BIO 221
Invertebrate Zoology I
Spring 2010

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http://www4.nau.edu/isopod

Lecture 12

Class Anthozoa

Class Anthozoa

a. 6,000 species, 3 subclasses

b. extremely successful

c. characteristics:

1. (10) loss of medusoid life stages

Class Anthozoa

2. (11) development of complex symmetry

a. hexaradial - multiple of 6

b. octoradial - multiples of 8

3. part of evoluton of mesentaries - larger food

Class Anthozoa

4. (12) evolution of actinopharynx (stomadaeum)
5. (13) evolution of syphonoglyph
6. (14) mesentarial filaments
7. (15-18) modifications of cnidae

d. other characters

i. internal or external skeletons

Class Anthozoa

8. All cnidaria are carnivores

a. some have photosynthetic symbionts

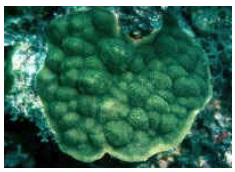
Anthozoa: Important Groups

Subclass Zoantharia (Hexacorallia)

Order Zoanthidia

Order Actinaria

Order Scleractinia

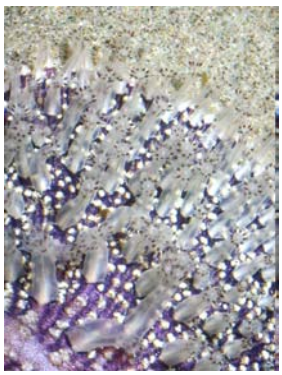


Anthozoa: Important Groups

Subclass Alcyonaria (Octocorallia)

1. soft corals, gorgonians, sea fans, sea whips, sea pens
2. tentacles in multiples of 8

Subclass Octocorallia



a. Two types of polyps
1. siphonozooids
2. autozooids
3. endoskeletons if present. spicules or axial rod.
4. rods used to for jewelry.

Subclass Octocorallia

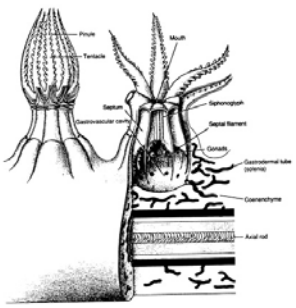


FIGURE 4–52 Structure of a gorgonian coral of the anthozoan subclass Octocorallia. (Redrawn from Bayer, F. M. 1956. Octocorallia. In Moore, R. C., Treatise on Invertebrate Paleontology. Courtesy of Geological Society of America and University of Kansas, Lawrence.)

a. Two types of polyps
1. siphonozooids
2. autozooids
3. endoskeletons if present. spicules or axial rod.
4. rods used to for jewelry.

Subclass Octocorallia

Order Gorgonacea

a. plant like, tough outer material

b. *Gorgonia*, *Muricea*, *Corallium*

How do corals grow?

(2)1. Coral growth is limited by certain physical factors:

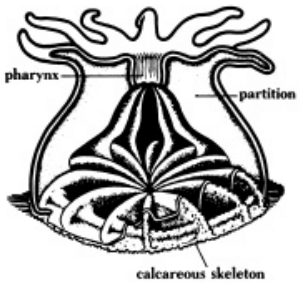
a. usually tropical (25o C)

b. water turbulence determines shape - like rock candy.

c. need clear water - siltation is bad.

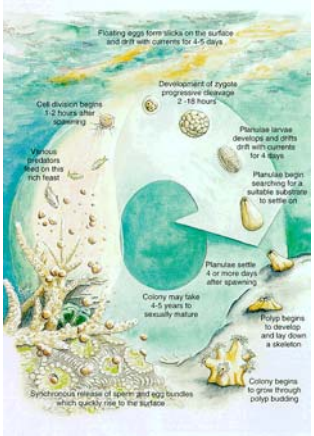
d. sunlight

How do corals grow?

