Classification

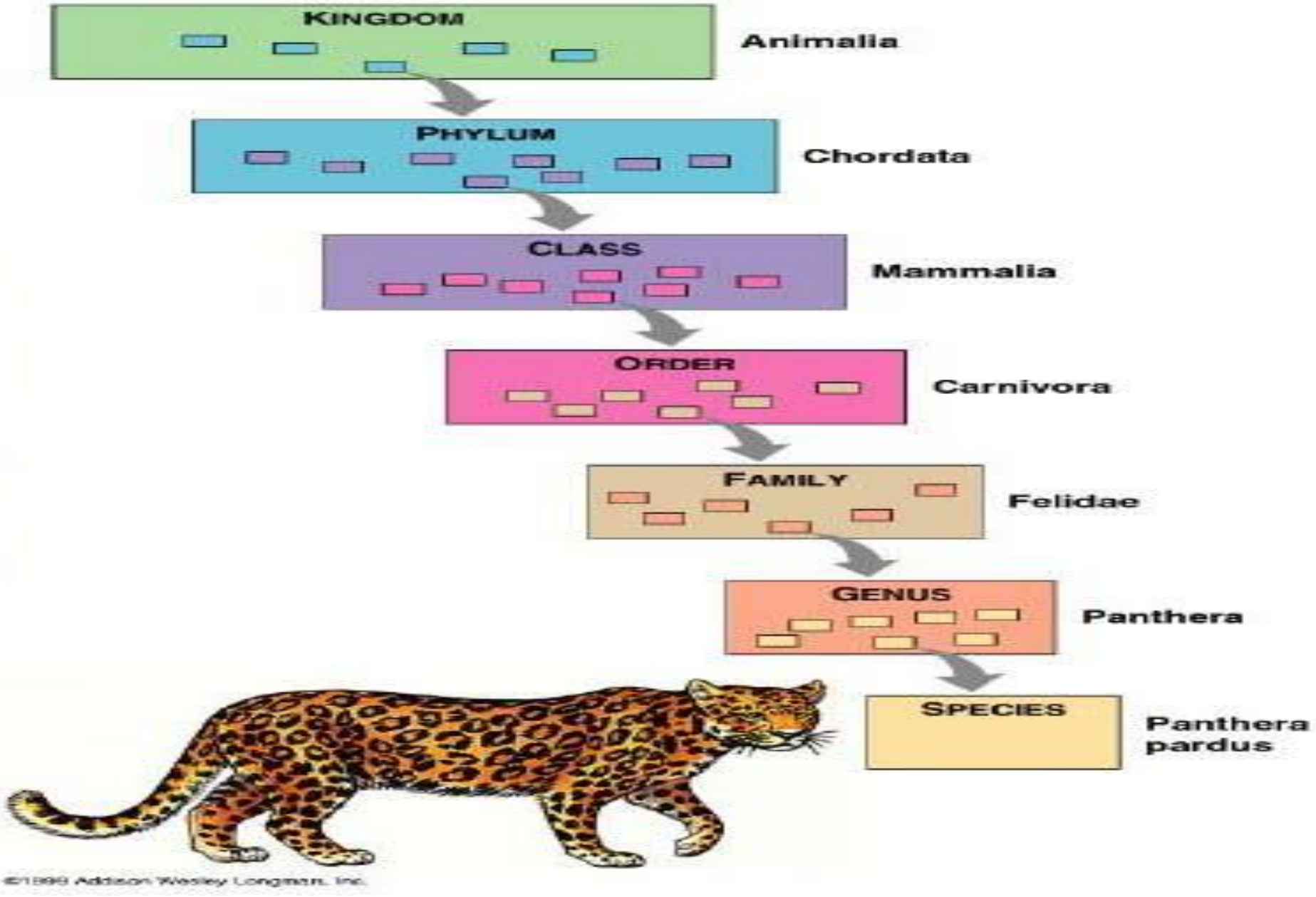
Aristotle 384 BC

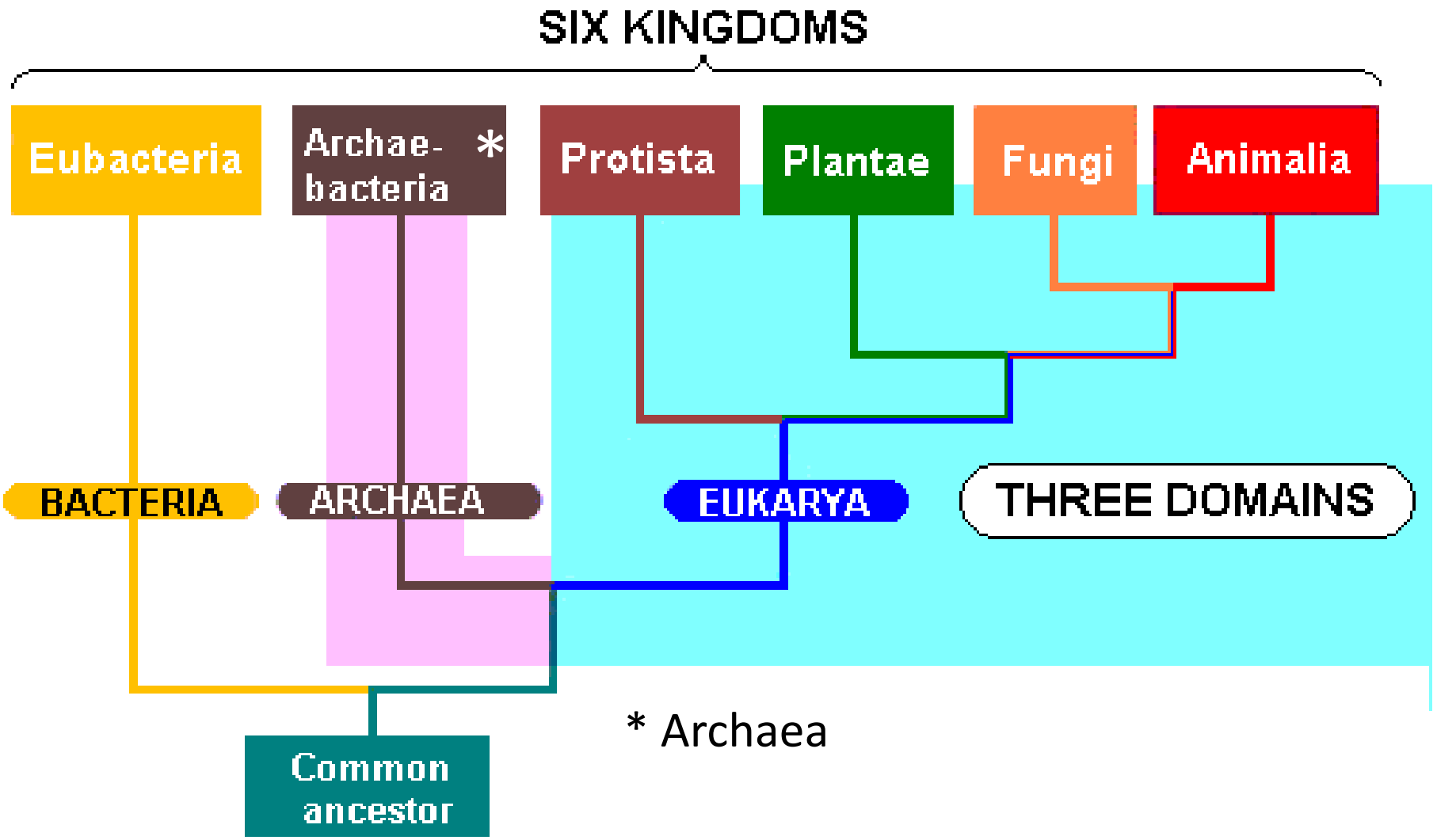
- Classified organisms as either plants or animals

Carolus Linnaeus 1707-1778

- Classification system
- Taxonomic groups of related organisms
- Binomial nomenclature (two names)
- *Homo sapiens*
- *Dermacentor andersoni*

Taxonomic Groups

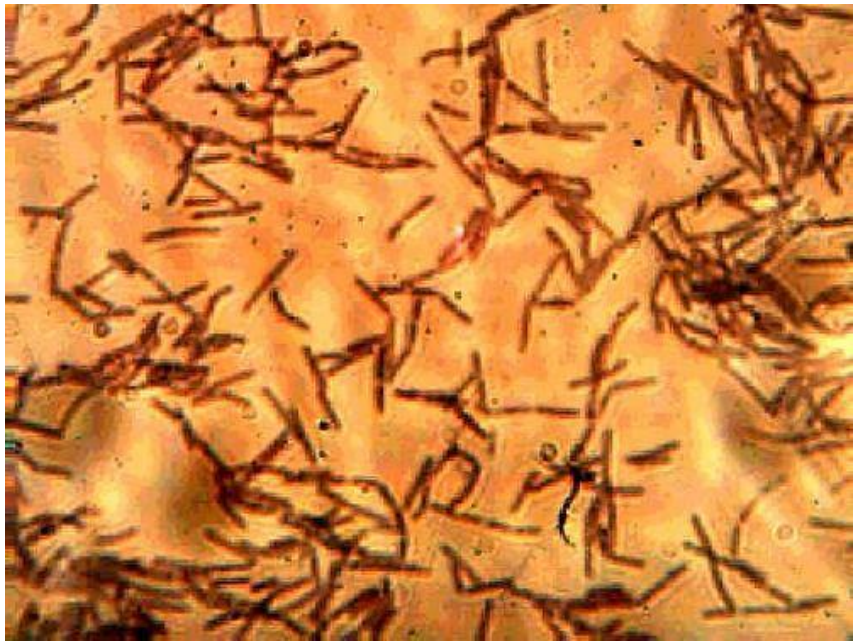



SIX KINGDOMS
Eubacteria
Archae-bacteria *
Protista
Plantae
Fungi
Animalia
BACTERIA
ARCHAEA
EUKARYA
THREE DOMAINS
Common ancestor

* Archaea

Kingdom Monera or Eubacteria

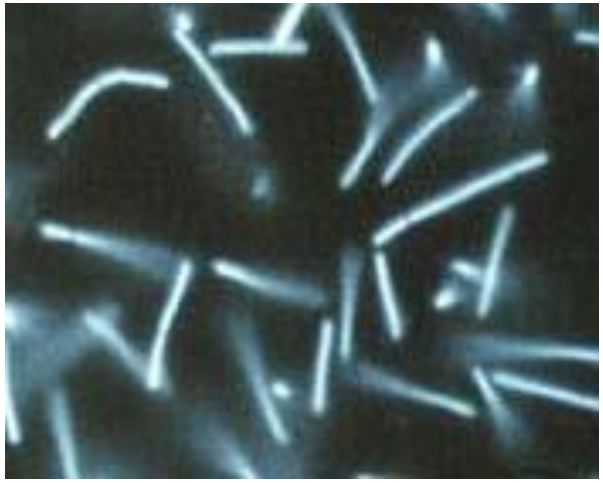
- Single celled
- Prokaryotic
- Make or absorb food
- Cell wall
  - peptidoglycan



Kingdom Archaea

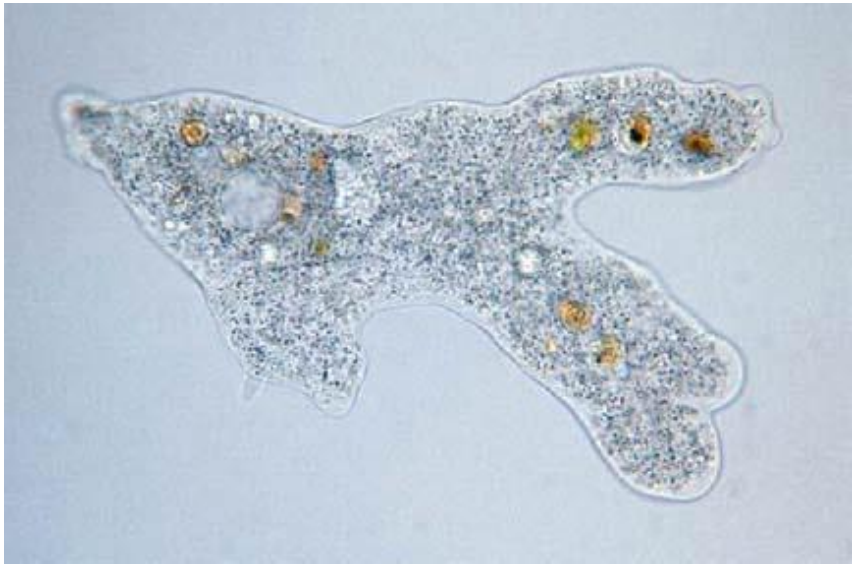
- Single celled
- Prokaryotic
- Make or absorb food
- DNA
  - Similar to Eukaryotic
- Cell wall
  - Pseudopeptidoglycan

  or protein only



Kingdom Protista

- Single celled
- Eukaryotic
- Ingest or produce food



Kingdom Fungi

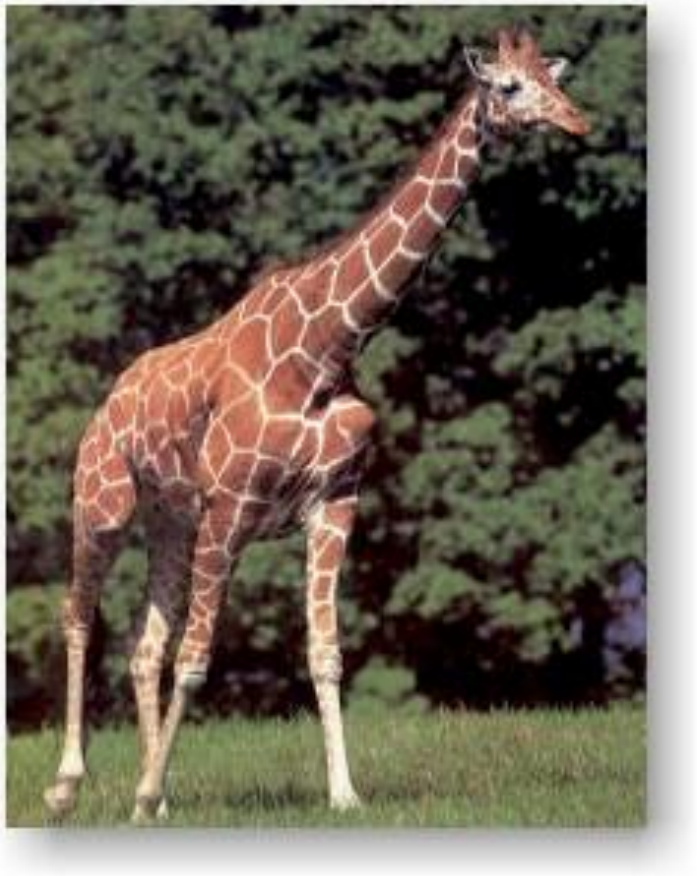
- Multicellular
- Eukaryotic
- Cell wall
  - Chitin
- Absorb food

Kingdom Plantae

- Multicellular
- Eukaryotic
- Cell wall
  - Cellulose
- Produce food
  - photosynthesis

Kingdom Animalia

- Multicellular
- Eukaryotic
- No cell wall
- Ingest food
- Motile

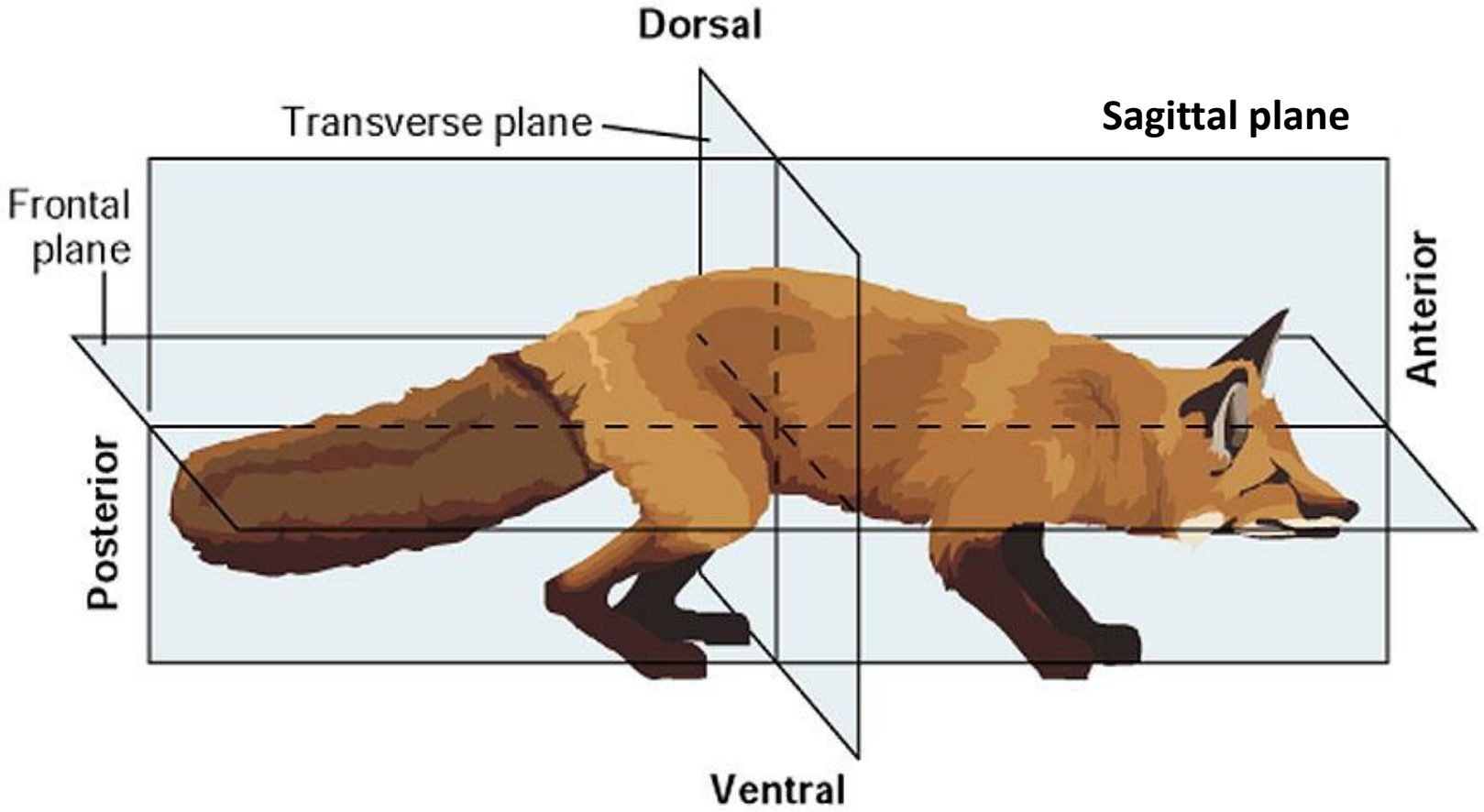


Asymmetry

Bilateral Symmetry

Radial Symmetry

Bilateral Symmetry

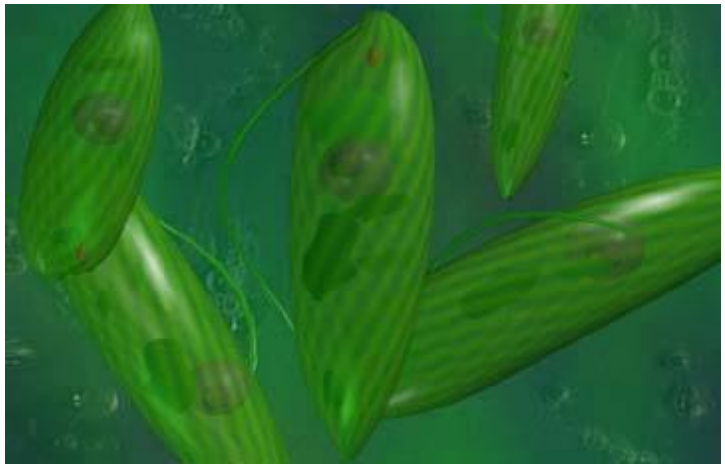


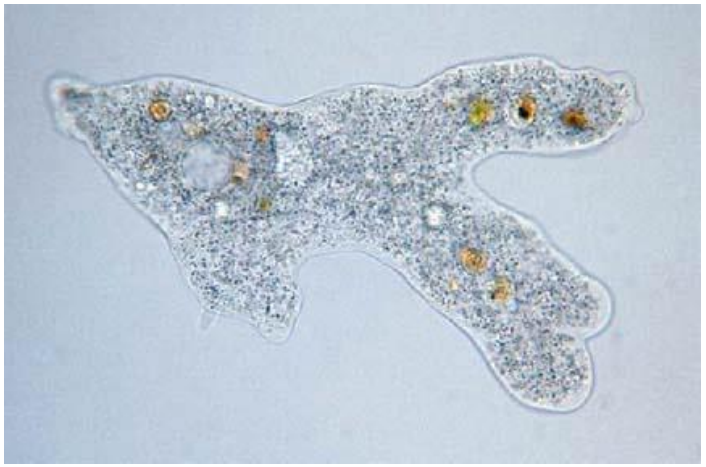
Protista

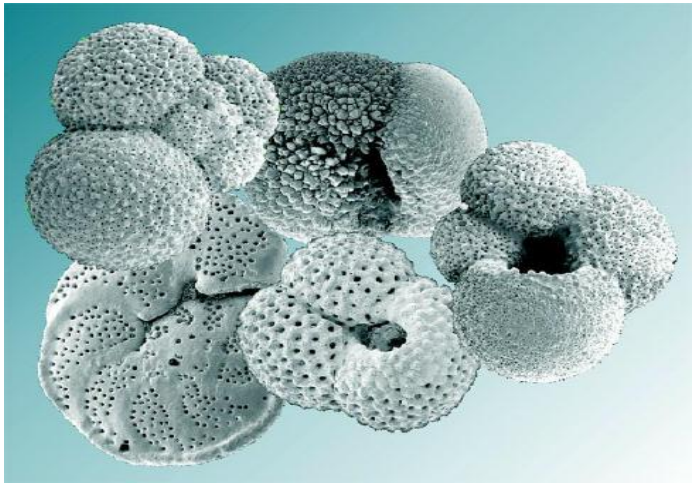
Leewenhoek

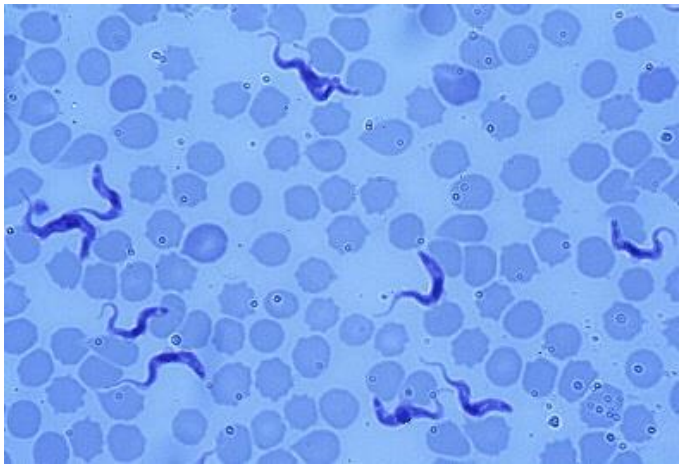
- First observed protozoa in 1675
- animalcules

Protozoa









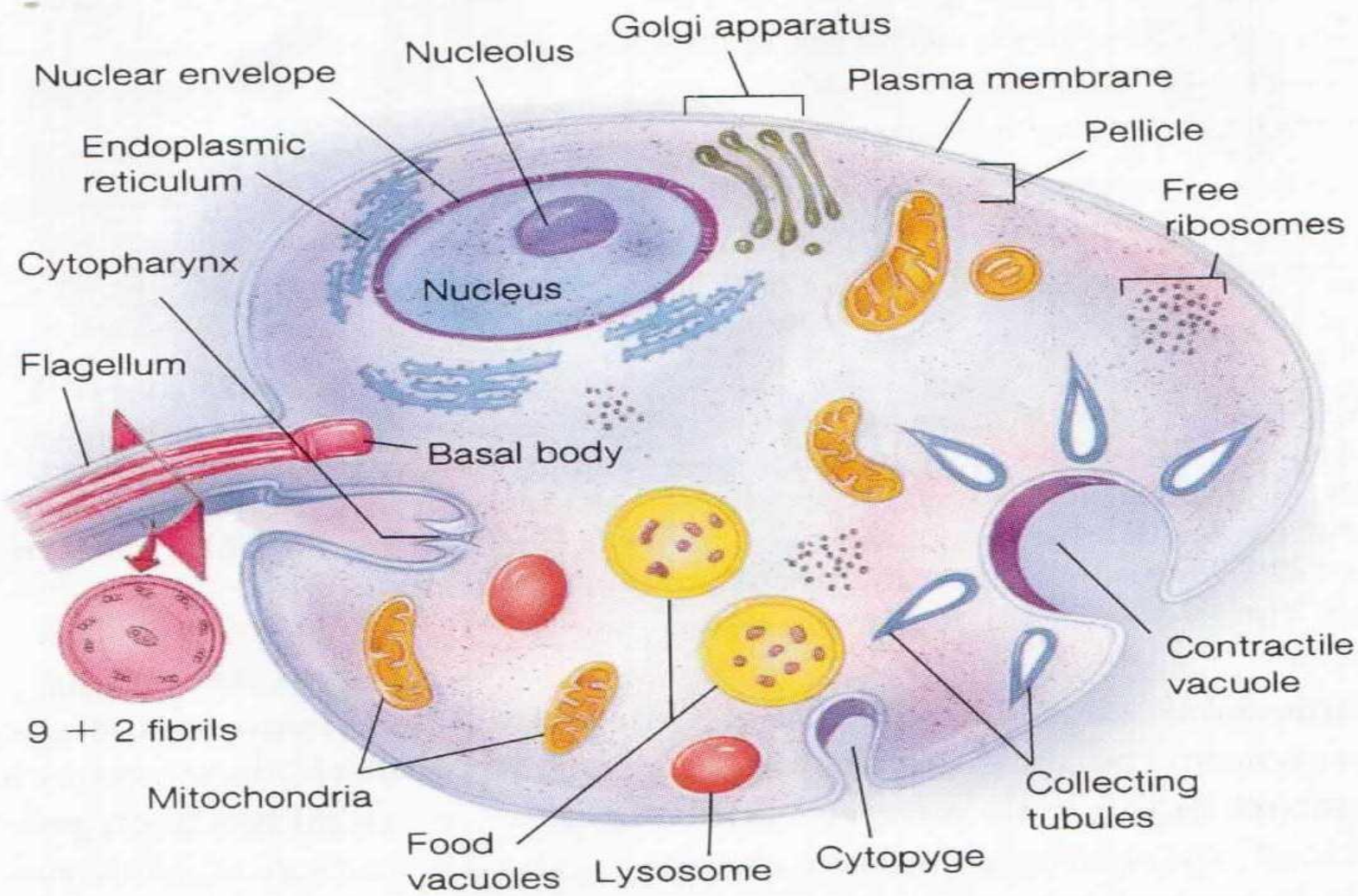
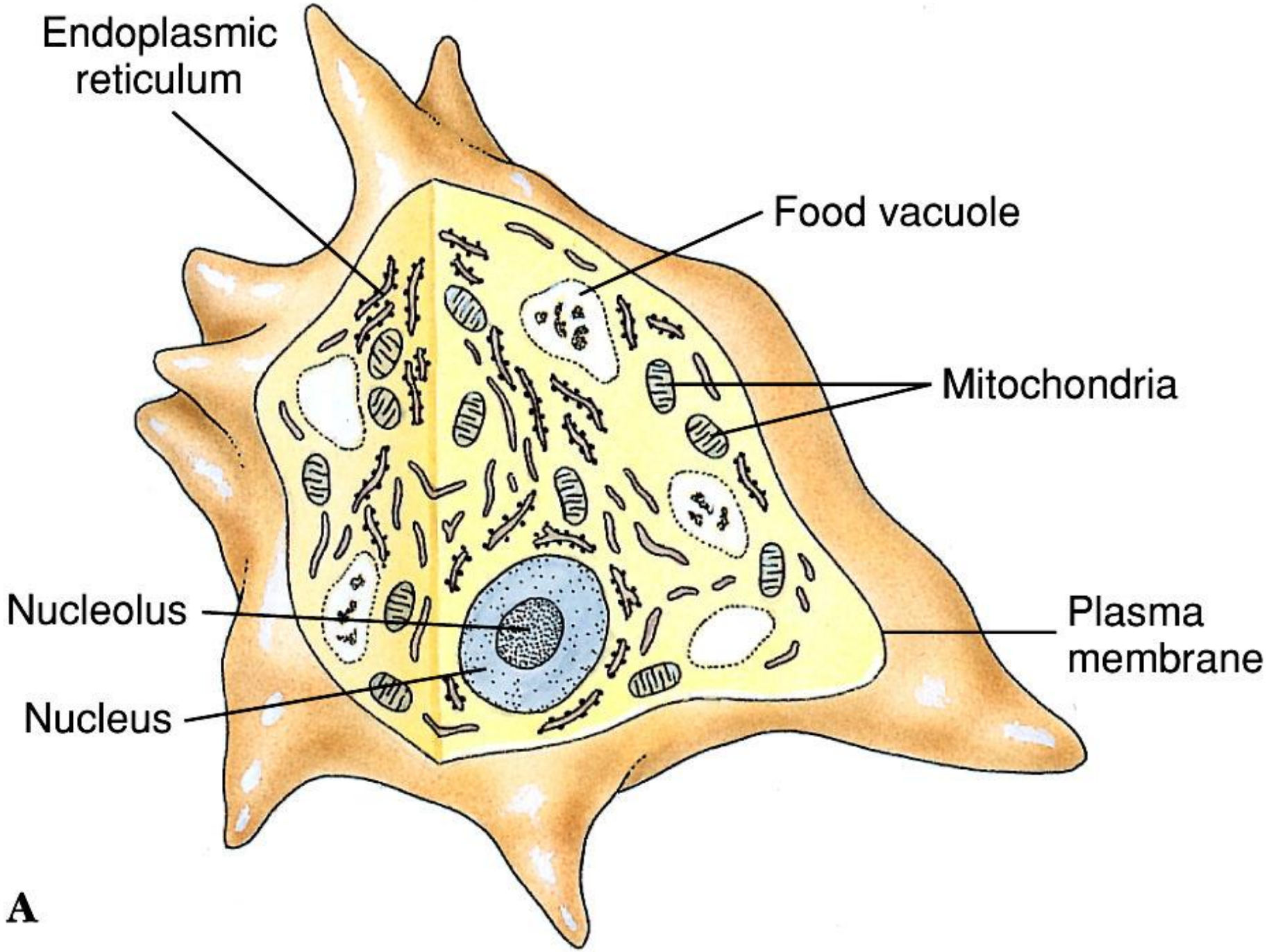
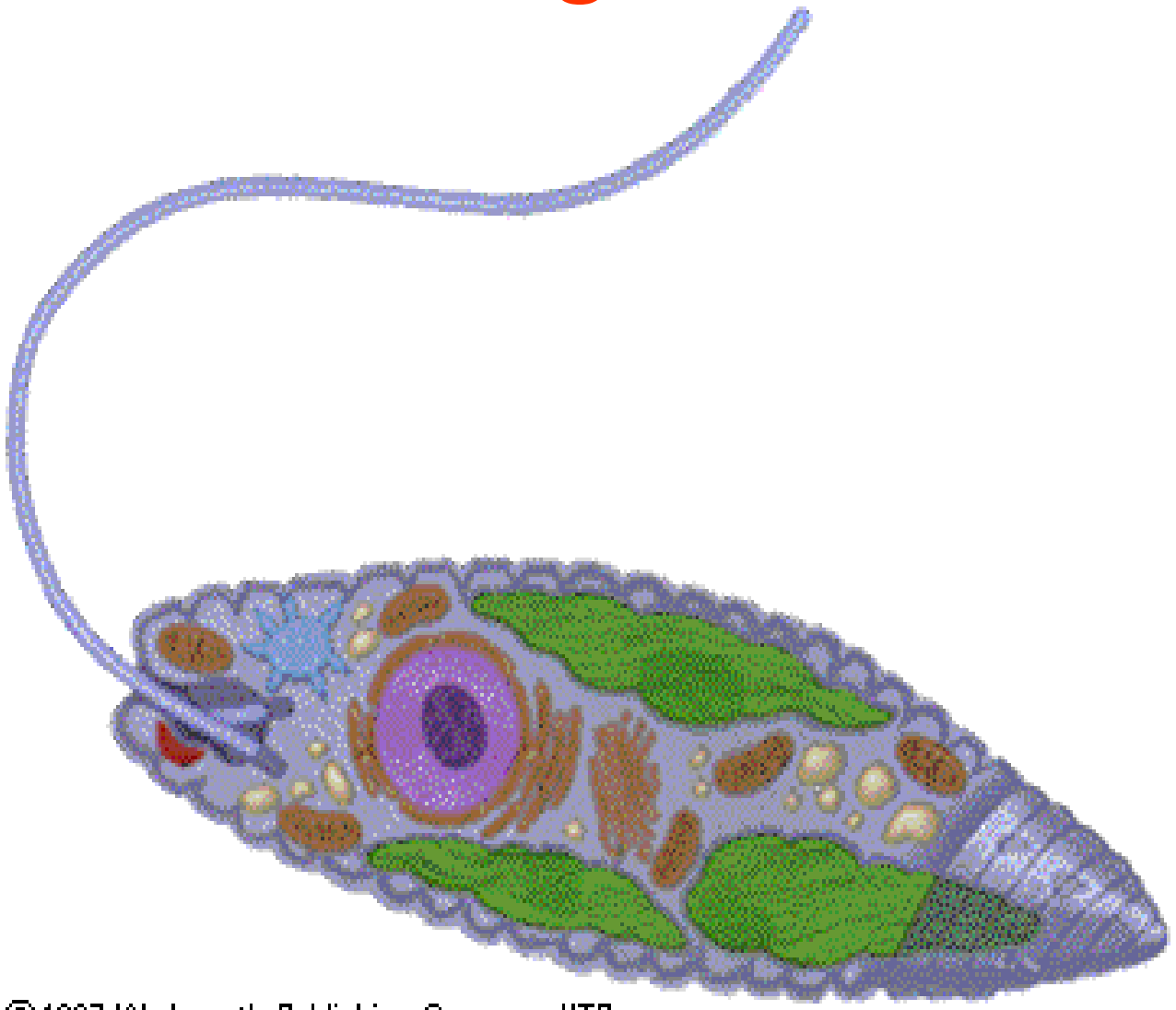


