Biology of animals

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ANIMAL KINGDOM

- What are and what are not animals
- Phylogeny
- Typical animal characteristics
  - Movement
  - Heterotrophy
  - Nerves
  - Senses

TYPICAL ANIMAL CHARACTERISTICS

- eukaryotic cell with nucleus
- mitochondria
- Unikonta
- Opisthokonta: chitin, flat mitochondrial cristae
- without cell wall
- collagen
- $CaCO_3$ and SiO_2 skeleton
- glycogen, specific sterole biosynthesis
- small mitochondrial genome (16 000 p nucleotids, 37 genes)
- ultrastructure of kinetosome, 2nd centriole, striated roots

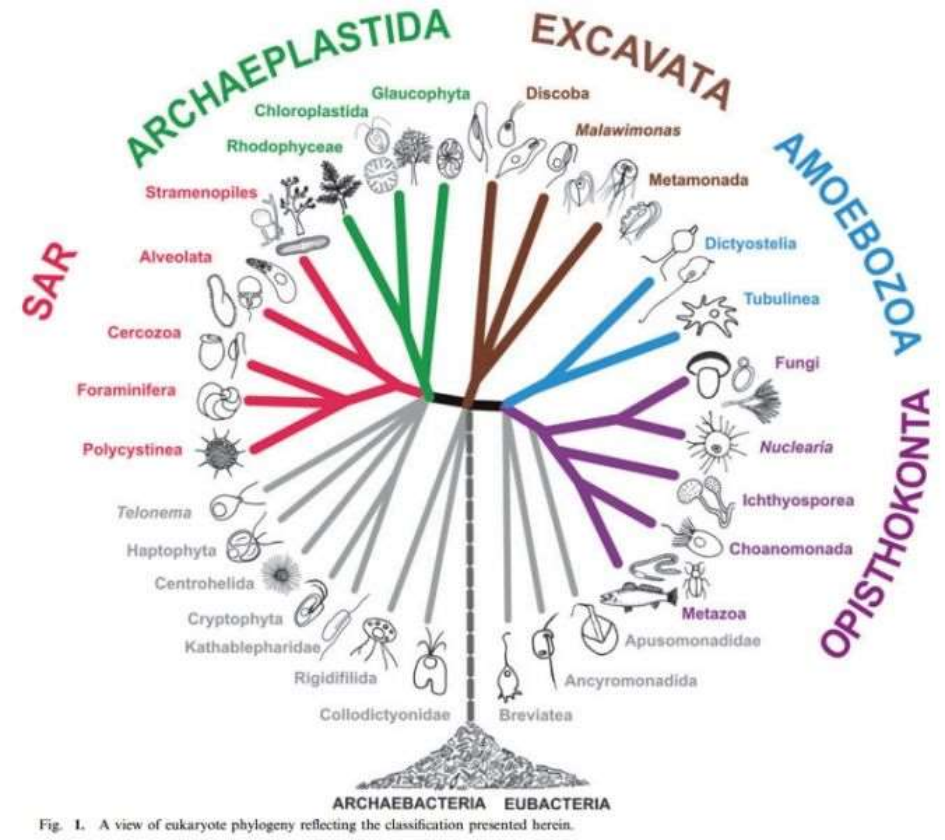

Fig. 1. A view of eukaryote phylogeny reflecting the classification presented herein.

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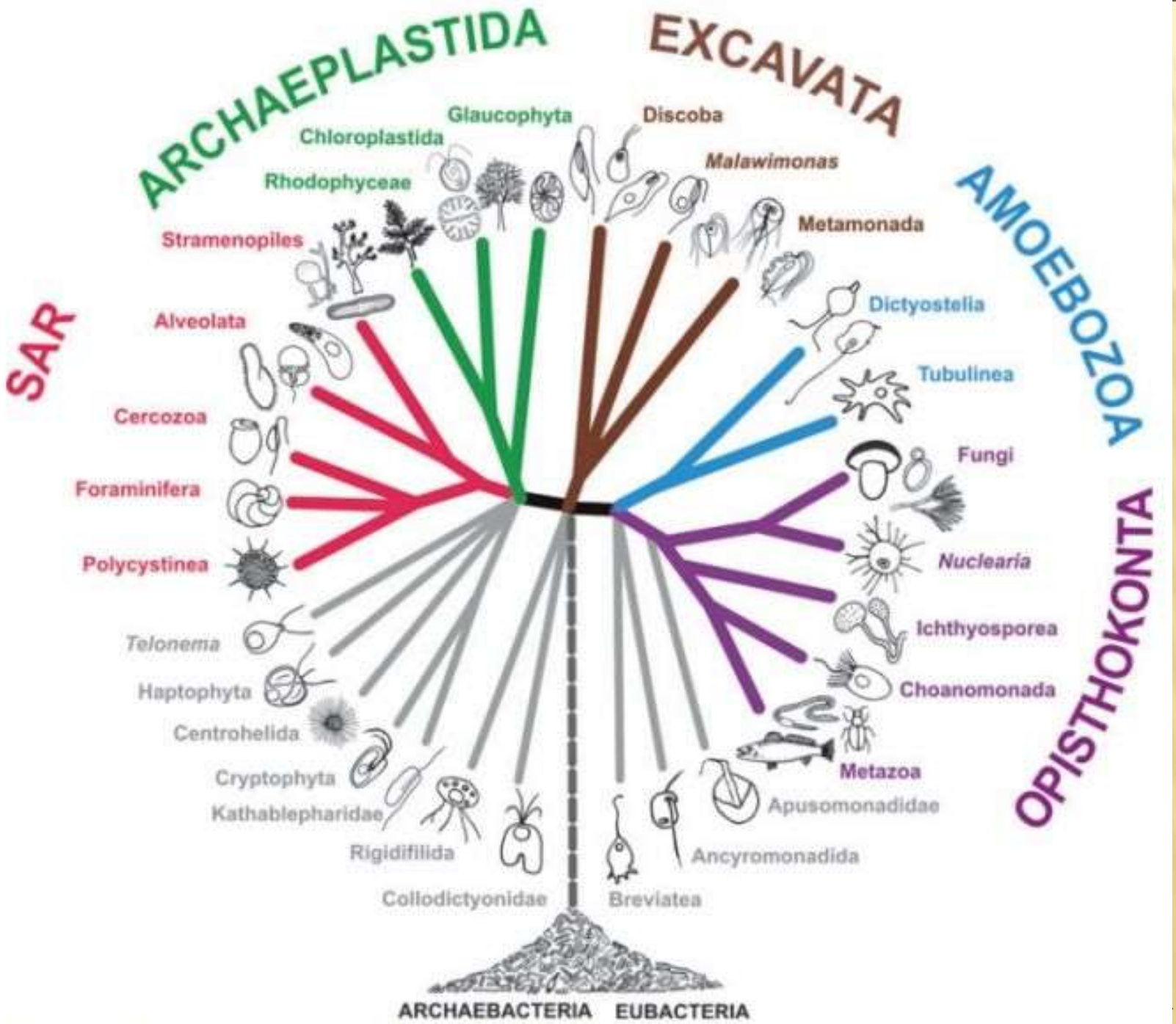
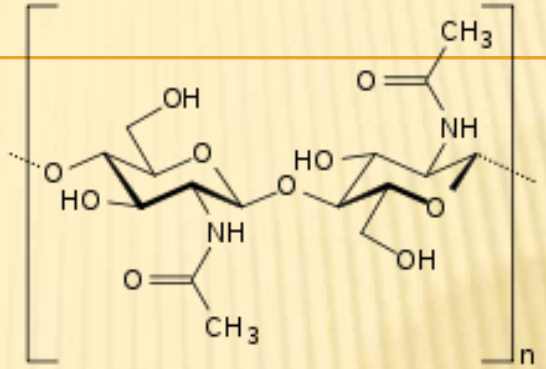
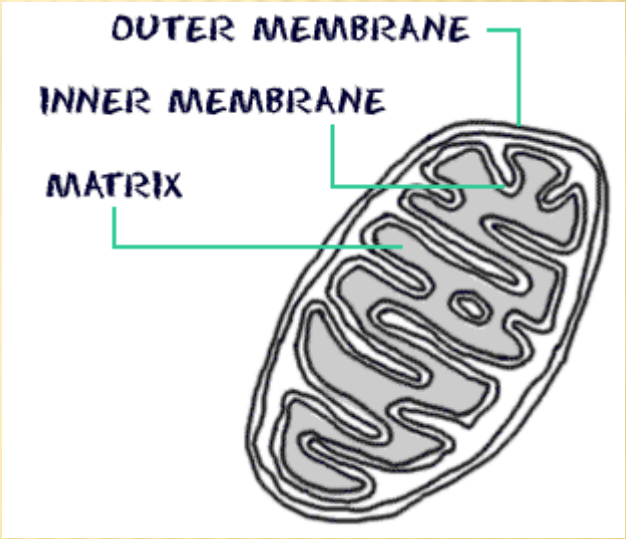


Fig. 1. A view of eukaryote phylogeny reflecting the classification presented herein.

TYPICAL OPISTOKONT CHARACTERISTICS

- chitin: polymer of *N*-acetyl-D-glucosamine

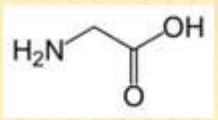


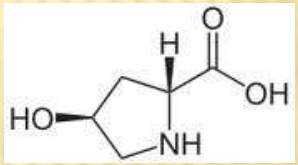


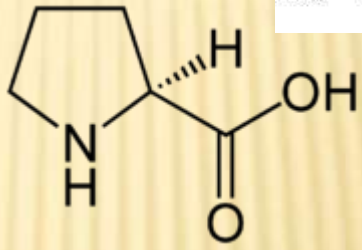
- flat mitochondrial cristae
  - small mitochondrial genome (16 000 p nucleotids, 37 genes)

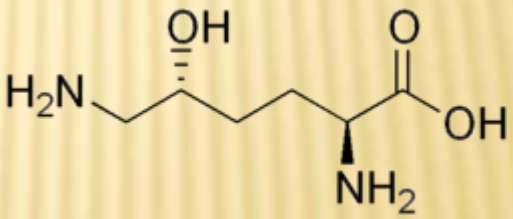
TYPICAL ANIMAL CHARACTERISTICS

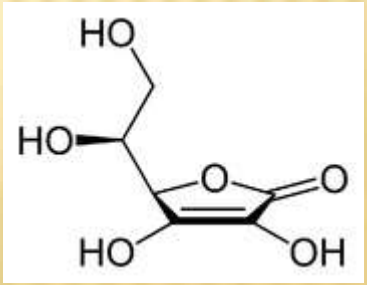
- collagen
  - glycine, proline, hydroxyproline, hydroxylysine
  - ascorbic acid