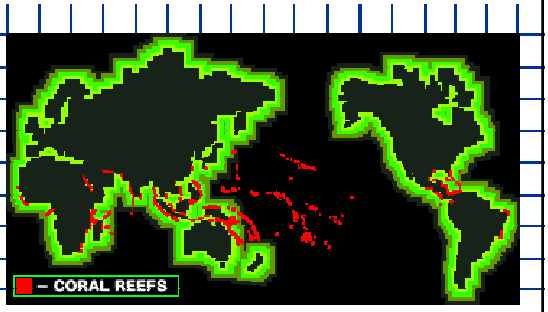


Stony coral polyp. This young animal is shown as if partly cut away to reveal the gastrovascular cavity and, beneath the polyp, the beginning of the calcareous skeleton. (After Pfurtscheller.)

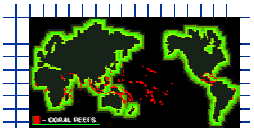
Life Cycle of Stony Corals

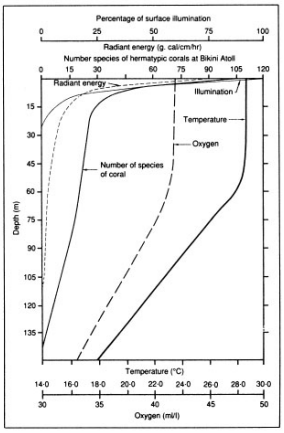


Distribution of Corals

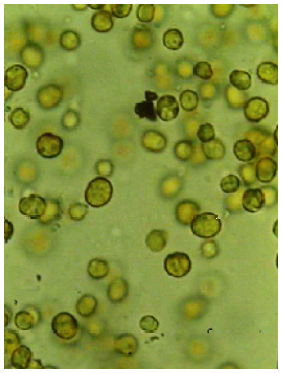


Distribution of Corals





How do corals grow?



Zooxanthellae (zoochlorellae)

1. symbiotic algae that lives within cells of gastrodermis

a. are dynoflagellates

b. nonflagellated form (palmella stage)

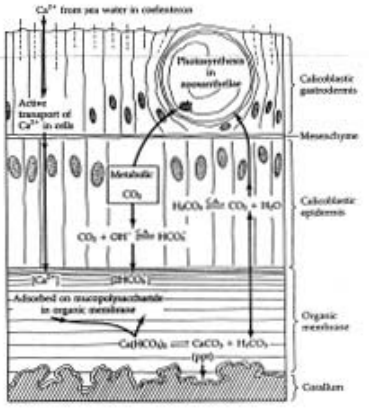
1. Palmellae evidently seek out corals for obtain nitrates and phosphates.

2. also avoid predators.

2. corals get photosynthetate.

3. also benefit from use of H_2CO_3 (carbonic acid) by "zooxs."

How do corals grow?



How do corals grow?

The Reaction Is:

$Ca^{++} + 2HCO_3^- \rightarrow Ca(HCO_3)_2 \rightarrow$

$CaCO_3$ (to test) + $H_2CO_3 \rightarrow H_2O$

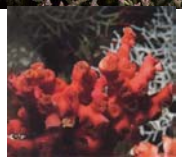
+ CO_2(to DF)

How do corals grow?

Reaction is mediated by carbonic anhydrase

a. enzyme that can push the reaction in either direction

How do corals grow?



Rate of skeleton deposition related to amount of light, temperature.

a. Fossils provide record of climate.

6. Fulvic acid soil (Australia) fluoresces under UV light

b. provides record of runoff; wet dry years.

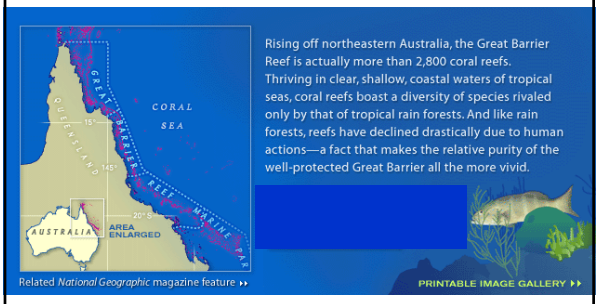
Coral Reef Formation

1. Can have enormous effect on marine geology.

a. Fringing reefs - around volcanic islands.

b. Barrier reefs - along continents.