FIGURE 17.3

A Protozoan Protist. This drawing of a stylized protozoan with a flagellum illustrates the basic protozoan morphology. *From:* "A LIFE OF INVERTEBRATES" © *1979 W. D. Russell-Hunter.*



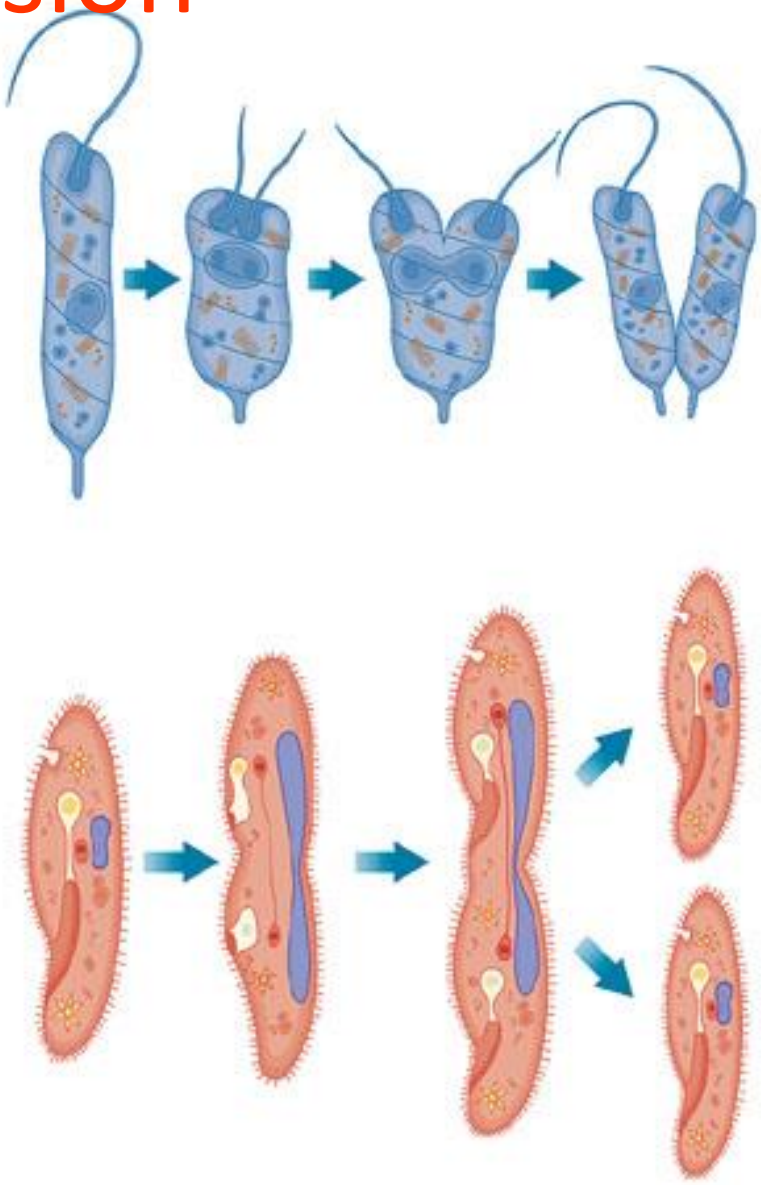
Flagella



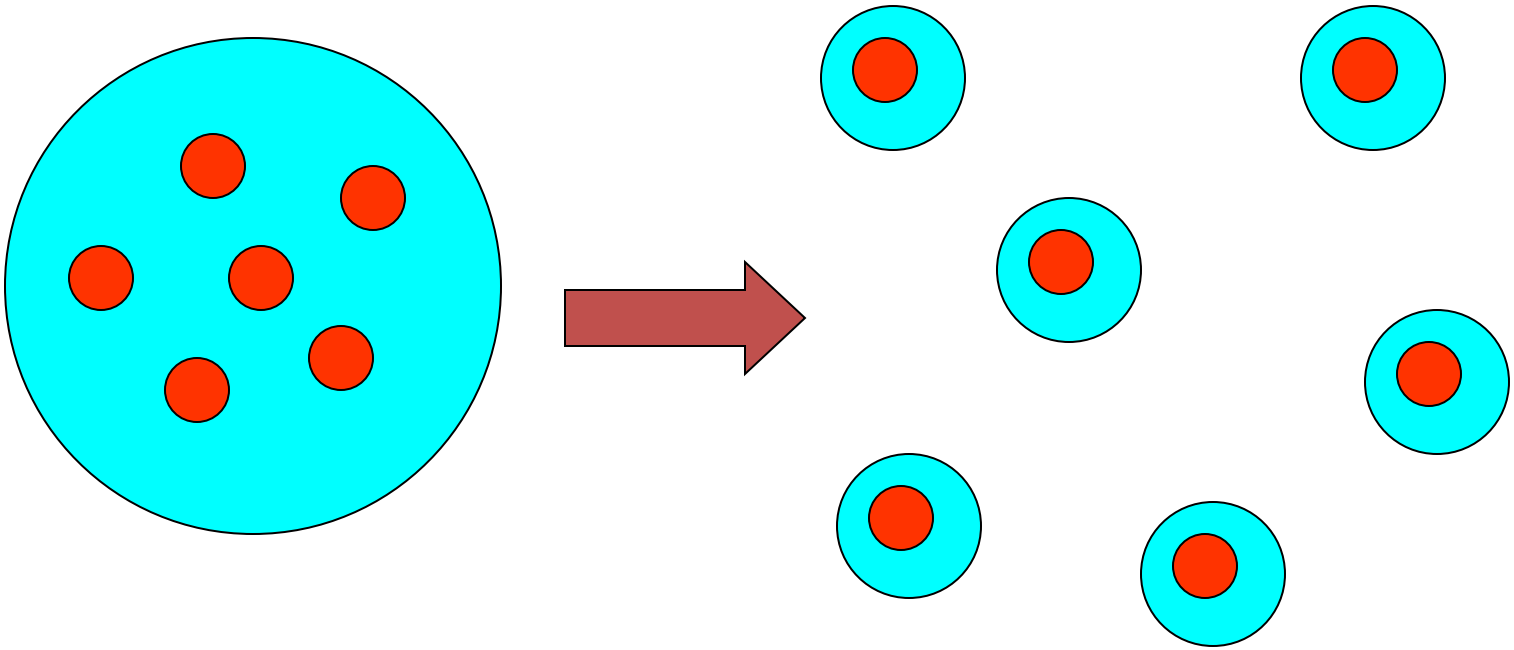
Cilia

Binary Fission

- Mitosis
  - Division of nucleus
- Cytokinesis
  - Division of cytoplasm

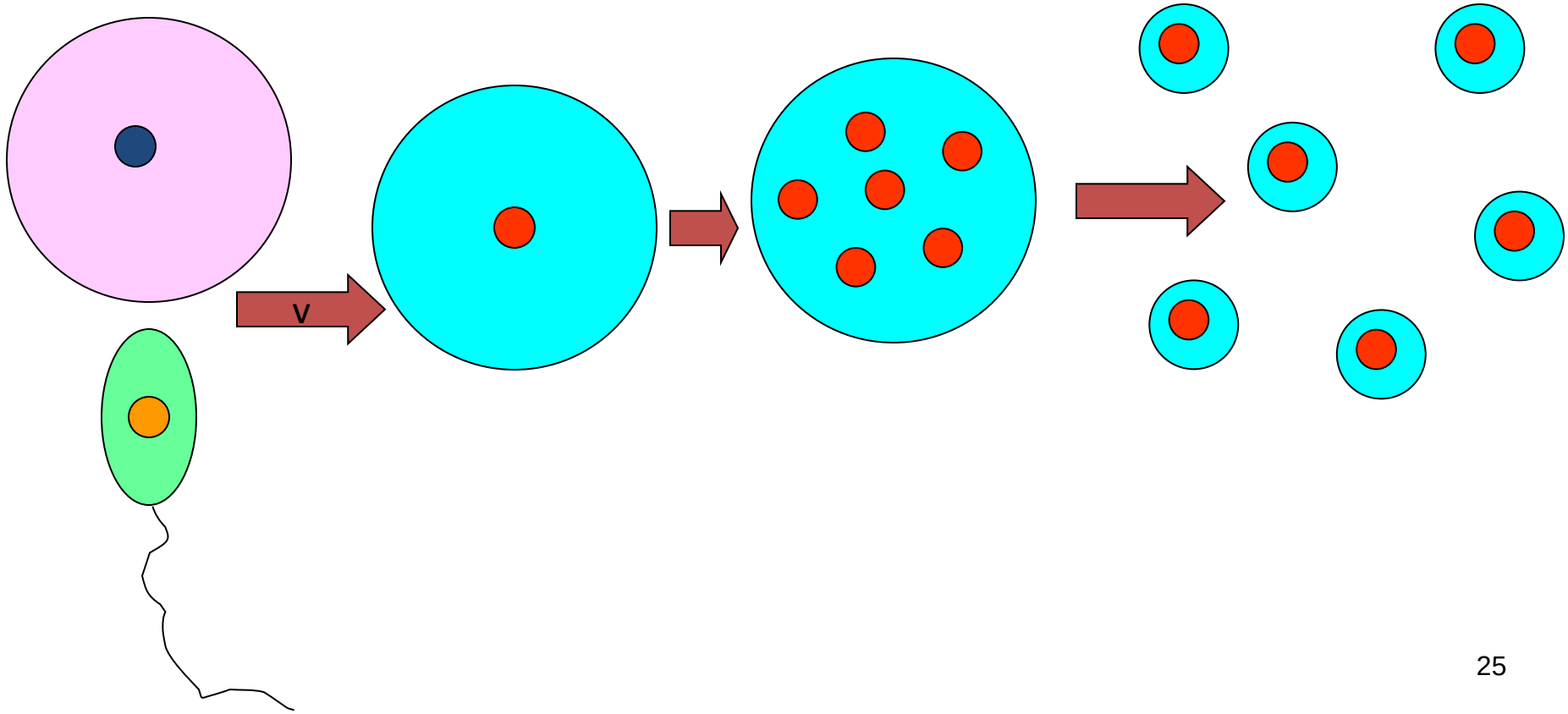


Schizogony



Sporogongy

- Like schizogony except occurs after union of gametes



Symbosis

- Living together
- Parasitism
- Commensalism
- Mutualism

Parasitism

- Parasite benefits
- Host harmed

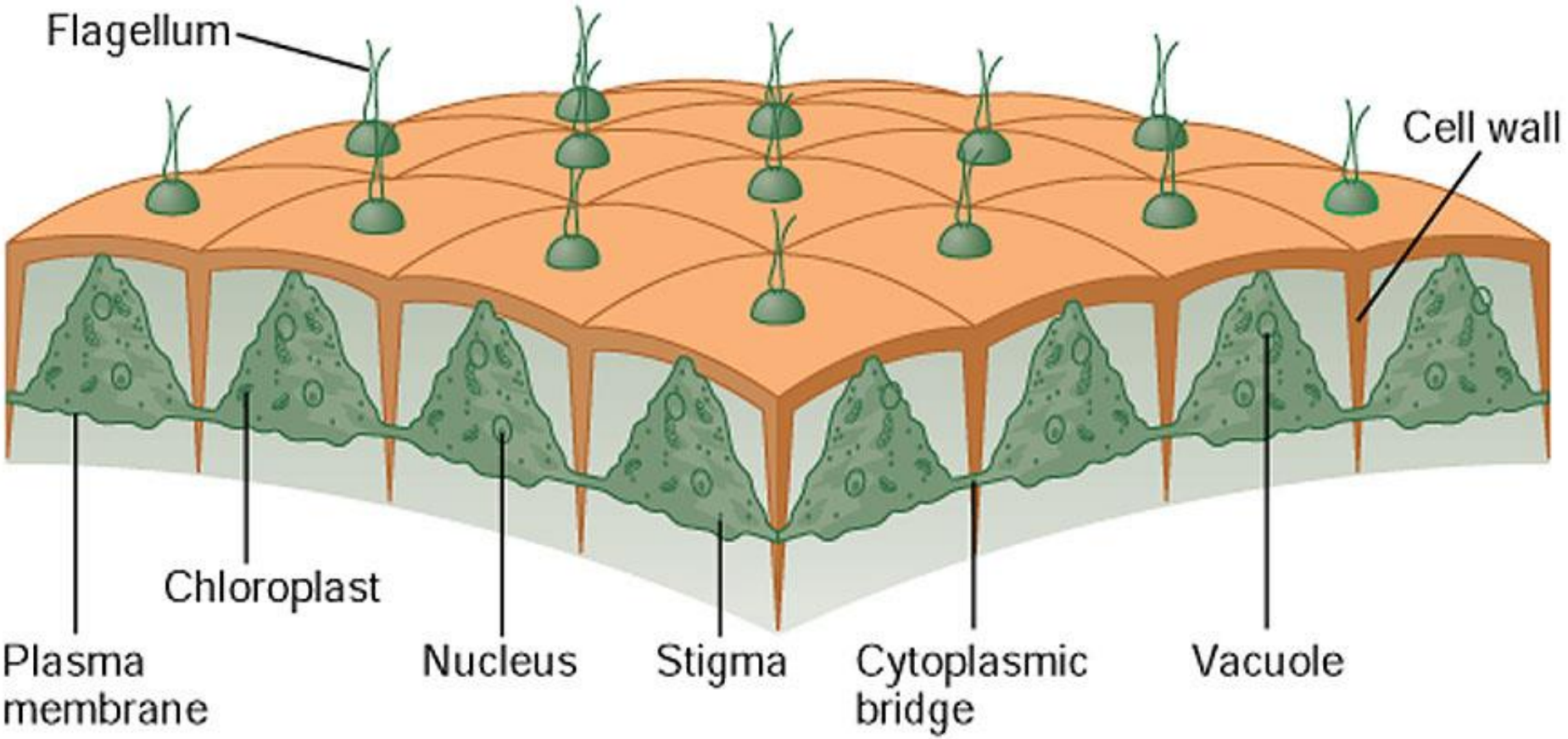
Commensalism

- Bird nest and tree
- Bird benefits
- Tree not affected

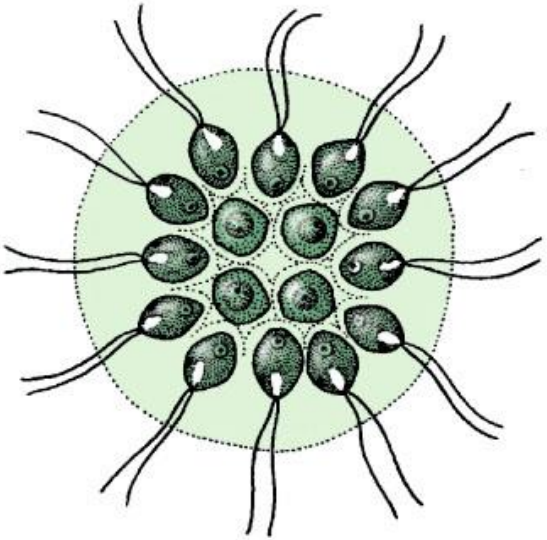
Mutualism

- Both organisms benefit from living together
  - Fungs and Roots of vascular plants.
  - Hoofed animals and bacteria in their intestine
  - Bee and pollination in flowers

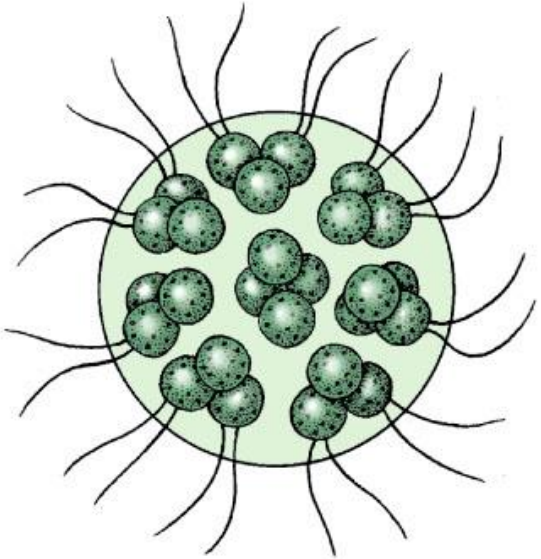
Volvox, A Colonial Flagellate



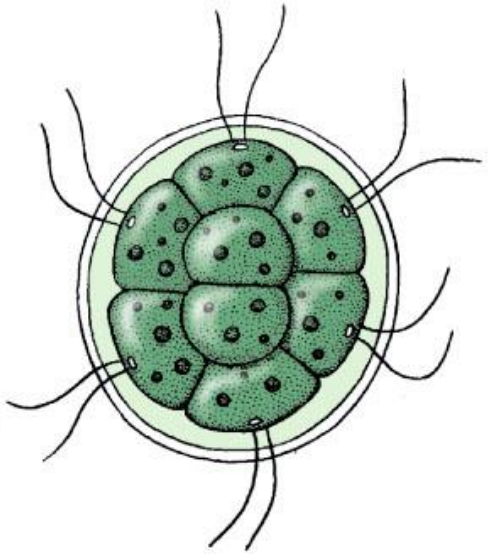
Chlamydomonas



Gonium



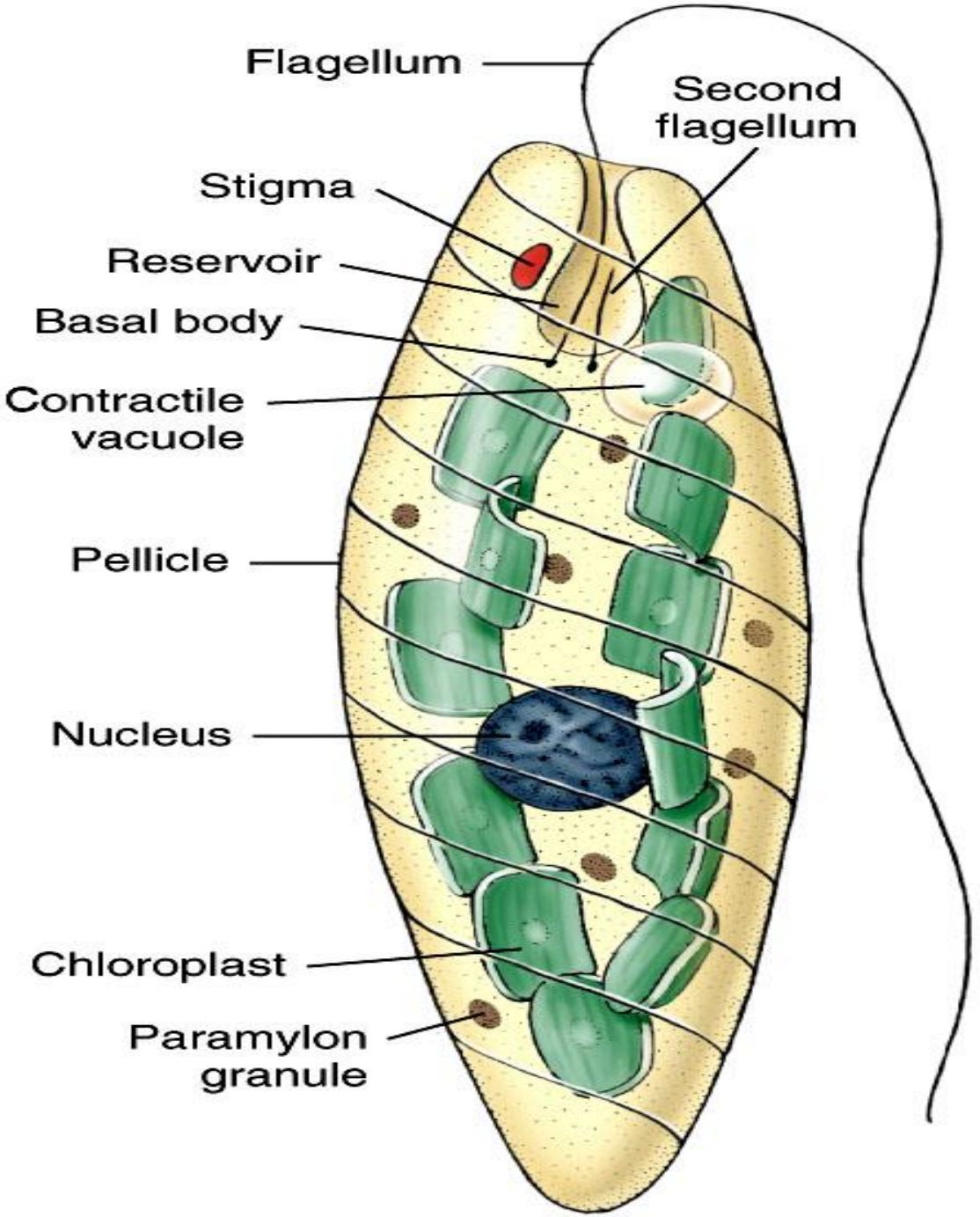
Eudorina



Pandorina

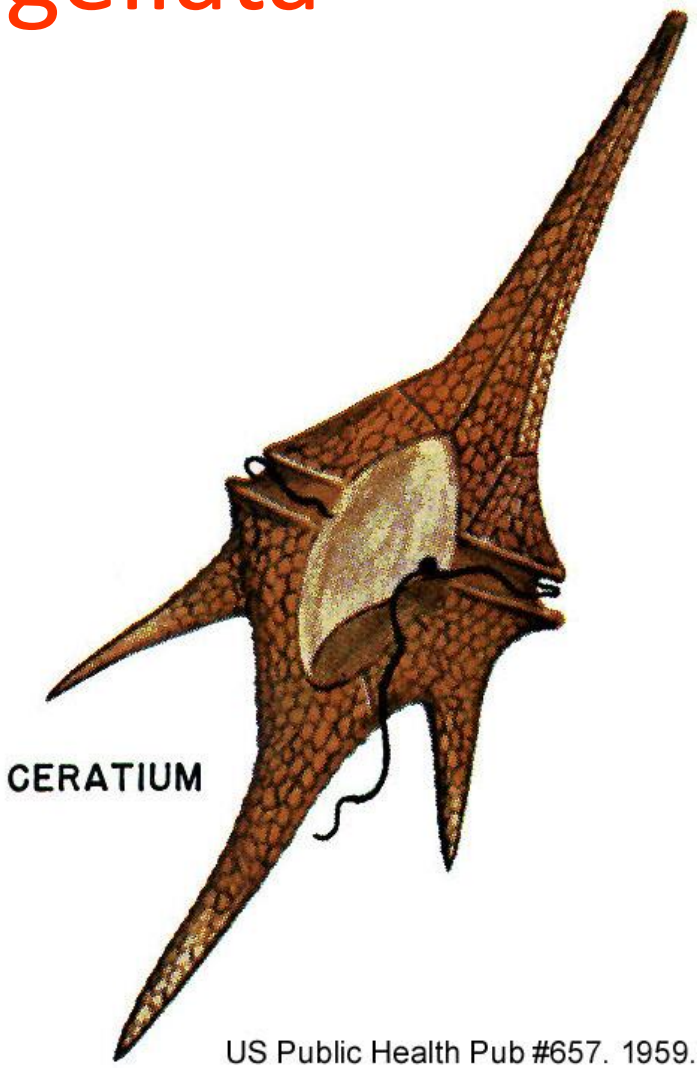
- Euglena
  - Chloroplasts
    - Photosynthesis
    - Paramylon
    - Stigma or Eyespot

Euglena



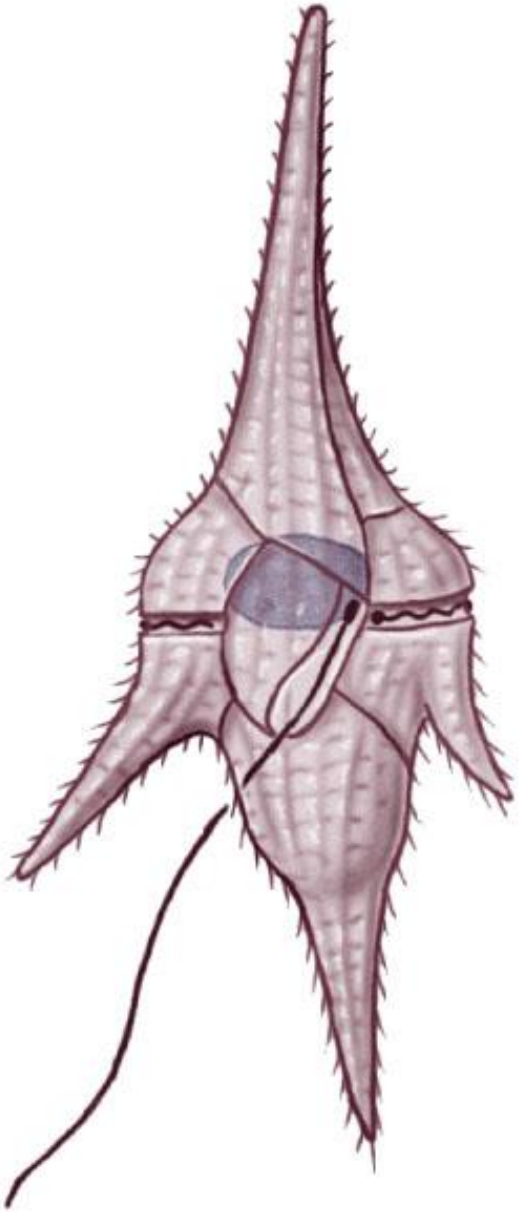
Dinoflagellata

- Two flagella
  - Transverse
  - Longitudinal
- Some photosynthetic
- Some heterotrophic
- Some have cell wall made of plates
- Red tide
  - neurotoxin

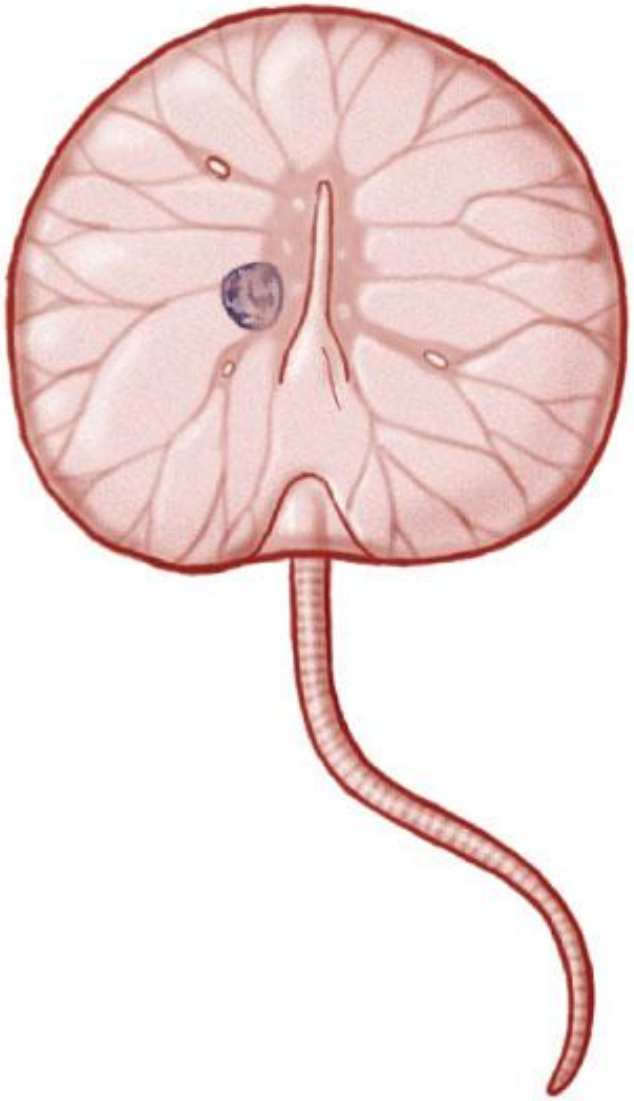


US Public Health Pub #657. 1959.