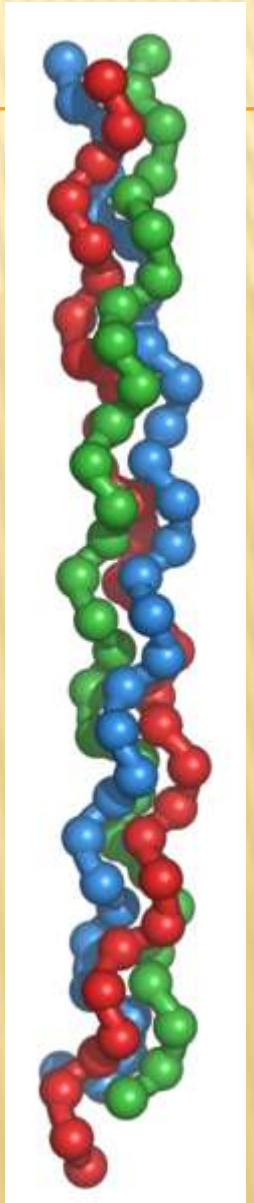






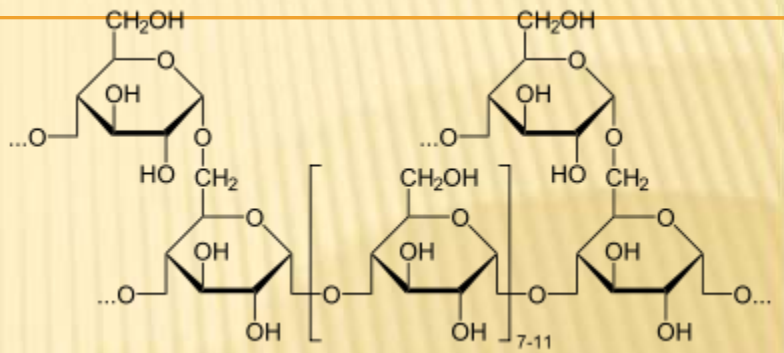


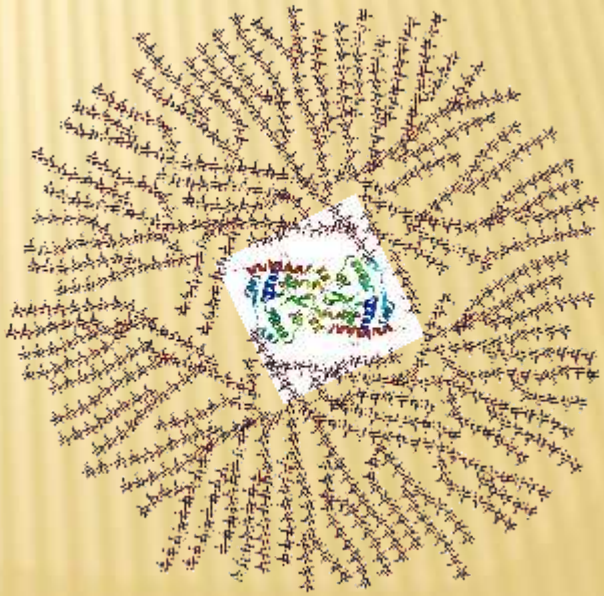




TYPICAL ANIMAL CHARACTERISTICS

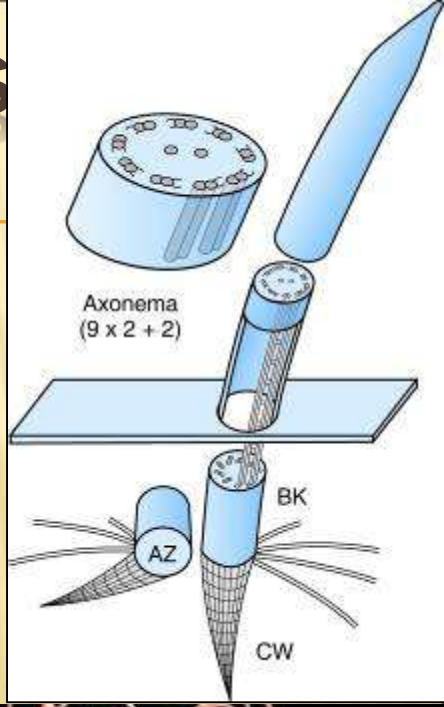
- glycogen





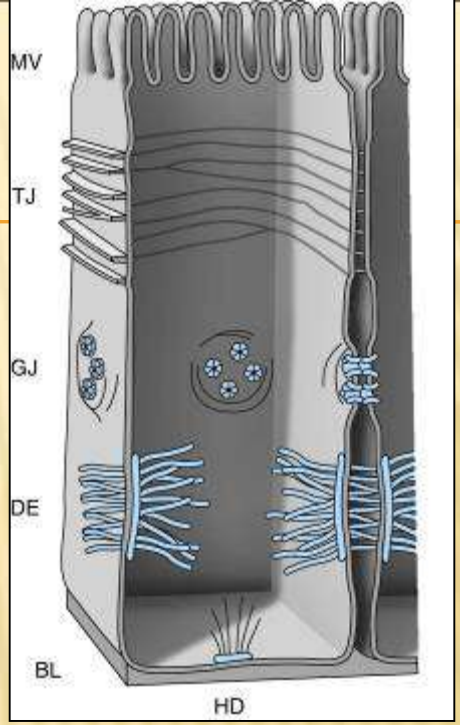
TYPICAL ANIMAL CHARACTERISTICS

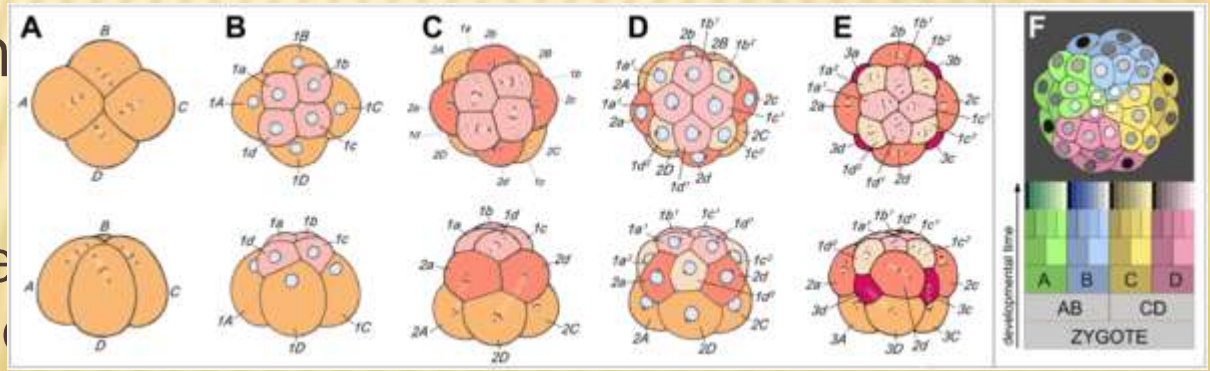
- ultrastructure of kinetosome, 2nd centriole, striated roots



MULTICELULARITY

- adhesion
  - extracellular matrix with collagen and glycoproteins;
  - epidermis: basal lamina
  - intercellular junctions
    - tight junction
    - septate junction
    - desmosome
- comun
- egg ce
  - large
    hom





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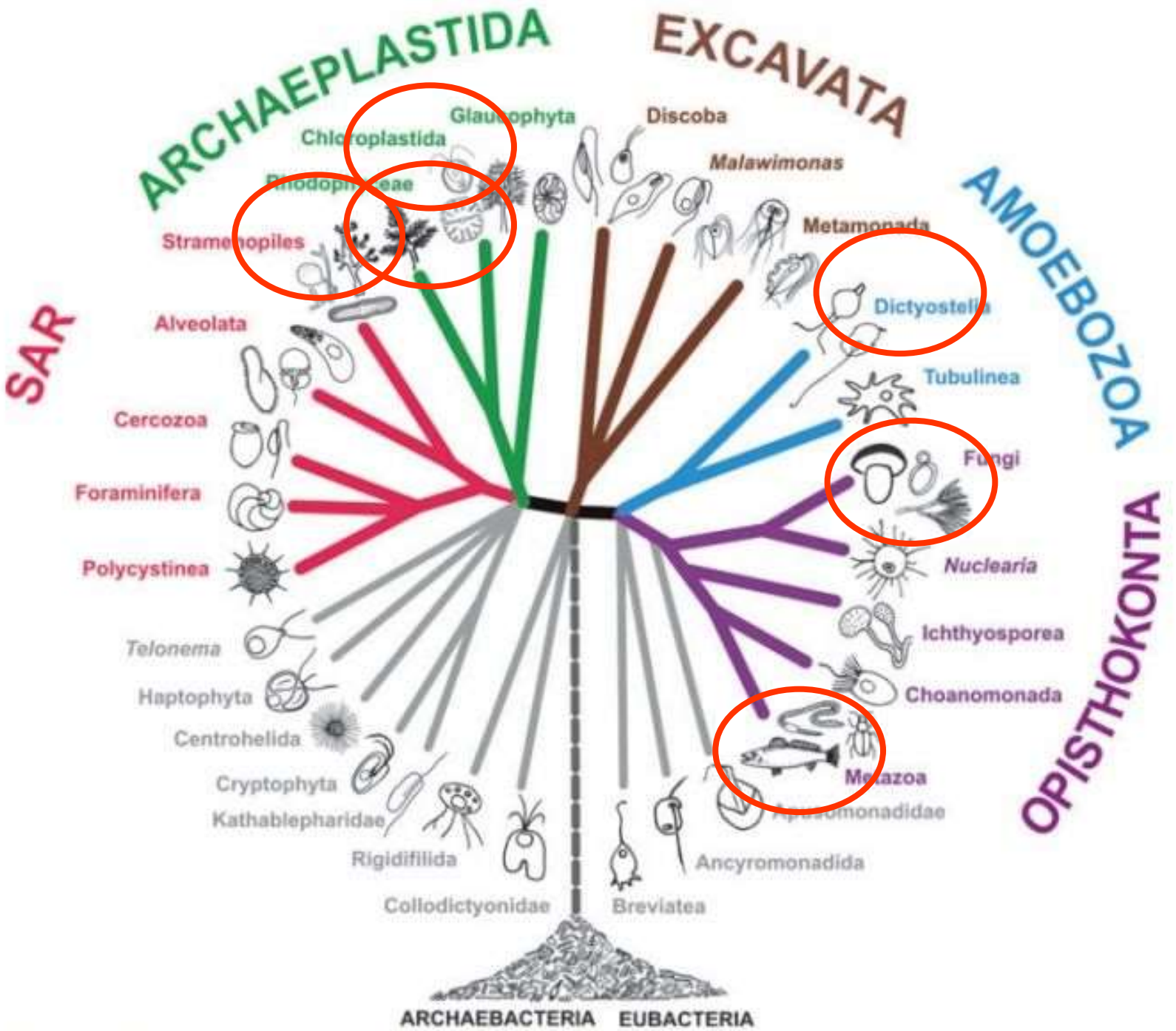