Barrier reefs - along continents



Atolls and Darwin

1. Showed that sea level changes (or erosion) can permit formation of reef rings around volcanic island.

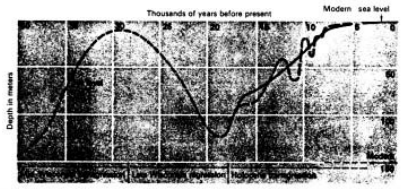
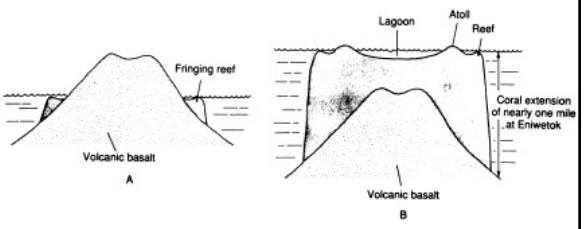


FIGURE 4–64 Sea level changes during the last Pleistocene interglacial and glacial periods. Transgression refers to encroachment by the sea as a result of glacial melting and sea level rise; regression refers to the reverse conditions. *(From Curray, J. H. 1965. Late Quaternary history, continental shelves of the United States. In The Quaternary of the United States. Princeton University Press, Princeton. p. 725.)*

Atolls and Darwin

2. Also the weight of the reef can cause subsidence.



Atolls and Darwin

3. Darwin would have been famous for this alone.

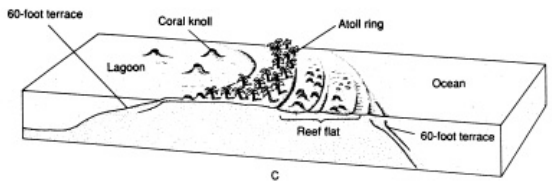
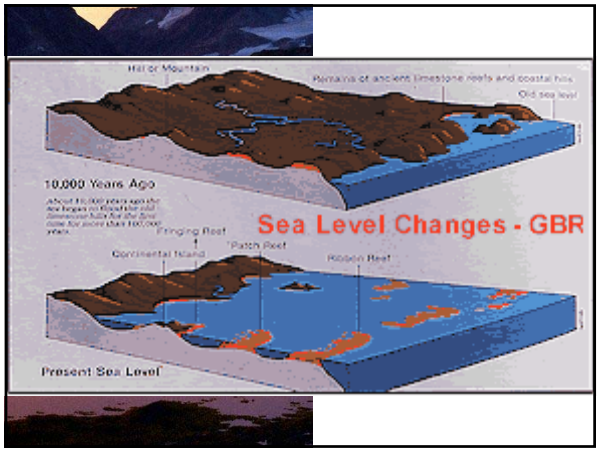


FIGURE 4–65 Formation of an atoll. **A,** Fringing reef around an emergent volcano. **B,** Continuous deposition of coral as the volcanic cone subsides, leading to the formation of a great coralline cap; the emergent part of the cap is atoll. **C,** Section through part of the atoll. *(After Ladd.)*

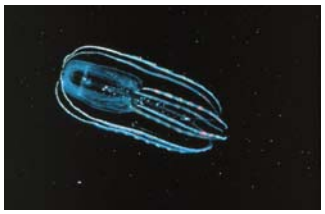


Phylum Ctenophora

1. Small, translucent delecate animals that swim or drift slowly in sea.

a. abundant near shore, much more so than previously thought.

b. like syphozoans, are predators, significantly affect local diversity

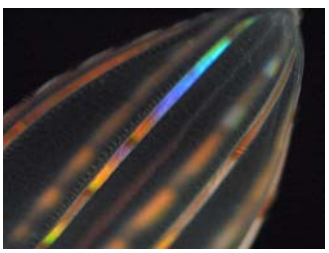


Phylum Ctenophora

2. Name means, "comb-bearer"- refers to 8 rows of ciliary combs

a. each row consists of a succession of small plates fused at base

b. stroke in successive waves toward aboral pole



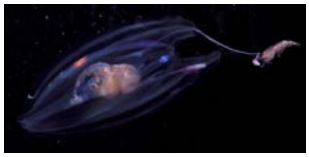
Phylum Ctenophora

3. May vary in color

a. clear, reddish (cold water); golden (zooxanthellae)

b. many are bioluminescent

1. light without heat produced by oxidation of luciferin.