Gymnodinium



Ceratium

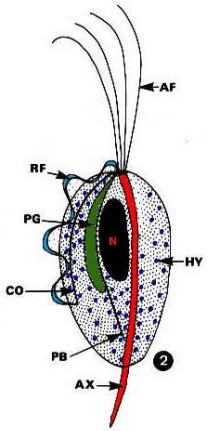


Noctiluca

- **Trichonympha**

- Symbiont in gut of termite
- Break down cellules
- Motile
- Teardrop shape

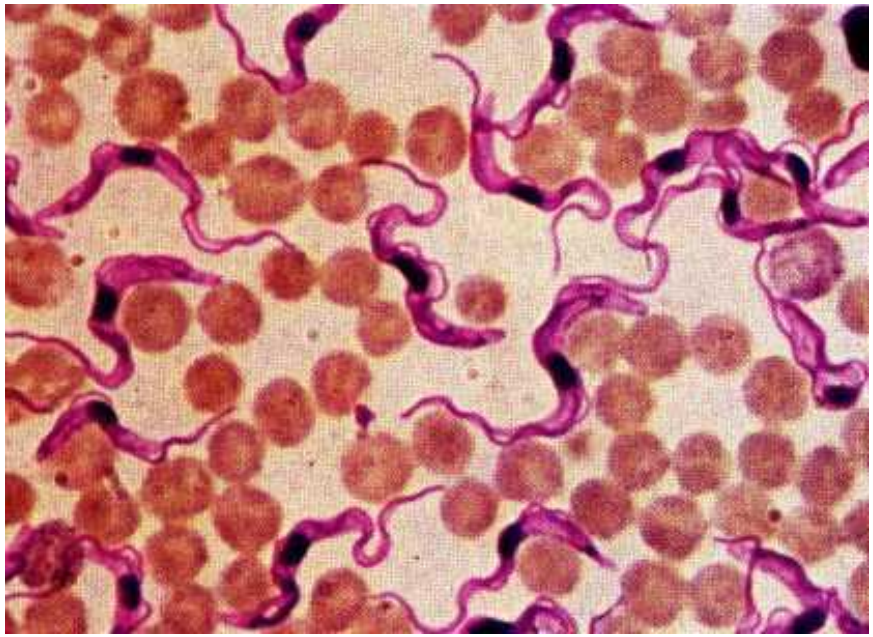
Trichonympha campanula



- ***Trichomonas vaginalis***
- Five flagella
- STD(sexually transmitted disease)
- White discharge and itching
- Most people a asymptomatic

Trichomonas galline

- **Trypanosoma**
  - Parasites in the blood
  - Chagas disease
    - Central and South America
  - Sleeping sickness
    - Africa

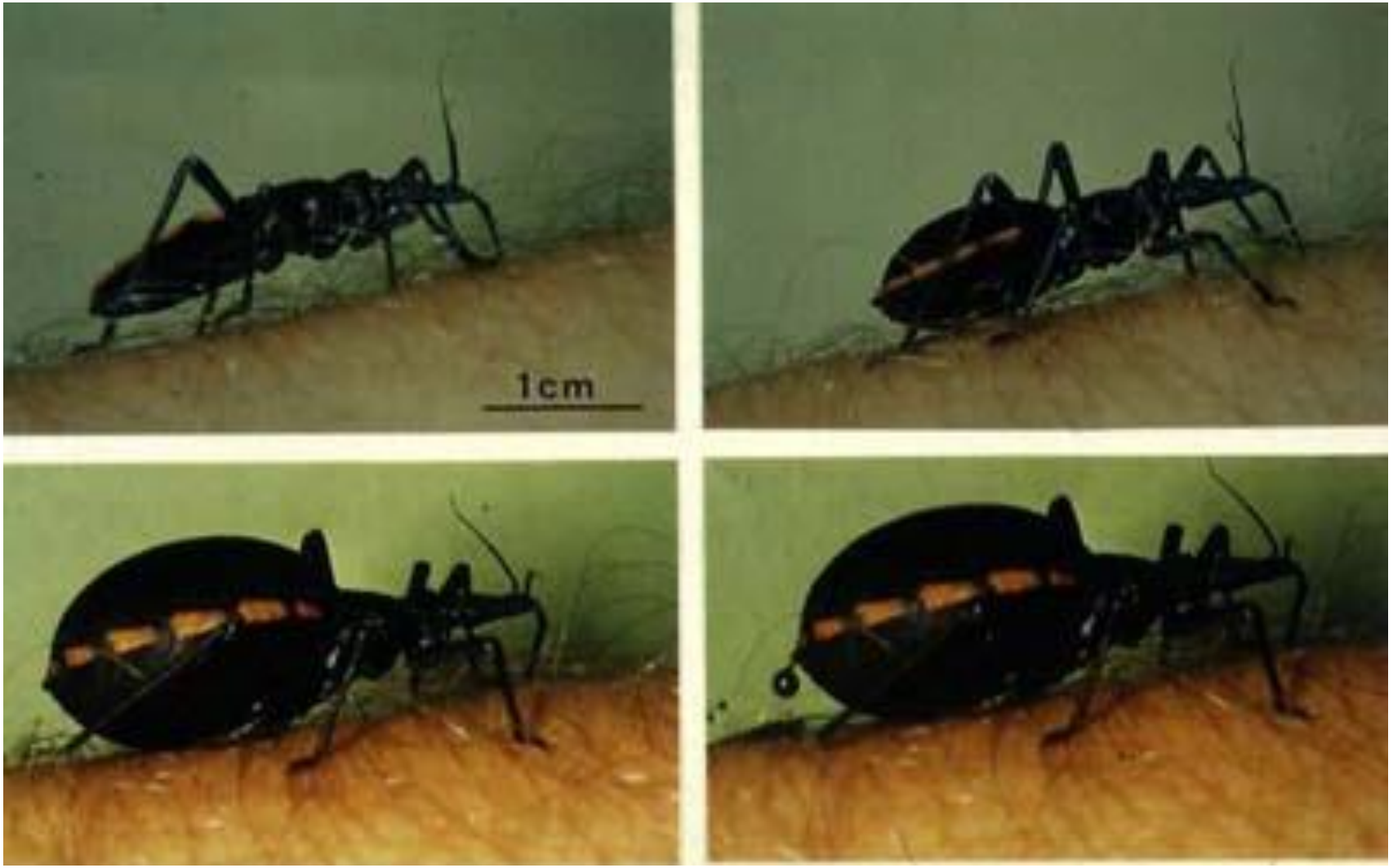


Chagas Disease

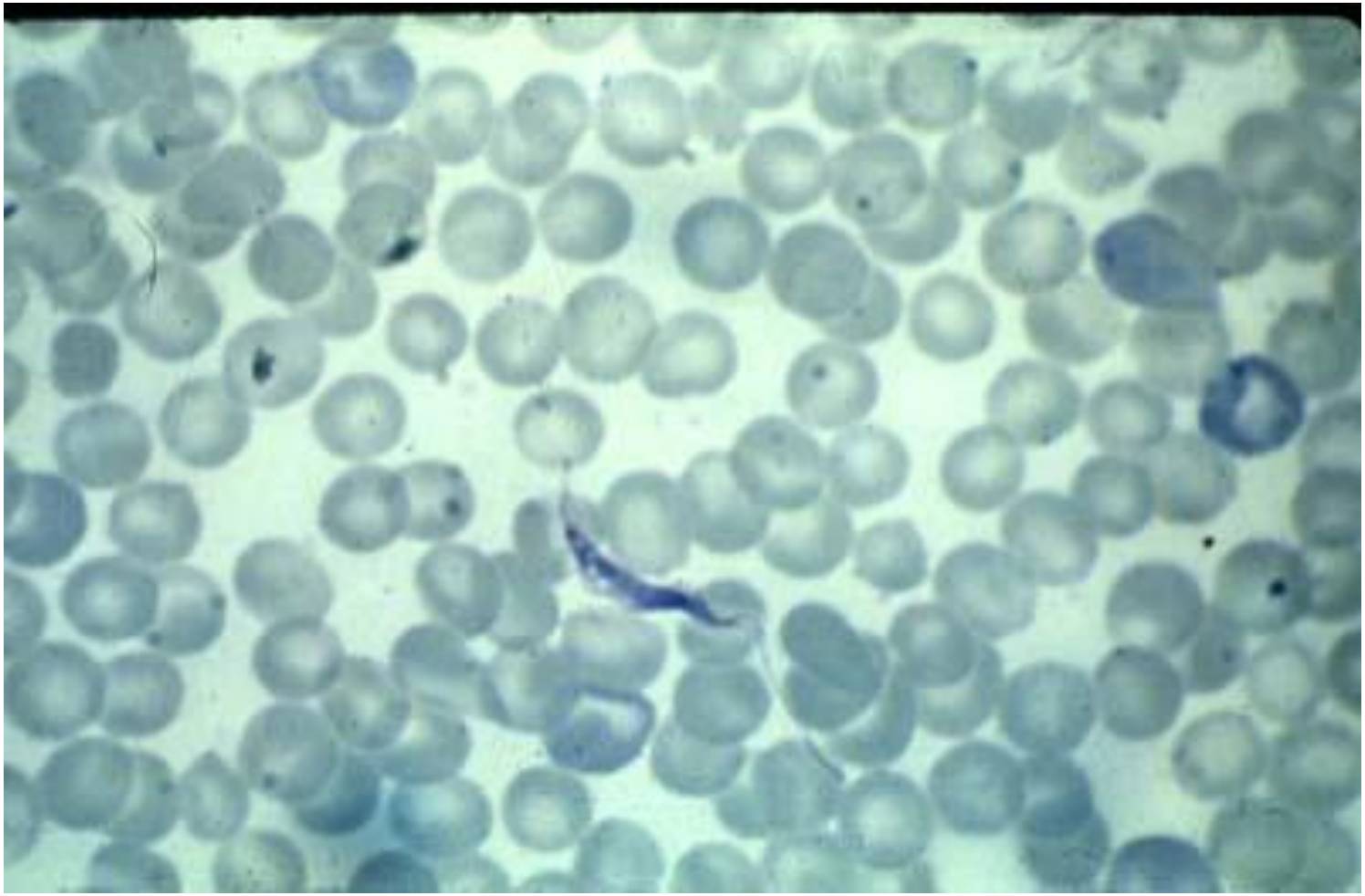
Kissing Bugs hide in cracks in walls of houses during the day.

Feed at night

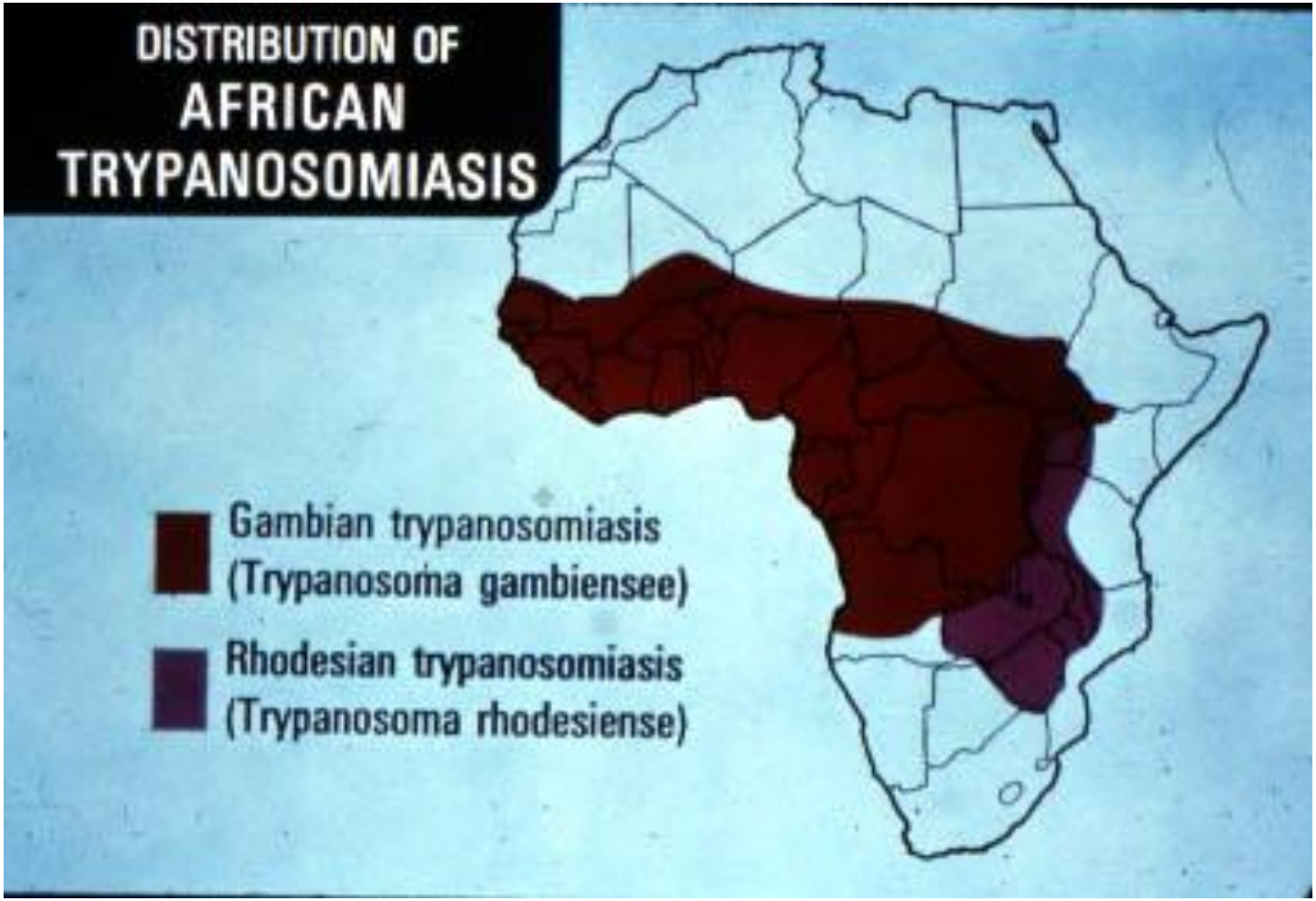
Feeding bugs defecate & feces including Trypanosomes are rubbed into bite or mucous membranes



Trypanosomes invade blood

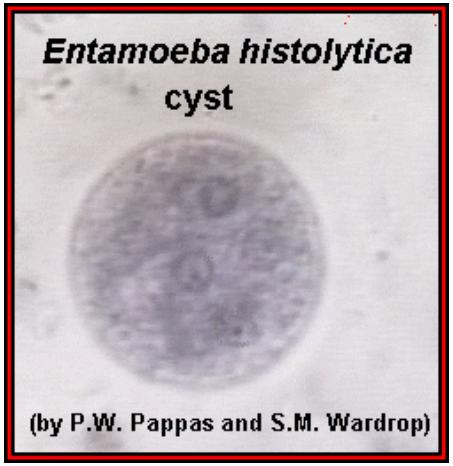


African Sleeping Sickness



Entomoeba histolytica

- Amoebic dysentery
- Transmitted by food & water contaminated with cysts
- Bloody diarrhea



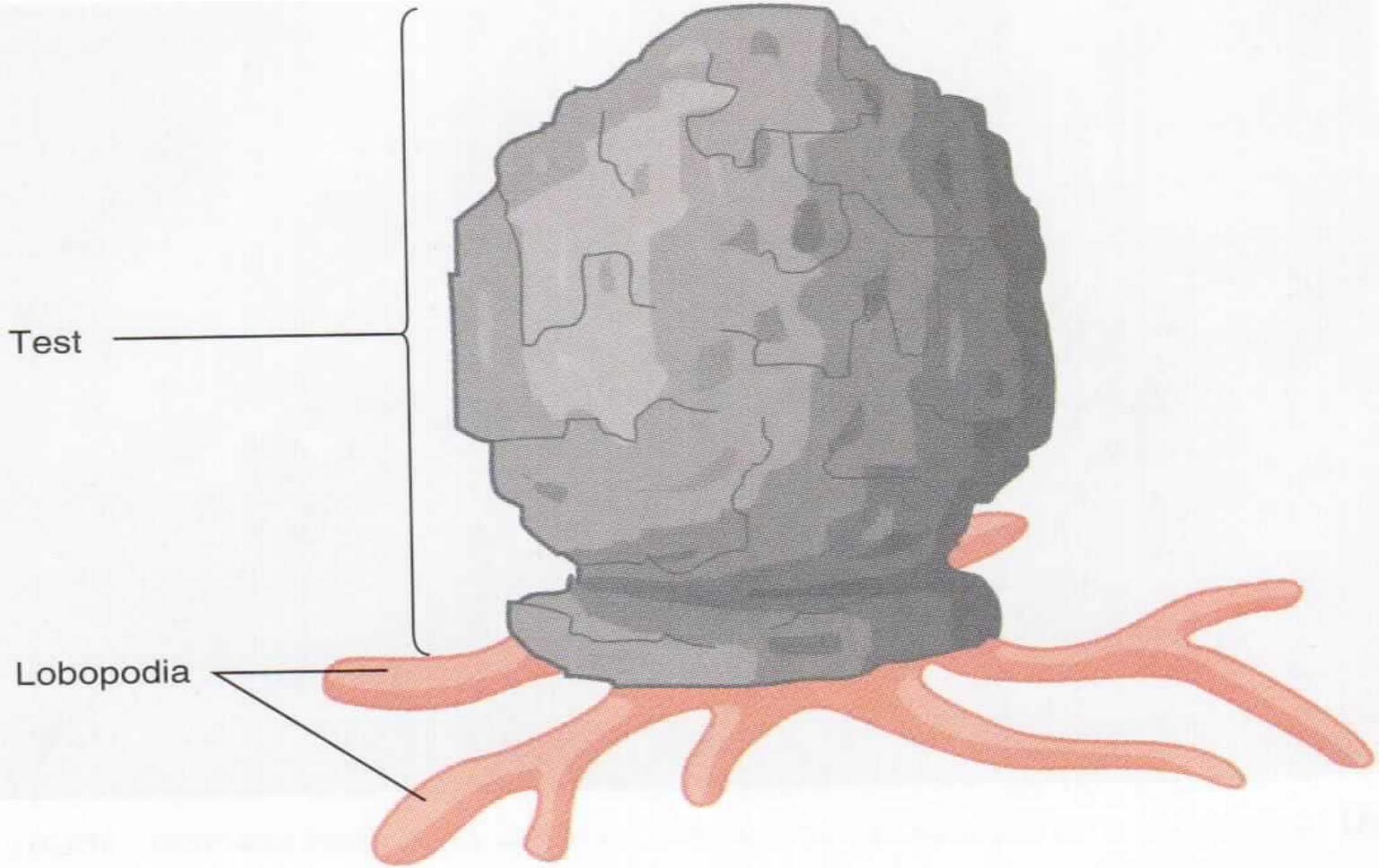
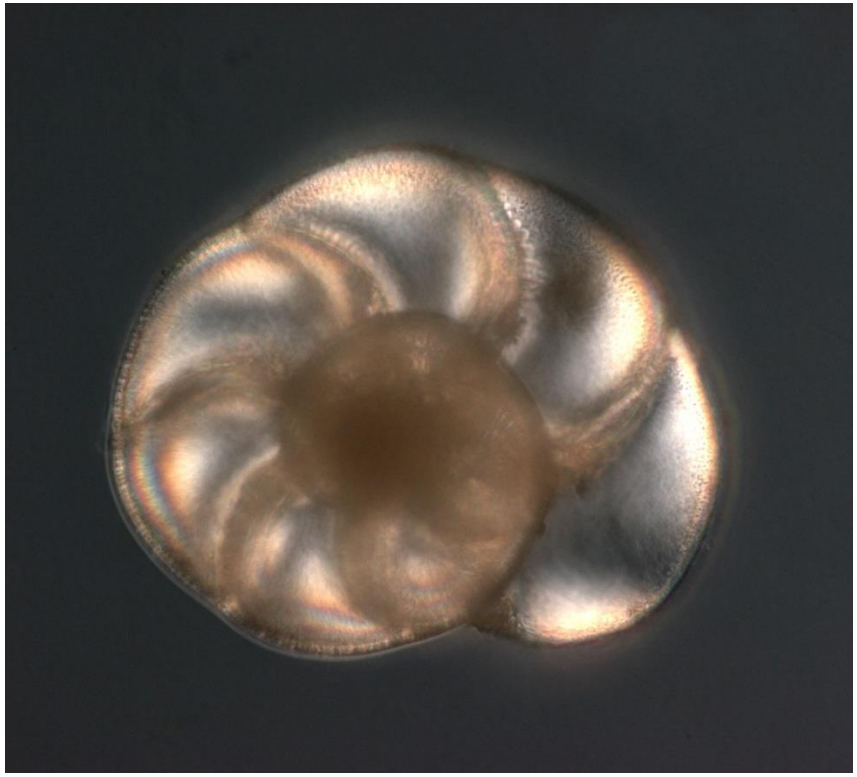


FIGURE 17.12

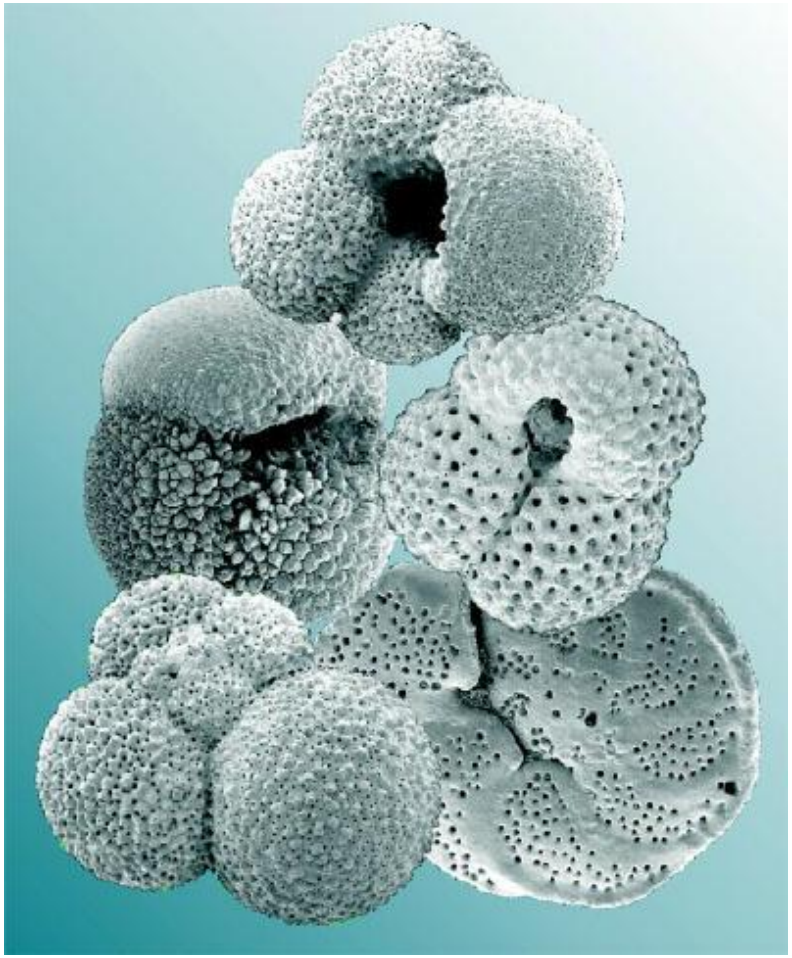
Subphylum Sarcodina. *Difflugia oblongata*, a common freshwater, shelled amoeba. The test consists of cemented mineral particles.

Foraminifera

- Secrete a test (shell) of calcium carbonate
- Grow new chambers as organism increases in size
  - Foramen (opening) between chambers
- Shells constitute vast deposits on ocean floors

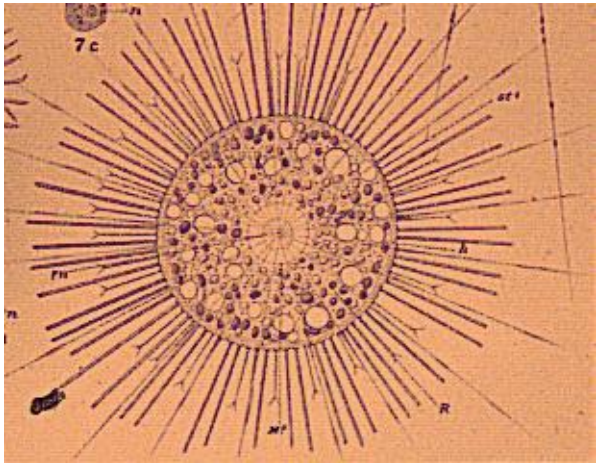


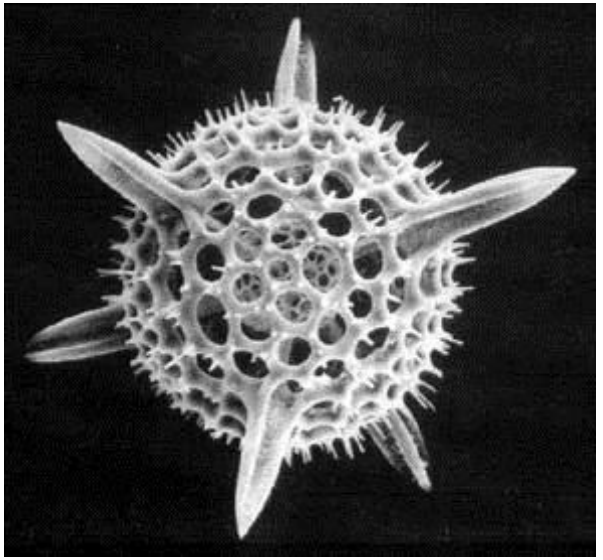
Foraminifera Tests



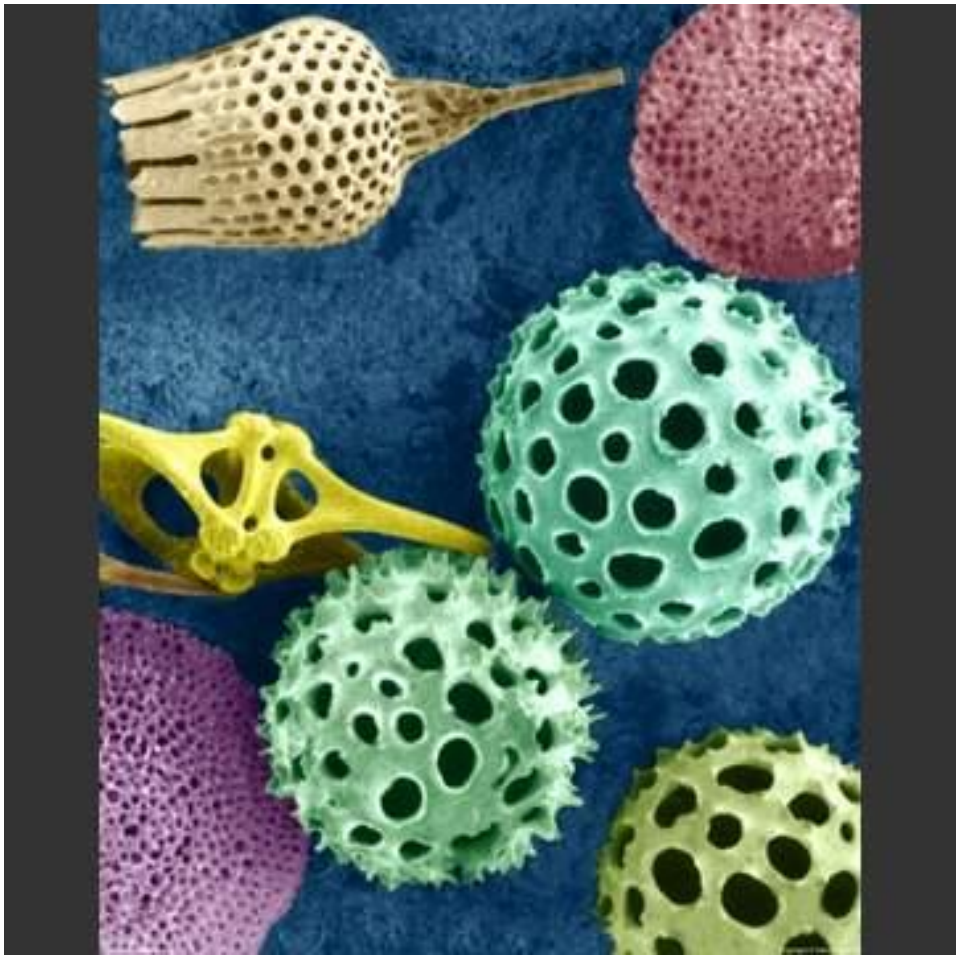
Radiolaria

- Abundant in the ocean
  - Ocean floors covered
  - Forms sedimentary rock
- Siliceous test (shell)
  - Skeleton made of silica
  - Numerous geometric designs



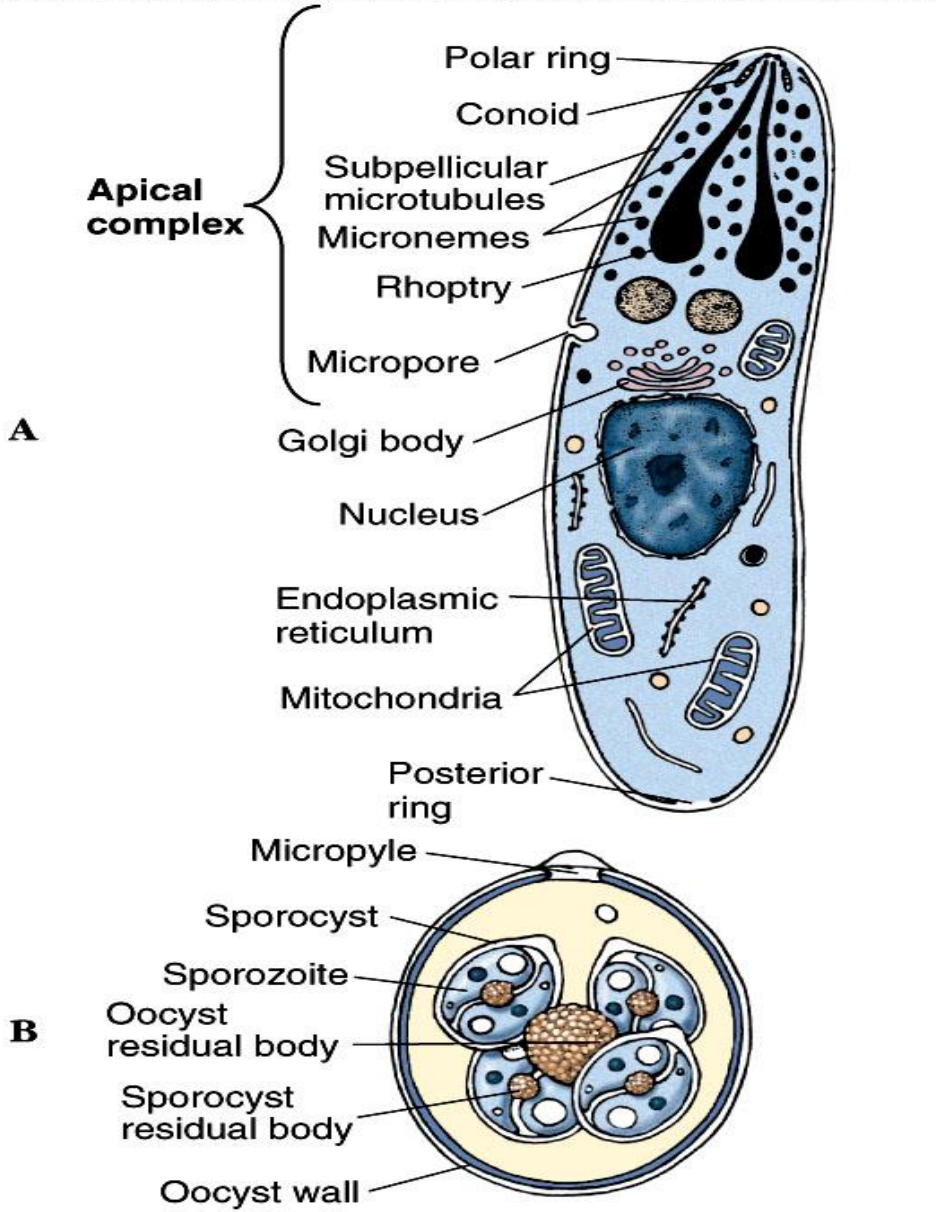


Radiolarian Tests



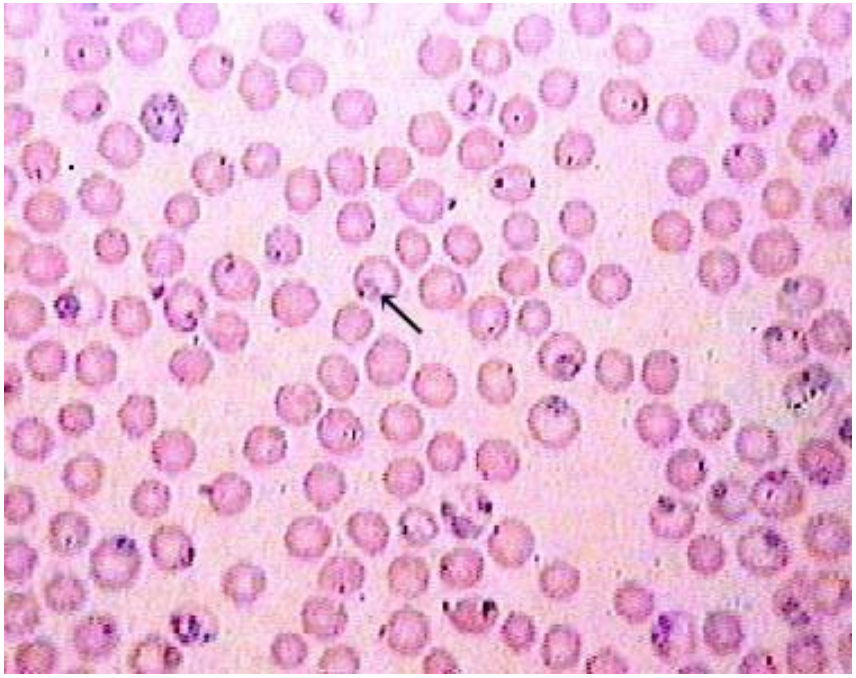
Phylum Apicomplexa

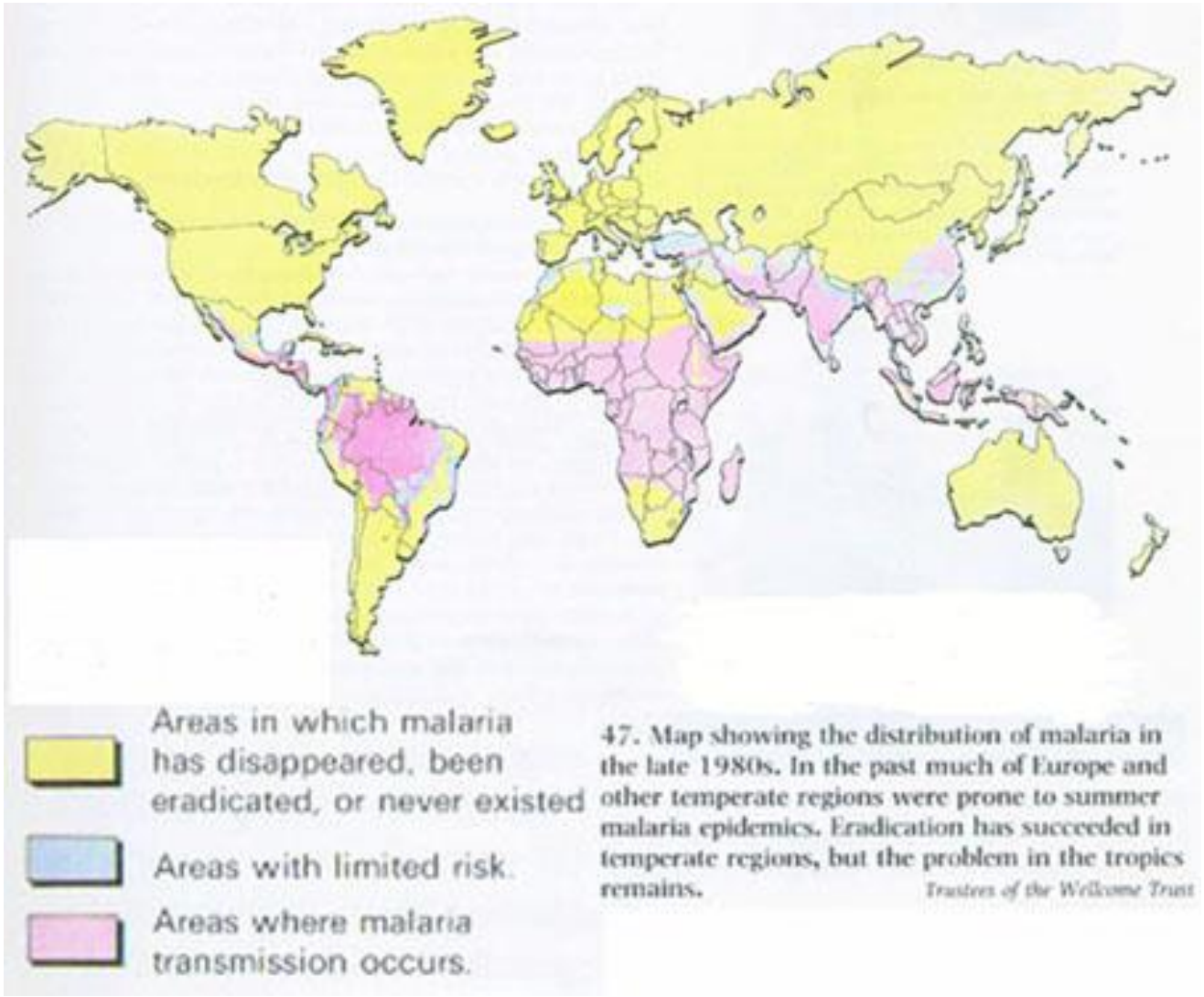
- Apical complex
  - Helps in penetrate h cells
- Endoparasites
- Eimeria Oocyst