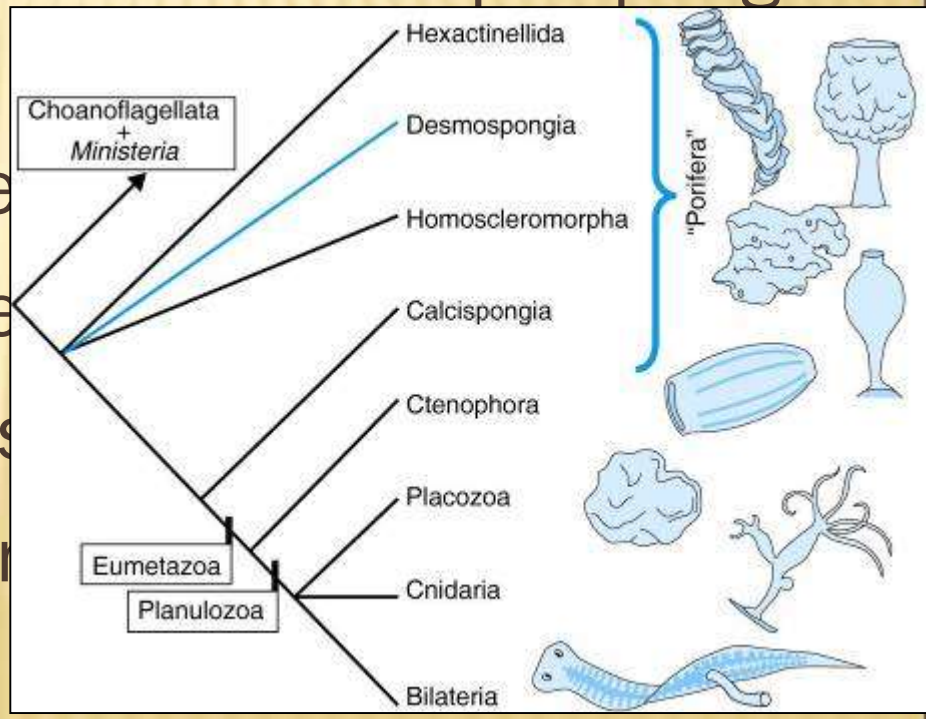
Fig. 1. A view of eukaryote phylogeny reflecting the classification presented herein.

TAXONOMY AND CLASSIFICATION

- Metazoa = multicellular animals
  - about 35 groups (taxa) on phylum level
  - relativity and arbitrary nature of taxonomic categories
    - kmen – phyllum – phylum (phyla)
    - třída – classis – class (classes)
    - řád – ordo – order (orders)
    - čeleď – familia – familly (families)
    - rod – genus – genus (genera)
    - druh – species – species (species)
      - ultra-
      - supra-
      - sub-
      - infra-
- International Code of Zoological Nomenclature
- the richest taxon

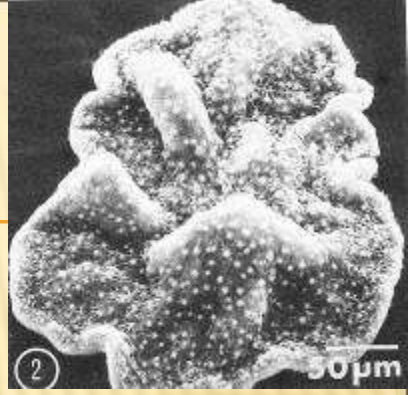
PHYLOGENY

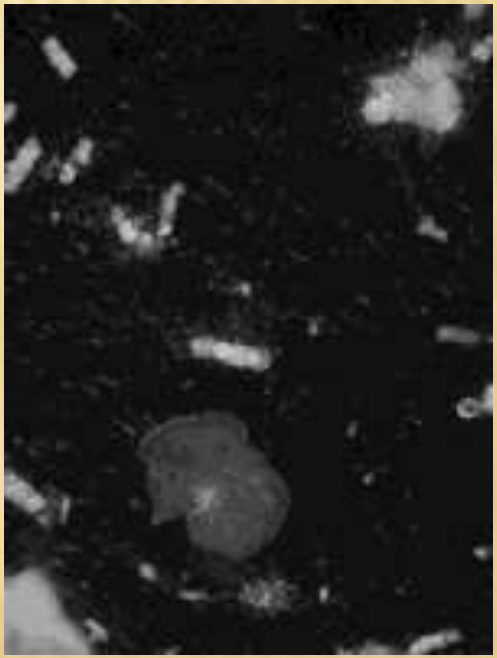
- Placozoa = placozoans = vločkovci
- Hexactinellida = hexactinellid sponges = křemitky
- Demospongiae = sponges = houbovci
- Homoscleromorpha = homoscleromorph sponges = plakíny
- Calcispongea = calcare
- Ctenophora = comb je
- Cnidaria = cnidarians
- Bilateria = bilateria
  - dvoustranně souměrní

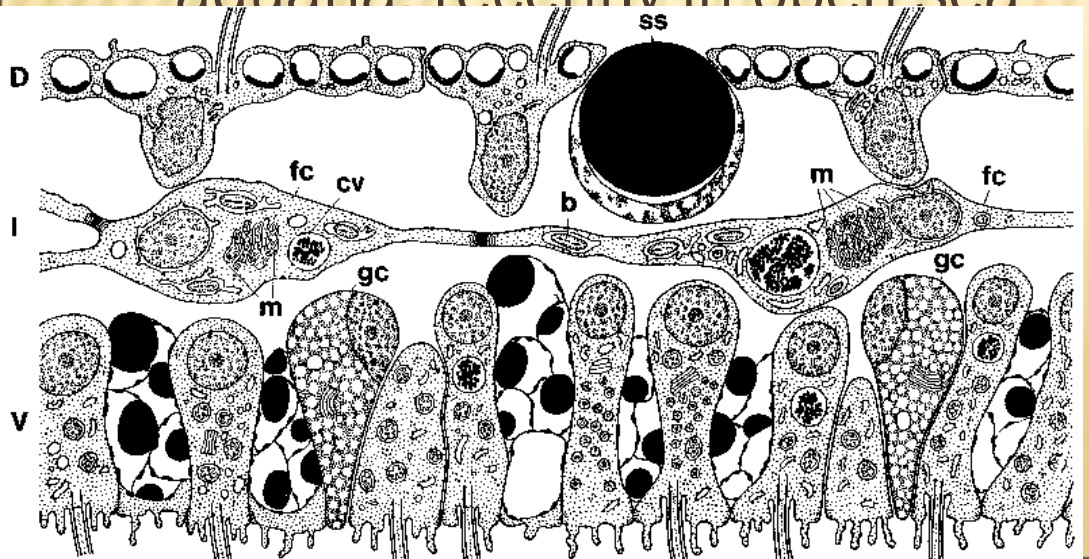


PLACOZOA

- body plan
  - flat, two cell layers, 4 cell types
  - iregular
  - several mm
- marine
  - observed in 1883 in marine aquaria, recently in open sea

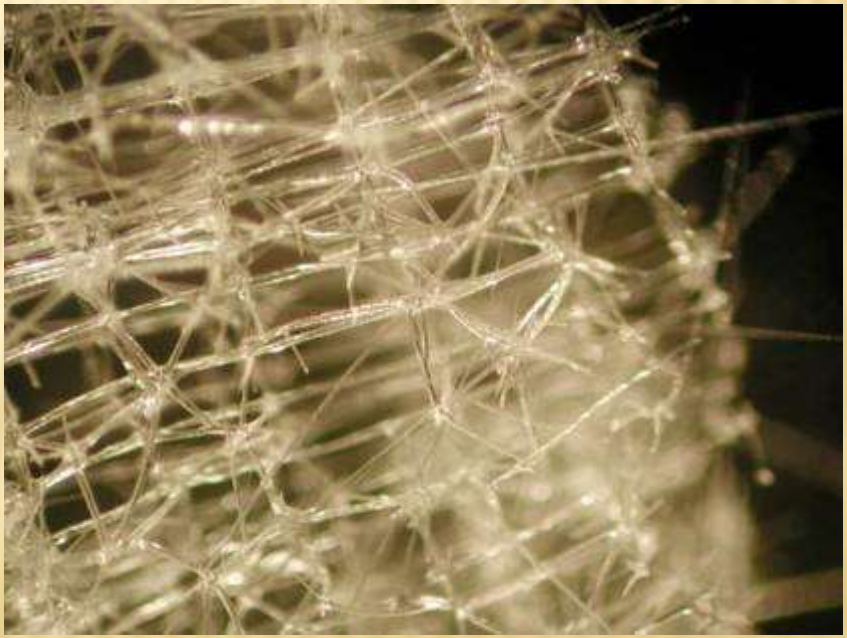






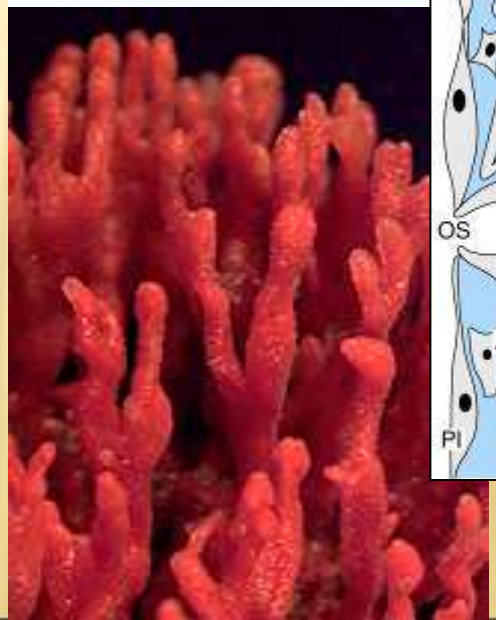
HEXACTINELLIDA

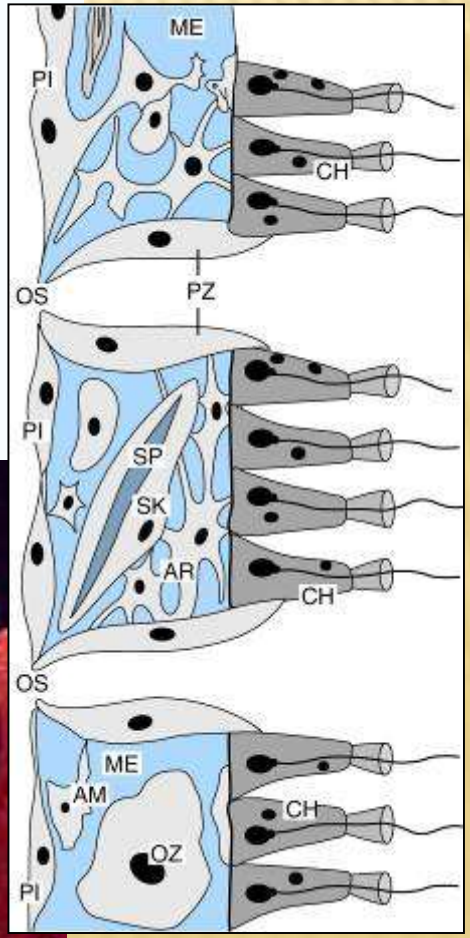
- body plan
  - many inhalant channels (ostia)
  - one common exhalant = osculum
  - syncytial „skin“, 10 cell types
  - silicious spicules
- deep sea



