

BIO 221 Invertebrate Zoology I Spring 2010

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<http://www4.nau.edu/isopod>

Lecture 6

Correction: Porifera

a. Are distinct from the Placozoa by:

1. **Have** collar cells (absent in other Metazoa)
13. **Lack** striated ciliary rootlets (present in other Metazoa)

b. Also have the following apomorphies

1. Aquiferous system
2. Layered construction
3. Spicules

Lower Metazoan Clades:

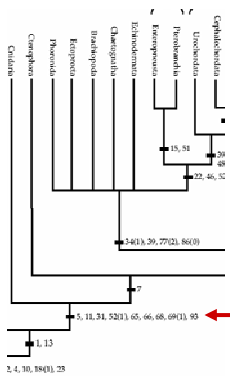
Choanoflagellata

Porifera

Placozoa

Cnidaria

Ctenophora



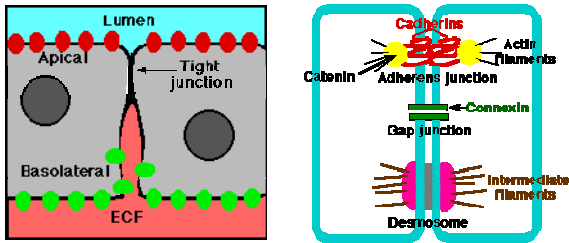
Cnidaria and Other Metazoa

Includes the major animal phyla –

b. Synapomorphies

- 5. – Gap junctions between cells
- 11. – Organized gonads
- 31 – Ectoderm and endoderm (gastrulation)
- 52(1) – Nervous system with at least a nerve net.

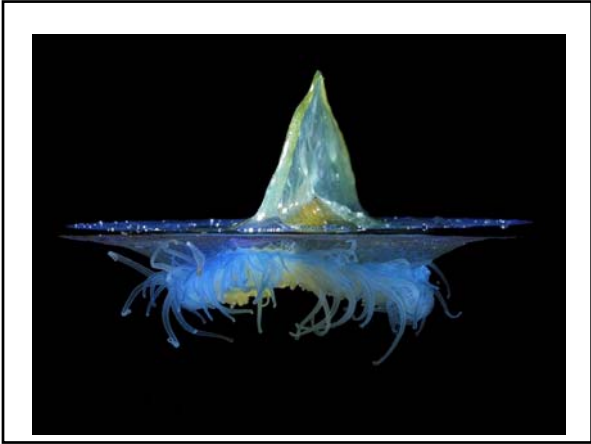
Tight and Gap Junctions

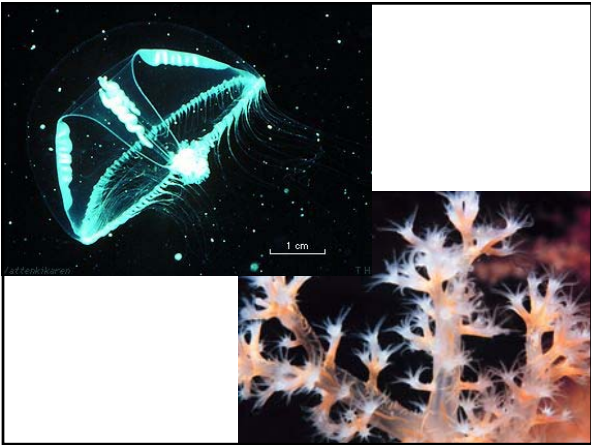


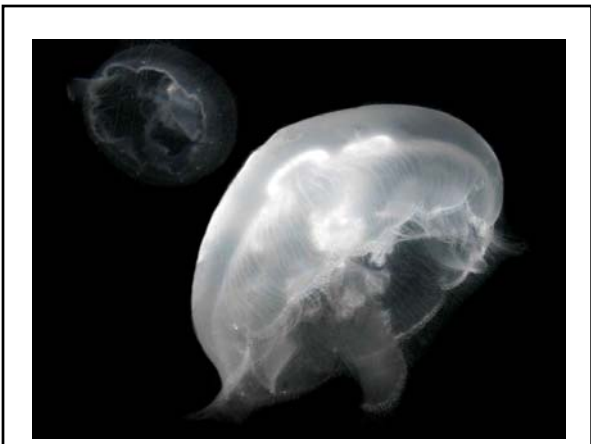
Cnidaria and Other Metazoa

Other Characters:

- 65. – Basal lamina beneath epidermis
- 66. – Striated myofibrils
- 68.- Synaptic nervous system
- 69(1) – Primary symmetry – radial (as ancestral trait)
- 93 – Body cuticle with collagen.