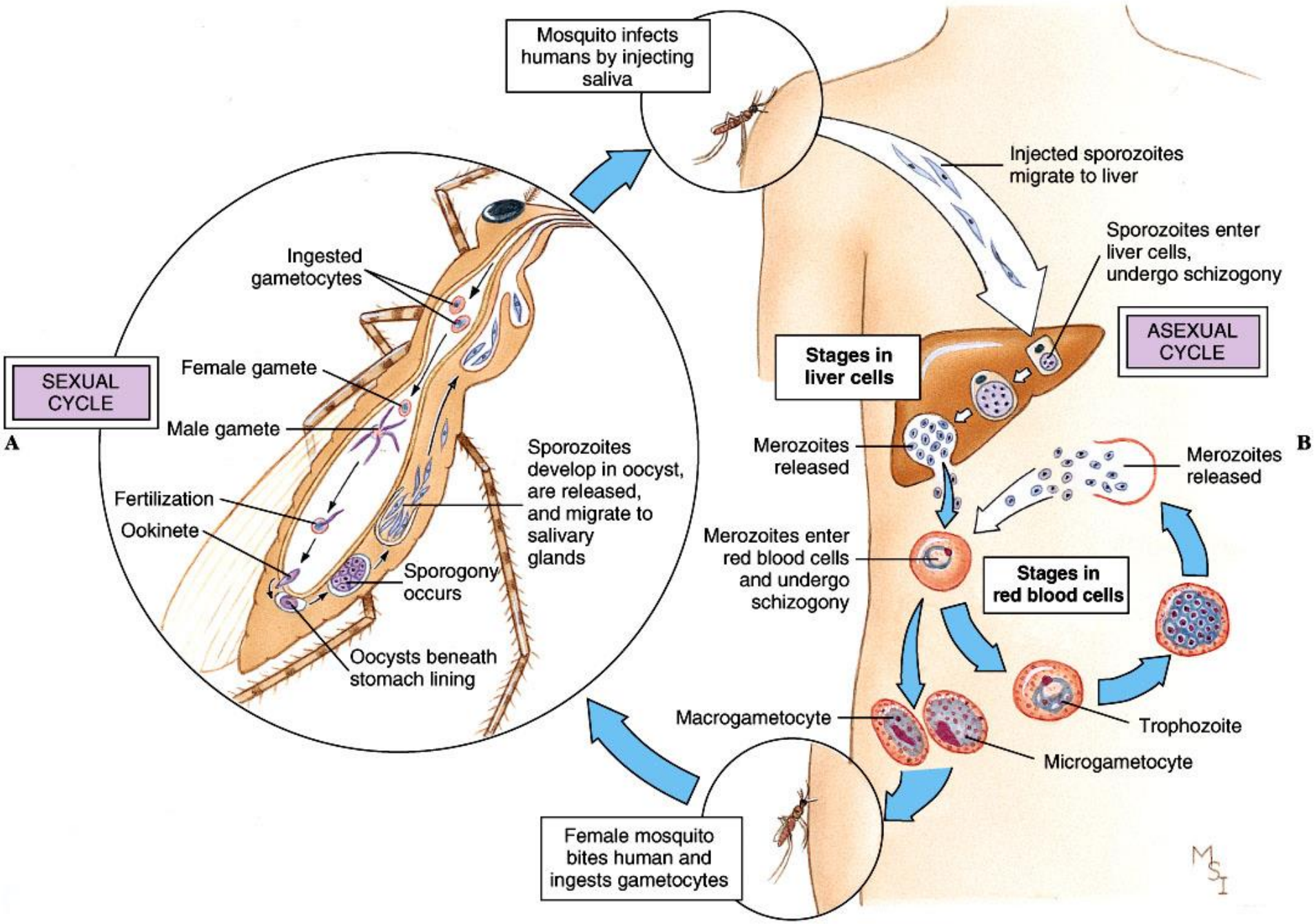
Plasmodium

- Malaria
- Most important parasitic disease of humans today
- Transmitted by bite of infected mosquitoes of genus **Anopheles**



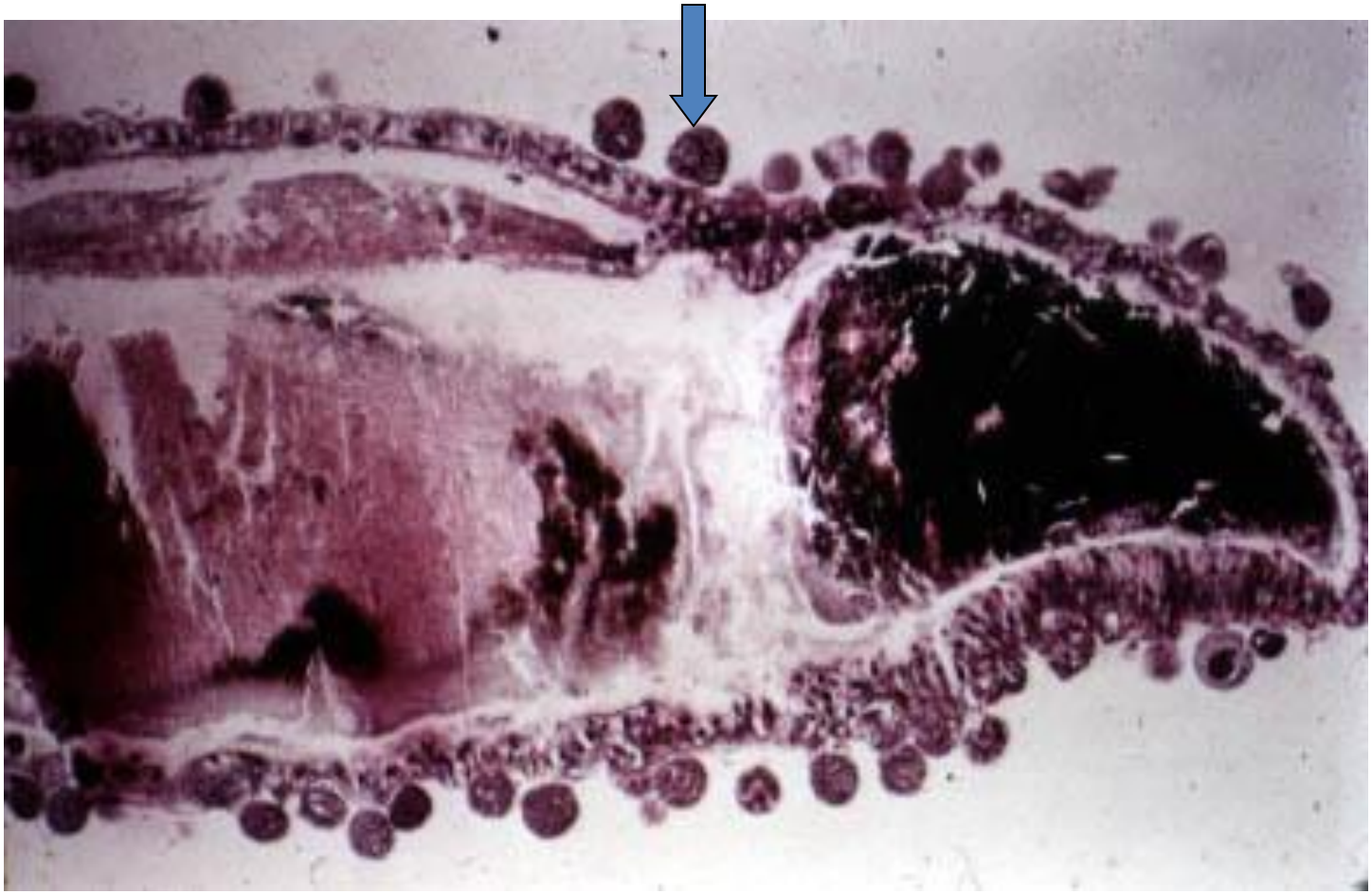


47. Map showing the distribution of malaria in the late 1980s. In the past much of Europe and other temperate regions were prone to summer malaria epidemics. Eradication has succeeded in temperate regions, but the problem in the tropics remains. *Trustees of the Wellcome Trust*



Mosquito feeds on blood of infected host & ingests gametocytes

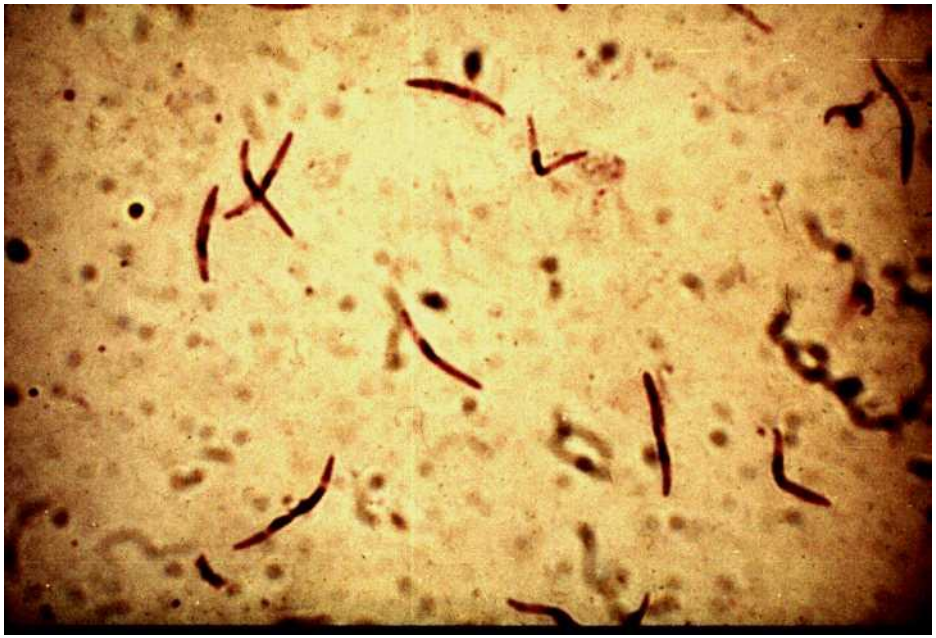
Gametes unite in mosquito stomach to form oocysts in wall of stomach



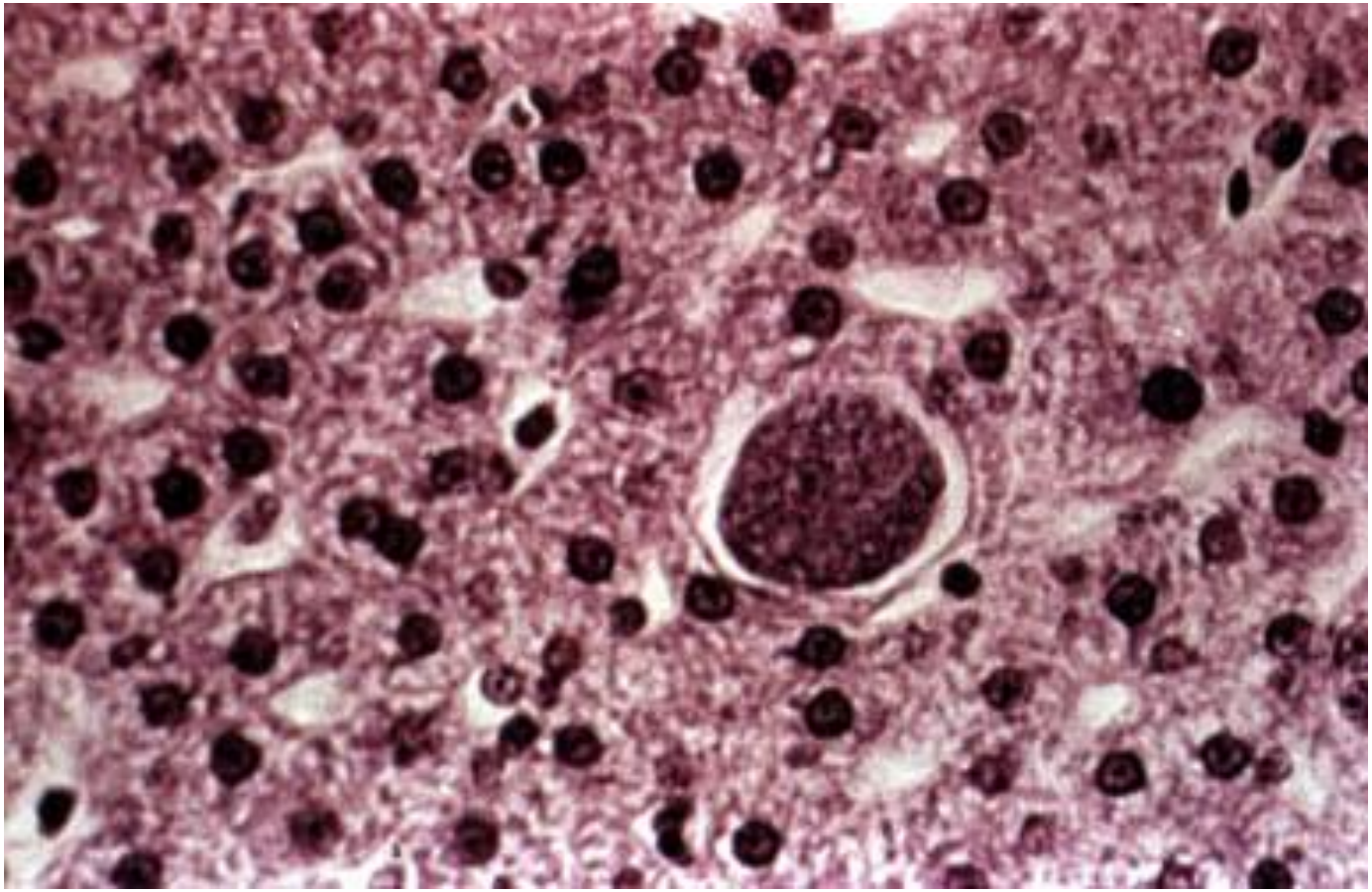
Oocysts

Scanning electron micrograph of the mid-gut of a heavily infected mosquito. The entire organ is covered with mature oocysts.
Malaria by A.J. Knell for the Wellcome Trust

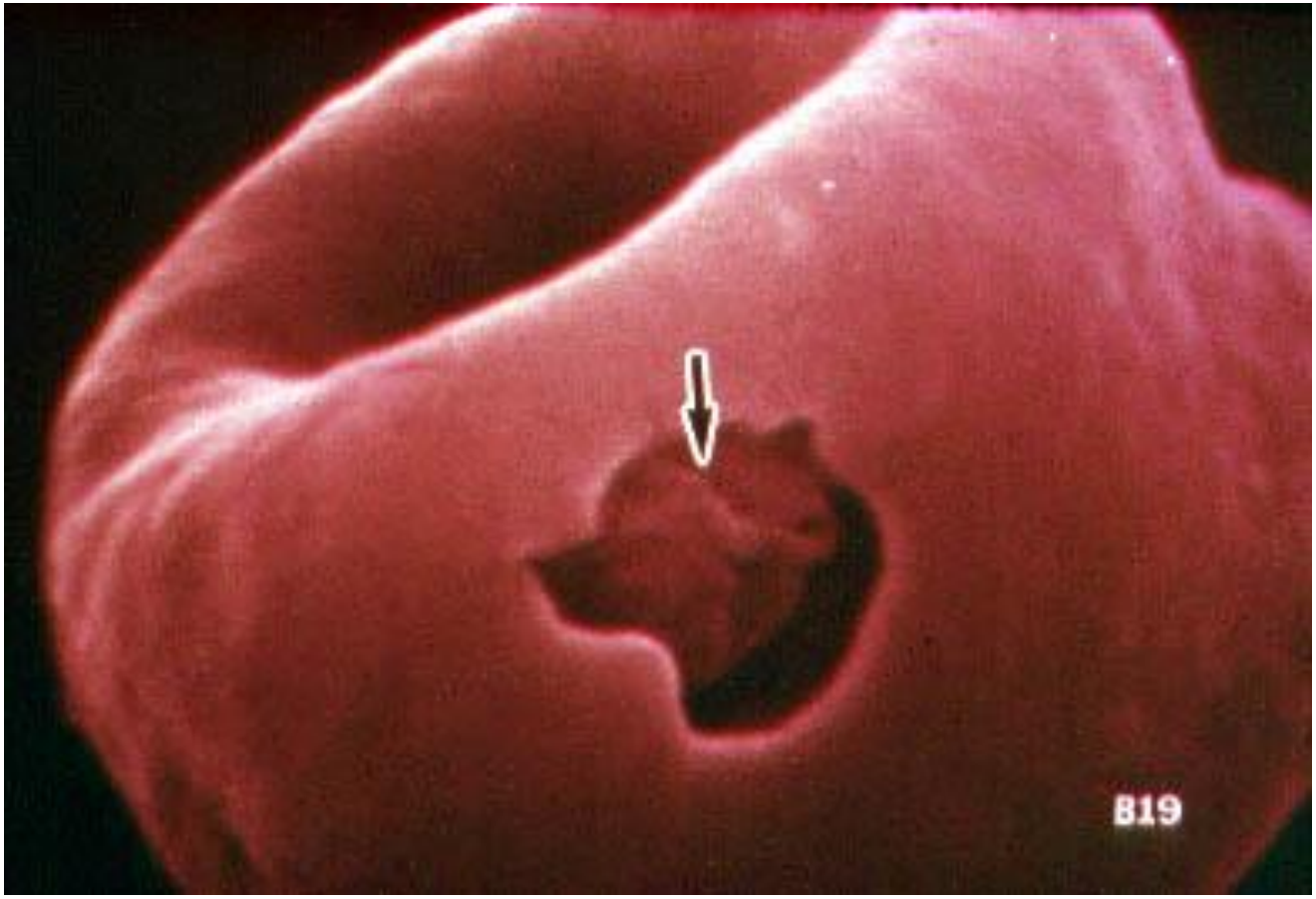
Sporozoites produced in oocysts by sporogony move to salivary glands of mosquito & are injected into next host



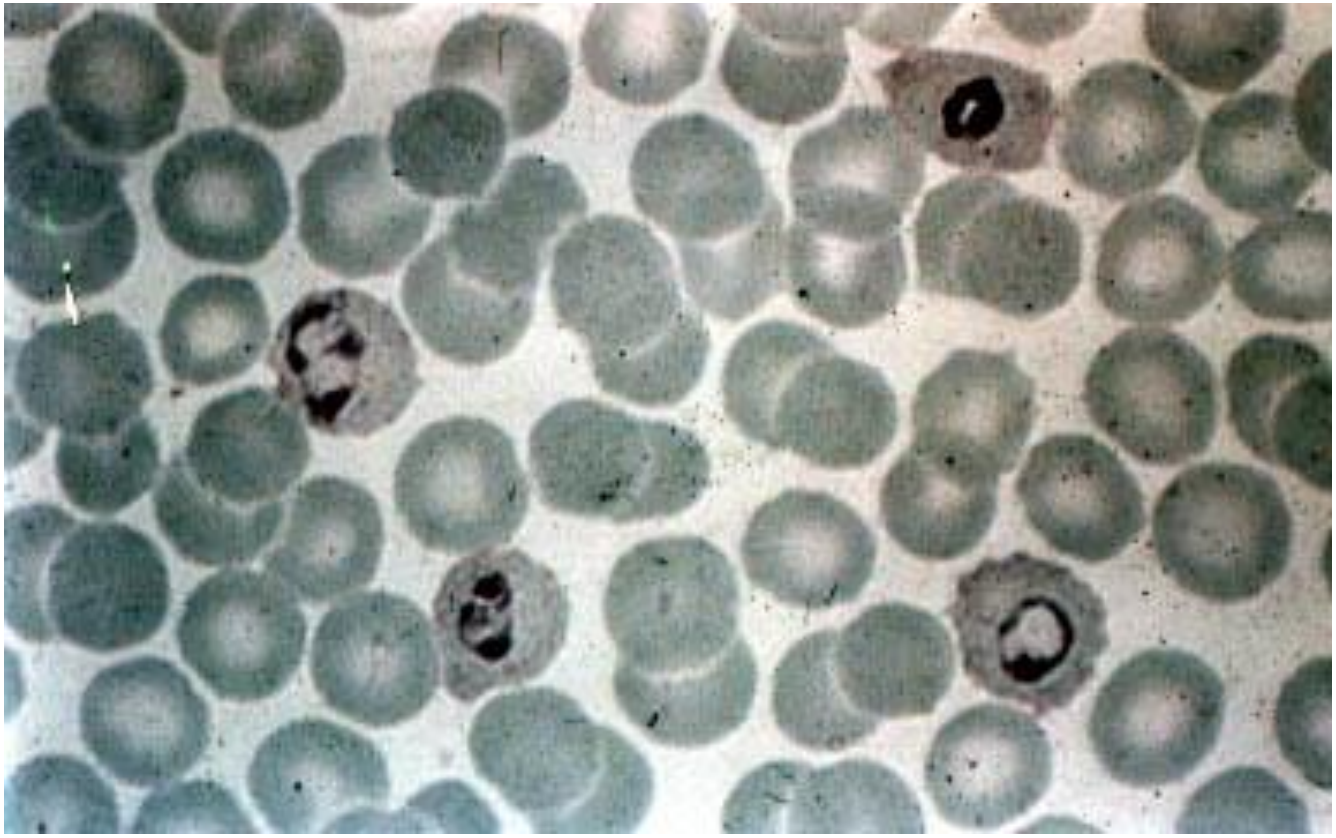
Sporozoites invade liver cells and undergo schizogony to produce merozoites



Merozoites invade circulating RBCs



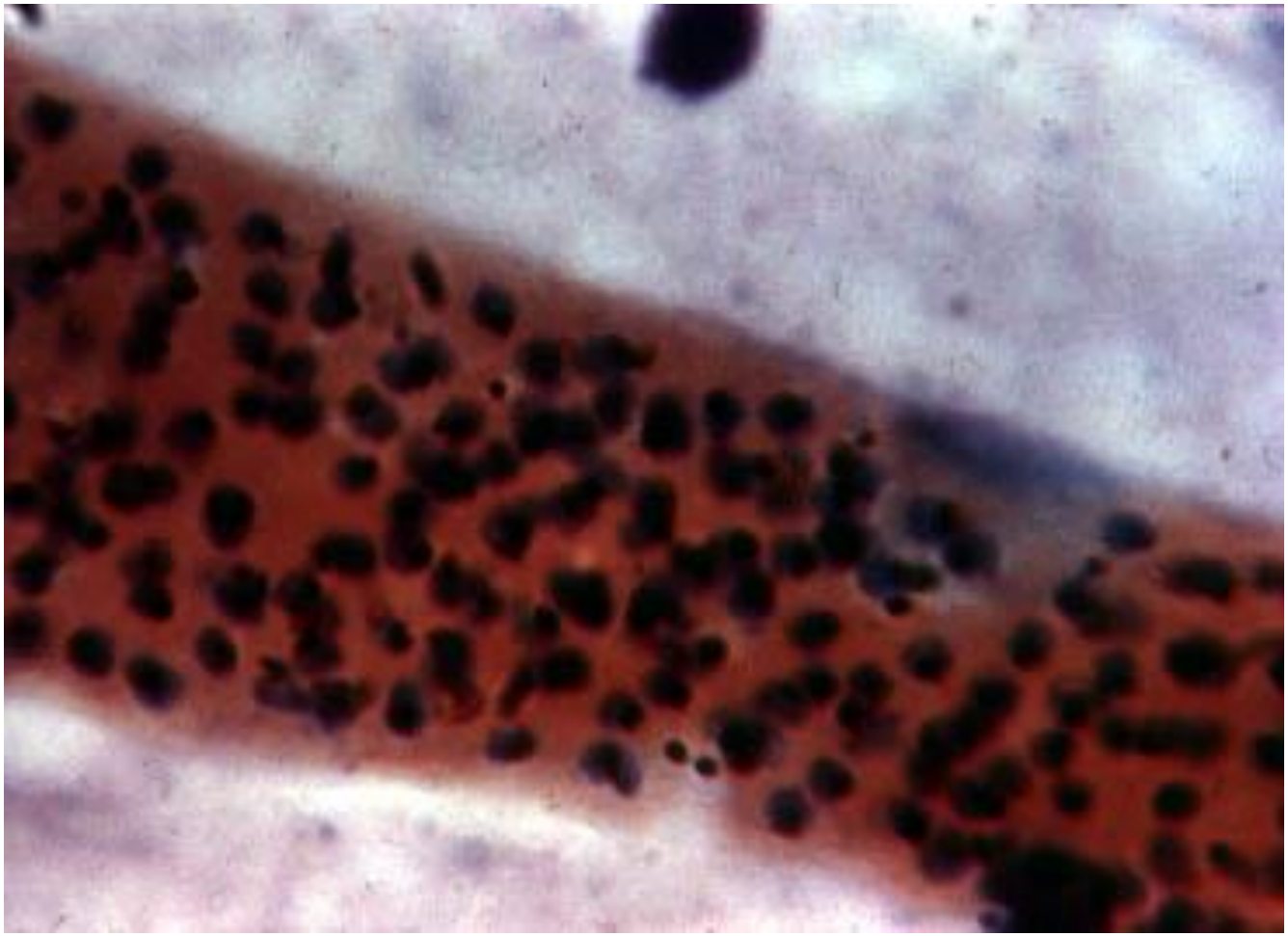
Each merozoite produces as many as 36 new merozoites through schizogony in RBCs



Merozoites rupture RBCs to invade other RBCs

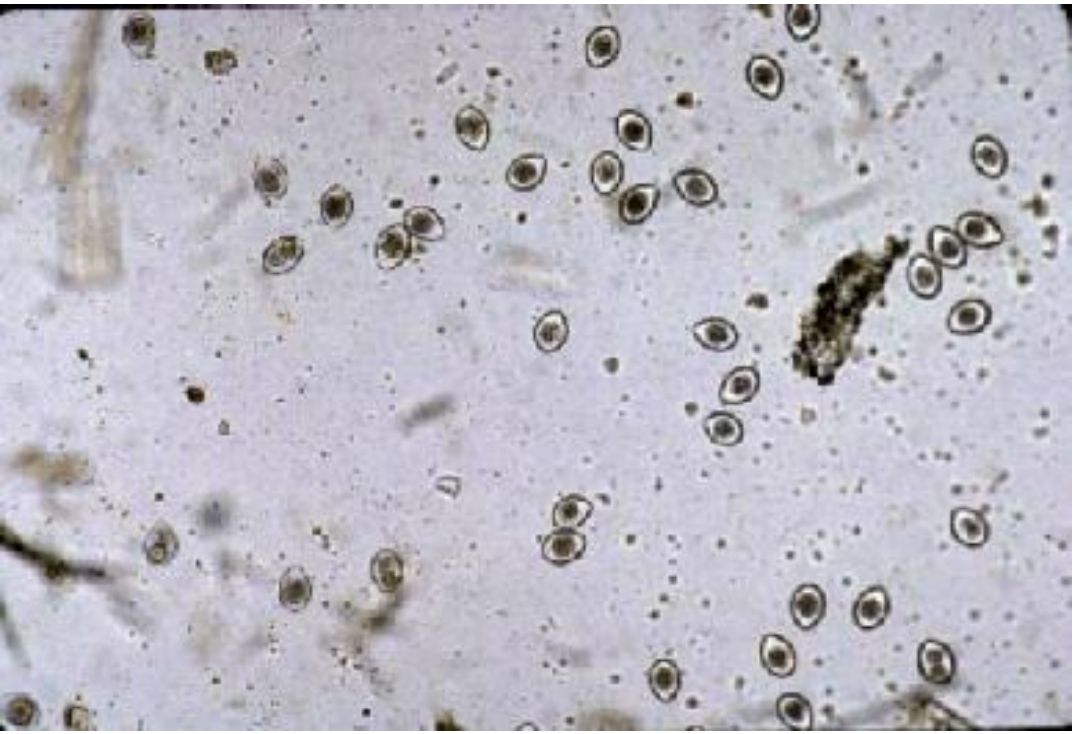
Simultaneous lysing of RBCs causes the sudden chills & fever typical of malaria

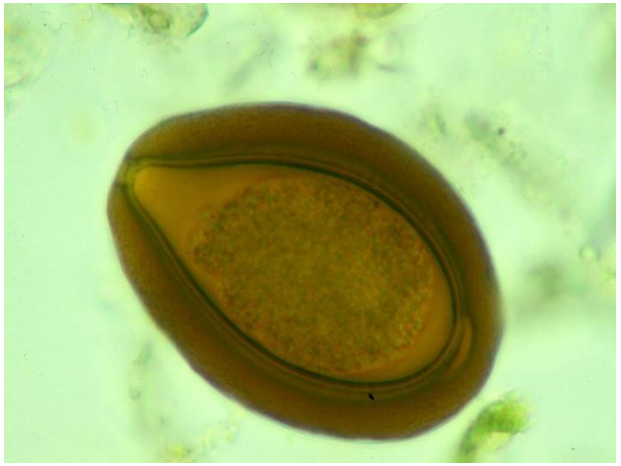
Gametocytes are produced in blood & ingested by mosquito to complete the cycle



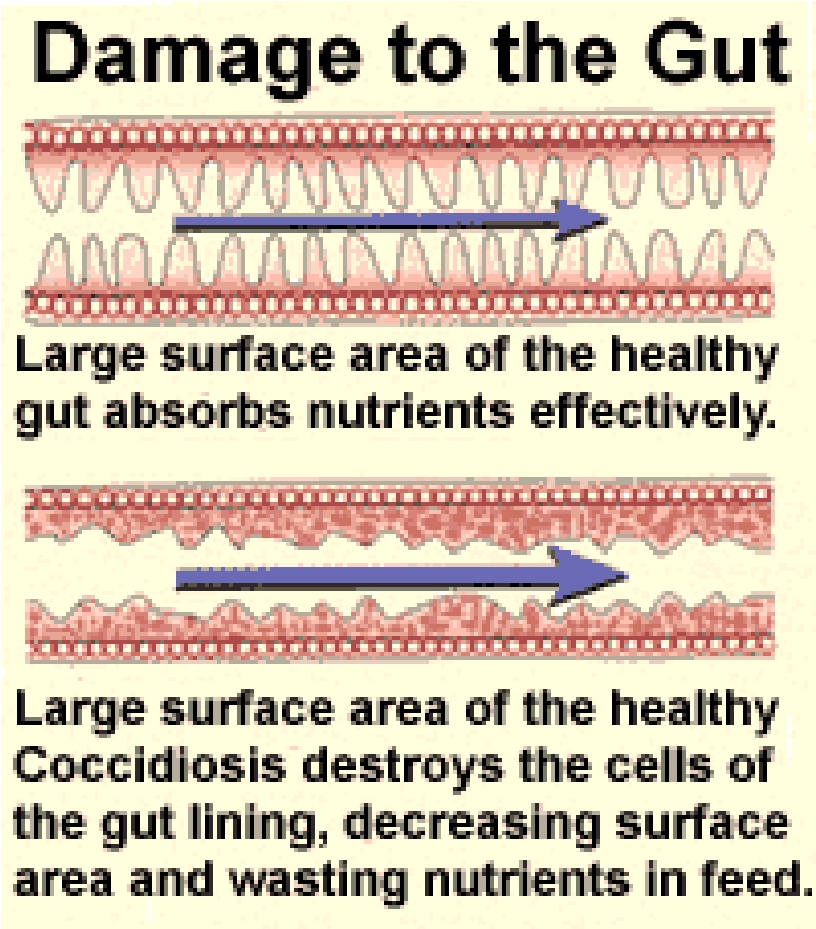
Eimeria

- Coccidiosis
  - Birds and mammals
- Bloody diarrhea

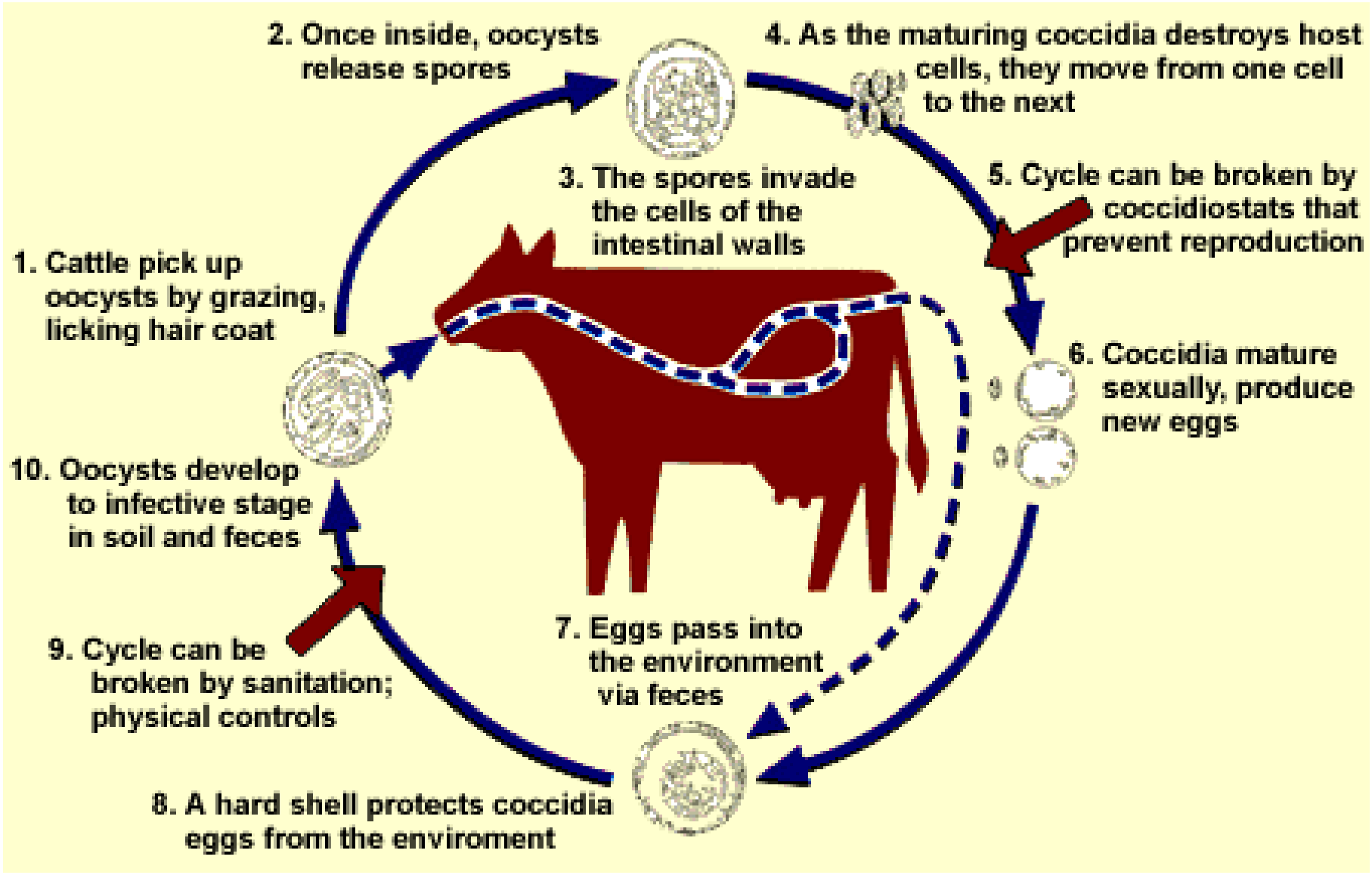




Coccidiosis



Coccidiosis



Trichocysts

- Released as a defense
- Long threadlike
- Release triggered by mechanical or chemical stimulation