DEMOSPONGIA (SYN. SILICISPONGEA)

- body plan
  - many inhalant channels (ostia), one common exhalant = osculum
  - multicellular „skin“, 20 cell types
  - silicious spicules, calcareous spicules, spongin
- sea: large colourful spp., fresh water





DEMOSPONGIA

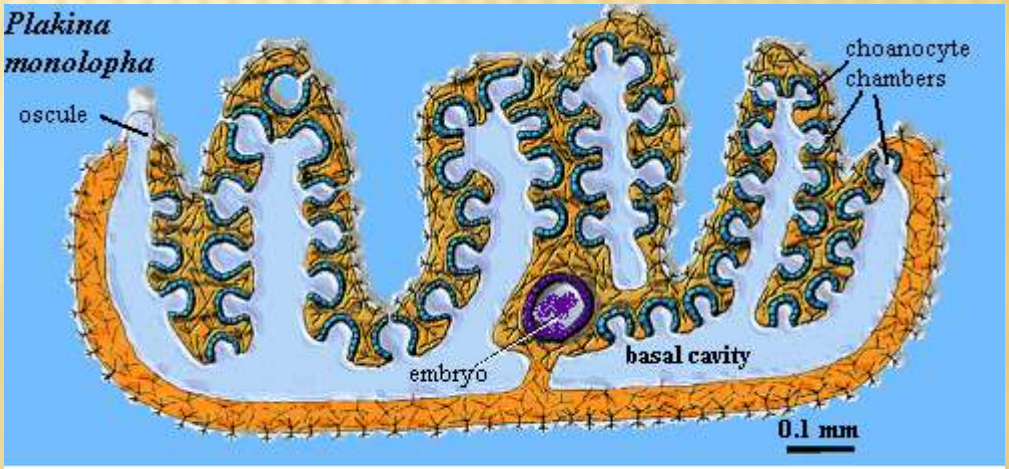
- food
  - filtrators
  - photosynthetic symbionts (*Verongia*)

CALCISPONGEA

- body plan
  - smaller, simpler, calcium carbonate
- marine

HOMOSCLEROMORPHA

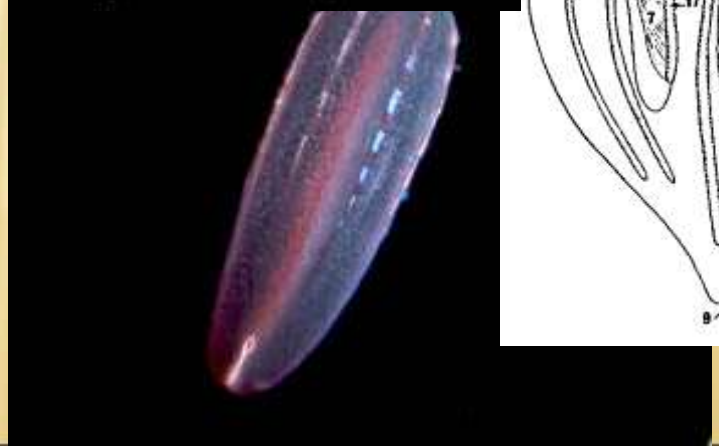
- body plan
  - flat lichen-like layers on rocks
- marine
- basal lamina

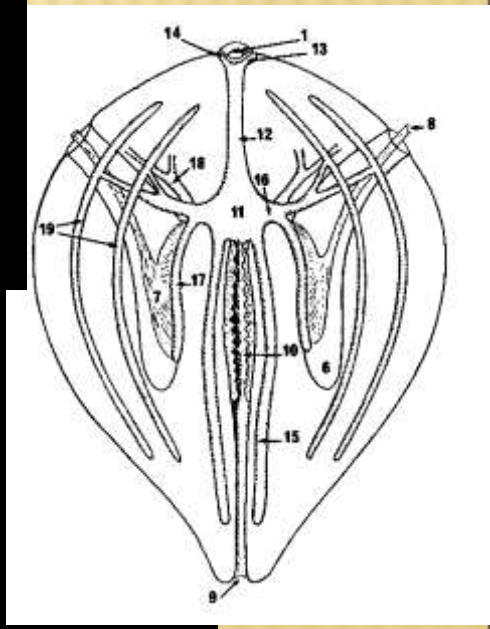


Cross-section of basal homoscleromorph. Adapted from Muricy et al. (1998)

CTENOPHORA = COMB JELLY

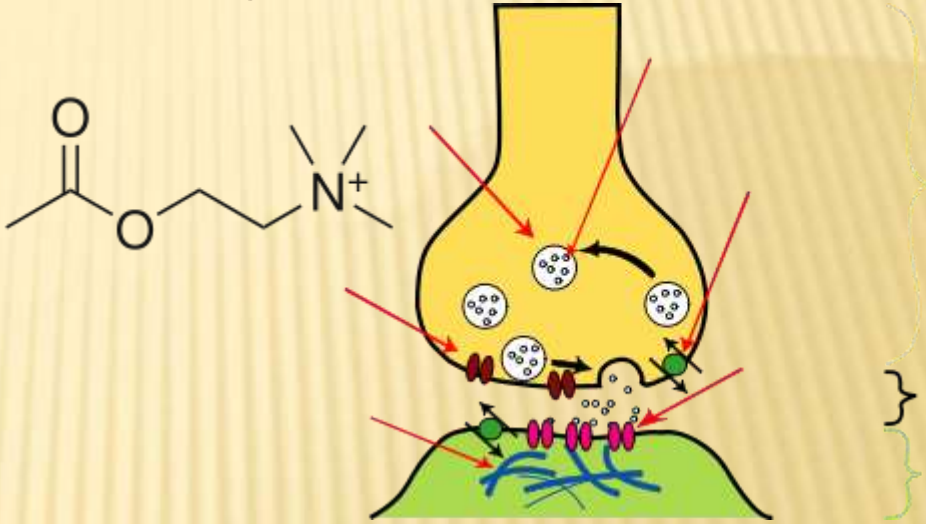
- body plan
  - biradially symmetrical
  - ectoderm, endoderm: epithelium = basal membrane
  - mezoglea
  - mouth opening
- marine

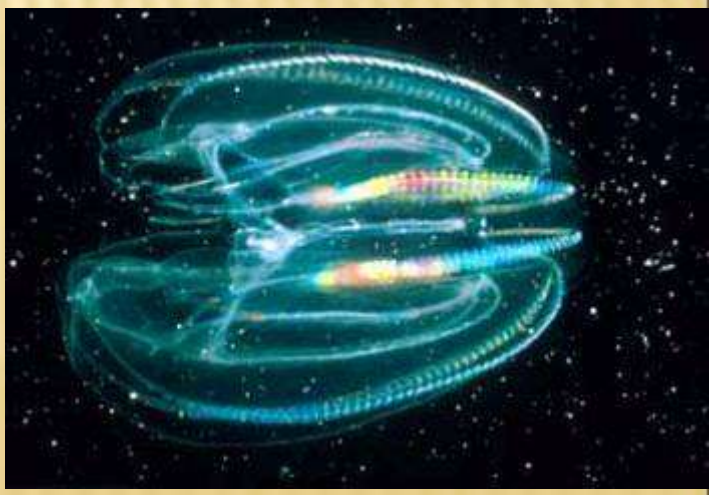




CTENOPHORA = COMB JELLY

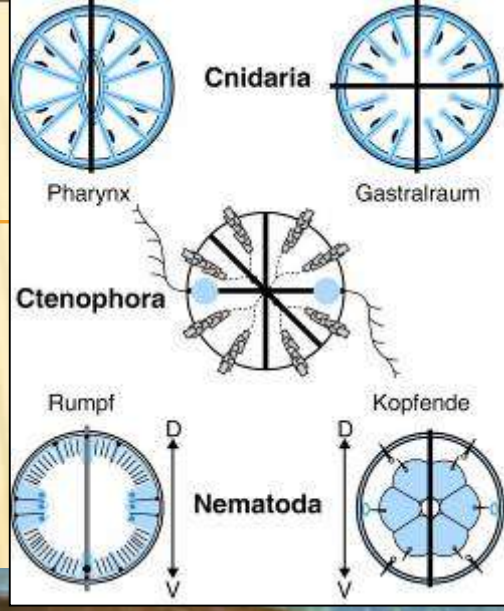
- nerves
  - synapse with neurotransmitter acetylcholine
- food
  - predators
    - adhesive cells = colloblasts
  - filtrators
- reproduction sexual
  - hermaphrodites
- swimming
  - 8 ciliated plates
  - bioluminiscence