Metridium senile

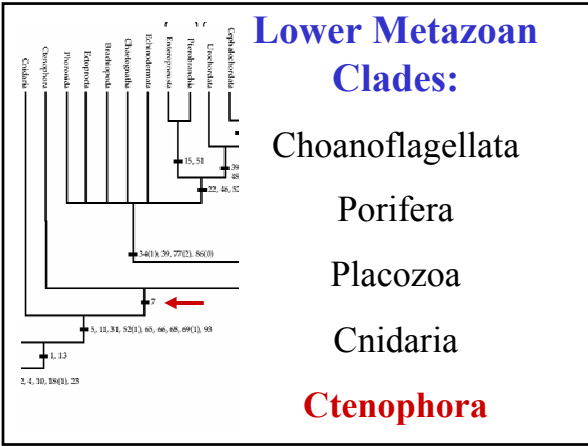


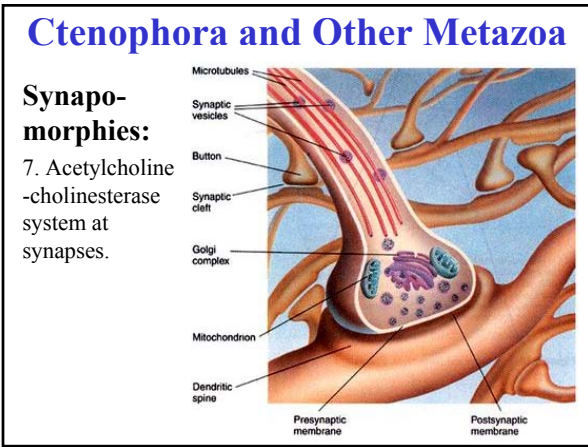
Lophogorgia chilensis

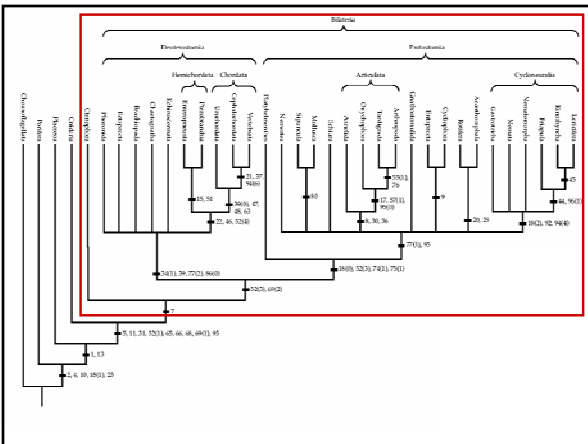


Sea fan and brain coral









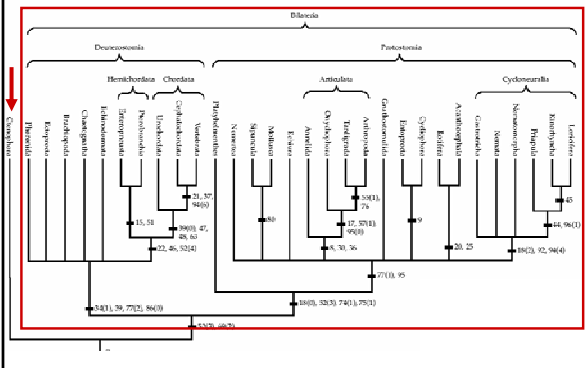
Ctenophora

Autapomorphies:

1. comb rows
2. unique digestive system
3. unusual symmetry



Bilateria



Bilateria

1. Includes *two* major groups separated by particular developmental characteristics:
 - a. **Deuterostomia**
 - b. **Protostomia**

Ventrally Located Nervous System



Synapomorphies Common to Bilateria

- a. 52(3) - Ventrally located nervous system.
- b. 69(2) - Primary symmetry bilateral with cephalization.