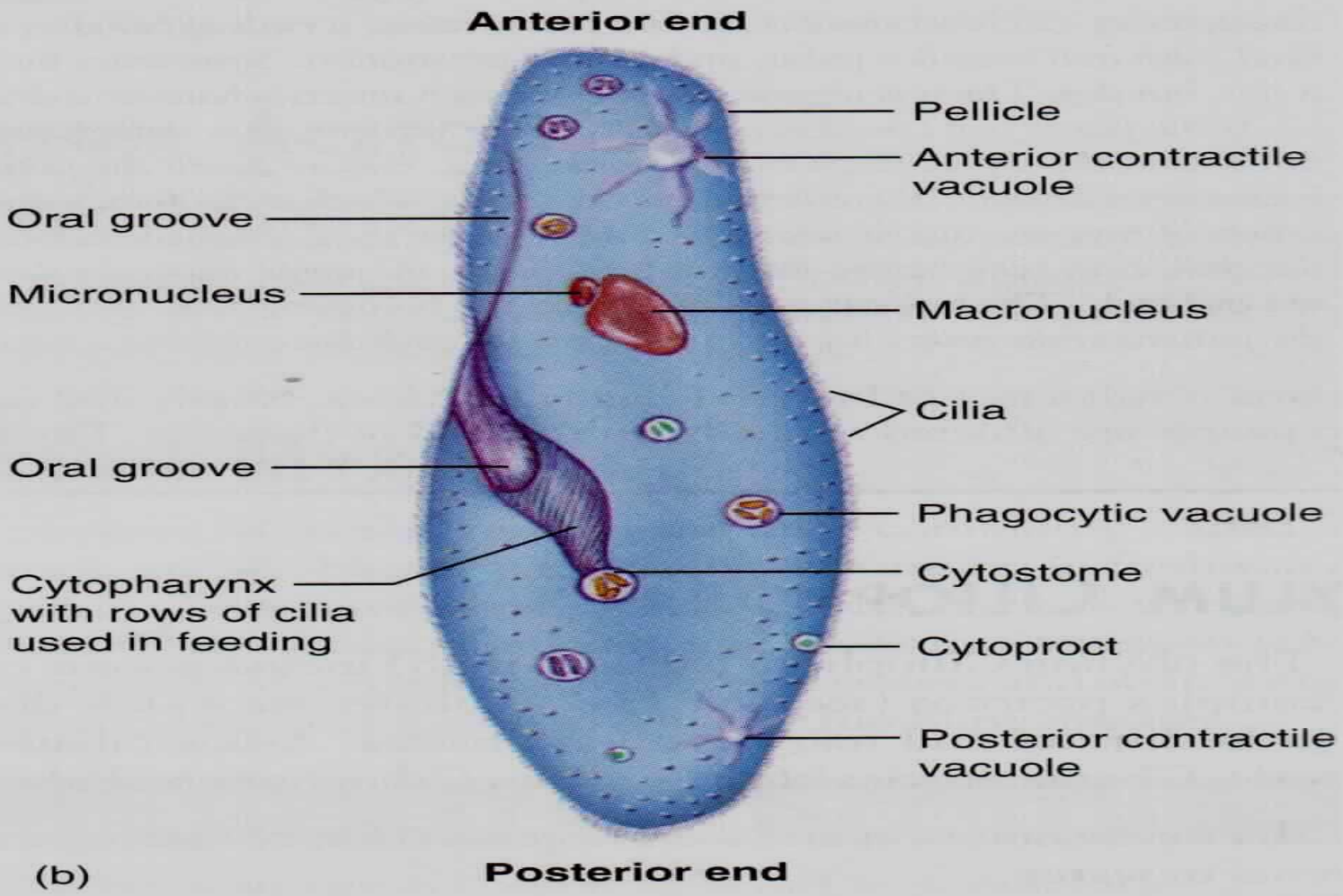
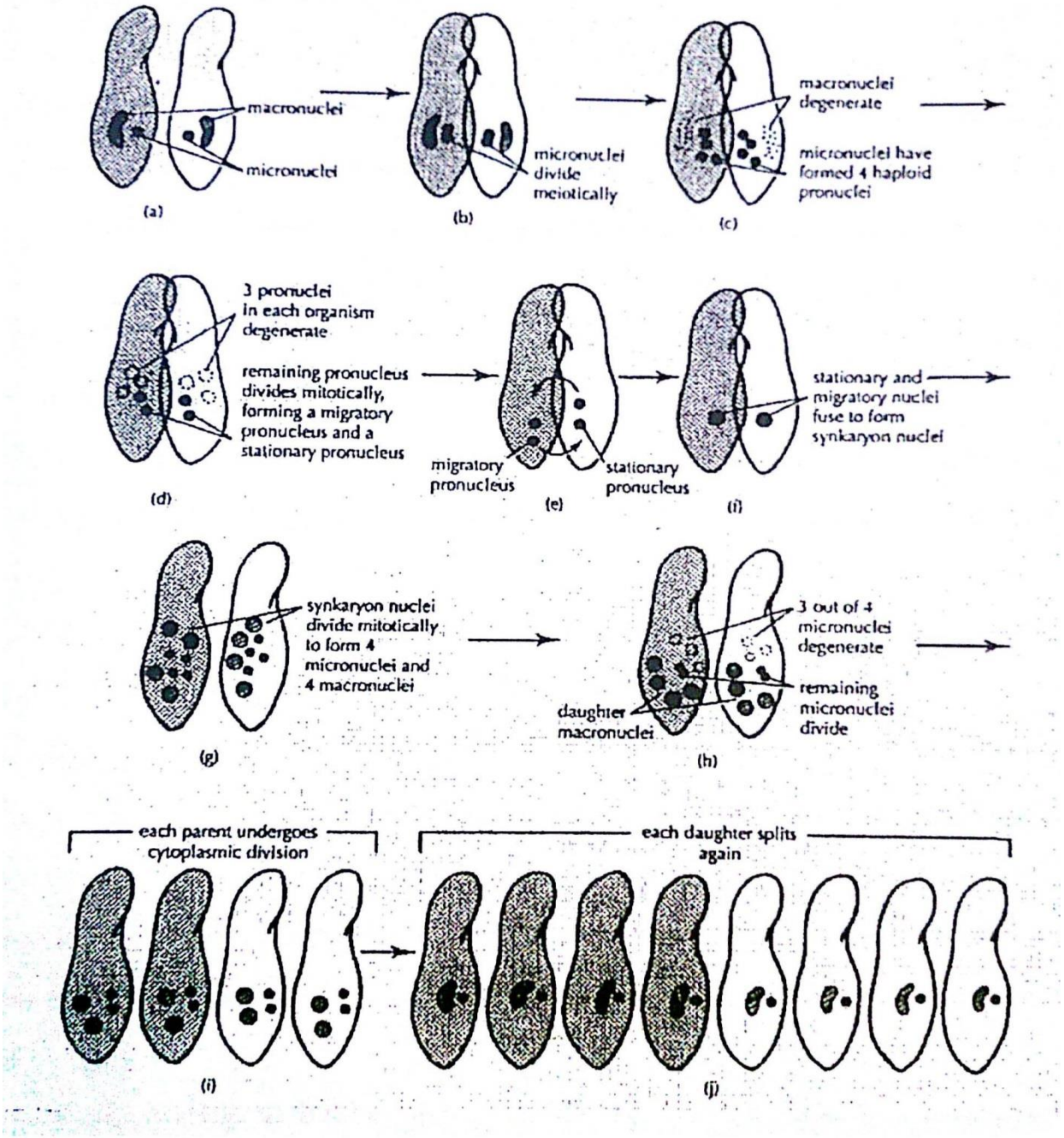
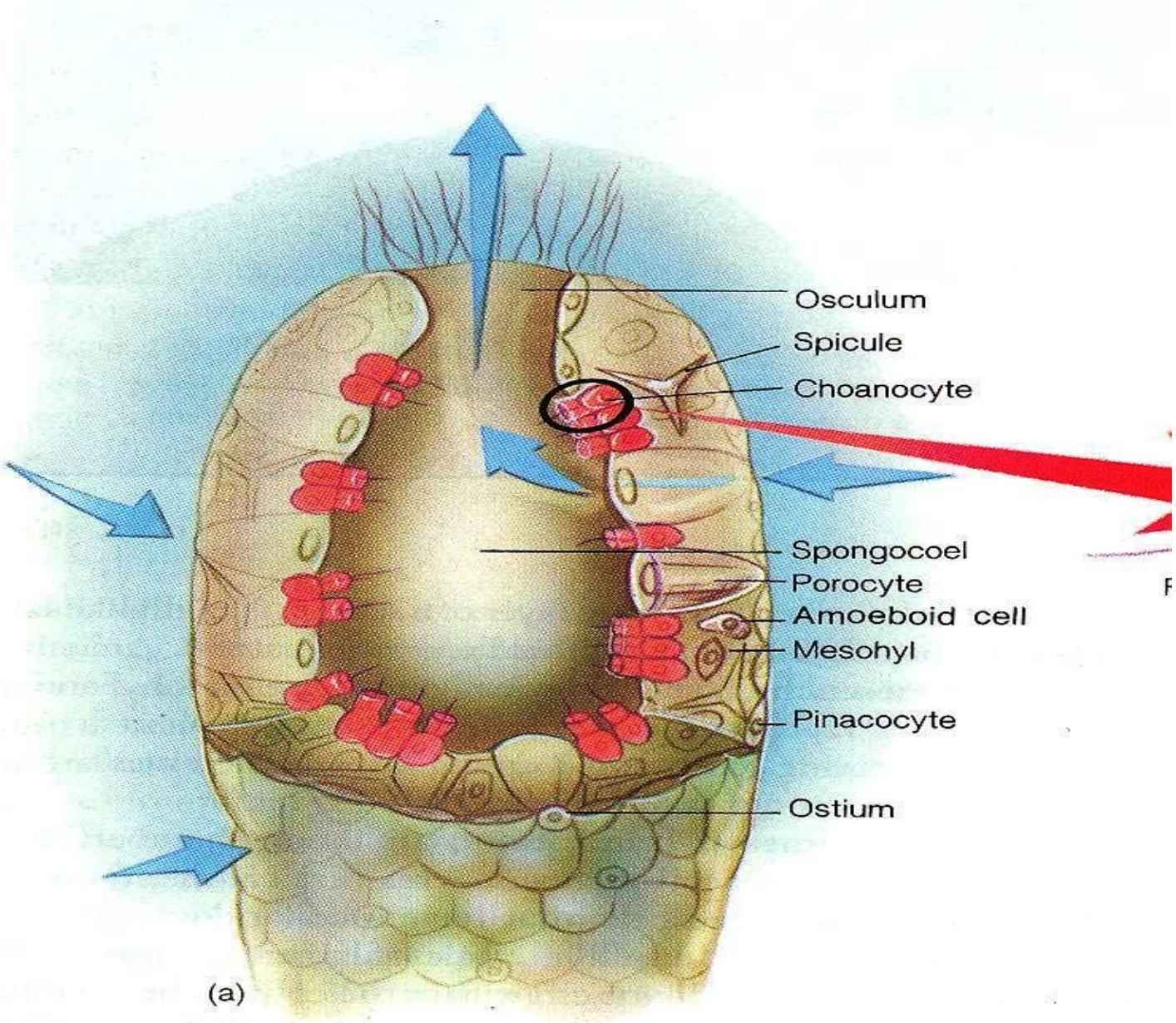


FIGURE 17.17

Phylum Ciliophora. *(a)* The ciliate, *Paramecium sonneborn*. This paramecium is 40 μm in length. Note the oral groove near the n dle of the body that leads into the cytopharynx (SEM ×1,600). *(b)* The structure of a typical ciliate such as *Paramecium*.


macronuclei
micronuclei
(a)
micronuclei divide meiotically
(b)
macronuclei degenerate
micronuclei have formed 4 haploid pronuclei
(c)
3 pronuclei in each organism degenerate
remaining pronucleus divides mitotically, forming a migratory pronucleus and a stationary pronucleus
(d)
migratory pronucleus
stationary pronucleus
(e)
stationary and migratory nuclei fuse to form synkaryon nuclei
(f)
synkaryon nuclei divide mitotically to form 4 micronuclei and 4 macronuclei
(g)
3 out of 4 micronuclei degenerate
remaining micronuclei divide
daughter macronuclei
(h)
each parent undergoes cytoplasmic division
(i)
each daughter splits again
(j)

Phylum: Porifera


Osculum
Spicule
Choanocyte
Spongocoel
Porocyte
Amoeboid cell
Mesohyl
Pinacocyte
Ostium
(a)

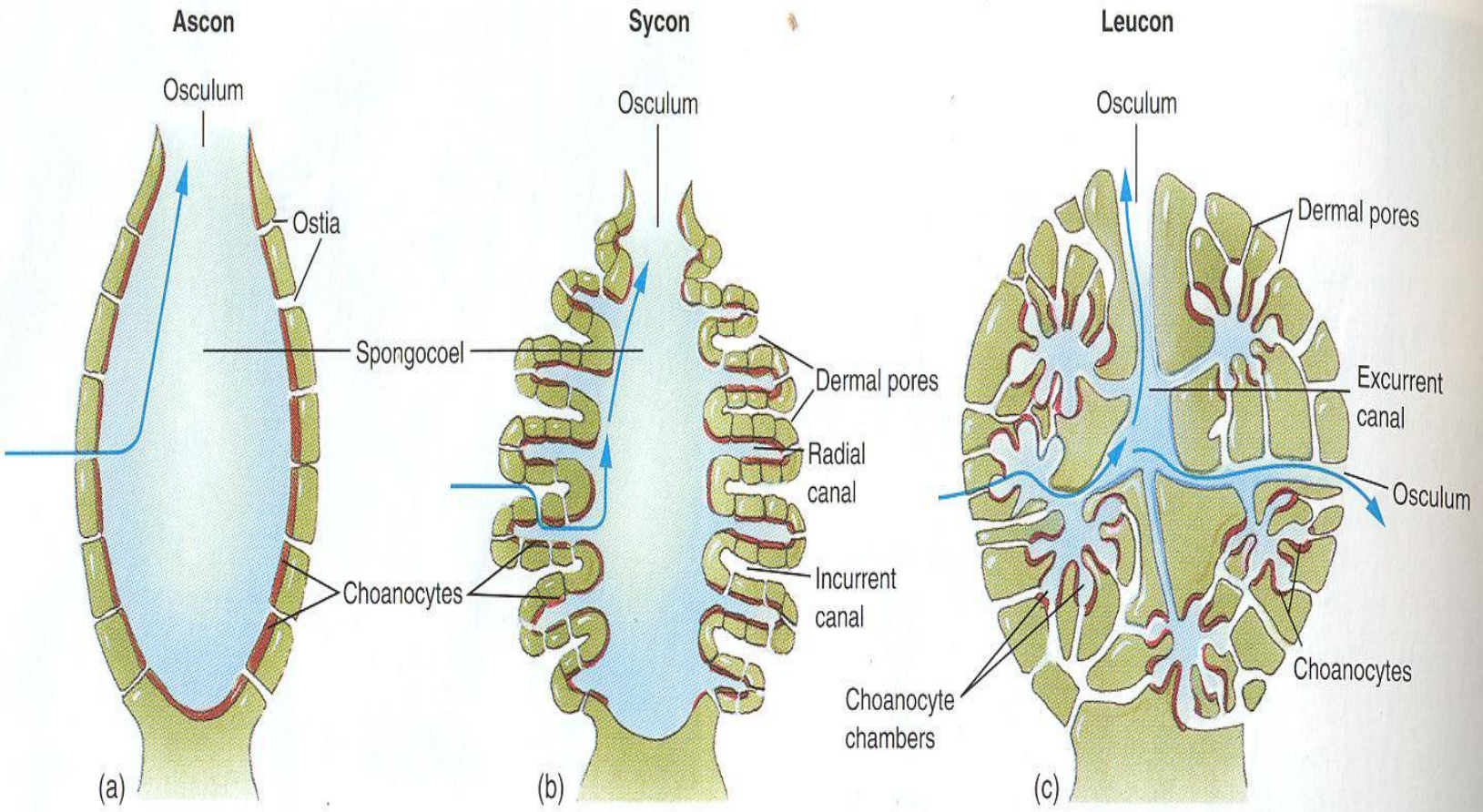
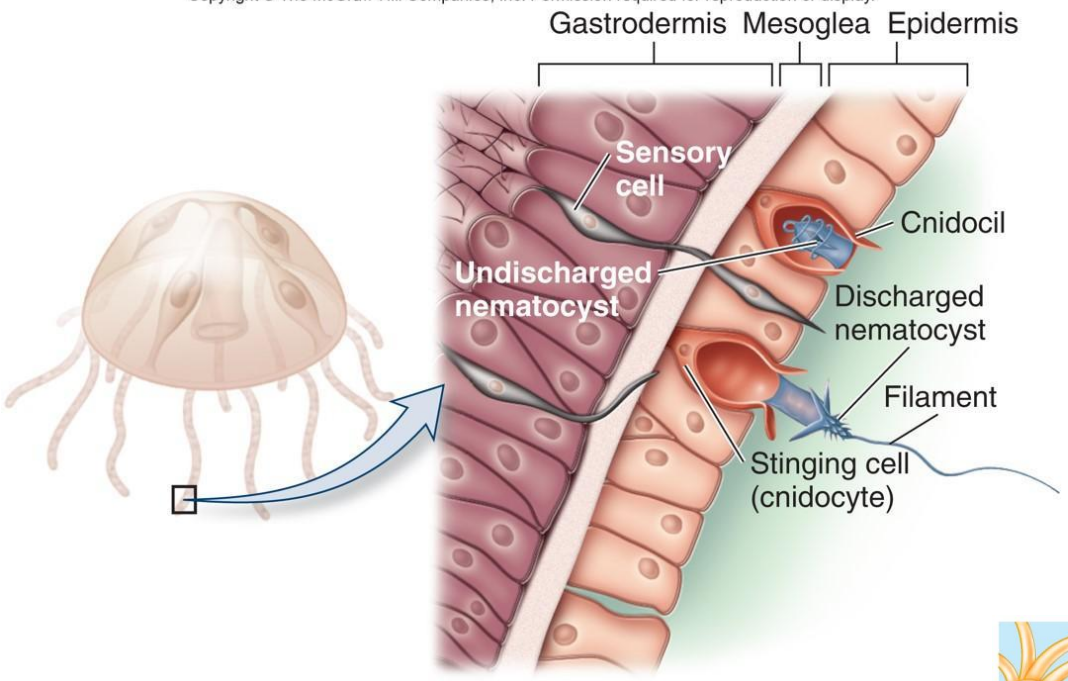


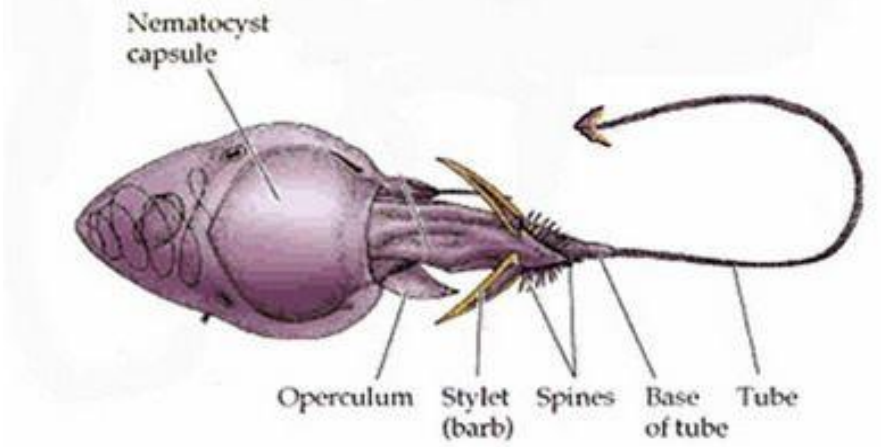
FIGURE 18.7

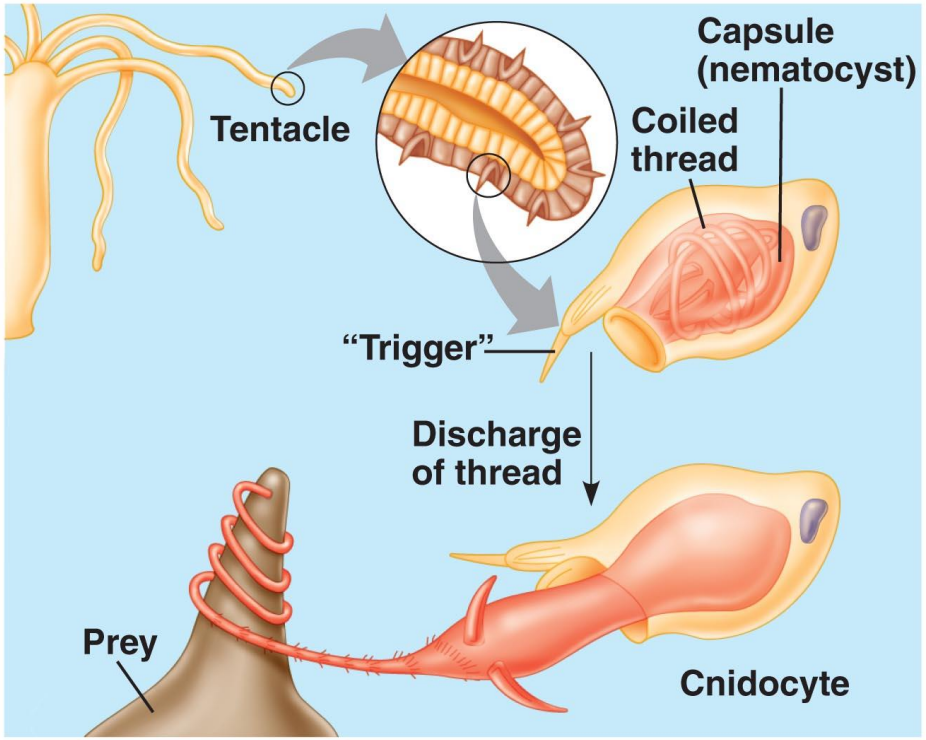
Sponge Body Forms. *(a)* An ascon sponge. Choanocytes line the spongocoel in ascon sponges. *(b)* A sycon sponge. The body wall of sycon sponges appears folded. Choanocytes line radial canals that open into the spongocoel. *(c)* A leucon sponge. The proliferation of canals and chambers results in the loss of the spongocoel as a distinct chamber. Multiple oscula are frequently present. Blue arrows show the direction of water flow.



Nematocyte

DISCHARGED NEMATOCYST





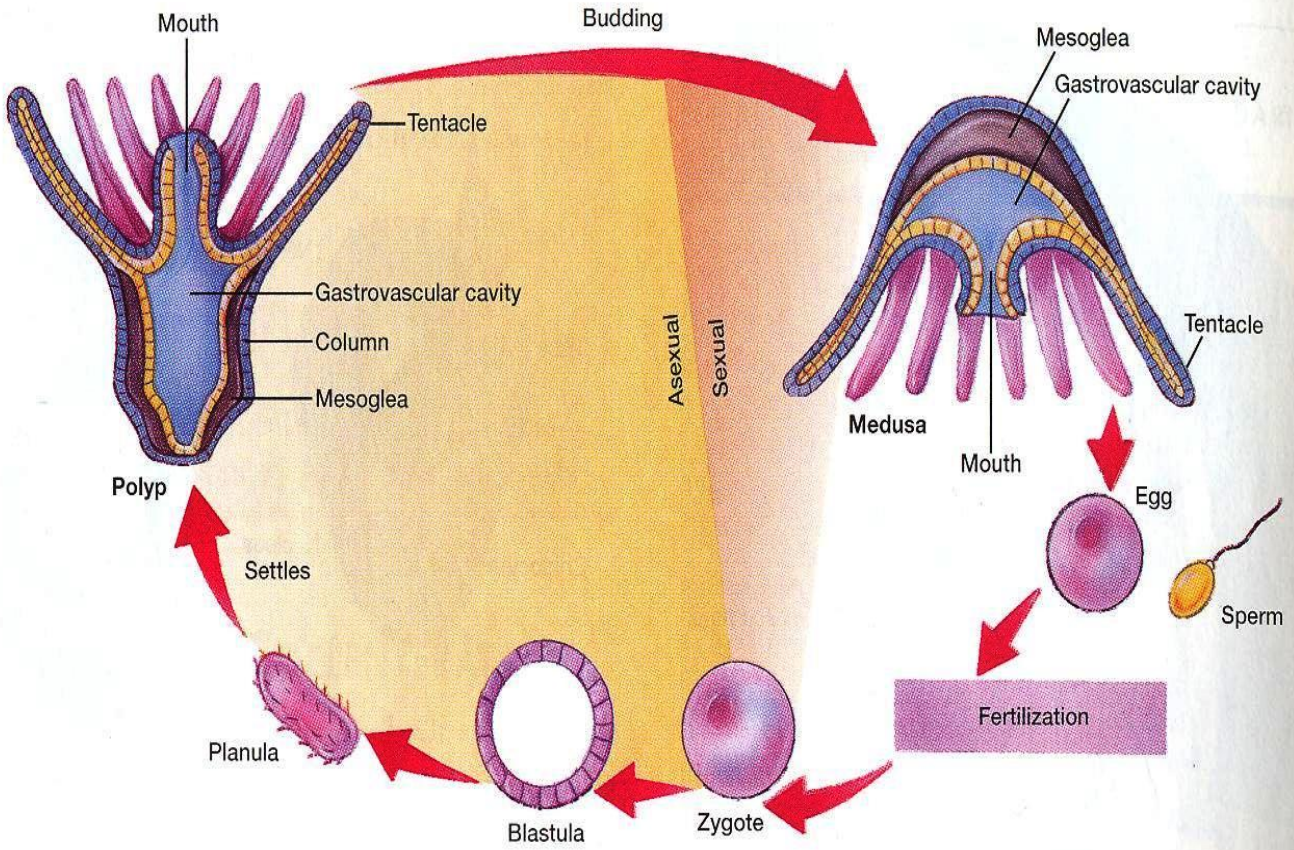


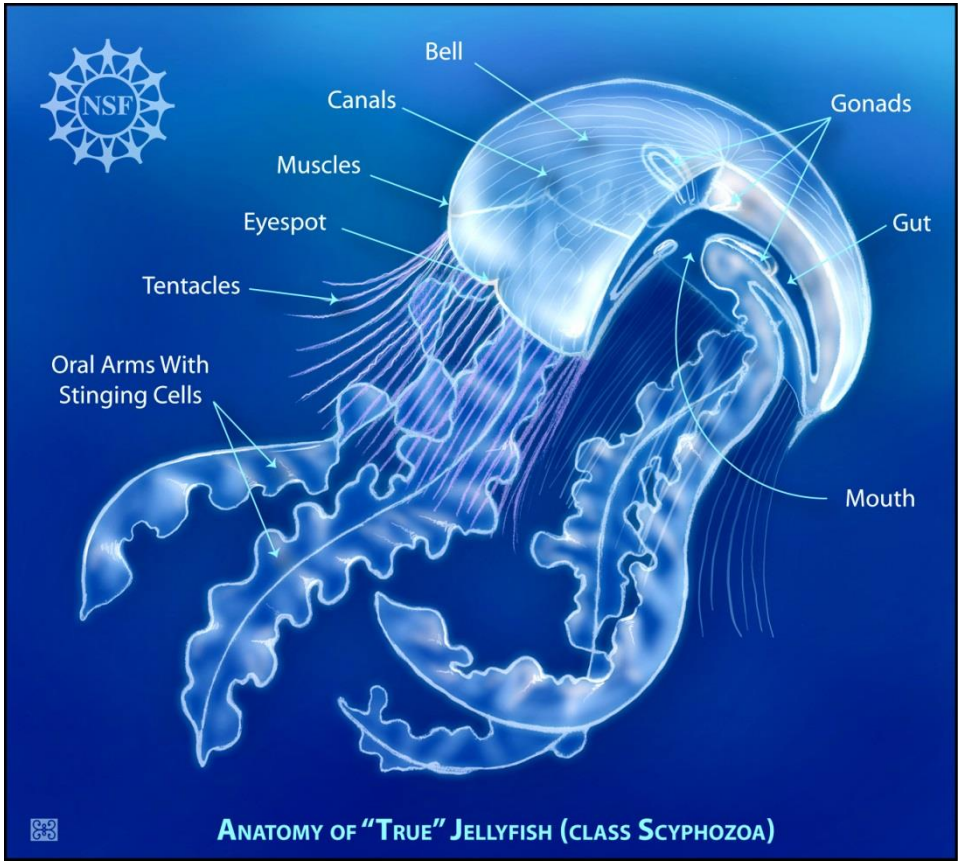
FIGURE 18.11

Generalized Cnidarian Life Cycle. This figure shows alternation between medusa and polyp body forms. Dioecious medusae produce gametes that may be shed into the water for fertilization. Early in development, a ciliated planula larva forms. After a brief free-swimming existence, the planula settles to the substrate and forms a polyp. Budding of the polyp produces additional polyps and medusa buds. Medusae break free of the polyp and swim away. The polyp or medusa stage of many species is either lost or reduced, and the sexual and asexual stages have been incorporated into one body form.

