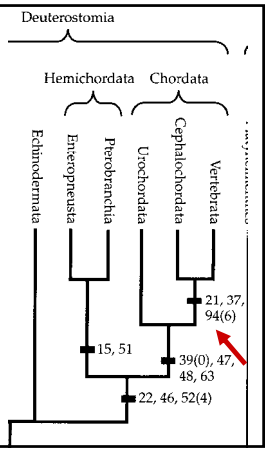


Phylum Chordata

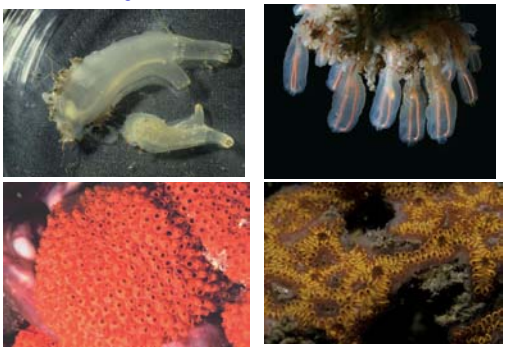
1. Synapomorphies separating Urochordates from Cephalochordates and Vertebrates:

a. 21 – myotomes – blocks of muscles arranges in segments.

b. 37 – longitudinal musculature derived from segmental enterocoelic pouching.

c. 94(6) – dorsal hollow nerve chord.

Subhylum Urochordata



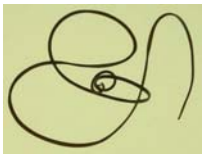
Subphylum Cephalochordata

Subphylum Vertebrata

Blastocoelomates

General Features



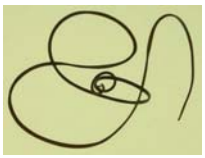




1. A large and heterogeneous group.

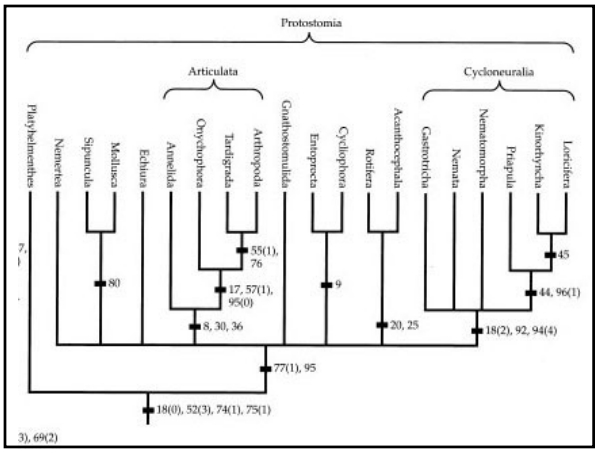
a. also known as "Aschelminthes" - cavity worms.

General Features



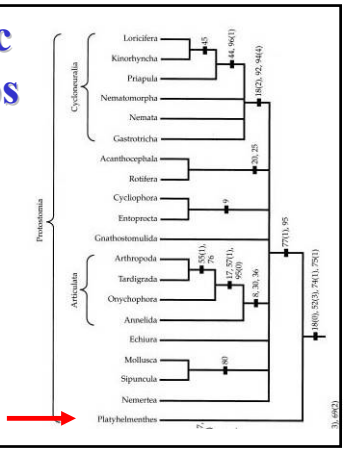

b. Nearly any source you consult will have a different arrangement of phyla with different presumed relationships.



Phylogenetic Relationships

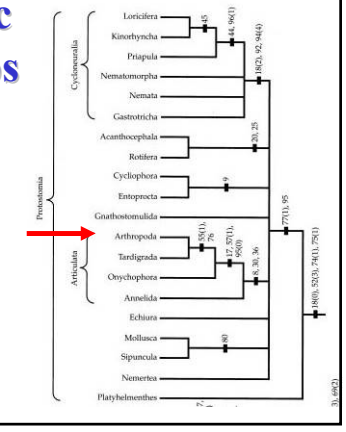
a. Probably derived from flatworm lineage.

b. Development resembles that of other protostomes.