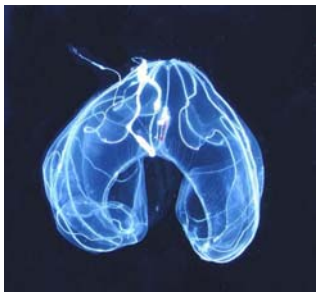


Box One

Characteristics of the Phylum Ctenophora

1. Diploblastic (or triploblastic?) metazoa, with ectoderm and entoderm separated by a cellular mesenchyme
2. Biradial symmetry; body axis oral–aboral
3. With adhesive structures called colloblasts
4. Gastrovascular cavity (gut) is the only "body cavity"; gut with stomodeum and canals that branch complexly throughout body; gut ends in two small anal pores
5. Without discrete gas exchange, excretory, or circulatory systems (other than the gut)
6. Nervous system in the form of a nerve net or plexus, but more specialized than that of cnidarians
7. Musculature always formed of true mesenchymal cells
8. Monomorphic, without alternation of generations and without any kind of an attached sessile life stage
9. With eight rows of ciliary plates (combs or ctenes) at some stage in their life history; comb rows controlled by unique apical sense organ
10. Some adults and most juveniles with a pair of long tentacles, often retractable into sheaths
11. Most are hermaphroditic; typically with a characteristic cydippid larval stage

Phylum Ctenophora

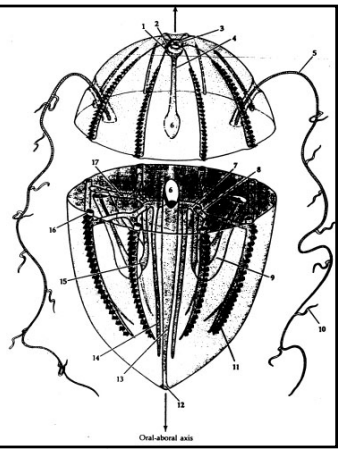


Phylum Ctenophora

1. Diploblastic - similar to cnidarians.

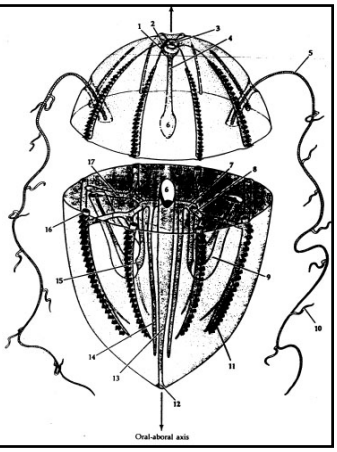
a. Molecular and other evidence places them in the Radiata.

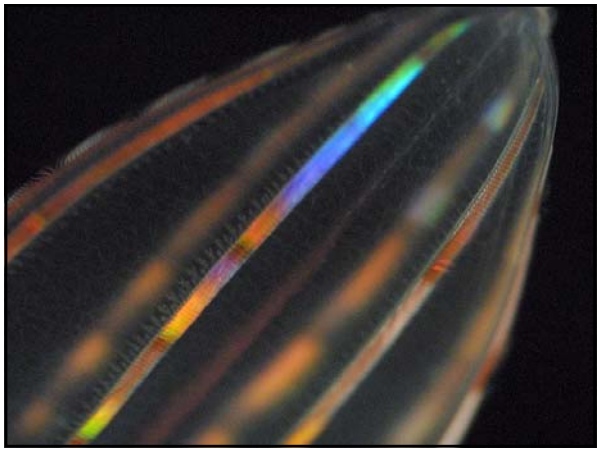
b. However, some would like to place them in different location.