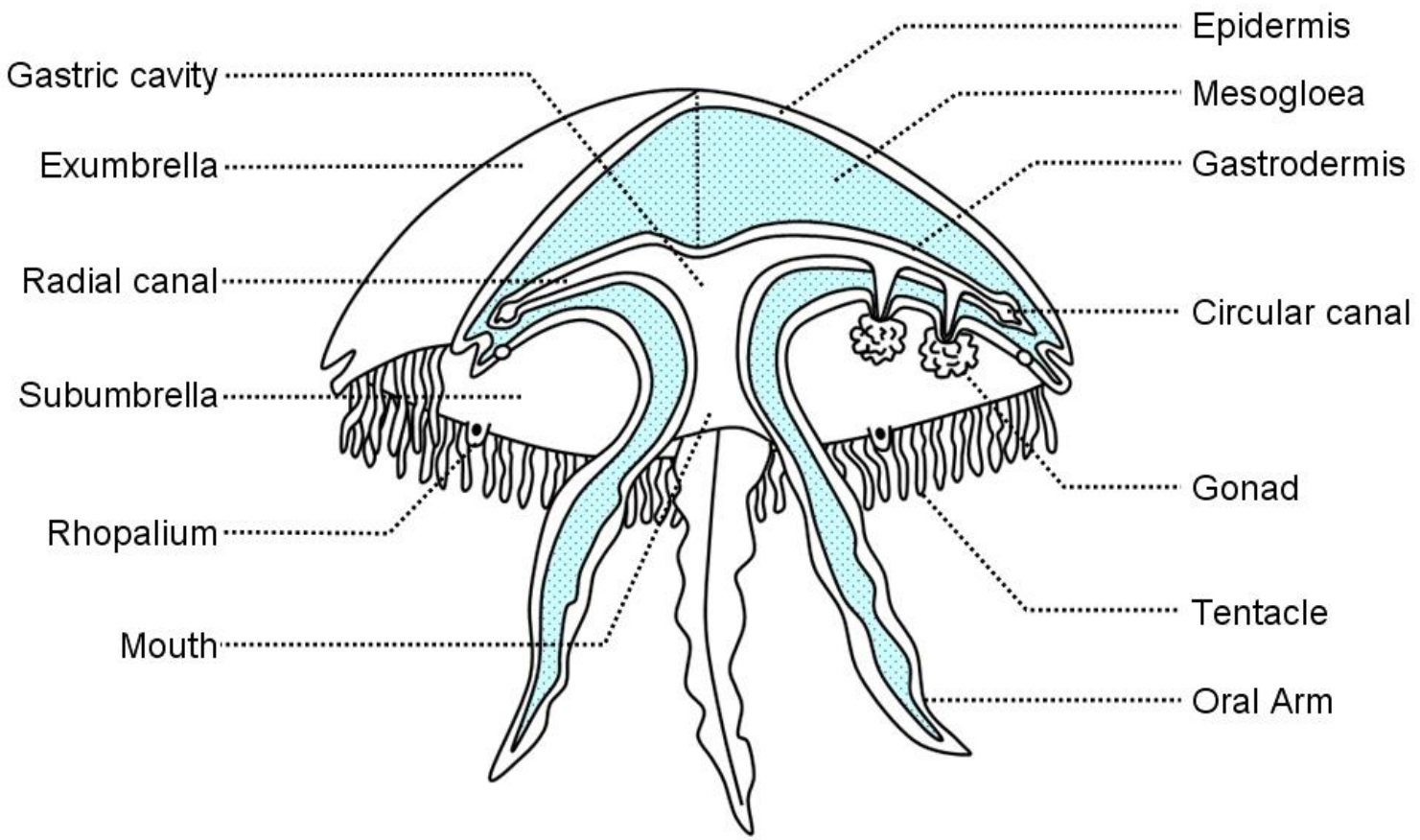
1- Class: Hydrozoa

2-Class: Scyphozoa

Jellies (class Scyphozoa)



Scyphozoa



Aurelia medusa – cutaway diagram

Scyphozoa

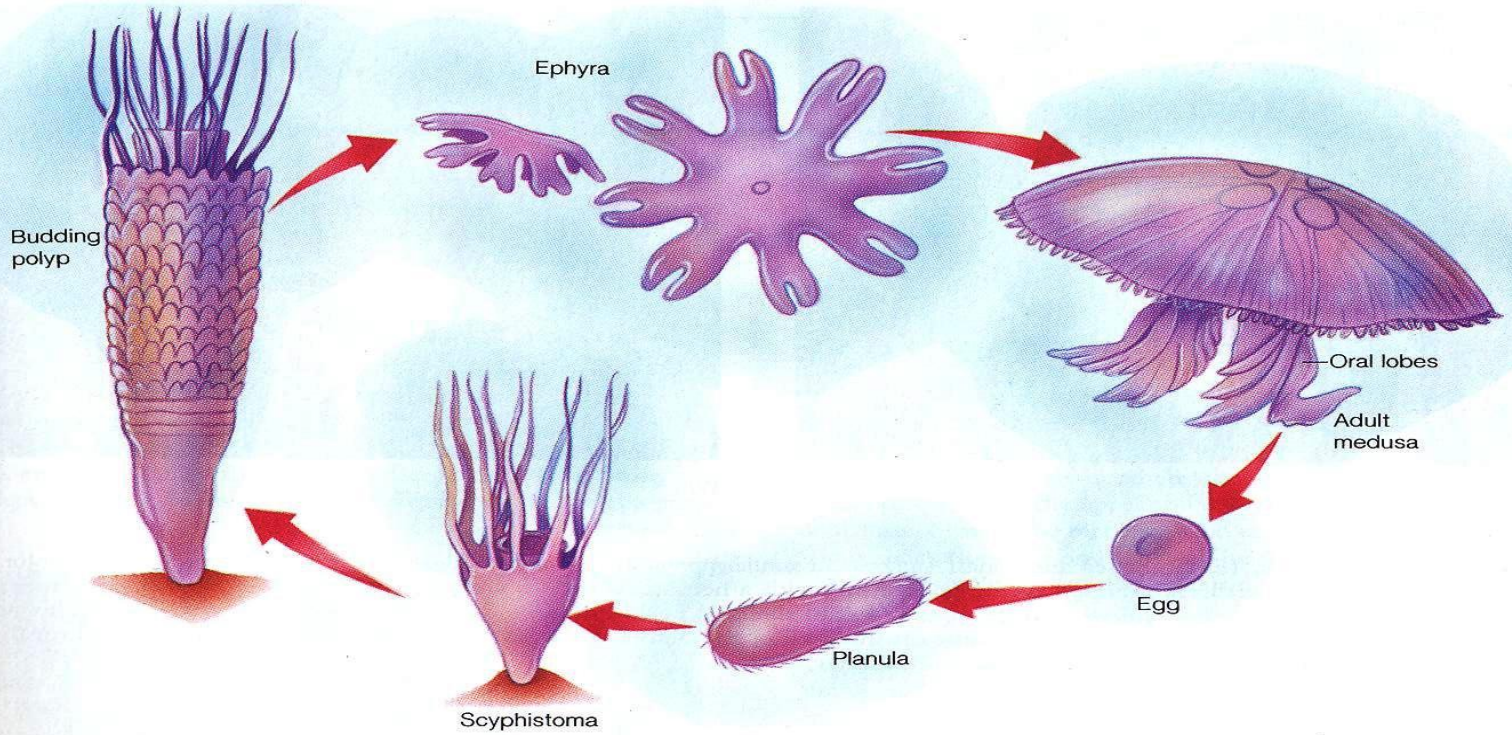
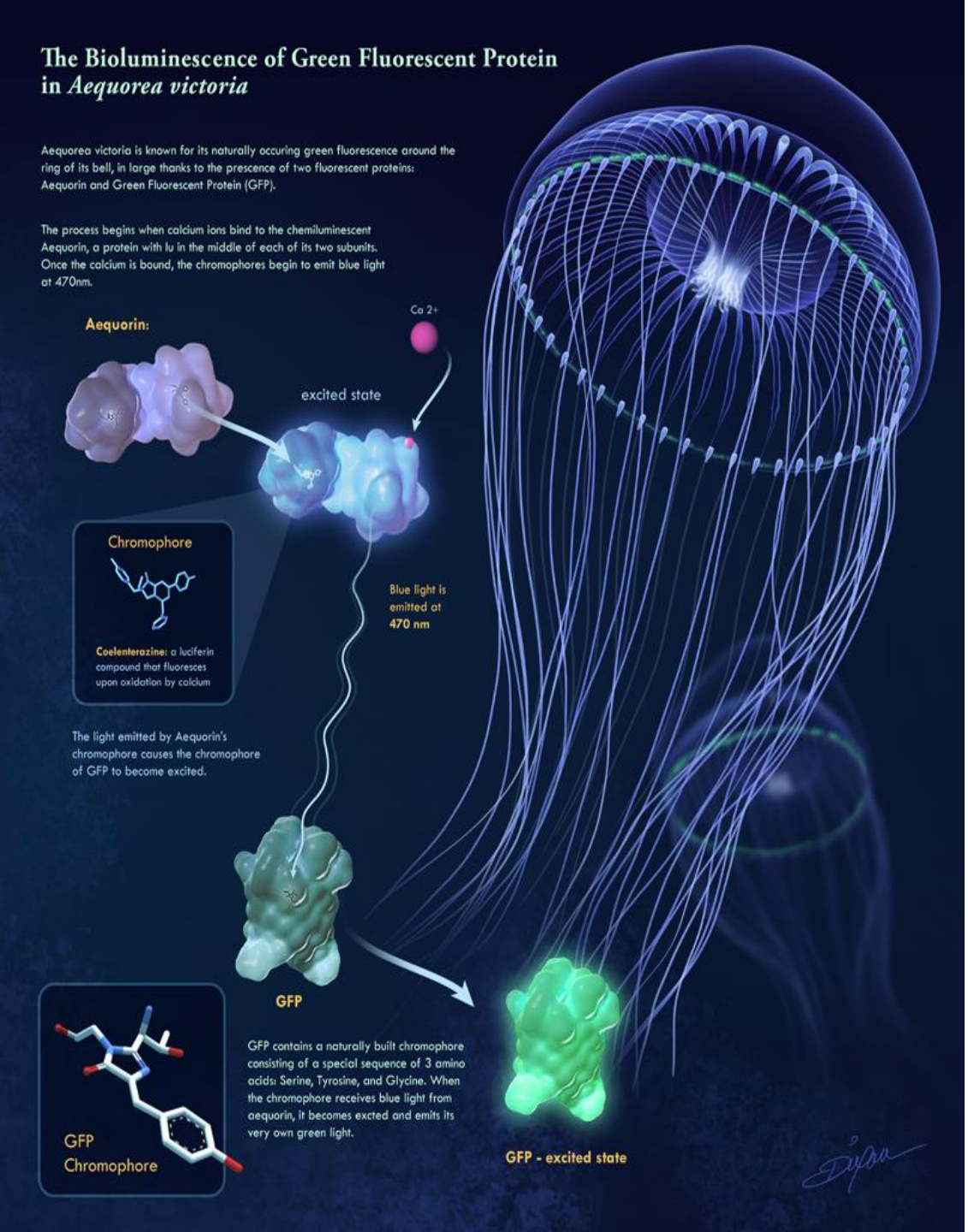
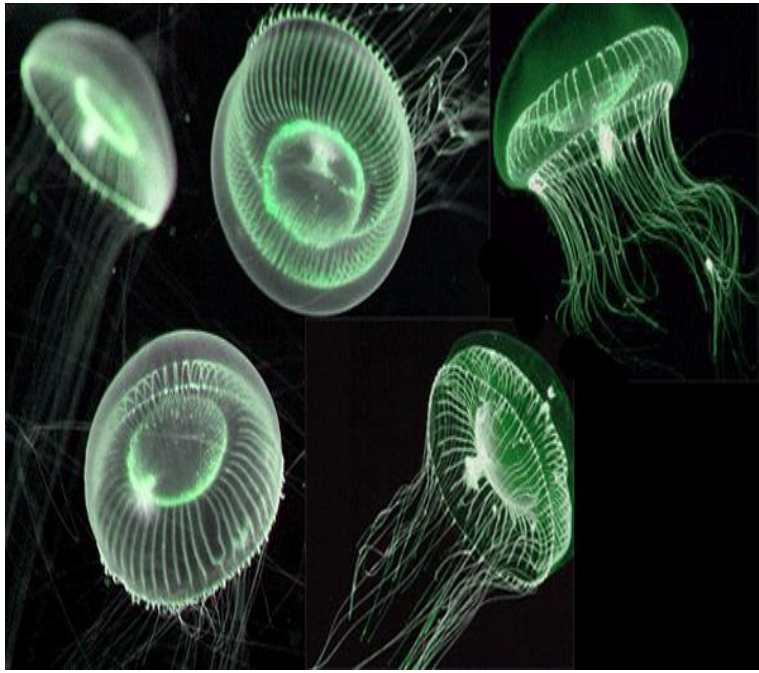


FIGURE 18.16

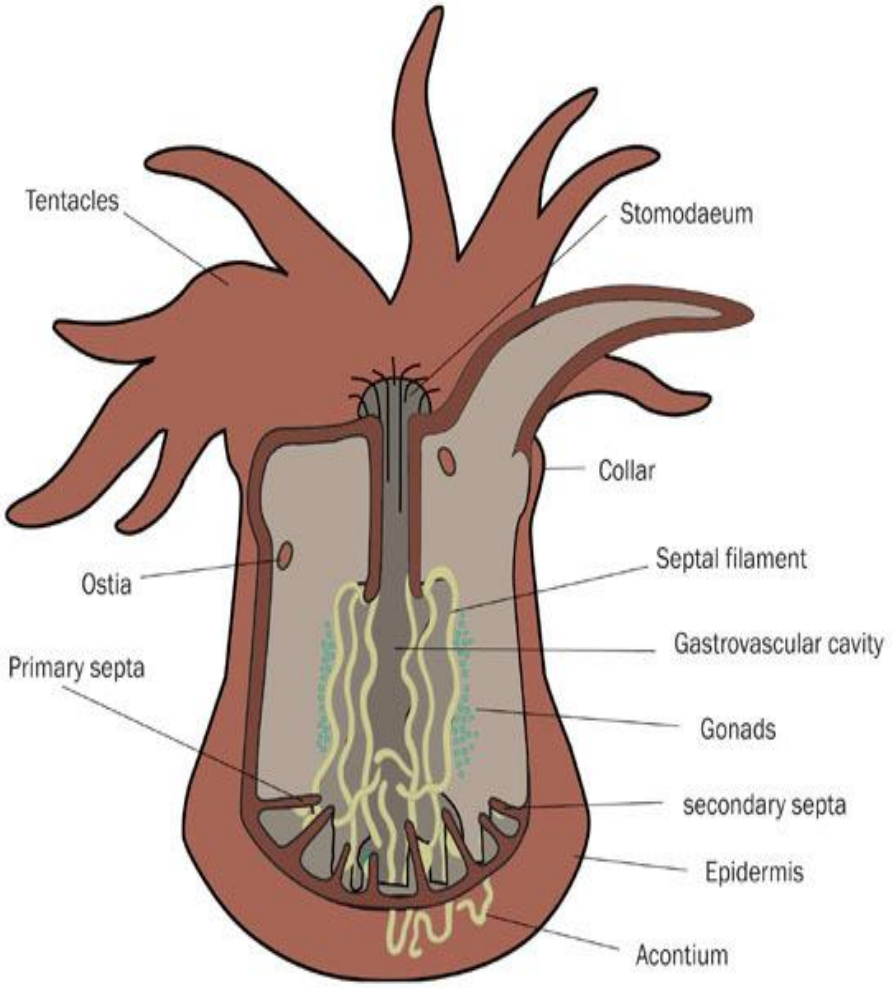
***Aurelia* Life History.** *Aurelia* is dioecious, and like all scyphozoans, the medusa (10 cm) predominates in the organism's life history. The planula (0.3 mm) develops into a polyp called a scyphistoma (4 mm), which produces young medusae, or ephyrae, by budding.


The Bioluminescence of Green Fluorescent Protein in *Aequorea victoria*
Aequorea victoria is known for its naturally occuring green fluorescence around the ring of its bell, in large thanks to the prescence of two fluorescent proteins: Aequorin and Green Fluorescent Protein (GFP).
The process begins when calcium ions bind to the chemiluminescent Aequorin, a protein with lu in the middle of each of its two subunits. Once the calcium is bound, the chromophores begin to emit blue light at 470nm.
Aequorin:
Ca 2+
excited state
Chromophore
Coelenterazine: a luciferin compound that fluoresces upon oxidation by calcium
Blue light is emitted at 470 nm
The light emitted by Aequorin's chromophore causes the chromophore of GFP to become excited.
GFP
GFP contains a naturally built chromophore consisting of a special sequence of 3 amino acids: Serine, Tyrosine, and Glycine. When the chromophore receives blue light from aequorin, it becomes excted and emits its very own green light.
GFP - excited state
GFP Chromophore