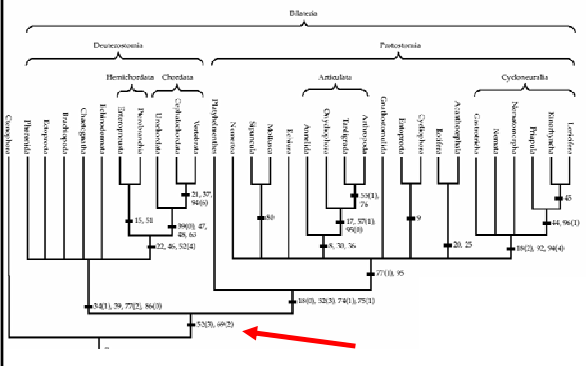
Primary Symmetry Bilateral with Cephalization



Higher or Lower?

1. Some researchers consider the *Deuterostomes* an ancestral group relative to the rest of the animal taxa.
2. Others consider the *Protostomes* to be more ancestral.
 - a. Note that it IS possible to rotate the phylogeny around the Deuterostome-Protostome node.

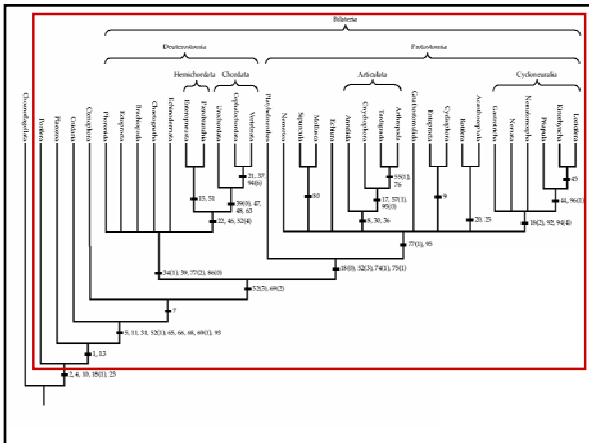
Rotation at the Proto-Deutero Node



Phylum Porifera The Sponges

Porifera and Metazoa

- a. Are distinct from choanoflagellates by:
 - 2. Multicellularity
 - 4. Epithelial tight junctions
 - 10. Collagen fibers in body
 - 18(1). Development w/ "radial" cleavage.
 - 23. Spermatozoa



Historical Remarks

- 1. An odd group of animals- seem to have arisen independently from most other animal groups.
 - a. They lack true embryological germ layering
 - 1. As mentioned, consist mainly of a loose aggregation of cells.
 - 2. cell types arise from mobile cells that are **totipotent**.

Totipotent:
Cells can
transform into
any cell type.

Historical Remarks

2. Early invert.
zoologists
considered them
allied with
Cnidaria

a. But were later
classified by R. E.
Grant (*Grantia*) as
Porifera



Historical Remarks

3. Later students
recognized them
as distinct from
other animal
phyla

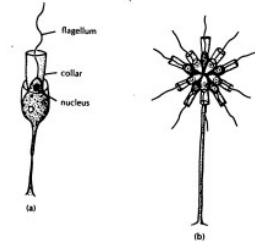
a. Huxley (among
others) suggested
classification as
PARAZOA -



Evolutionary Origins

1. Possibly derived from choanoflagellates

a. Note similarity in colony structure to inner walls of sponge.



Evolutionary Origins

2. As we will see, sponge embryology seems to contradict this

a. Early stages do resemble early development of true Metazoa

b. This similarity, however, could represent convergence.

Evolutionary Origins

3. However, Molecular evidence (Wainright et al. 1993)

a. Suggests close link between choanoflagellates and sponges

b. Tree branch with fungi as sister group has sarcomastigophroans as sister group.