Phylum Ctenophora

2. Comb rows are unique in Animal Kingdom.



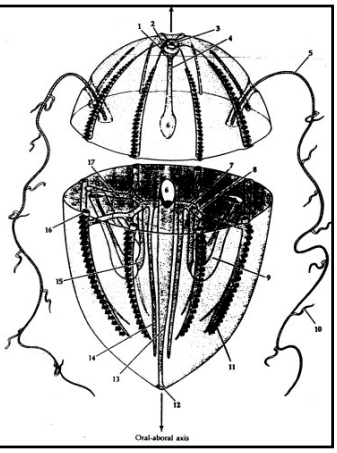


Phylum Ctenophora

3. In addition to comb rows, tentacles.

a. paired, come out of sheaths that project into body.

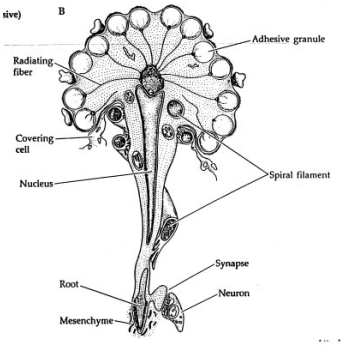
b. often long, trail in the water column, highly mobile.



Phylum Ctenophora

c. Tentacles equipped with adhesive structures - colloblasts

1. used to capture prey, tentacles withdrawn across mouth.



Phylum Ctenophora

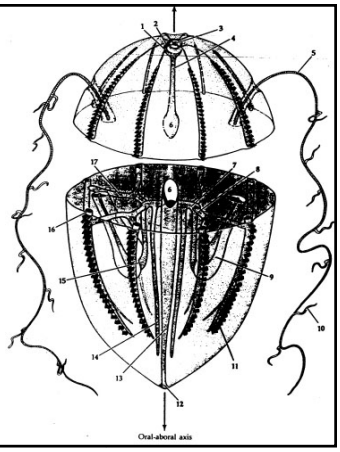
4. Food drawn into large pharynx, then to stomach for rapid digestion.

a. digested material circulated through gastrovascular canals

b. some material leaves through anal pores.

1. a complete gut?

2. most people don't consider it such.



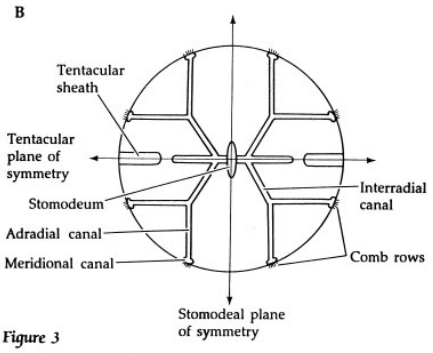


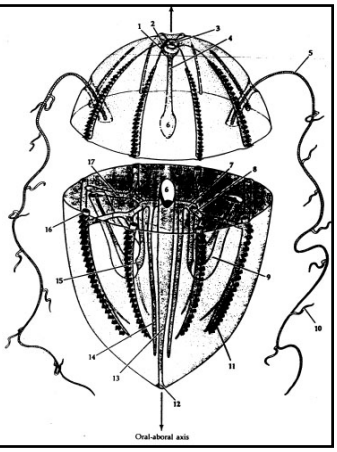
Figure 3

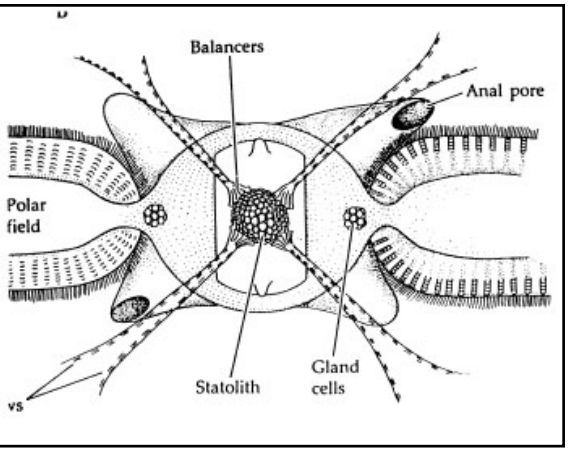
The ctenophoran *Bauplan*. A, A cydippid ctenophore (cross section). B, Ctenophoran biradiality and the planes of symmetry (oral view). (A from Bayer and Owre 1968.)