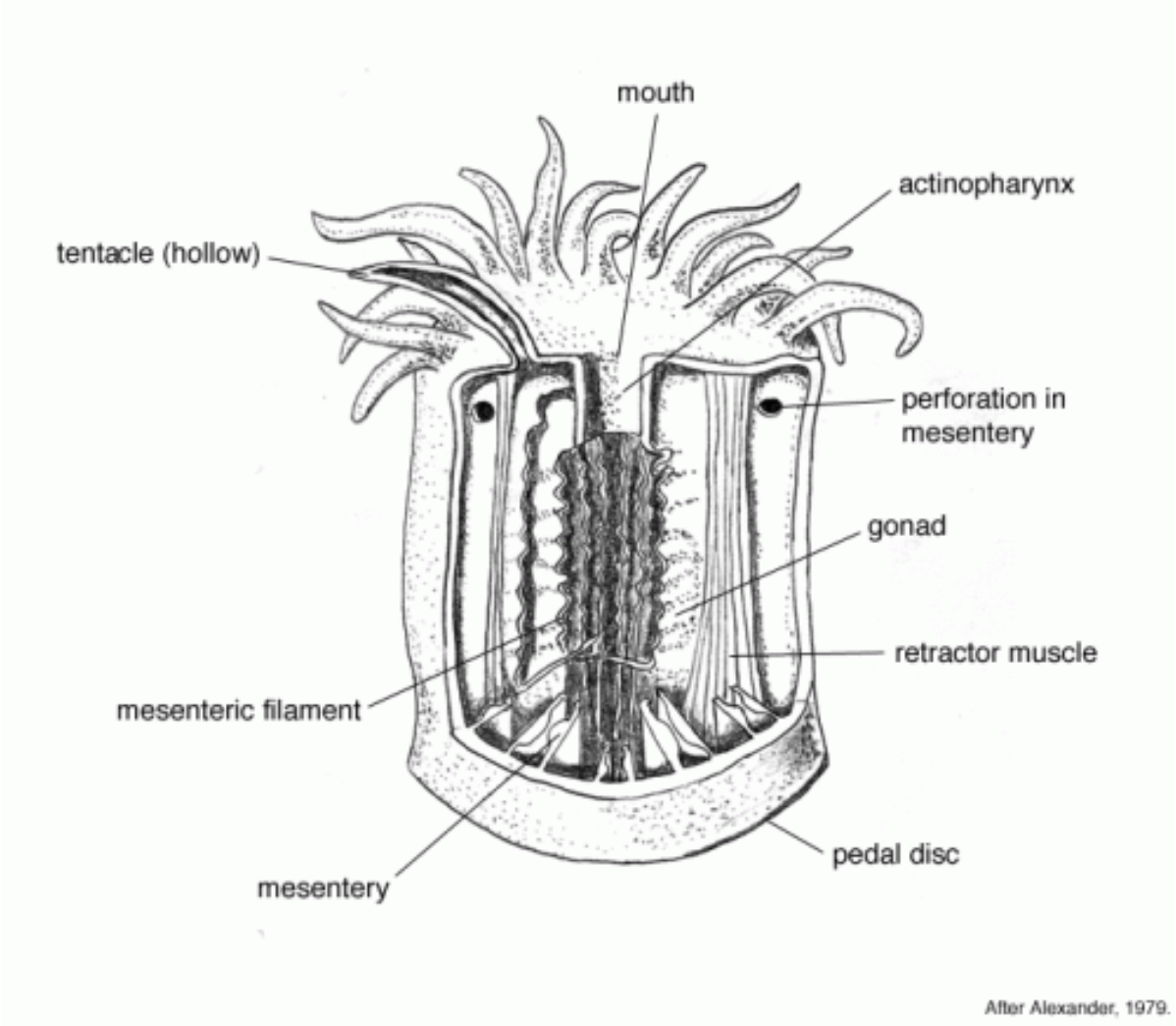
Scyphozoa



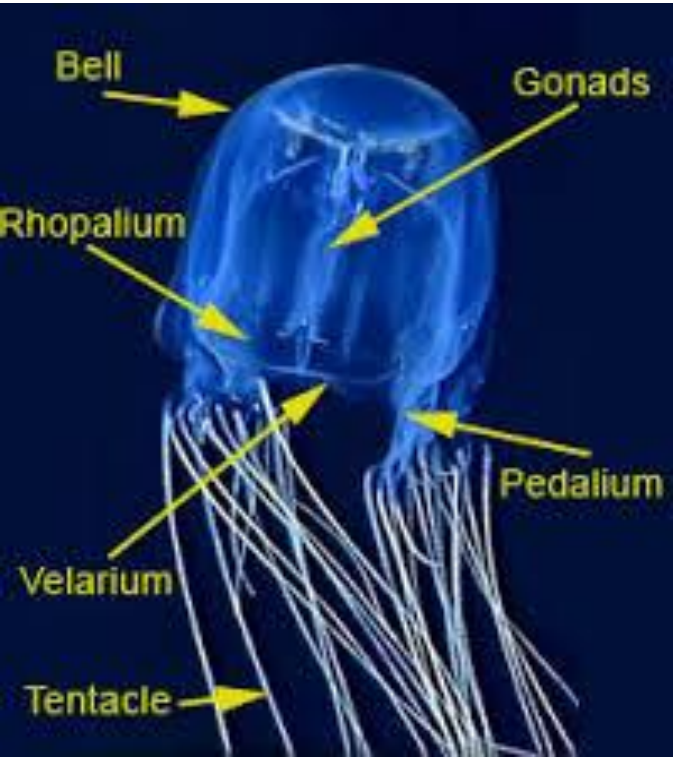
3- Class: Anthozoa

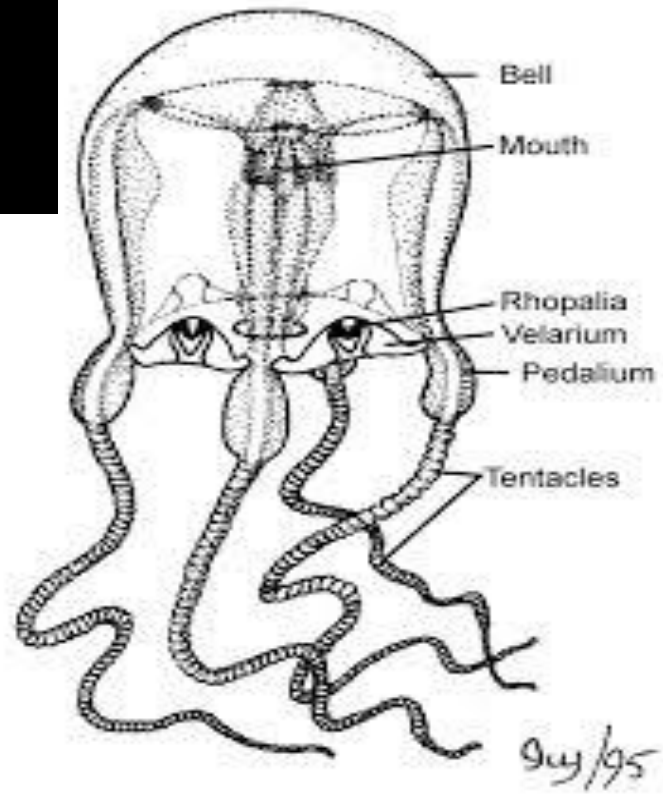


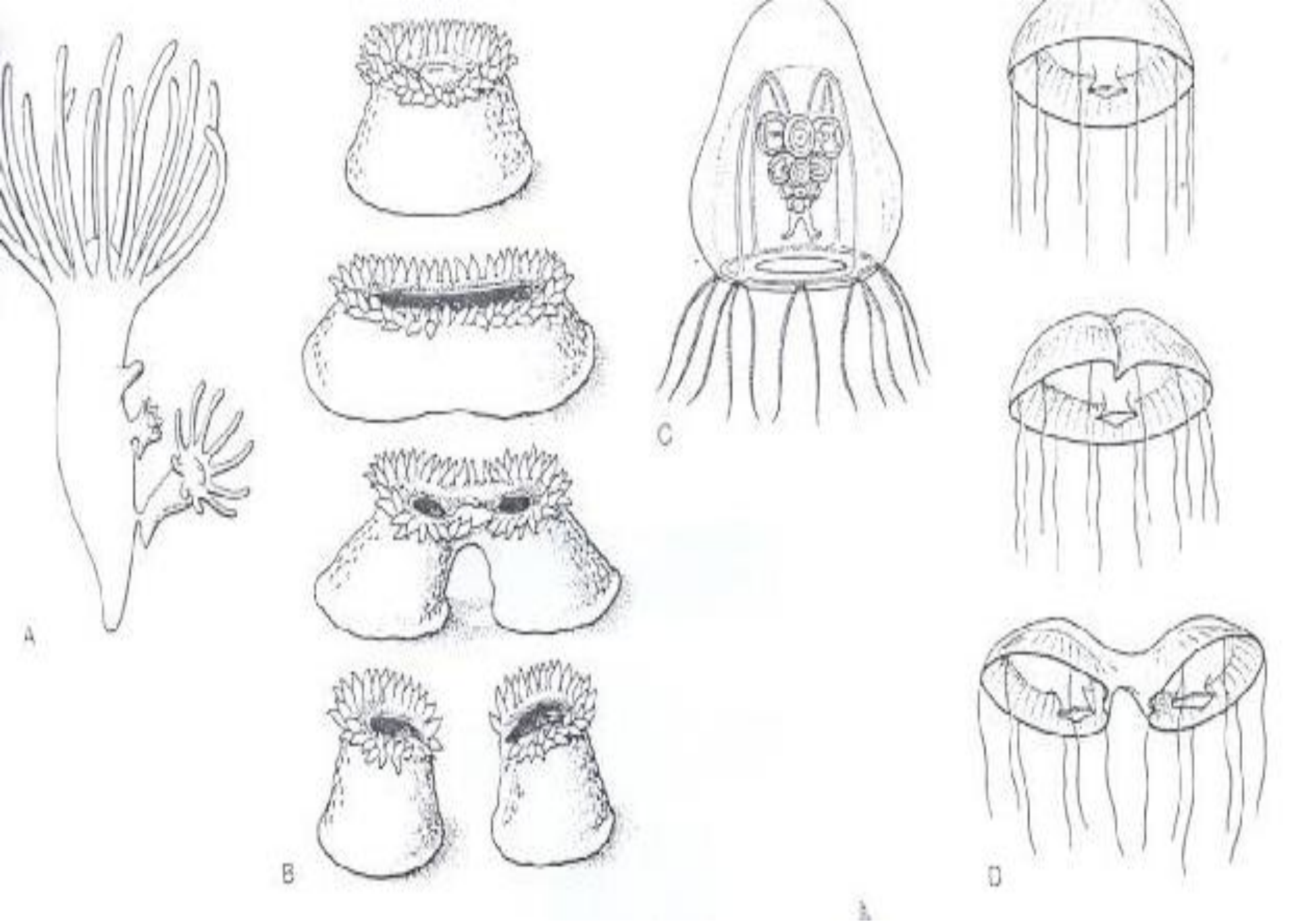
3- Class: Anthozoa



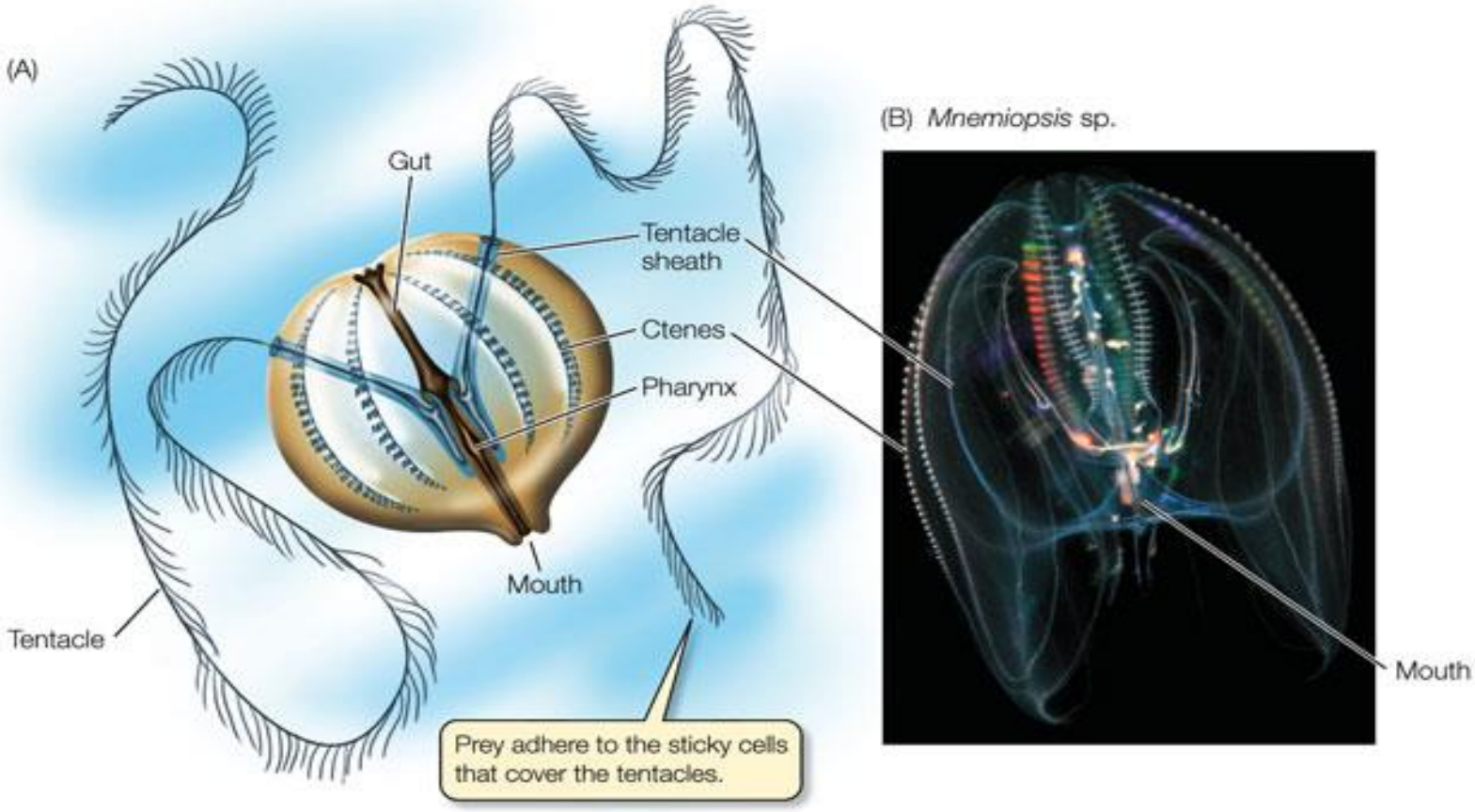
4- Class: Cubozoa





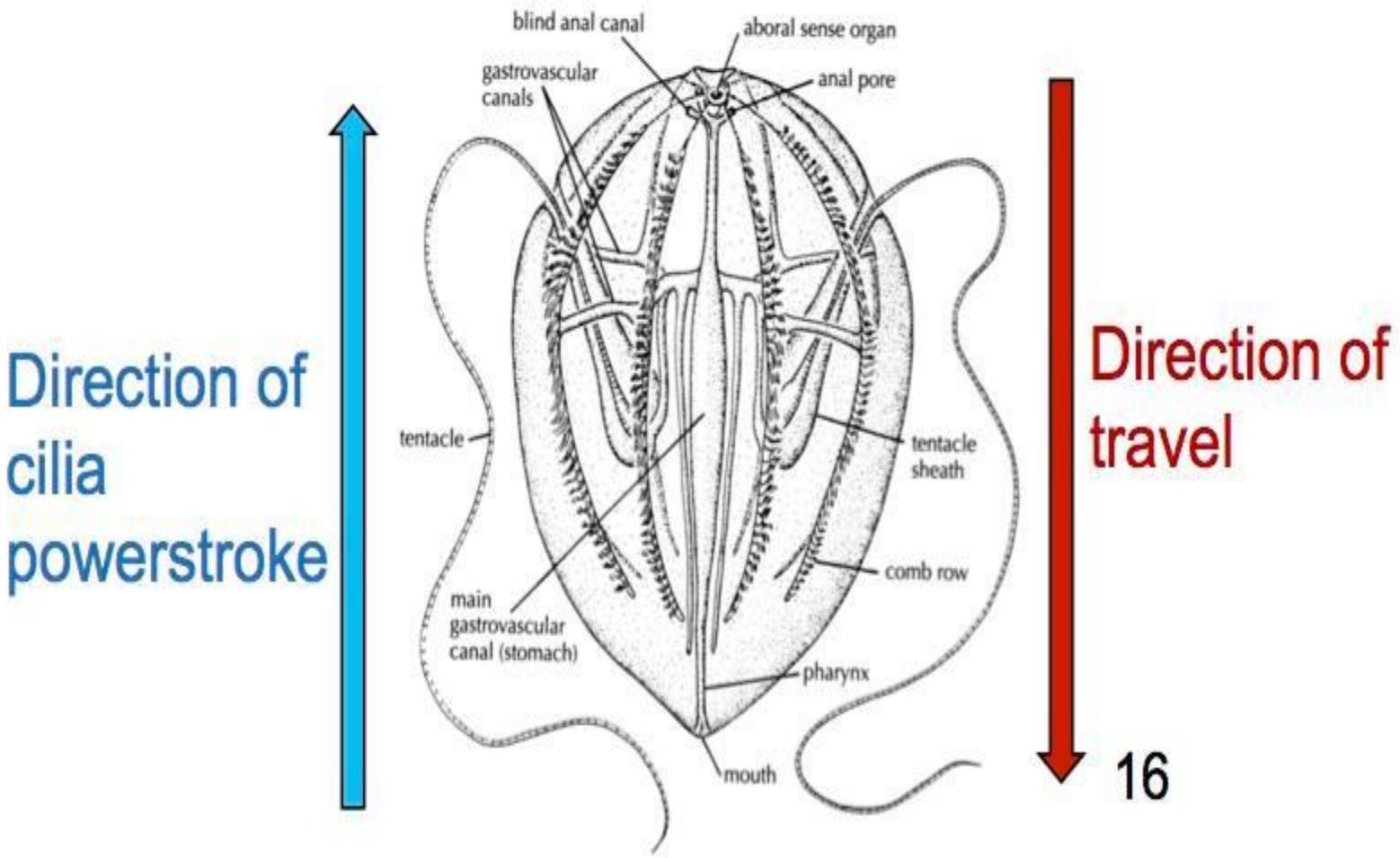

A
B
C
D

Phylum: Ctenophra



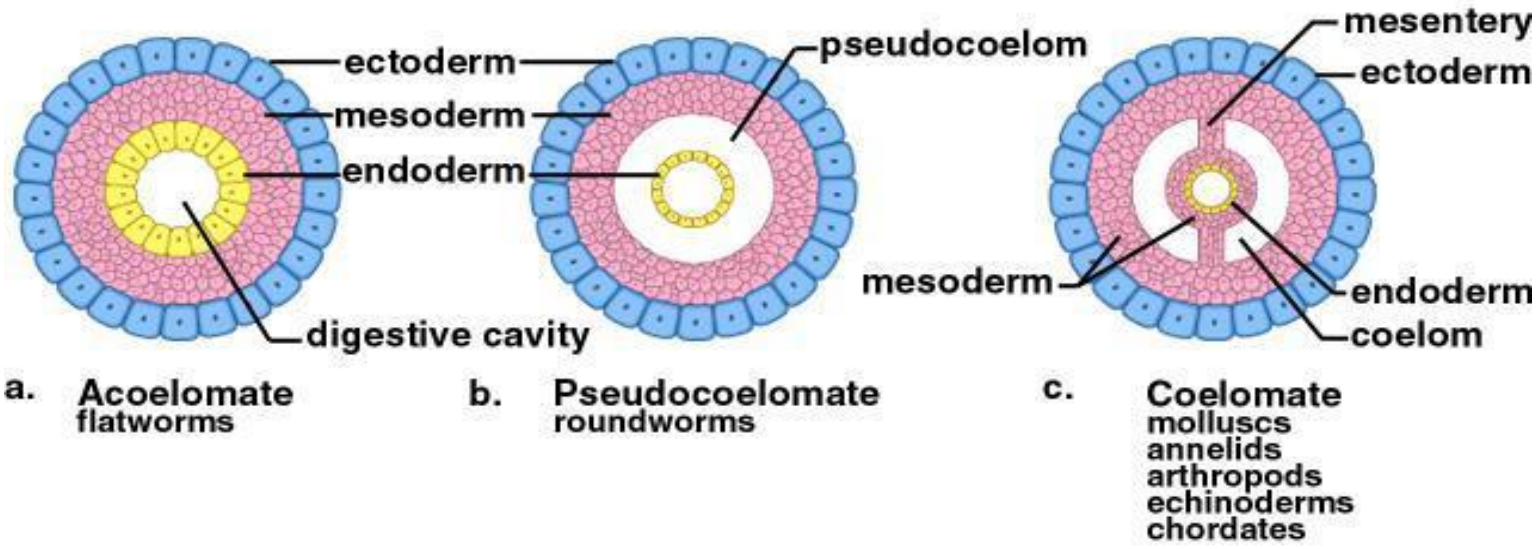
***LIFE 8e*, Figure 31.17**

Phylum: Ctenophra



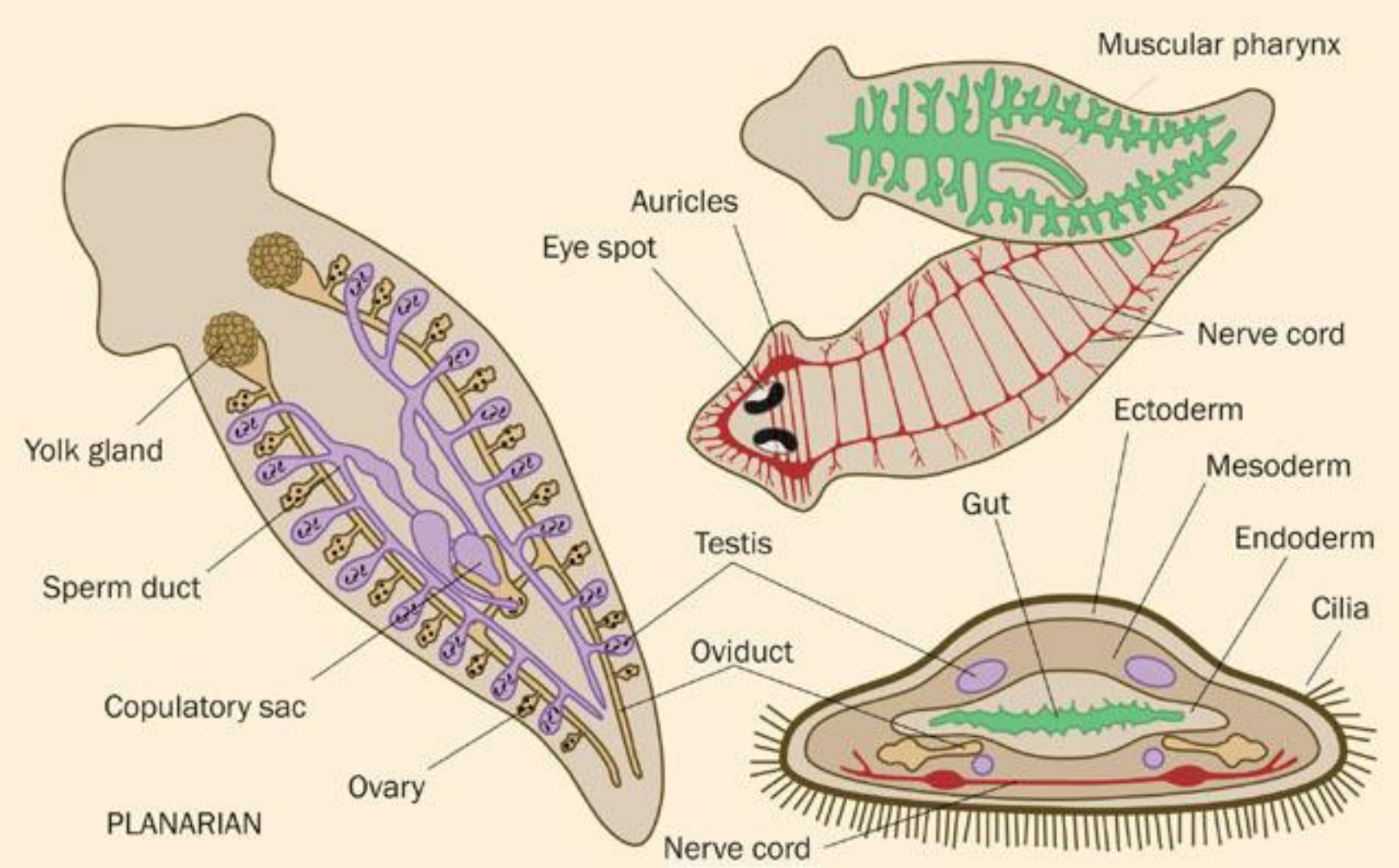
Coelomate

Acoelomate, pseudocoelomate, coelomate comparison



Class Turbellaria

Class: Turbellaria



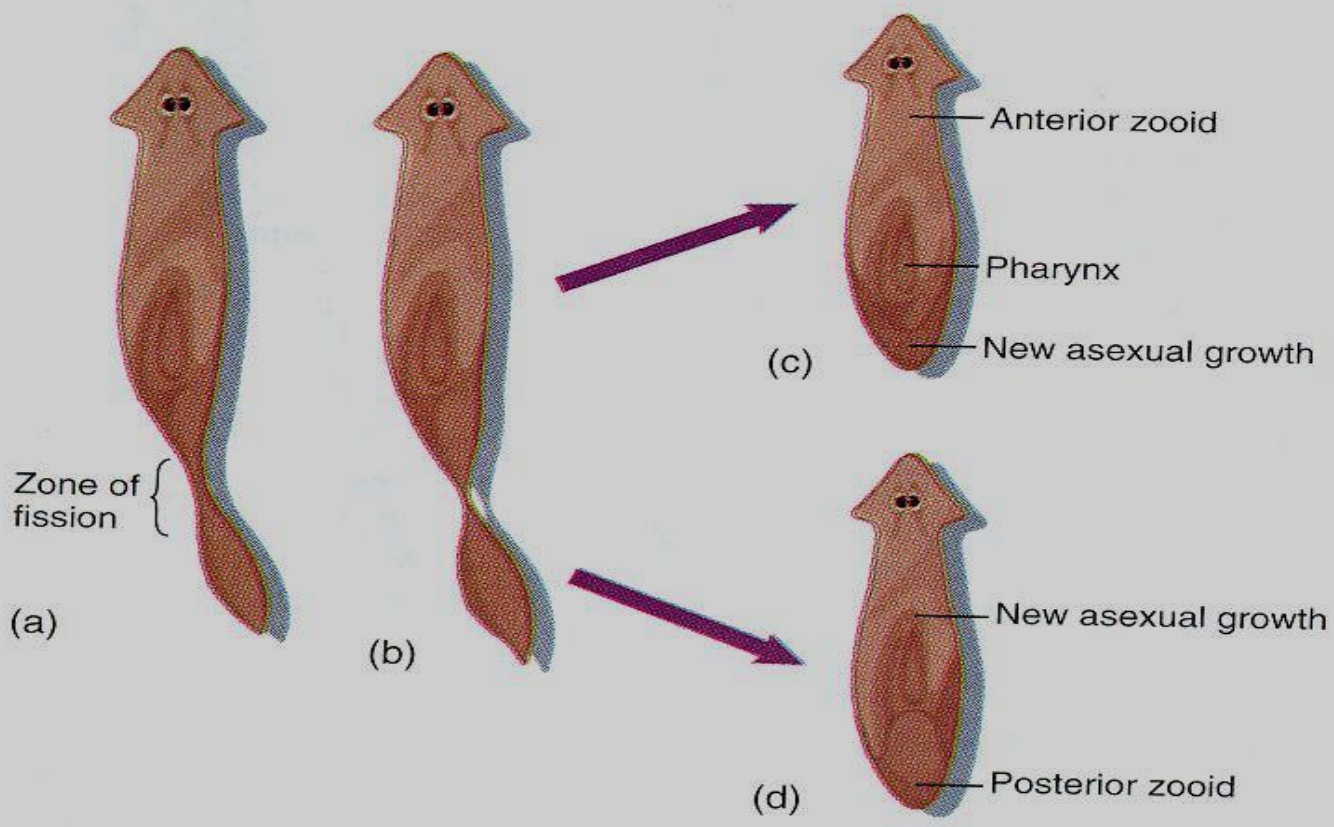
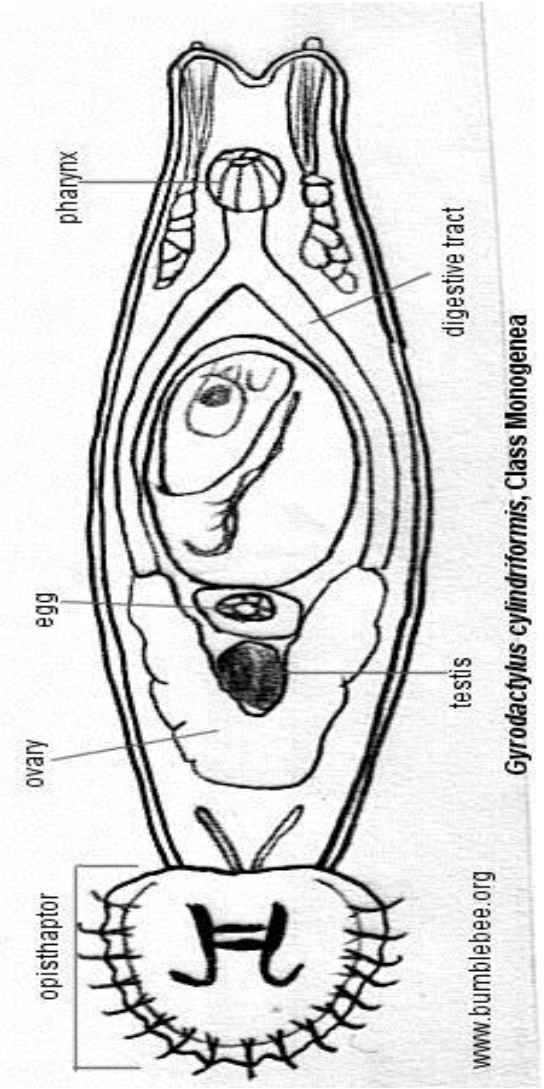


FIGURE 19.8

Asexual Reproduction in a Turbellarian. *(a)* Just before division and *(b)* just after. The posterior zooid soon develops a head, pharynx, and other structures. *(c,d)* Later development.

Trematoda, monogenea



Trematoda, Digenea

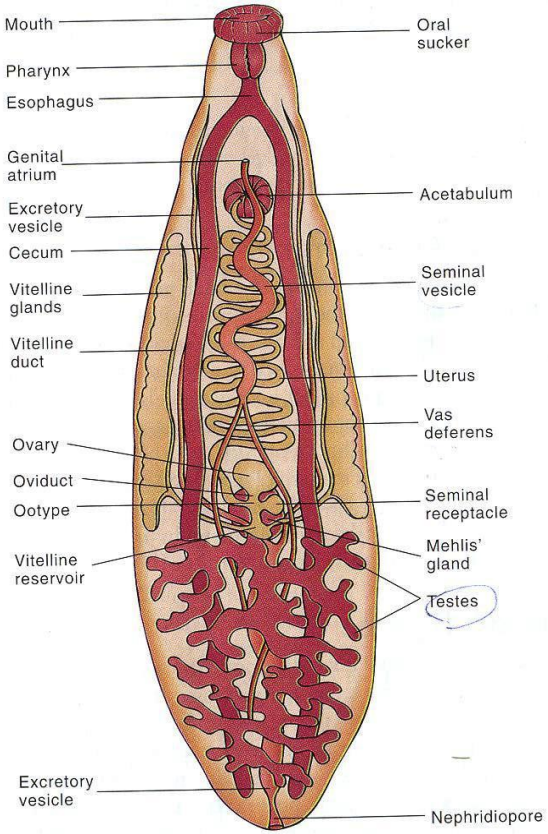
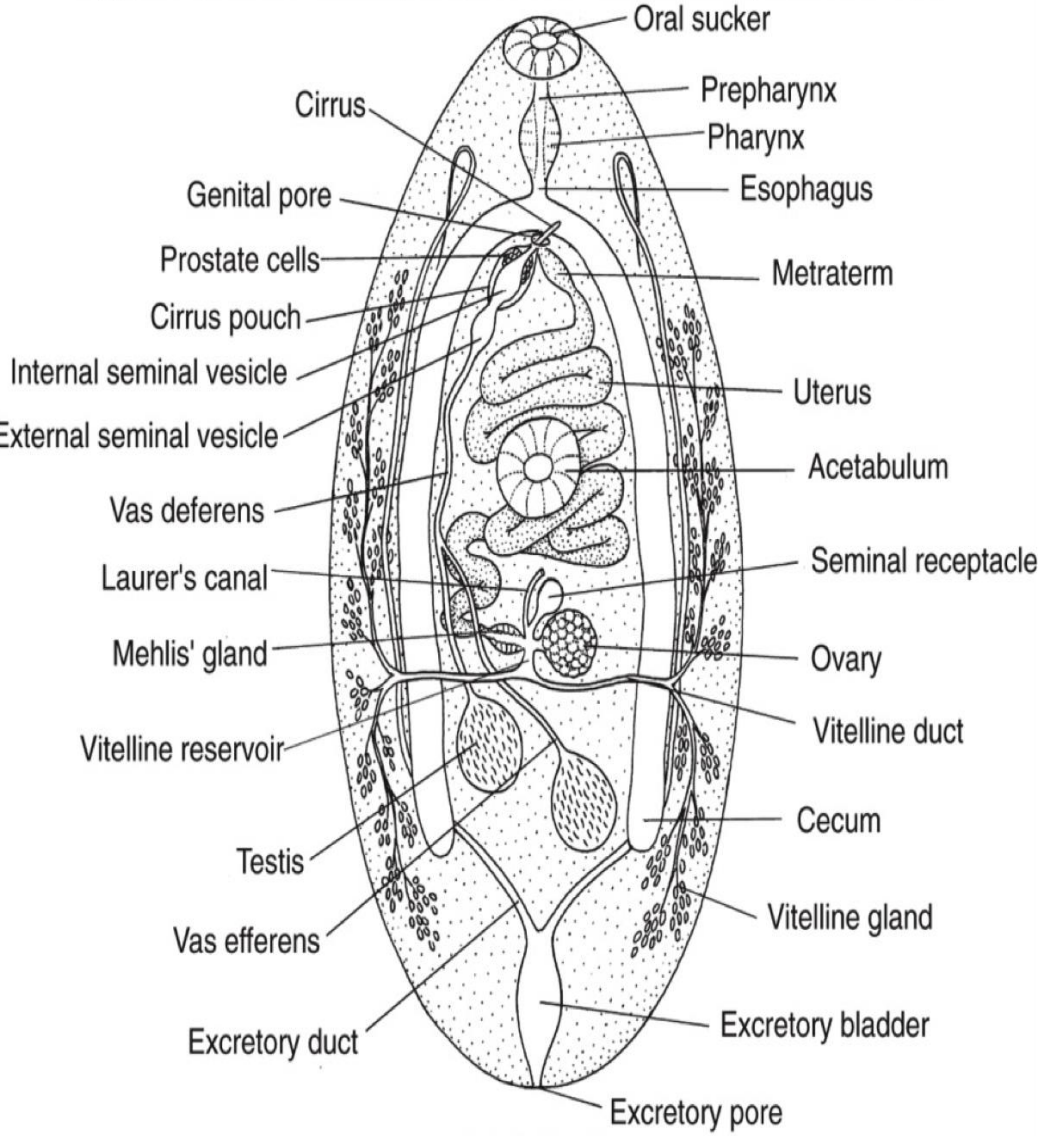


FIGURE 19.11

Generalized Fluke (Digenetic Trematode). Note the large percentage of the body devoted to reproduction. The Mehlis' gland is a conspicuous feature of the female reproductive tract; its function in trematodes is uncertain.



Drawing by William Ober.

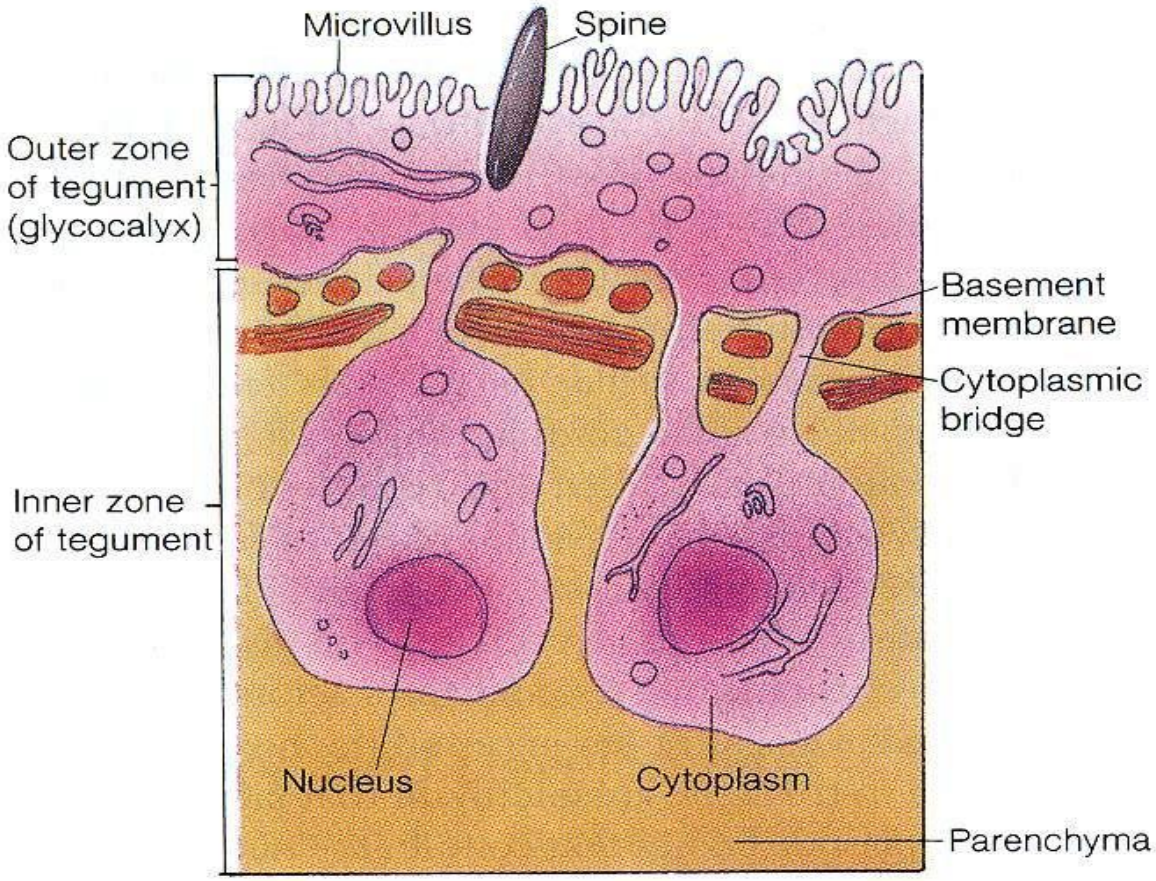


FIGURE 19.12

Trematode Tegument. The fine structure of the tegument of a fluke. The tegument is an evolutionary adaptation that is highly efficient at absorbing nutrients and for protection.

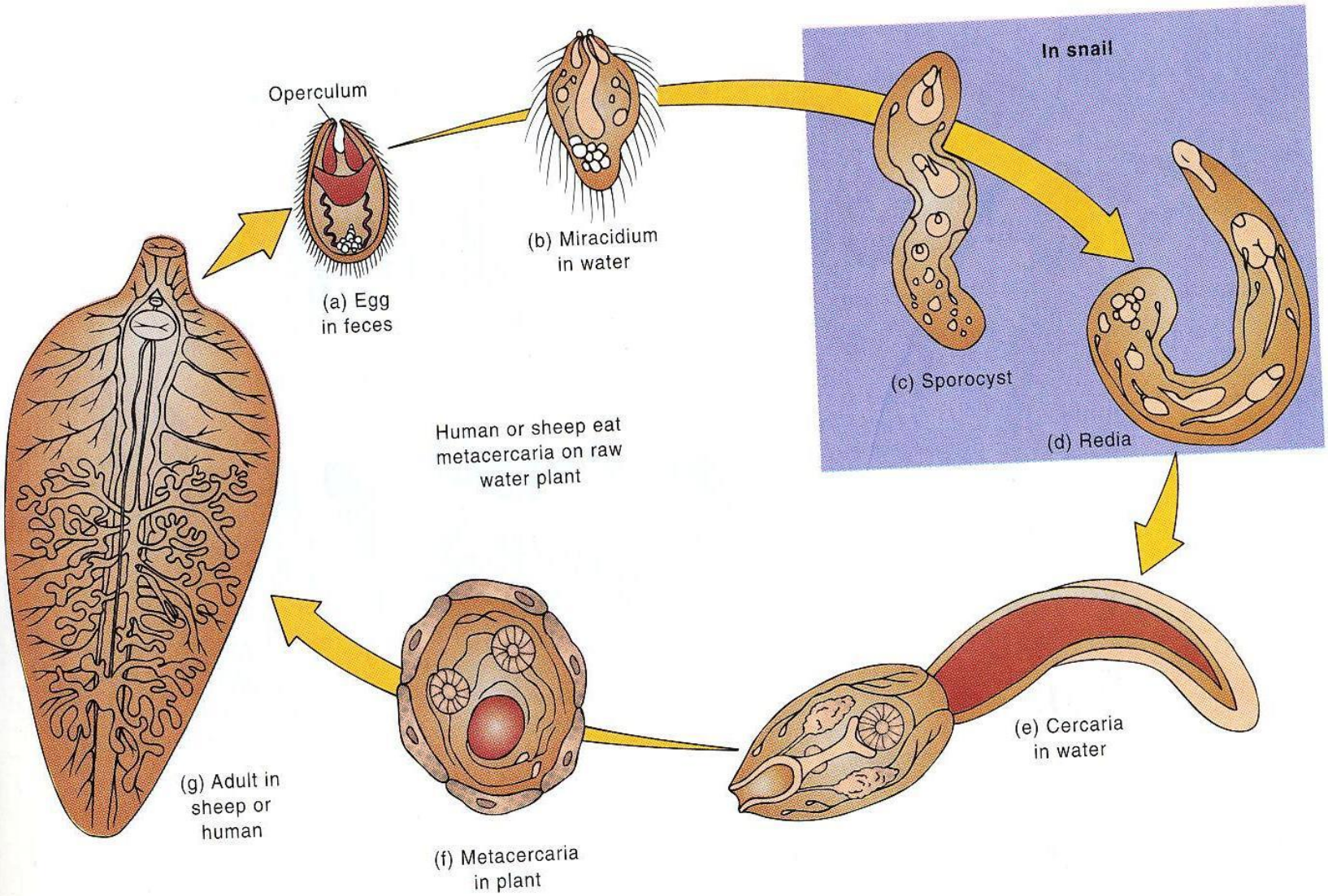


FIGURE 19.14

Class Trematoda: Subclass Digenea. The life cycle of the digenetic trematode, *Fasciola hepatica* (the common liver fluke). The adult is about 30 mm long and 13 mm wide. The cercaria is about 0.5 mm long.

...animals become infected when

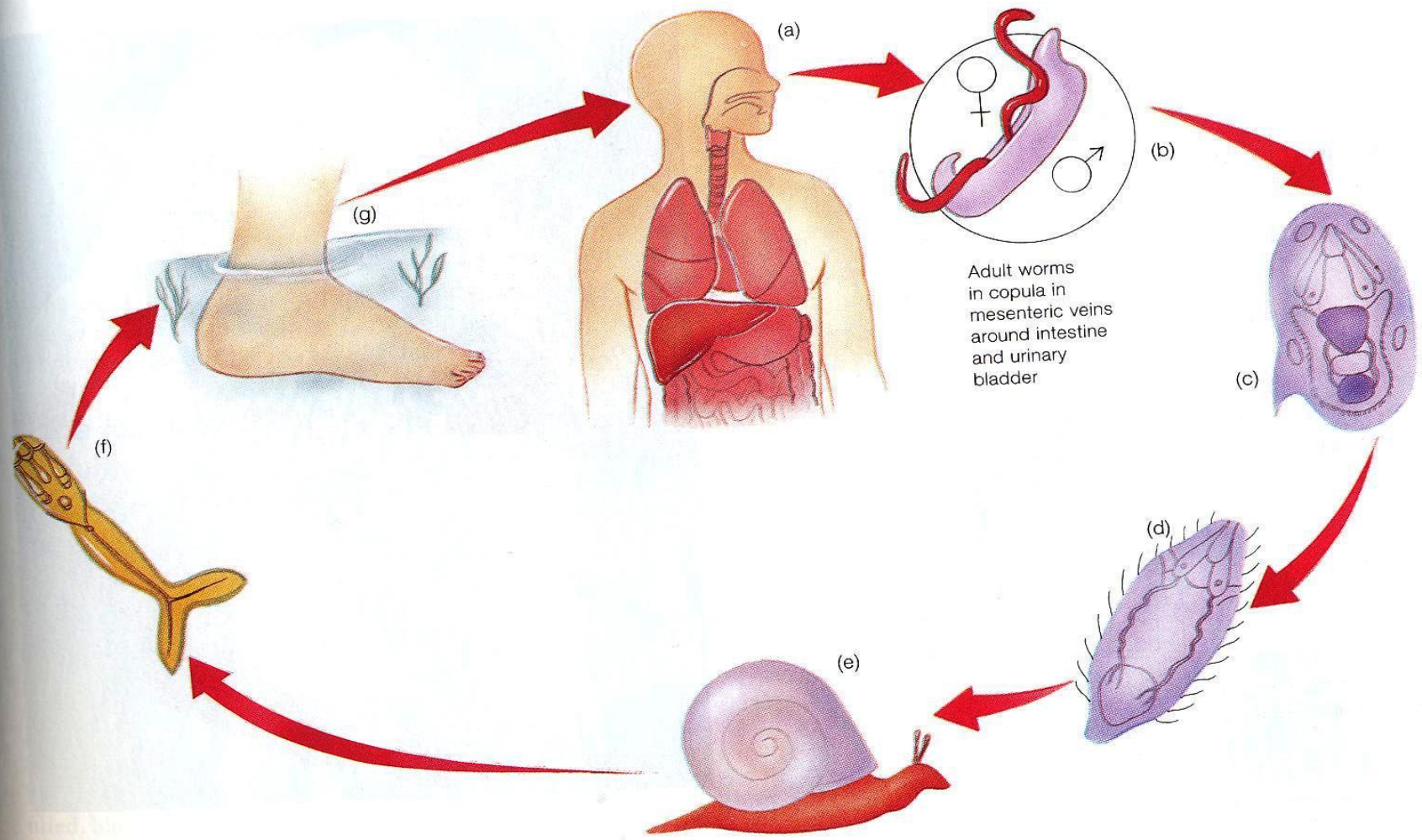


FIGURE 19.16

Representative Life Cycle of a Schistosome Fluke. The cycle begins in a human (*a*) when the female fluke lays eggs (*b*,*c*) in the thin-walled, small vessels of the large or small intestine (*S. mansoni* and *S. japonicum*) or urinary bladder (*S. haematobium*). Secretions from the eggs weaken the walls, and the blood vessels rupture, releasing eggs into the intestinal lumen or urinary bladder. From there, the eggs leave the body. If they reach fresh water, the eggs hatch into ciliated, free-swimming larvae called miracidia (*d*). A miracidium burrows into the tissues of an aquatic snail (*e*), losing its cilia in the process, and develops into a sporocyst, then daughter sporocysts. Eventually, forked-tailed larvae (cercariae) are produced (*f*). After the cercariae leave the snail, they actively swim about. If they encounter human skin (*g*), they attach to it and release tissue-degrading enzymes. The larvae enter the body and migrate to the circulatory system, where they mature. They end up at the vessels of the intestines or urinary bladder, where sexual reproduction takes place, and the cycle begins anew. The adult worms are 10 to 20 mm long.