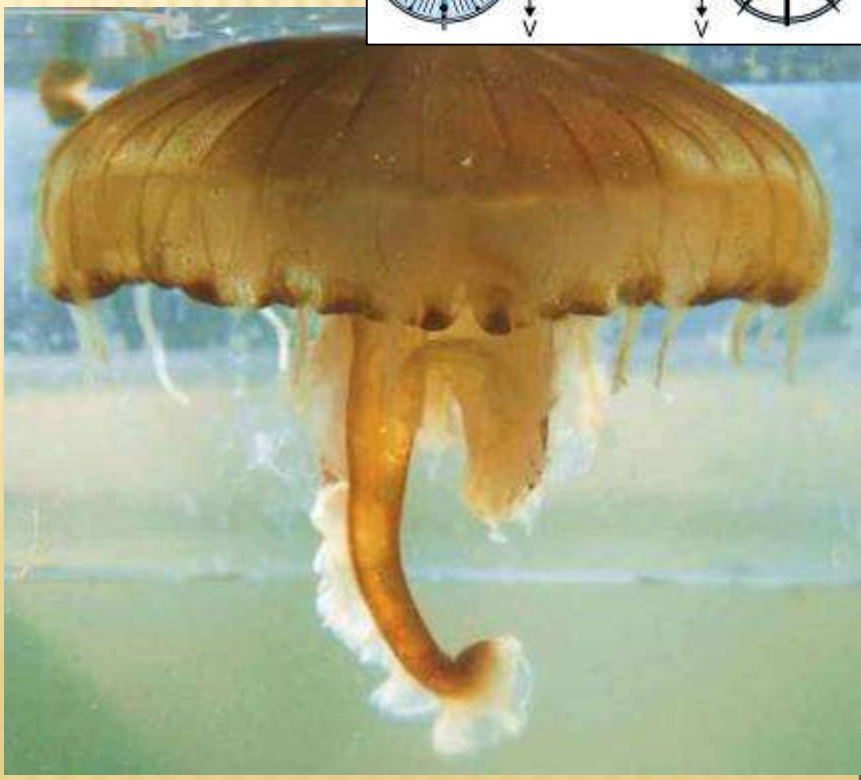




CNIDARIA

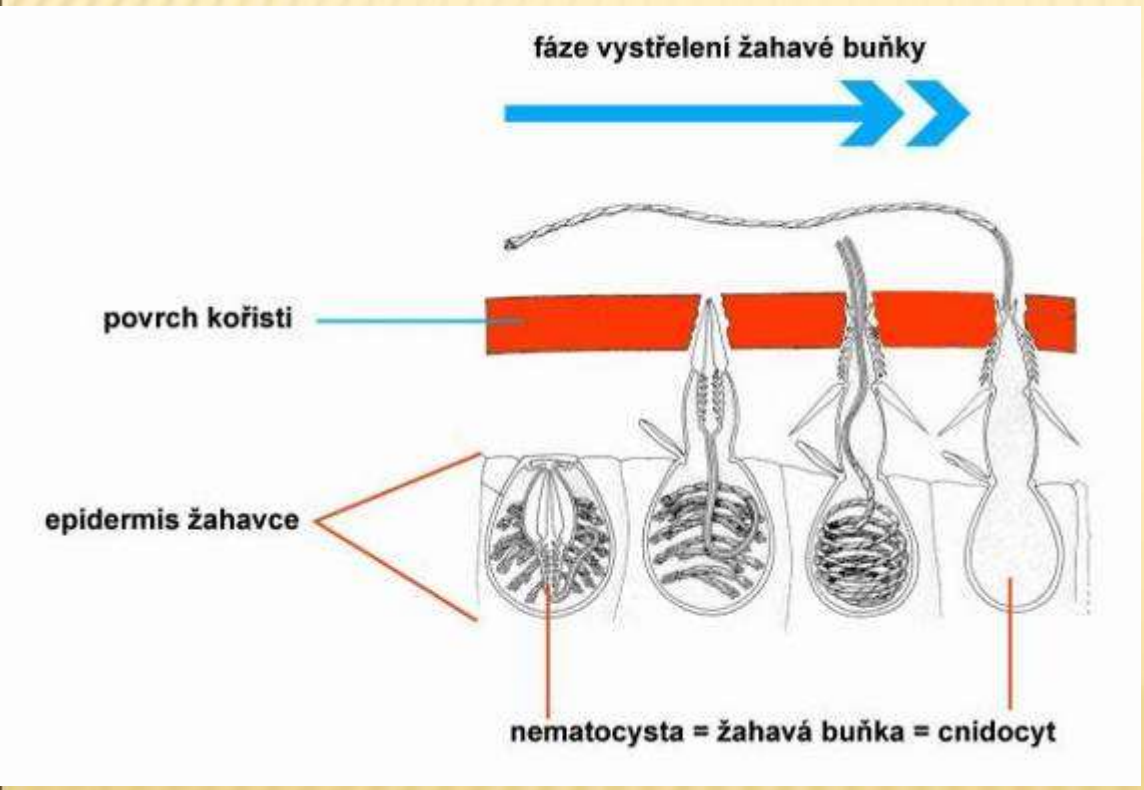
- body plan
  - biradial to radial (4, 6, 8)
  - ectoderm, endoderm, mezoglea
  - mouth opening
- corals, anemones, hydras, medusae, cubozoans

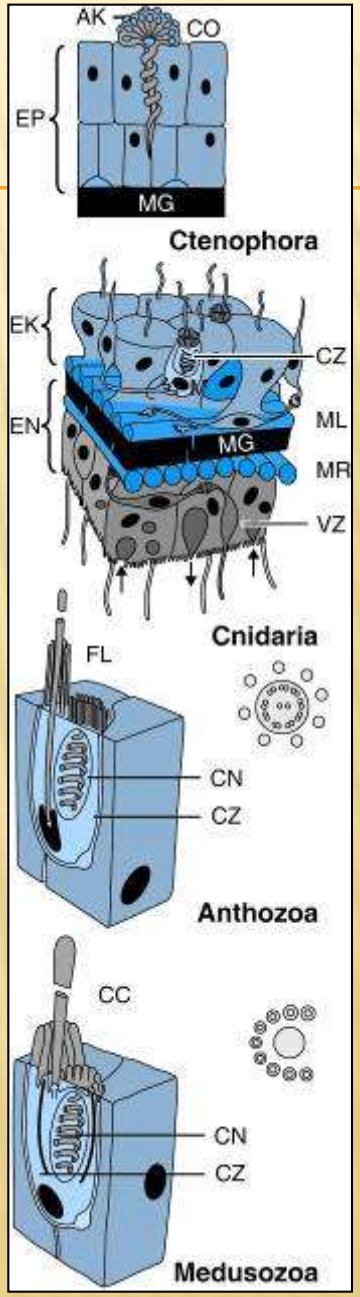




CNIDARIA

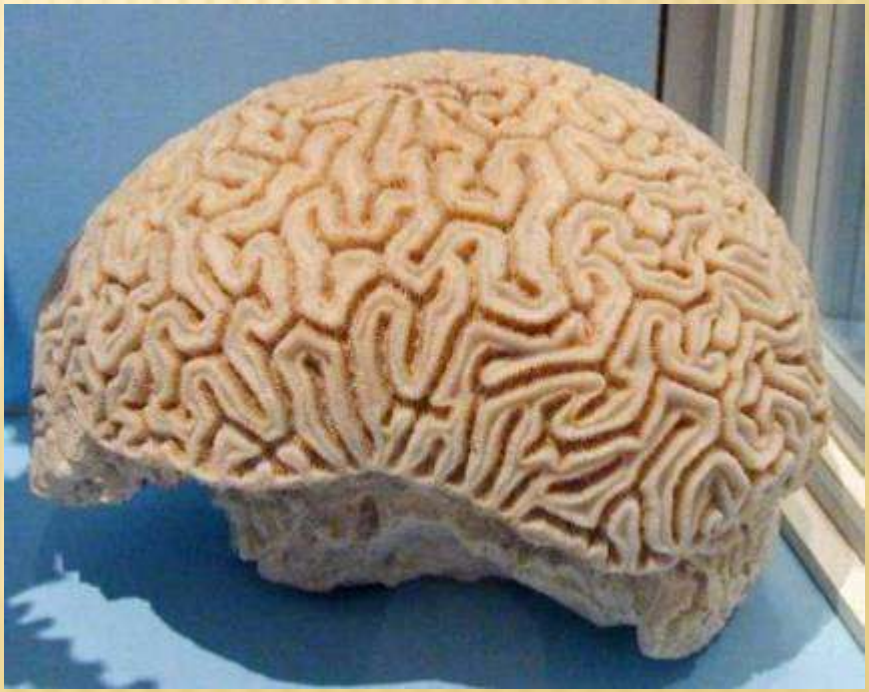
- cnidocytes
- venom
  - proteins





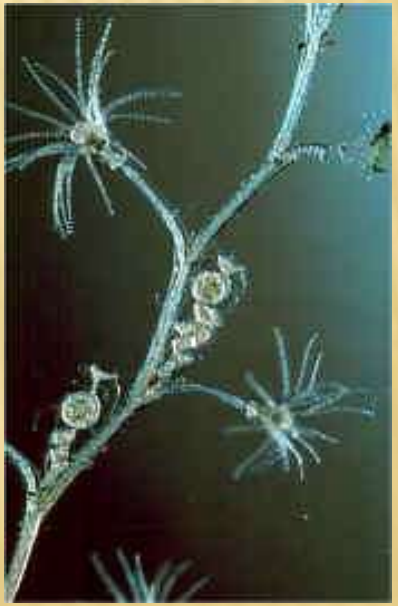
CNIDARIA

- skeleton
  - protein
  - chitin
  - calcium carbonate
    - coral reefs



CNIDARIA

- coloniality

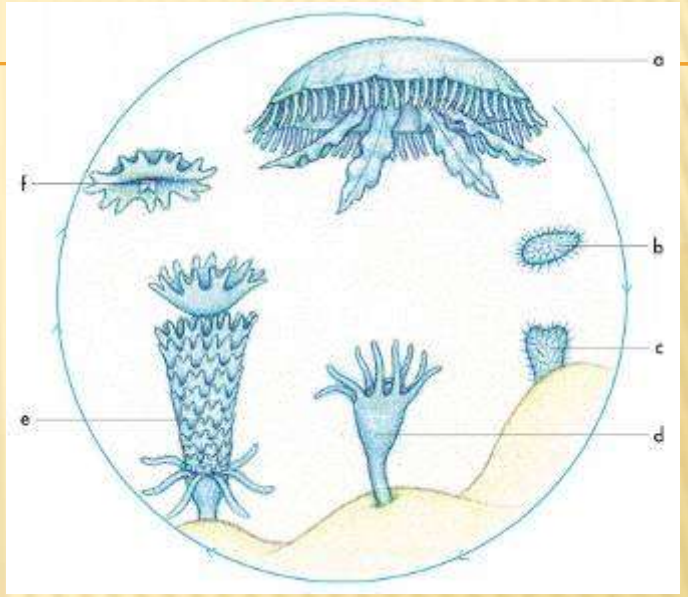


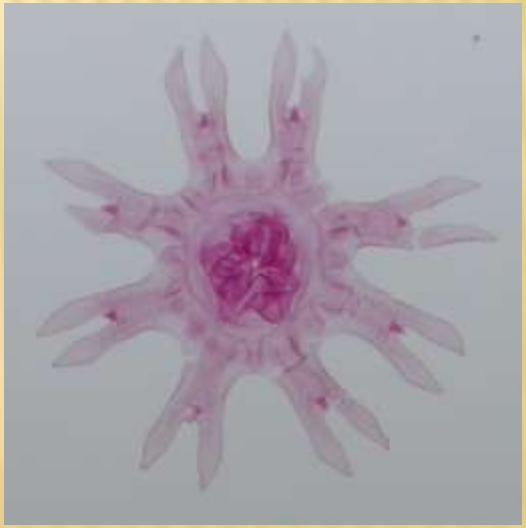
CNIDARIA

- food
- predators
- filtrators
- zooxanthela = Dinoflagellata

CNIDARIA

- reproduction
  - sexual
  - asexual
    - budding
    - strobilation
    - fragmentation
  - heterogony
    - polyp - medusa





CNIDARIA

- respiration (breathing)
  - body surface
  - oxygen from symbiotic algae
    - superoxid dismutase
    - katalase
    - peroxidase
- nitrogene excretion
  - ammoniotely