Phylum Ctenophora

Oral and Aboral ends

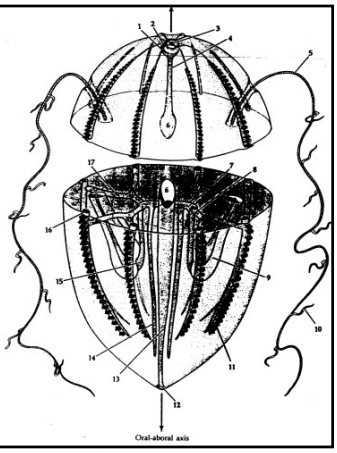
1. Oral end is obviously near mouth
2. Aboral end contains sensory structures
   a. contrary to some organisms, sensory end trails.

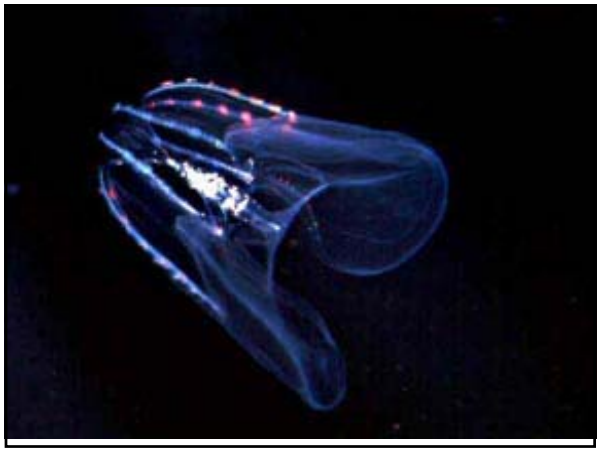


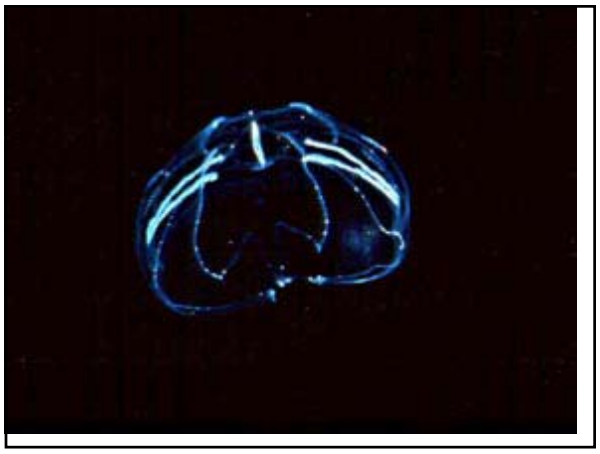


Phylum Ctenophora

b. Near anal pores is statocyst.
   1. performs same function as in medusae
   2. ctenophorans are more active swimmers, however, and swim in any direction.