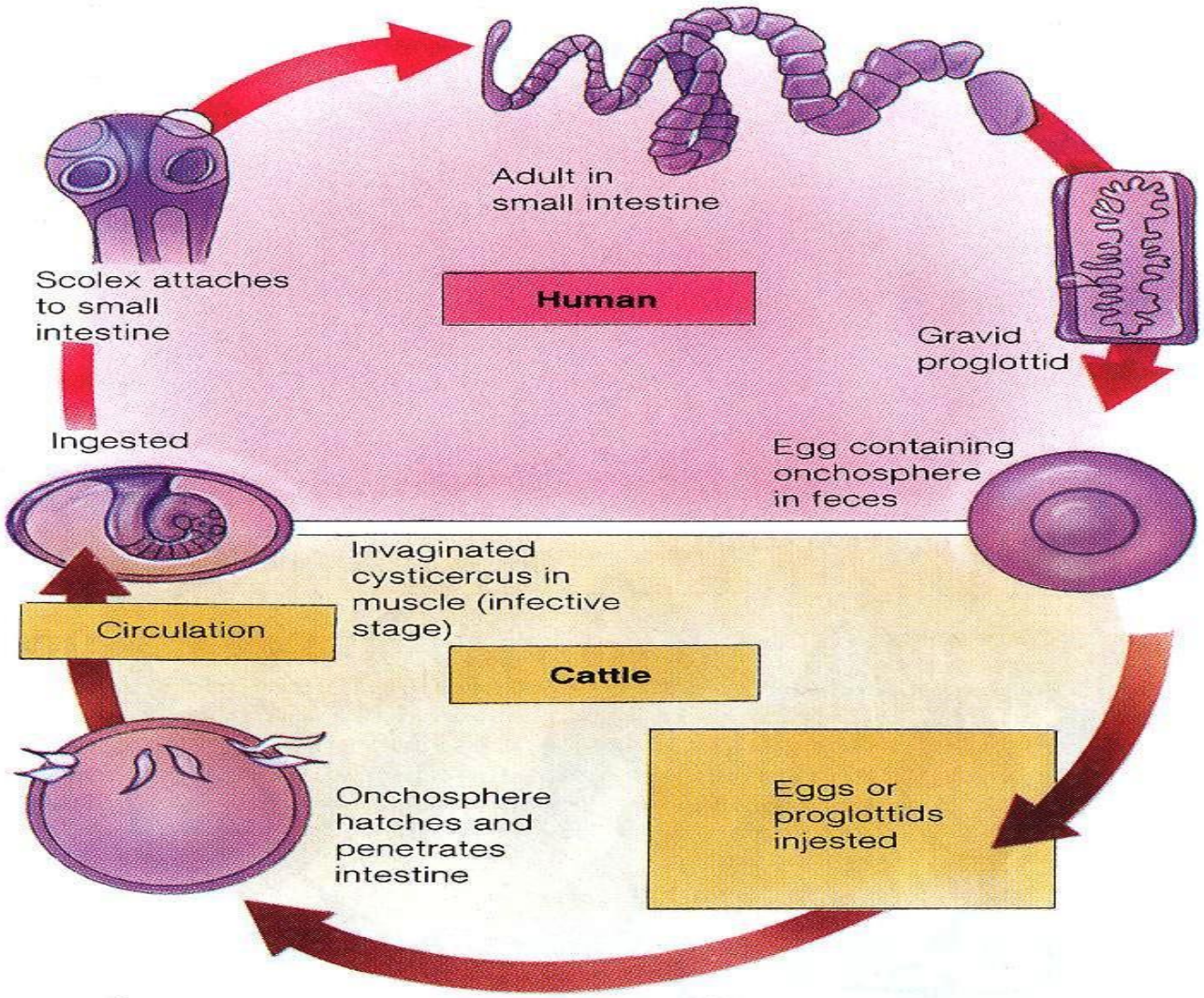


FIGURE 19.18

Life Cycle of the Beef Tapeworm, *Taeniarhynchus saginatus*. Adult worms may attain a length of 25 m. *Source: Redrawn from Centers for Disease Control, Atlanta, GA.*

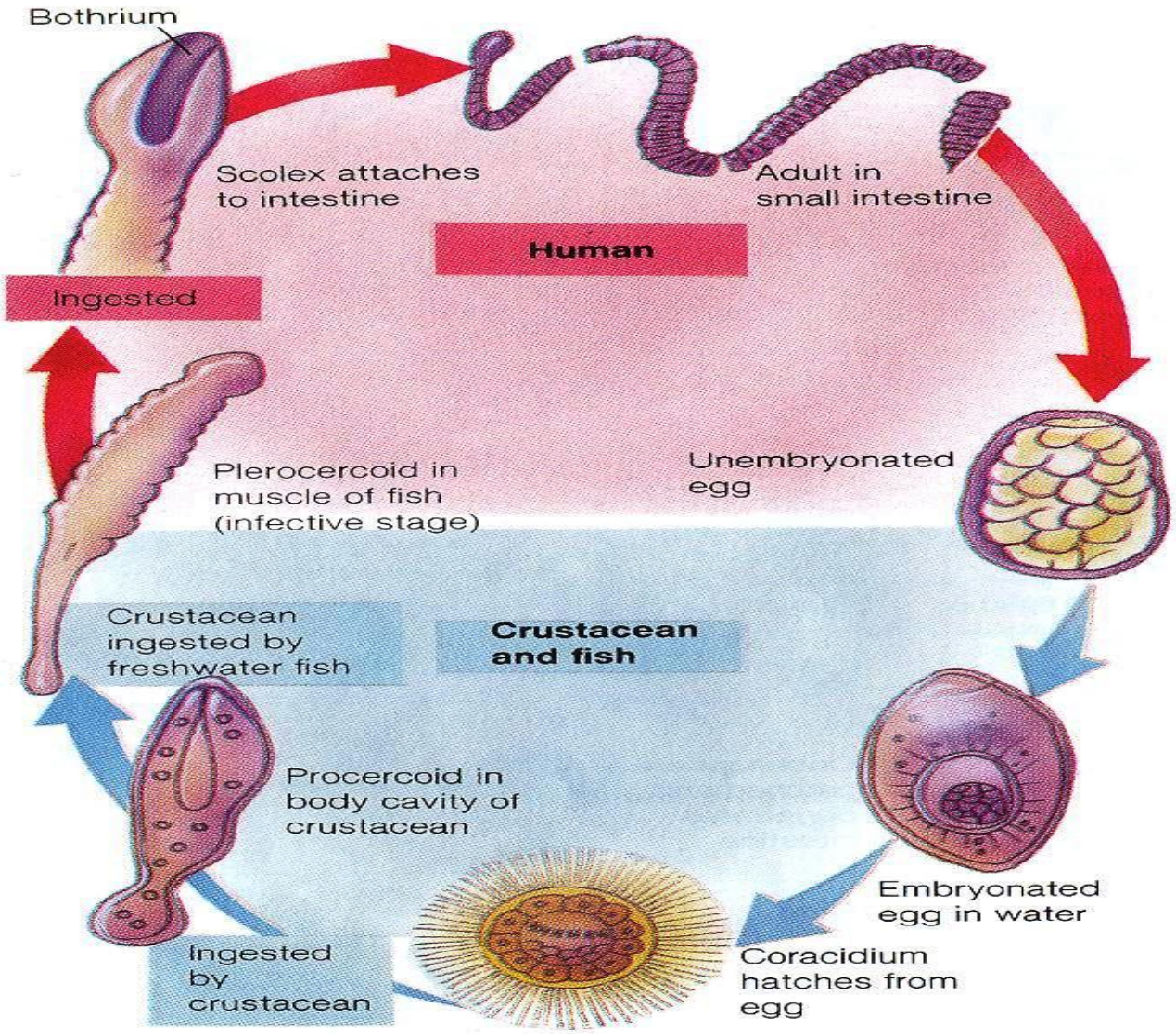


FIGURE 19.19

Life Cycle of the Broad Fish Tapeworm, *Diphyllobothrium latum*. Adult worms may be 3 to 10 m long. *Source: Redrawn from Centers for Disease Control, Atlanta, GA.*

Phylum: Nemertea

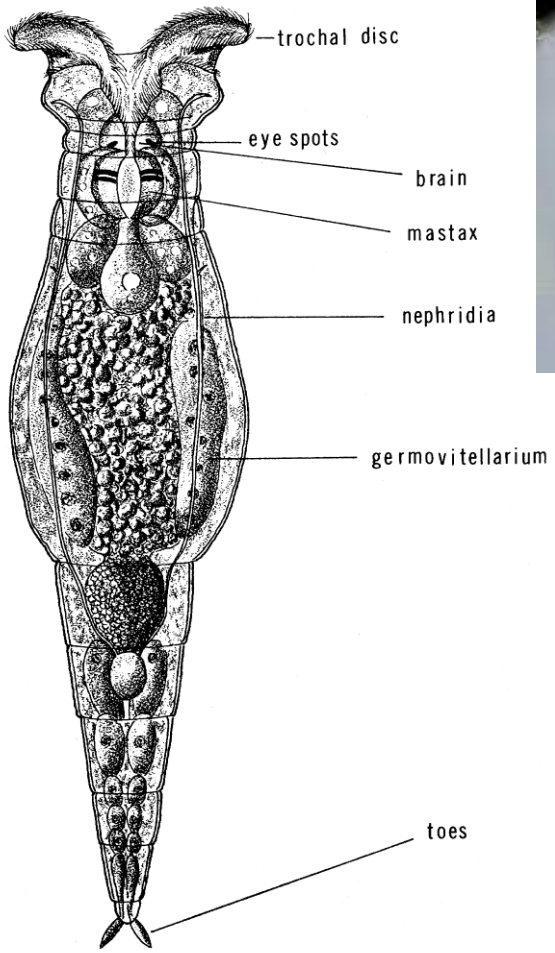
Pesudocoelomate

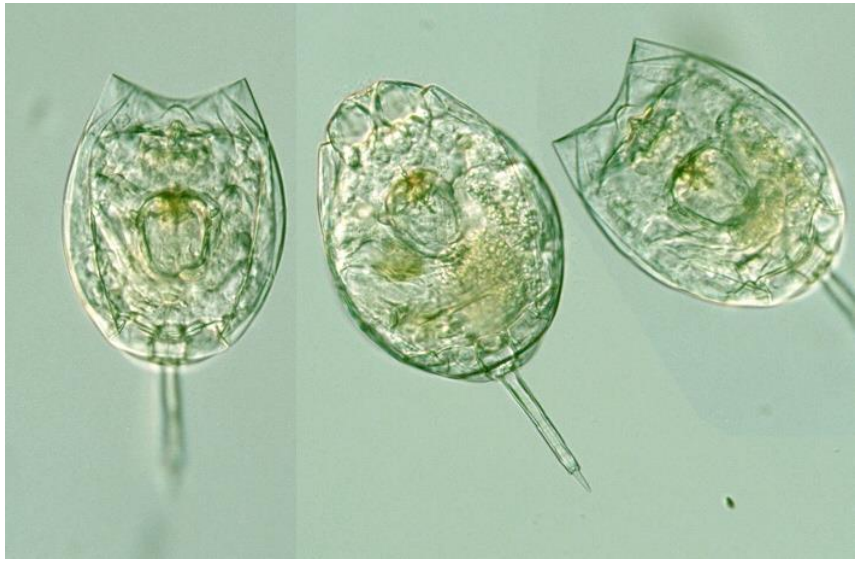
1- Phylum: Rotifera

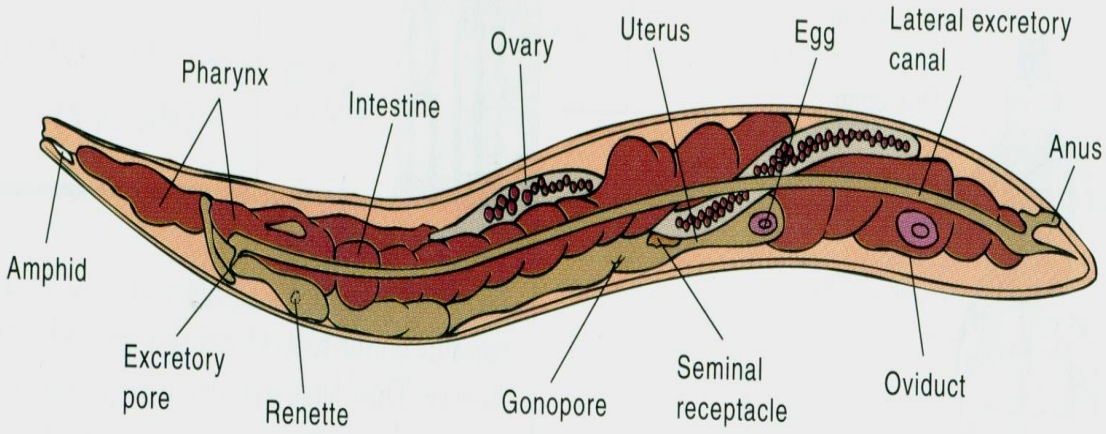
2- Phylum: Nematoda

3- Phylum: Acantocephala

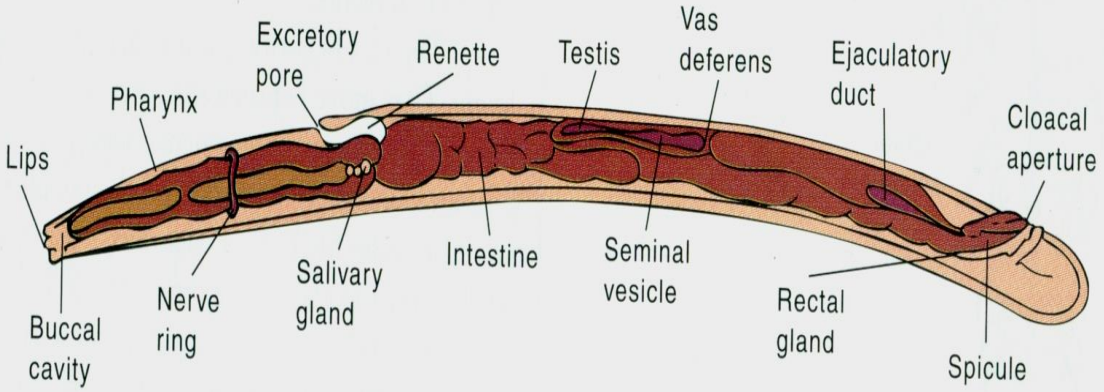
Phylum: Rotifera






Pharynx
Intestine
Ovary
Uterus
Egg
Lateral excretory canal
Anus
Amphid
Excretory pore
Renette
Gonopore
Seminal receptacle
Oviduct

(a)


Excretory pore
Renette
Testis
Vas deferens
Ejaculatory duct
Pharynx
Lips
Cloacal aperture
Buccal cavity
Nerve ring
Salivary gland
Intestine
Seminal vesicle
Rectal gland
Spicule

(b)

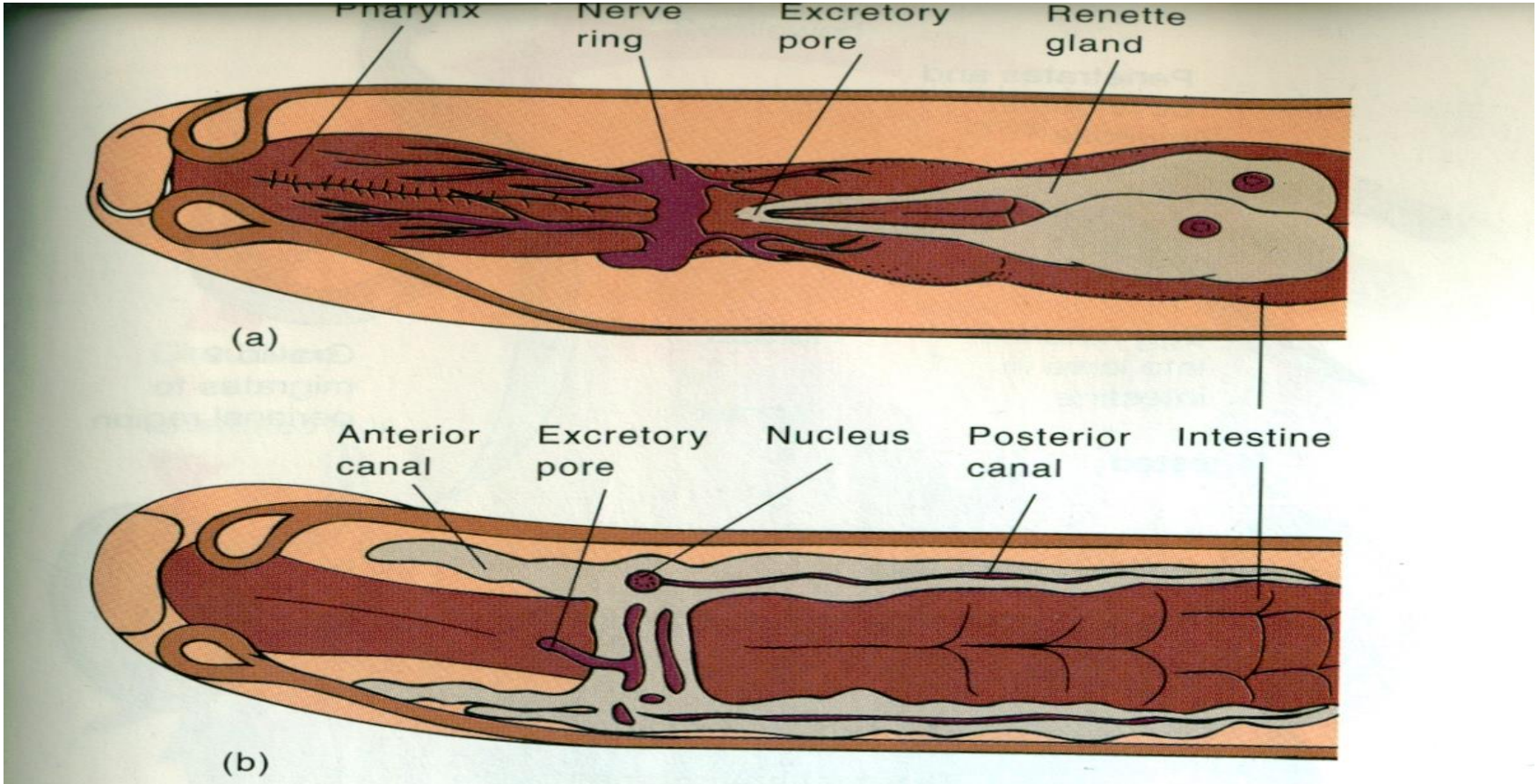


FIGURE 20.8

Nematode Excretory Systems. *(a)* Glandular, as in *Rhabditis*. *(b)* Tubular, as in *Ascaris*.

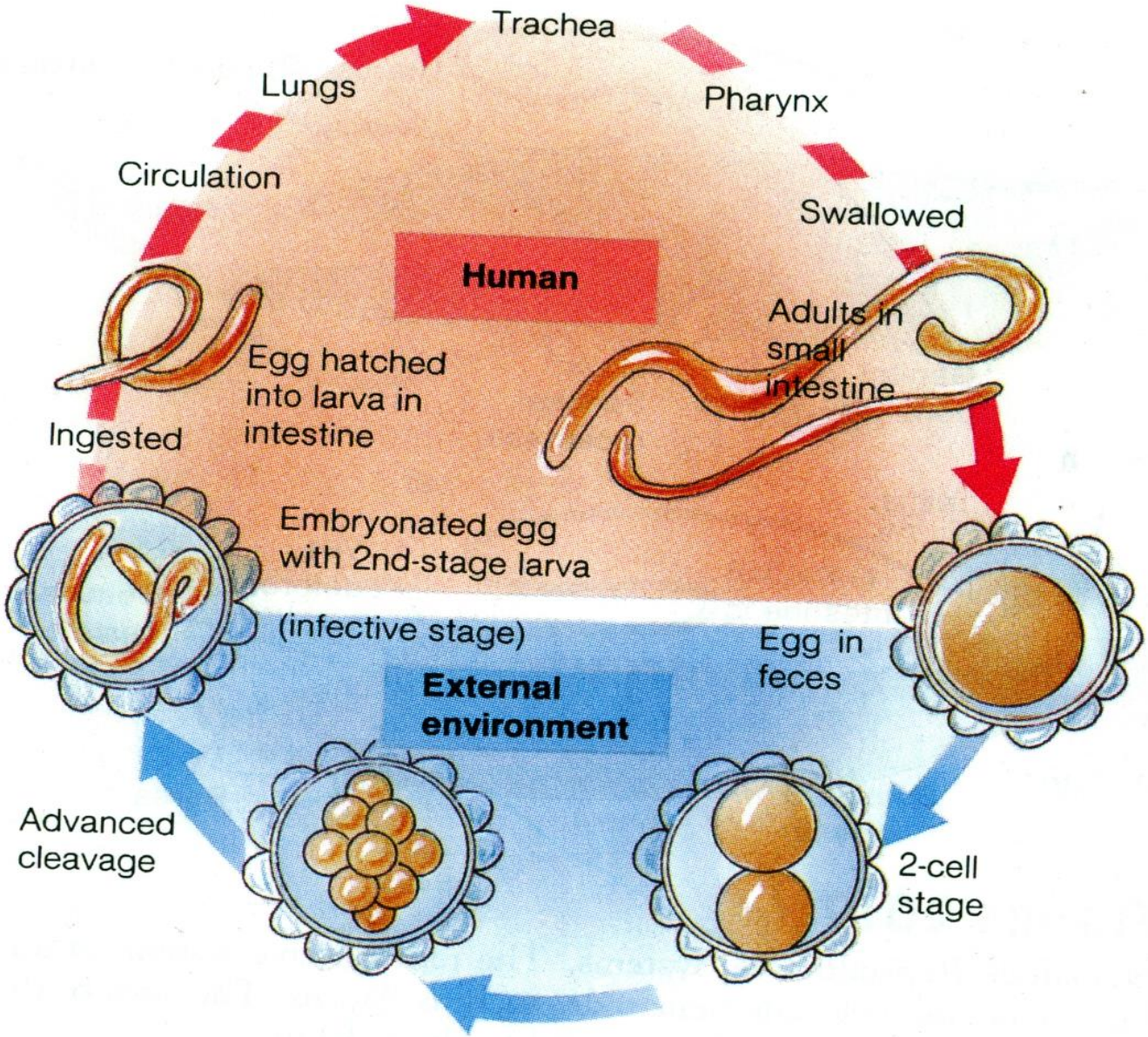
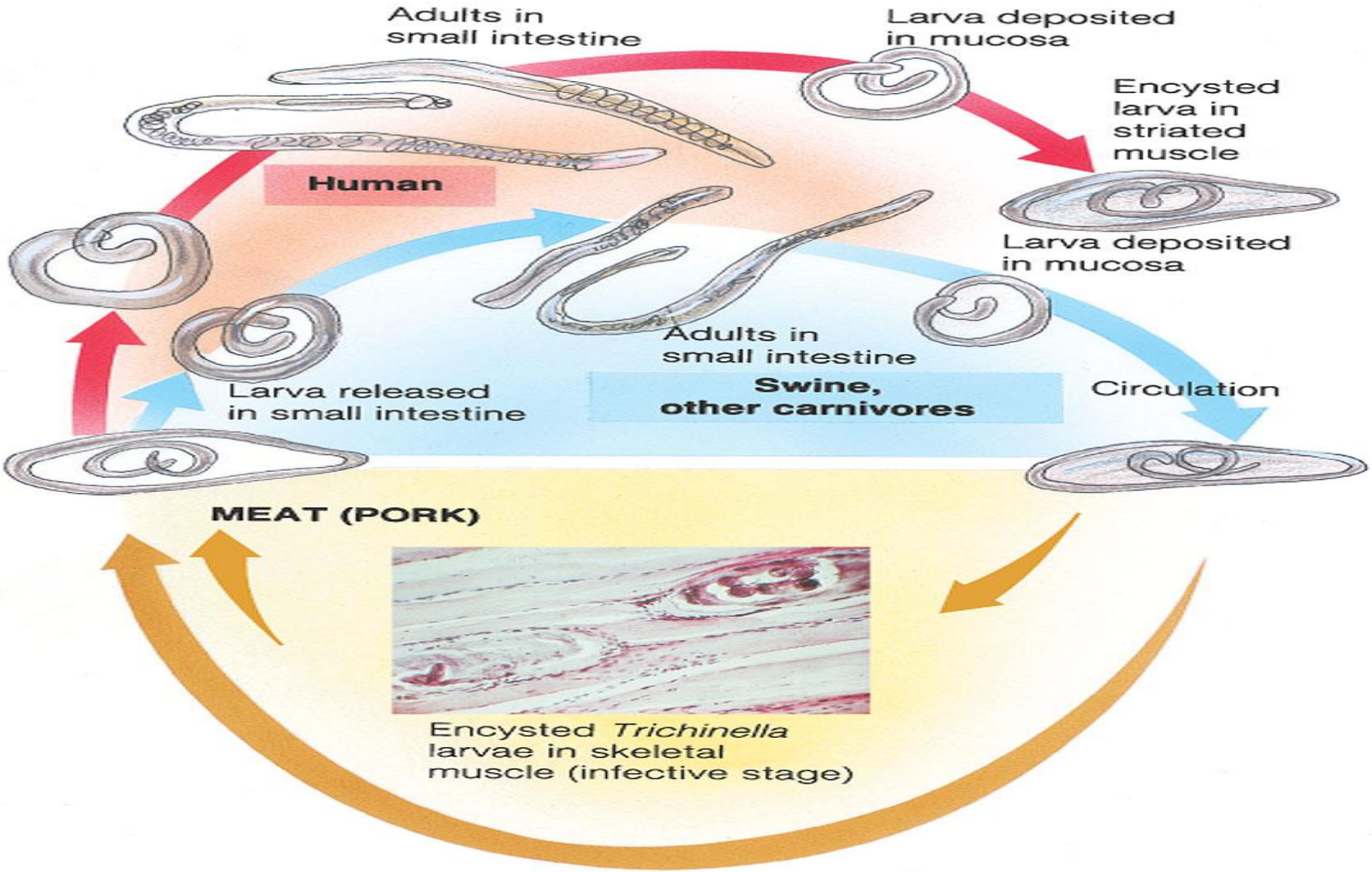


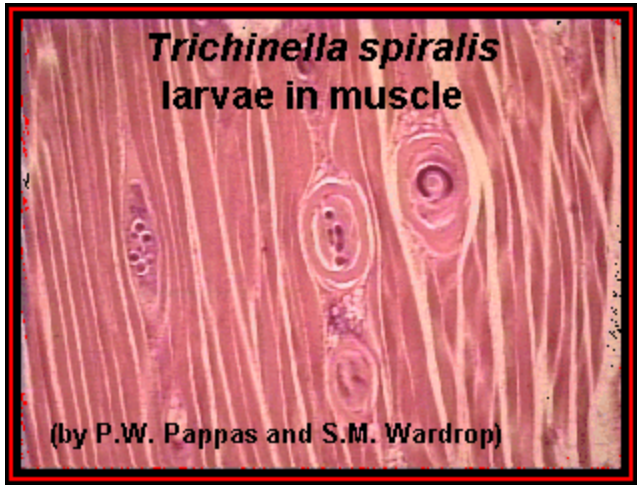
FIGURE 20.10

Life Cycle of *Ascaris lumbricoides*. (See text for details.) *Source:*

Trichinella spiralis

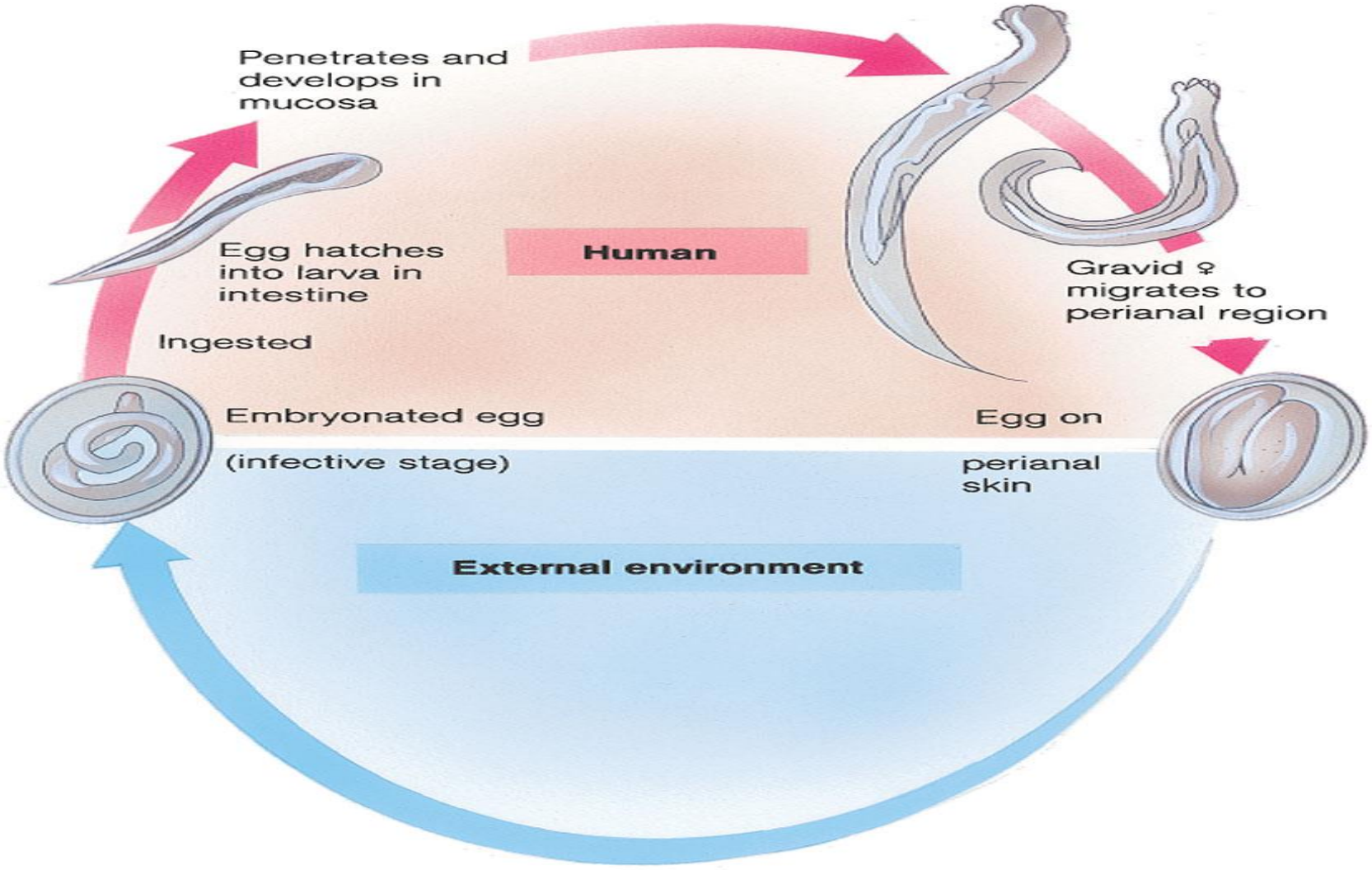


Trichinella spiralis



- Trichina worm
- Pigs, bear, dogs, cats, rats and man
- Trichinosis
  - Encysts in muscles

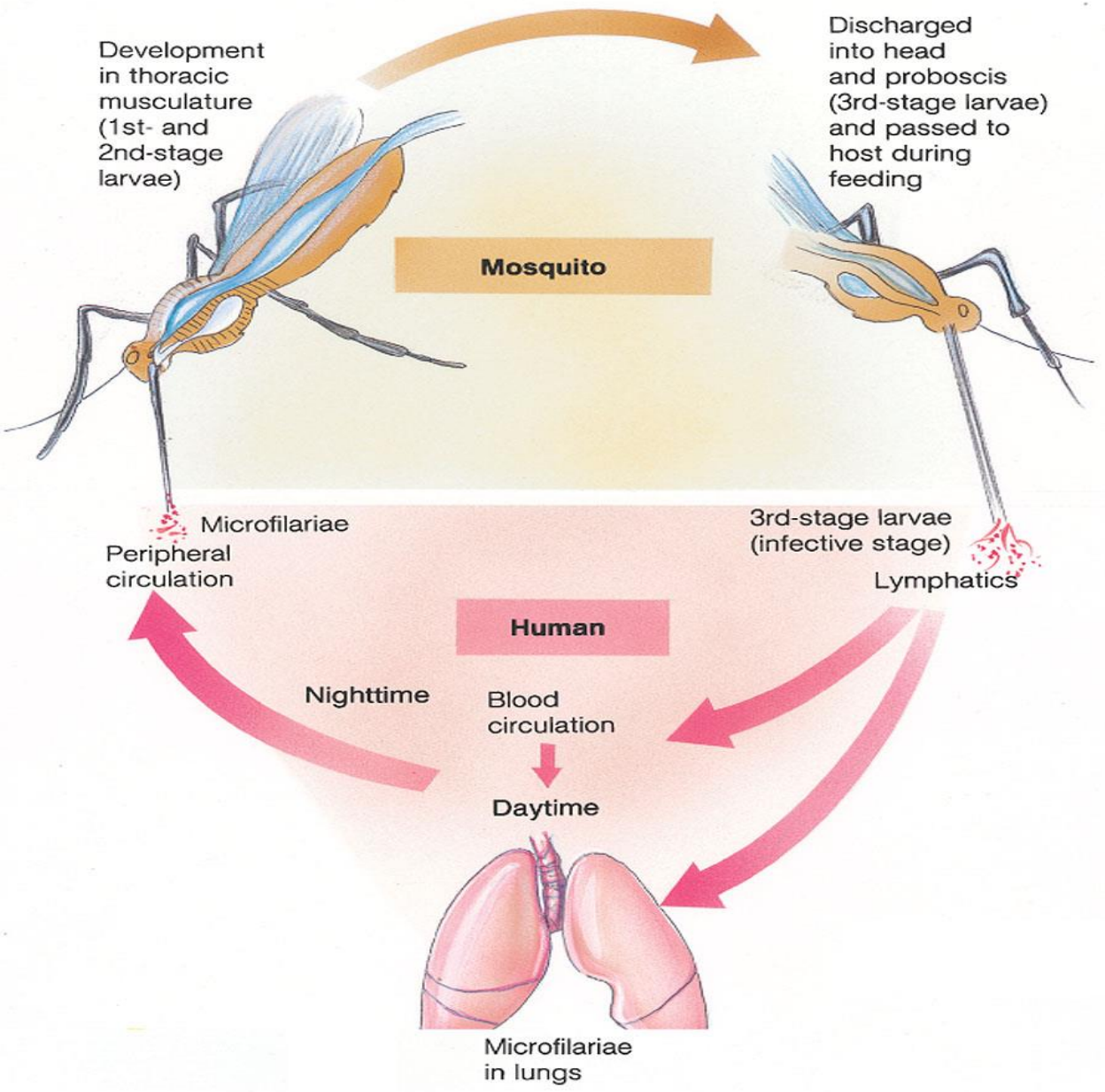
Enterobious vermicularis



Wuchereria bancrofti

Microfilaria of *Wuchereria bancrofti*

- Lives in lymphatic system
- Obstruct lymph to cause swelling
  - Elephantiasis



Phylum: Acanthocephala