Monophyletic Origins of the Metazoa: An Evolutionary Link with Fungi

Patricia O. Wainright, Gregory Hinkle, Mitchell L. Sogin,*
Shawn K. Stickle

A phylogenetic framework inferred from comparisons of small subunit ribosomal RNA sequences describes the evolutionary origin and early branching patterns of the kingdom Animalia. Maximum likelihood analyses show the animal lineage is monophyletic and includes choanoflagellates. Within the metazoan assemblage, the divergence of sponges is followed by the Cnidaria, the Ctenophora, the Pluteiacea, the Aplousobranchia, and finally by an unresolved polytomy of basal animal phyla. From these data, it was inferred that animals and fungi share a unique evolutionary history and that their last common ancestor was a flagellated protist similar to extant choanoflagellates.

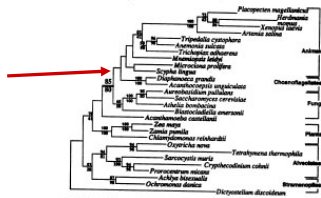
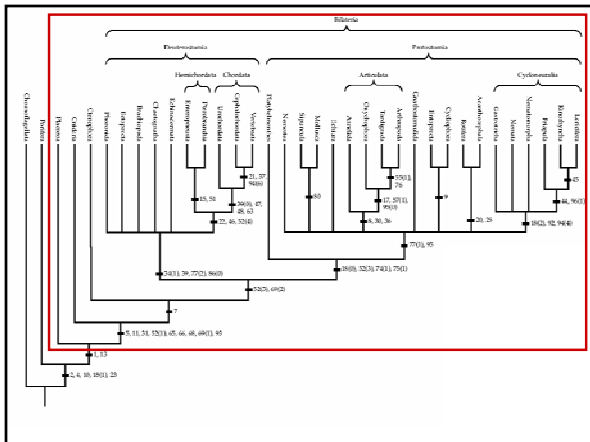


Fig. 5. Relation between animals, fungi, sponges, and other substrate groups inferred from complete 18S rDNA. A composite dataset method was used to align the 18S rDNA sequences from animals, sponges, fungi, ctenophores, cnidarians, and other outgroup groups. The divergences of the animal lineage from the 18S rDNA sequence method (1:1) was used to infer a relative probability with the use of a site frequency spectrum. The divergence of 1:10 indicates bootstrap support that support for a node is in maximum likelihood (percentage of 1:10 above the branches). The percentage of 1:10 support is given in parentheses. The confidence intervals of a node are given in parentheses below the branches. The rest of the tree is given within the 18S rDNA sequence (1:1). C: Confidence levels below 50% are not indicated.

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Evolutionary Origins

4. With respect to other groups (Conway Morris 1992; Brusca and Brusca 2004)
 - a. Porifera are the *sister group* to the rest of the Metazoa.



Number of Described Species

1. Approx 5,000 described species
 - a. 150 freshwater.
 - b. The rest (97%) are marine (suggests marine ancestry).
 - c. at least 4,000-6,000 are *undescribed*.

The Importance of This Group

1. Sponges are a major component of invertebrate subtidal (intertidal) communities.
 - a. Often are the dominant life form.
 - b. In coral reefs are second only to corals themselves.
1. in some systems seem crucial to existence of corals as well.

Filterers of DOC

2. Sponges are significant filterers of DOC (dissolved organic carbon), esp in coral reefs
 - a. coral reefs usually considered nonproductive waters
 - b. however, this is because of the action of sponges.
 - c. removal of turbidity allows corals to photosynthesize





The Importance of This Group

Exhibit important relationships with other animals

a. shelter for many species

1. *Leucetta losangelensis*: isopods, amphipods.
2. *Geodia* in Caribbean can house 16,000 shrimp.

The Importance of This Group

Some animals cultivate sponges on their bodies for protection.

- c. They produce secondary compounds.
 - 1. Permits predator avoidance; *Tedania*
 - 2. Some produce secretion that are virus, bacteria killers.

Spicule Characteristics

- a. Some allow sponges to be predators *Asbestopluma* sp.- have modified spicules that capture zooplankton as prey.
 - 1. See article by Kelly-Borges 1995
 - 2. calls into question the current classification of sponges as exclusive filter feeders.

Spicule Characteristics

- 3. Other recent work suggest that in fact, calcareous sponges are closer to metazoans than Hexactinellida and Demospongia.
 - a. produce hard substrate with spicules.
 - b. in Antarctic, spicule masses greatly increase species diversity.