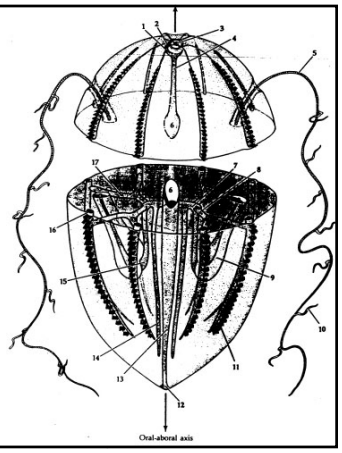


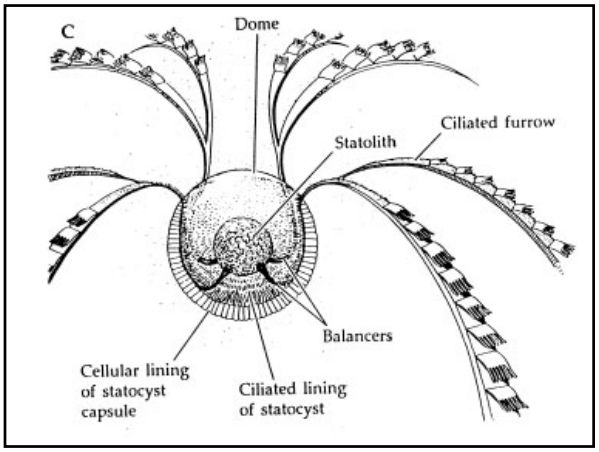


Phylum Ctenophora

c. Activities apparently coordinated by Polar fields.

1. Columns of ciliated cells that extend from statocyst.



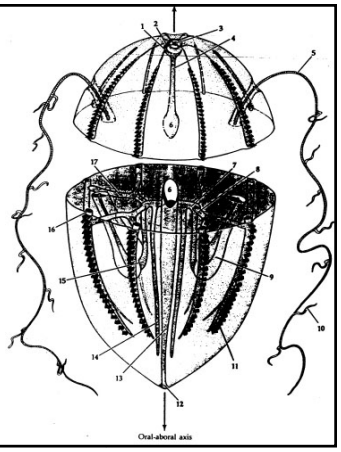


Phylum Ctenophora

2. Much integration appears to occur, however, within:

a. Ectodermal nerve net

b. 8 nerve strands that underlie ciliary bands.



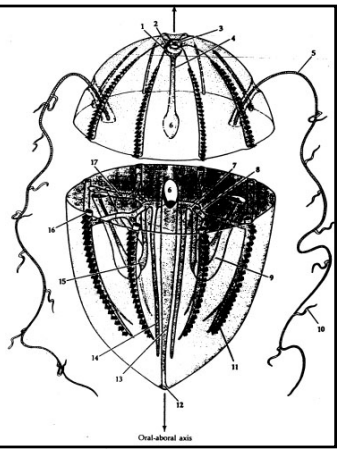
Phylum Ctenophora

These structures create a body that is biradially symmetrical

a. body is symmetrical around two planes

1. Pharangeal plane - elongated

2. Tentacular plane - paired at right angles to pharynx.



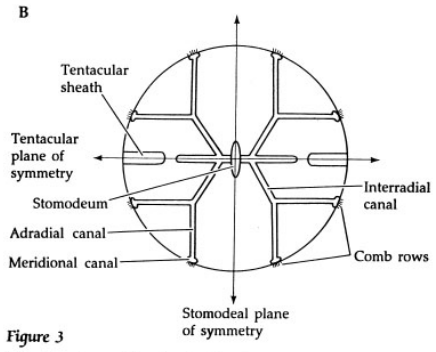


Figure 3

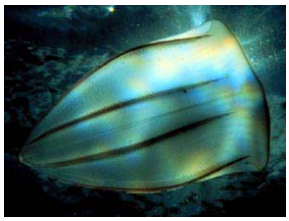
The ctenophoran *Bauplan*. A, A cydippid ctenophore (cross section). B, Ctenophoran biradiality and the planes of symmetry (oral view). (A from Bayer and Owre 1968.)

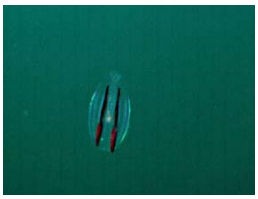
Ctenophoran Reproduction

1. All but a few species of ctenophorans are hermaphroditic.

a. Gonads are located along gastrovascular canals.

b. Sperm and eggs are in close proximity - but probably don't self.





Ctenophoran Reproduction

c. Most appear to be *semelparous*.