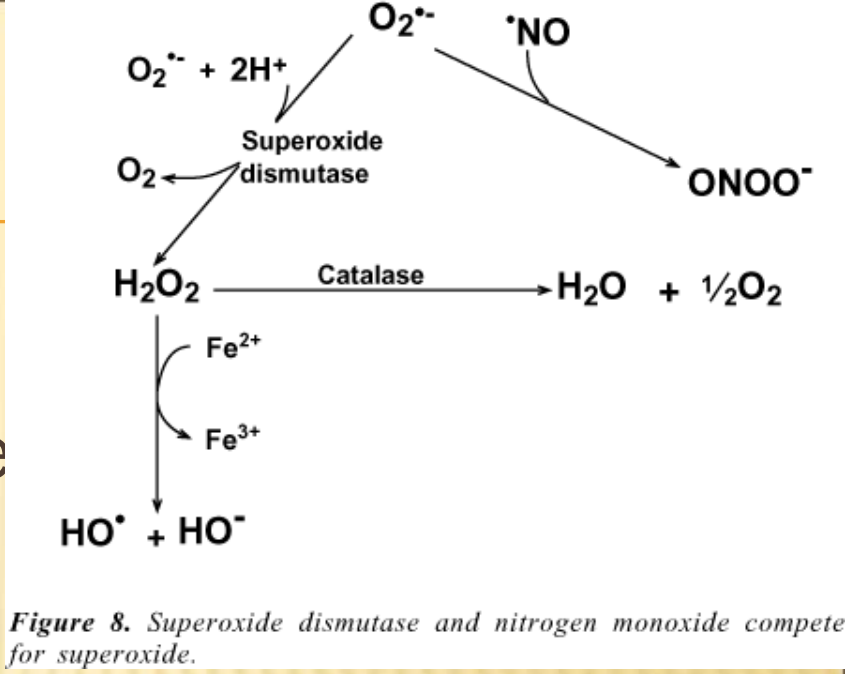
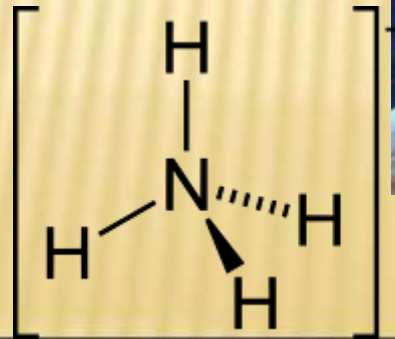
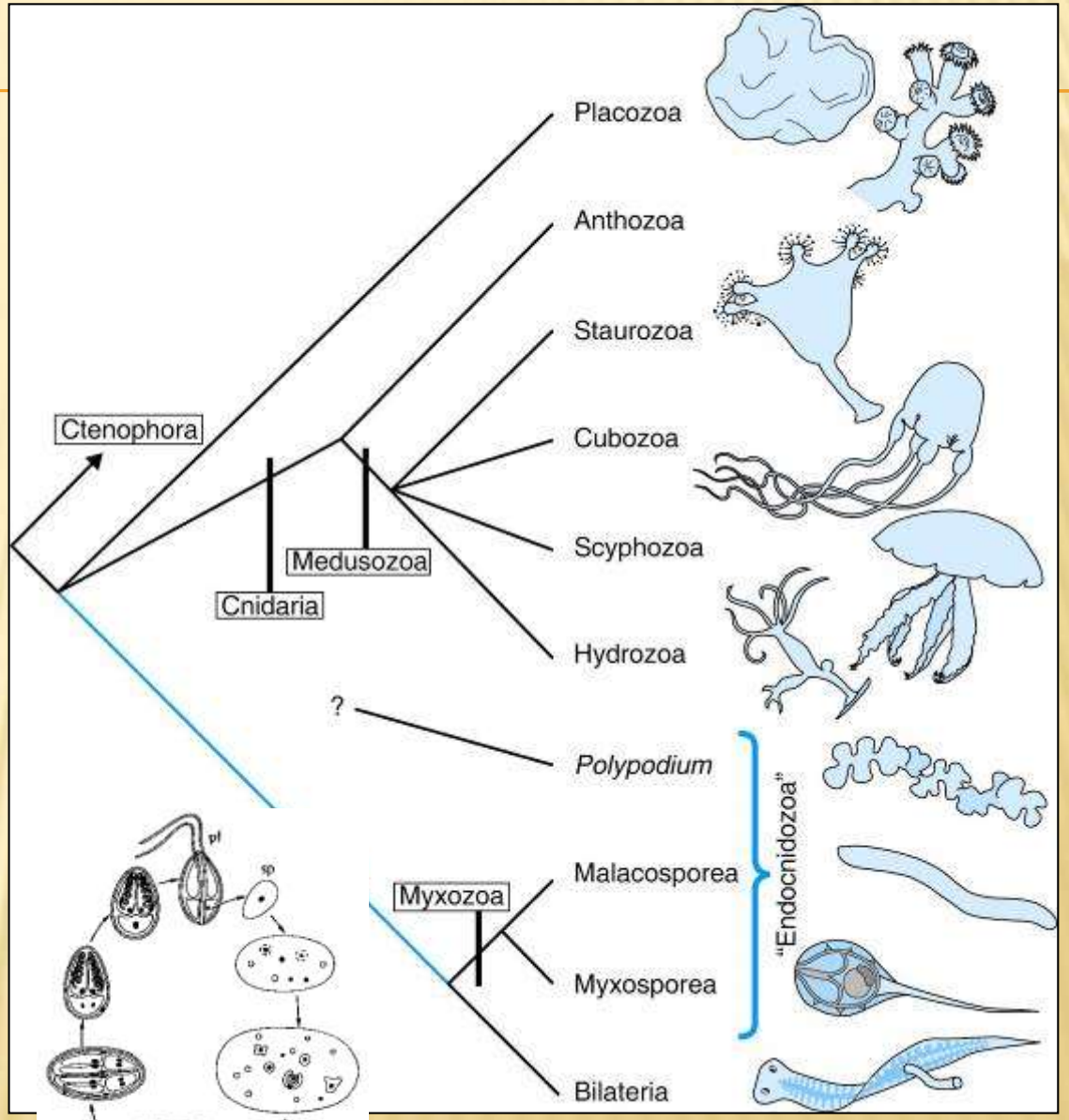


Figure 8. *Superoxide dismutase and nitrogen monoxide compete for superoxide.*



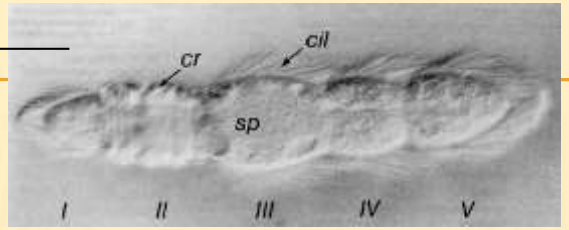
CNIDARIA

1. Anthozoa
   - corals
   - anemones
2. Staurozoa
3. Scyphozoa
   - medusae
4. Cubozoa
5. Hydrozoa
6. Myxozoa



BILATERIA

1. Mesozoa



2. Eubilateria

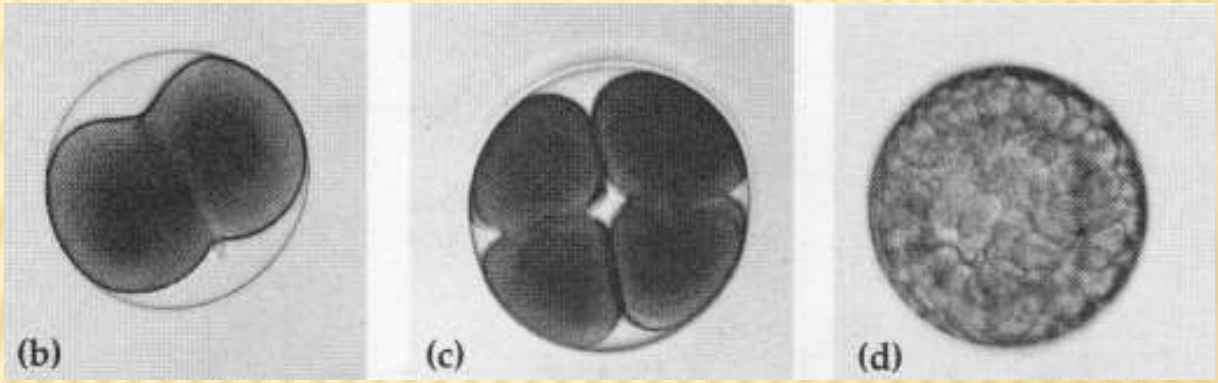
   1. Deuterostomia

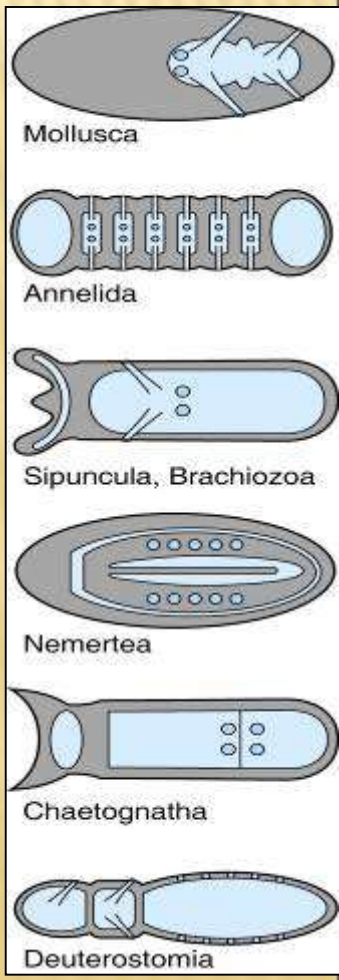
   2. Protostomia

      1. Lophotrochoz
      2. Ecdysozoa

DEUTEROSTOMIA

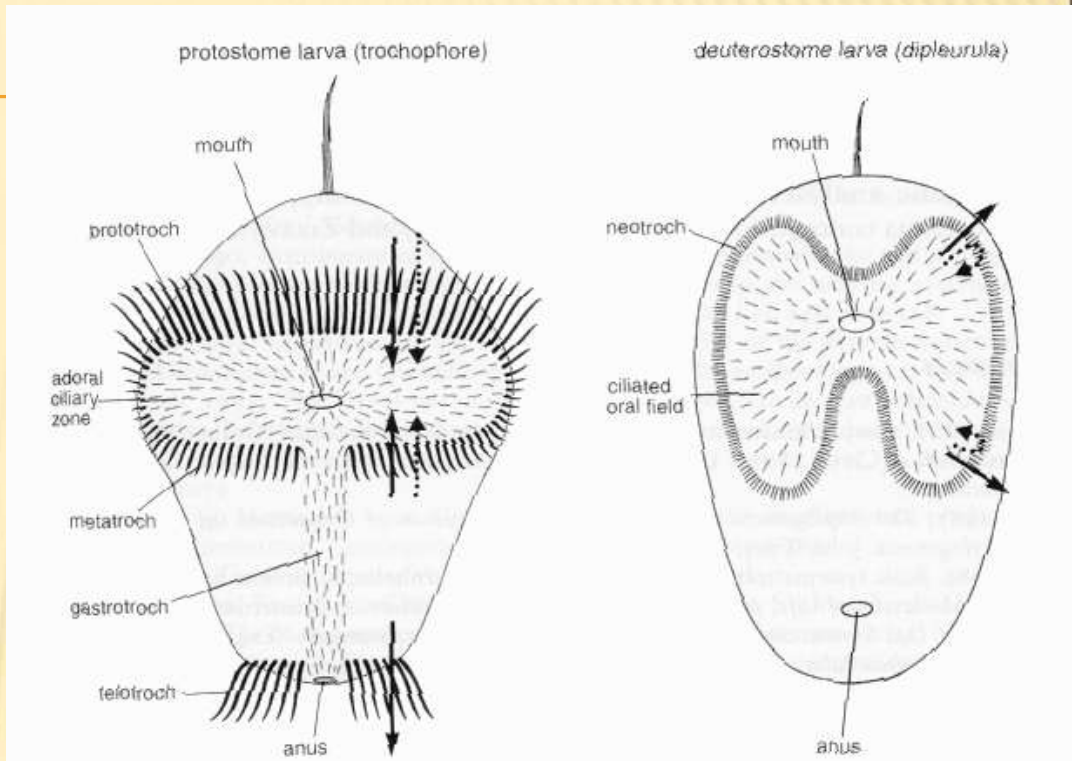
- radial cleavage
- three segmented coelom