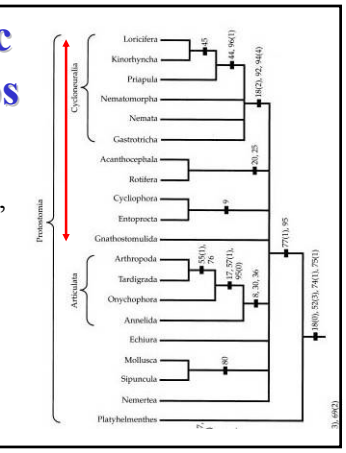
Phylogenetic Relationships

c. However, some evidence that certain phyla are related to Arthropods.



Phylogenetic Relationships

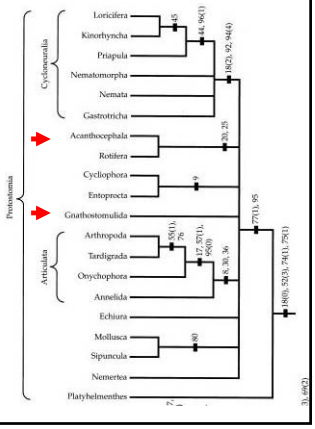
There is little doubt that the "blastocoelomates" are polyphyletic.

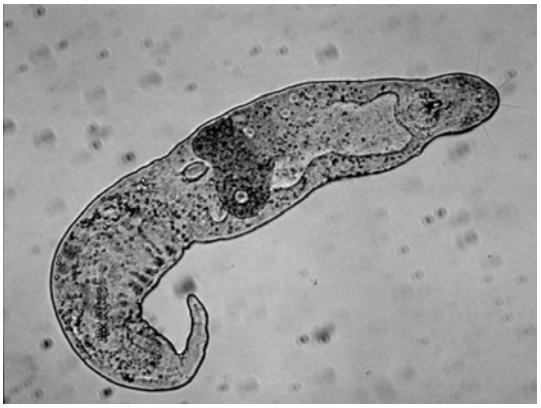


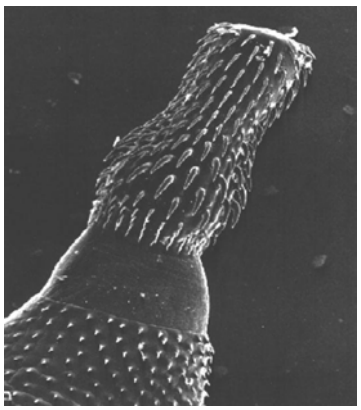
Phylogenetic Relationships

Flatworm allies:

1. Gnathostomulida
2. Acanthocephala





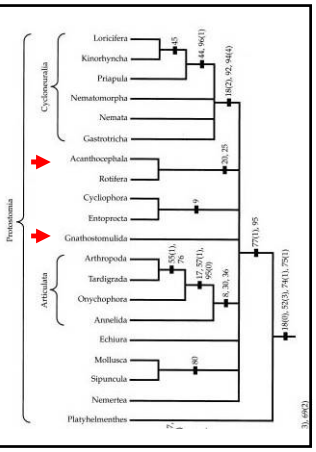


Phylogenetic Relationships

Flatworm allies:

1. Gnathostomulida
2. Acanthocephala - cestodes?

Not with recent molecular data.

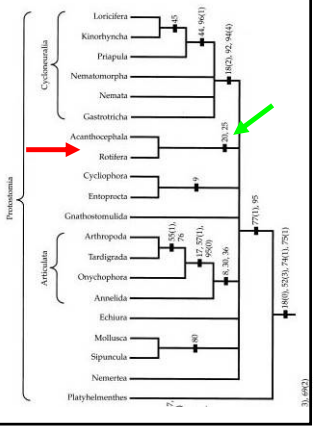


Phylogenetic Relationships

Acanthocephala appear to be most closely related to Rotifers:

20: Laminar epidermis;

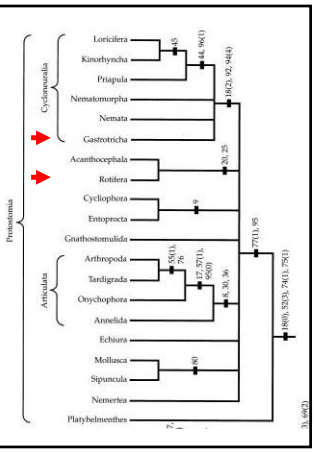
25: Sperm morphology.



Phylogenetic Relationships

Annelid Allies

1. Rotifera
2. Gastrotricha



Turbanella mustella