1. Reproduction appears to occur at specific times of year.

a. Dispersal of larvae on tides.

b. Adults usually die after reproduction.

Semelparity

Semele was the daughter of Cadmus and Harmonia, and the mother, by Zeus, of the god Dionysus

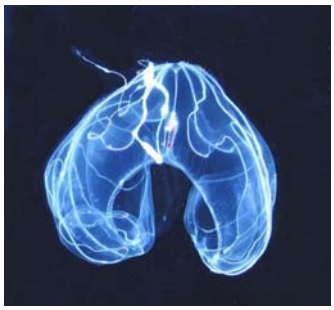
Evolution of Semelparity

2. If reproduction is favored at certain times and not others

a. e.g., for larval dispersal.

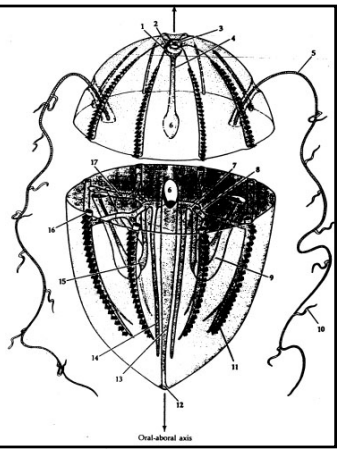
b. *And* if adult survivorship is low until next time,

c. *And* if fecundity is dependent on body size,



Evolution of Semelparity

d. may favor single explosive reproductive event.

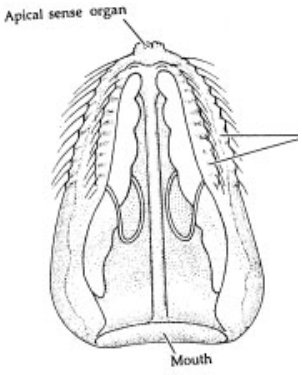


Ctenophoran Larvae

d. Larval stage is cydippid larva.

1. miniature adult with comb rows.

2. unique in animal kingdom.



Ctenophoran Larvae

e. Some evidence of relationship to trachyline hydrozoa indicated by larval stages of these animals.

7. Regeneration well-developed - permits asexual reproduction.

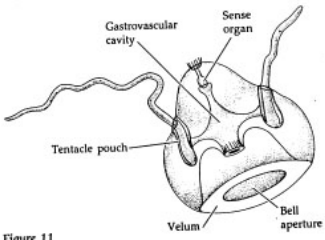


Figure 11

The aberrant trachyline medusa *Hydroctena*, which superficially resembles a ctenophore in its possession of an apical sensory structure and tentacular pouches. (After Hyman 1940.)

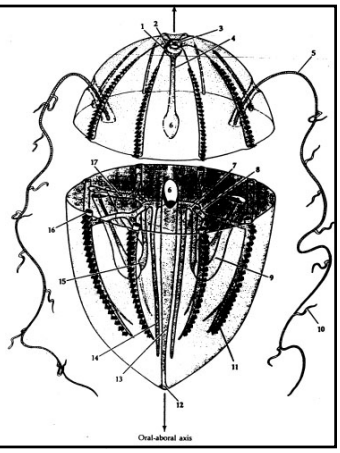
Important Groups

1. Two Classes:

a. Tentaculata - with tentacles; most ctenophores.

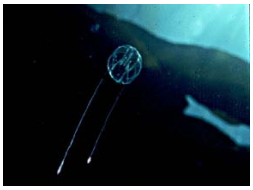
b. Nuda - without tentacles.

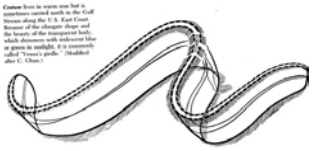
2. Brusca doesn't recognize these - systematics likely to be revised



Interesting Orders

1. Order Cydippida
   a. Globular, sea goosberries
   b. *Pleurobrachia*





Interesting Orders

2. Order Cestida
   a. Ribbon shaped, very transparent, beautiful
   b. *Cestum* - Venus' girdle; N. Atlantic, Mediterranean.