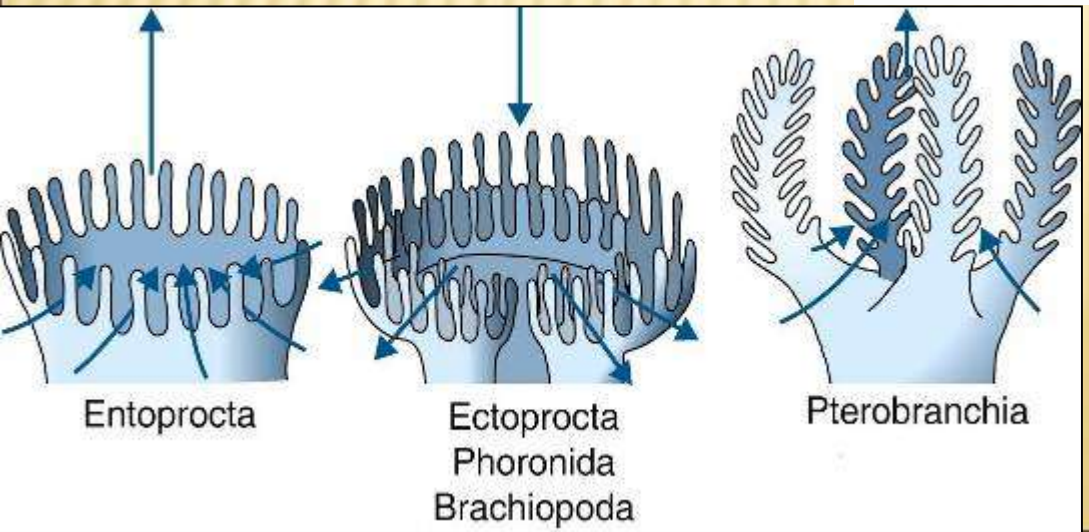




DEUTEROSTOMIA

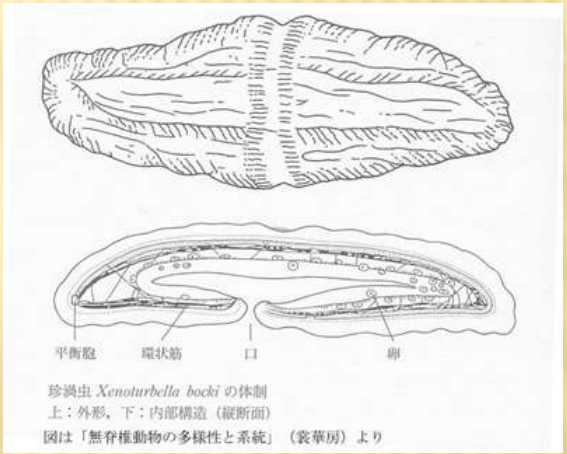
- larva dipleurula
- collecting system



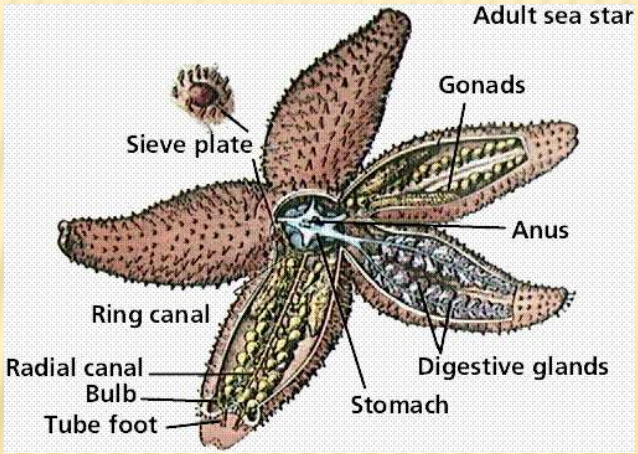


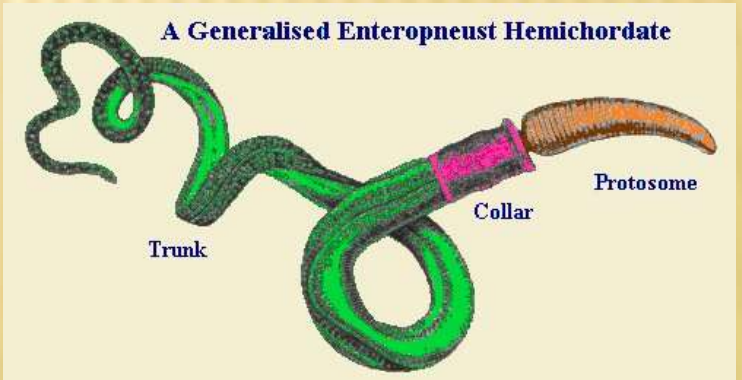
DEUTEROSTOMIA

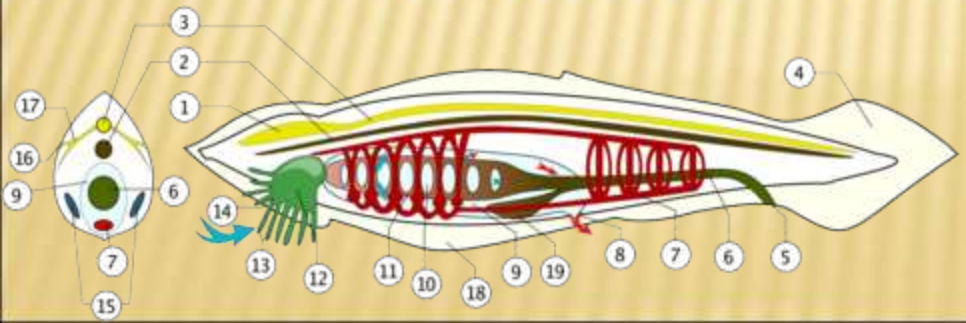
- Acoelomorpha
- Xenoturbellida
- Echinodermata
- Hemichordata
- Chordata

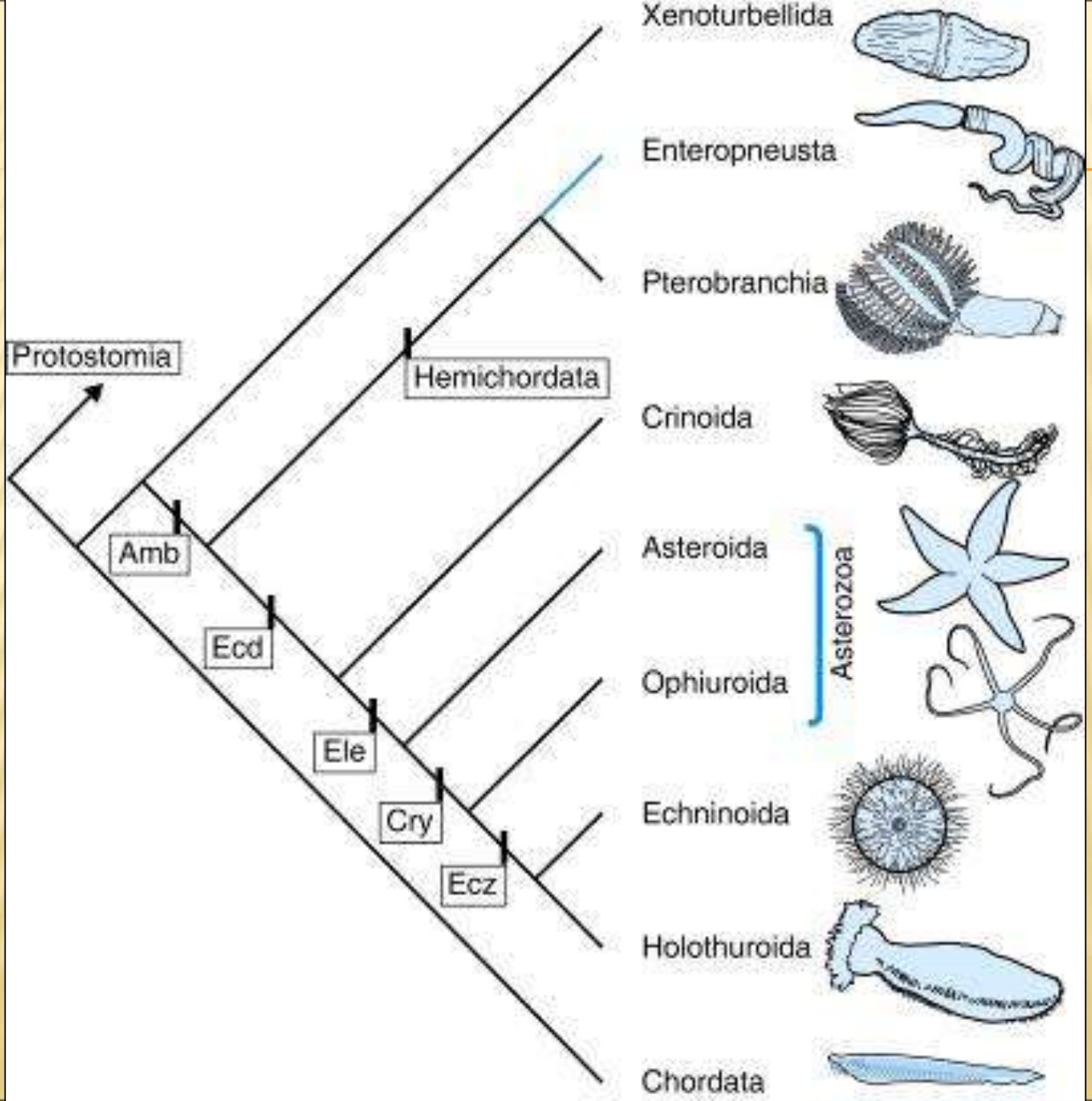


珍渦虫 *Xenoturbella bocki* の体制
上：外形，下：内部構造（縦断面）
図は「無脊椎動物の多様性と系統」（裳華房）より







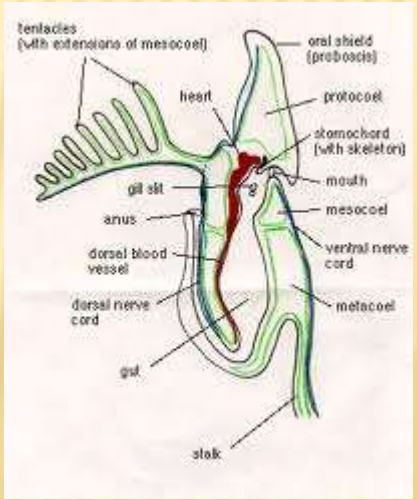

Xenoturbellida
Enteropneusta
Pterobranchia
Protostomia
Hemichordata
Crinoida
Amb
Asteroida
Asterozoa
Ecd
Ophiuroida
Ele
Cry
Echninoida
Ecz
Holothuroida
Chordata

XENOTURBELLIDA

- history
  - described in 1949
  - muddy bottom of Scandinavian fyords (100 m)
  - museum specimens
  - molecular – Mollusca, Bivalvia, Nuculidae, *Nucula tenuis* 97%
  - embryogeny of clams, metamorphosis not seen
  - 2003 new data - Deuterostomia
- body plan
  - slug like
  - 3 cm
  - no brain, neural network
  - no intestine, no excretory organ, no gonad

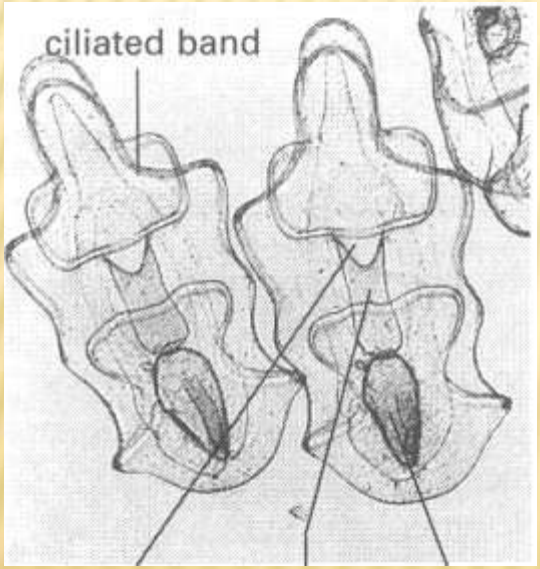
HEMICHORDATA

- stomochord
- pharynx = gill basket
- Enteropneusta
  - digging in sediment
- Pterobranchia
  - filtrators
  - in colonies



ECHINODERMATA

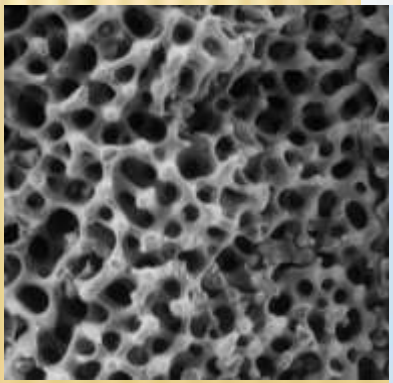
- body plan
  - bilateral larva
  - secondary pentaradial adult
  - terciary pentabiradial

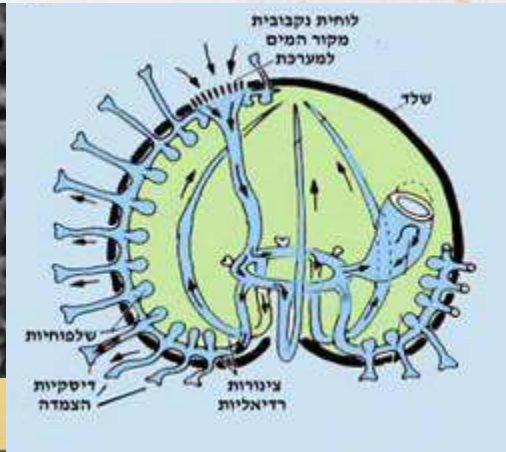


ECHINODERMATA

- skeleton
  - endoskeleton
  - mesodermal
- ambulacral system
  - tubes and sacs
  - madreporit
    - communication with sea water
    - osmoregulation
  - pseudopodia

    hydraulic force



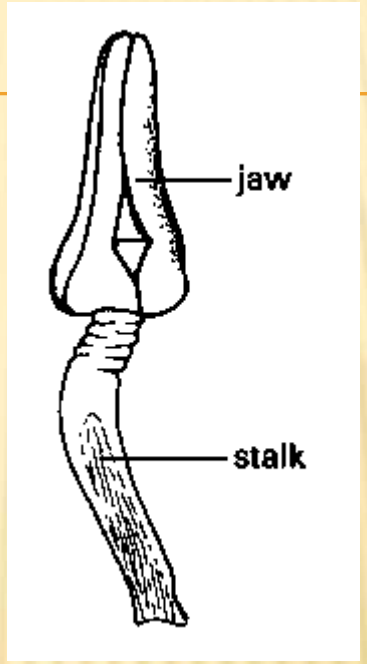


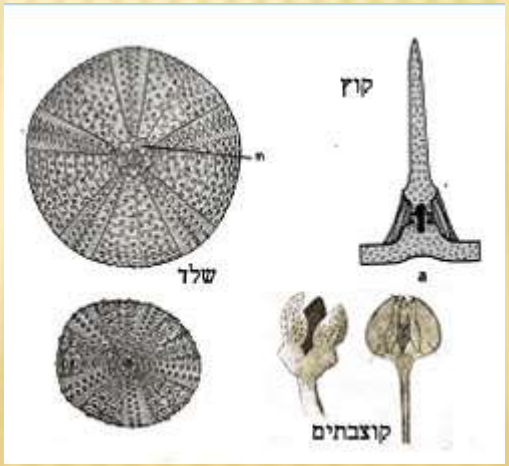
ECHINODERMATA

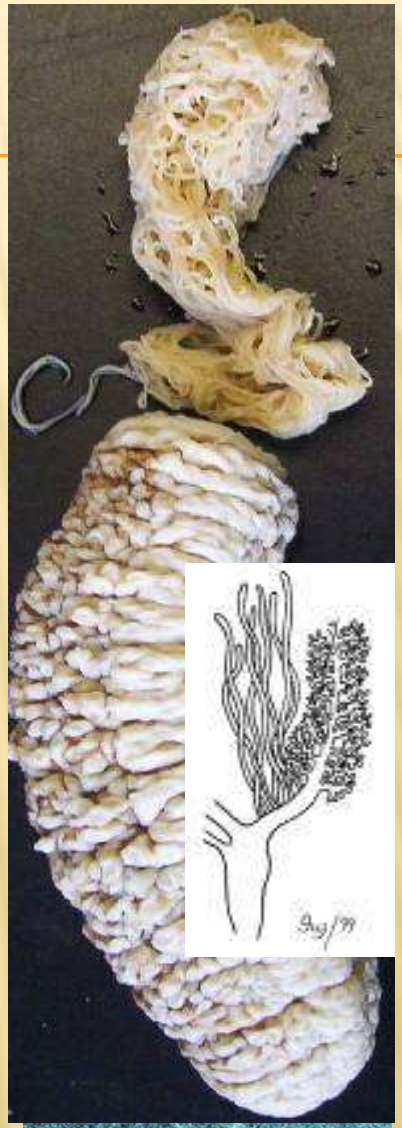
- reproduction
  - sexual
  - asexual
    - paratomy, regeneration
- ecology
  - marine
  - coral reefs - crown of thorns (*Acathaster*)
  - destroy oysters
  - food
    - sushi: urchin eggs, sea cucumbers

ECHINODERMATA

- defence
  - skeleton
  - spines
  - pedicellaria
  - sticky excretion
  - gut autotomy
  - regeneration

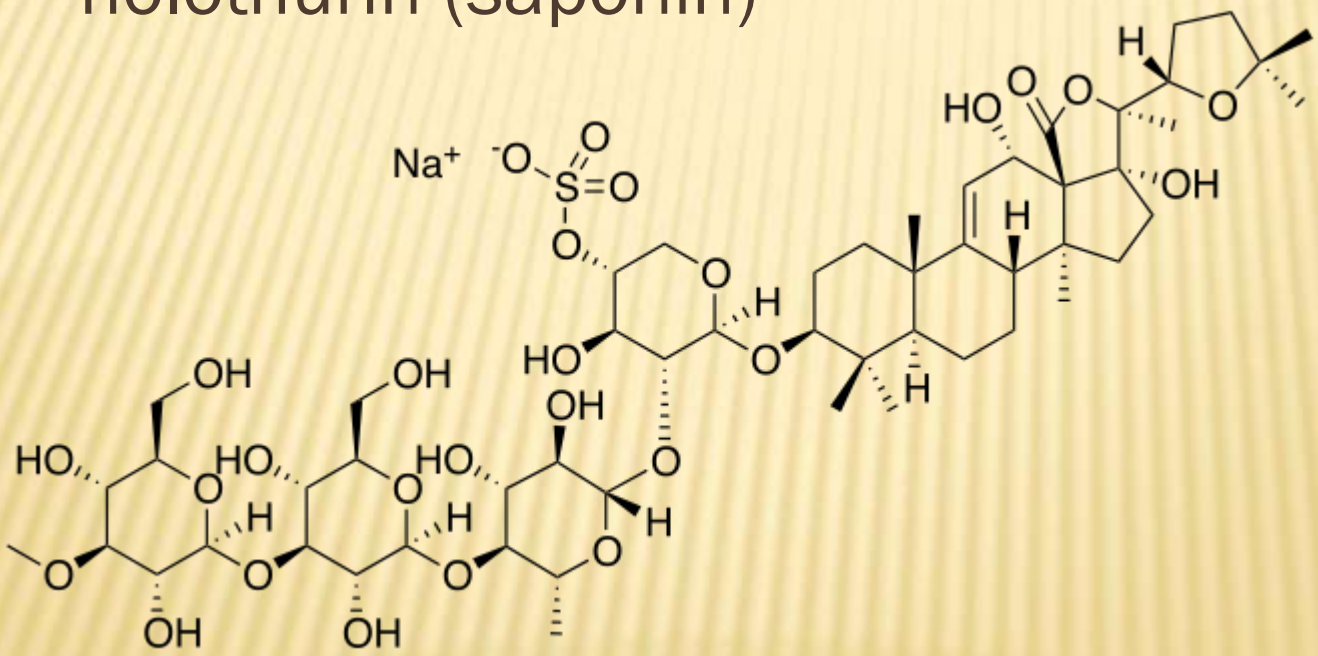






ECHINODERMATA

- defence
  - 60% protein and 40% carbohydrate
  - holothurin (saponin)



ECHINODERMATA

- system - 6000 spp.
  - Crinoida - 550
  - Asteroida – sea stars: 1500
  - Ophiuroida - 2000
  - Echinoida – sea urchins: 950
  - Holothuroida – sea cucumbers 900

CHORDATA