Subphylum Vertebrata

Superclass Agnatha (jawless vertebrates)

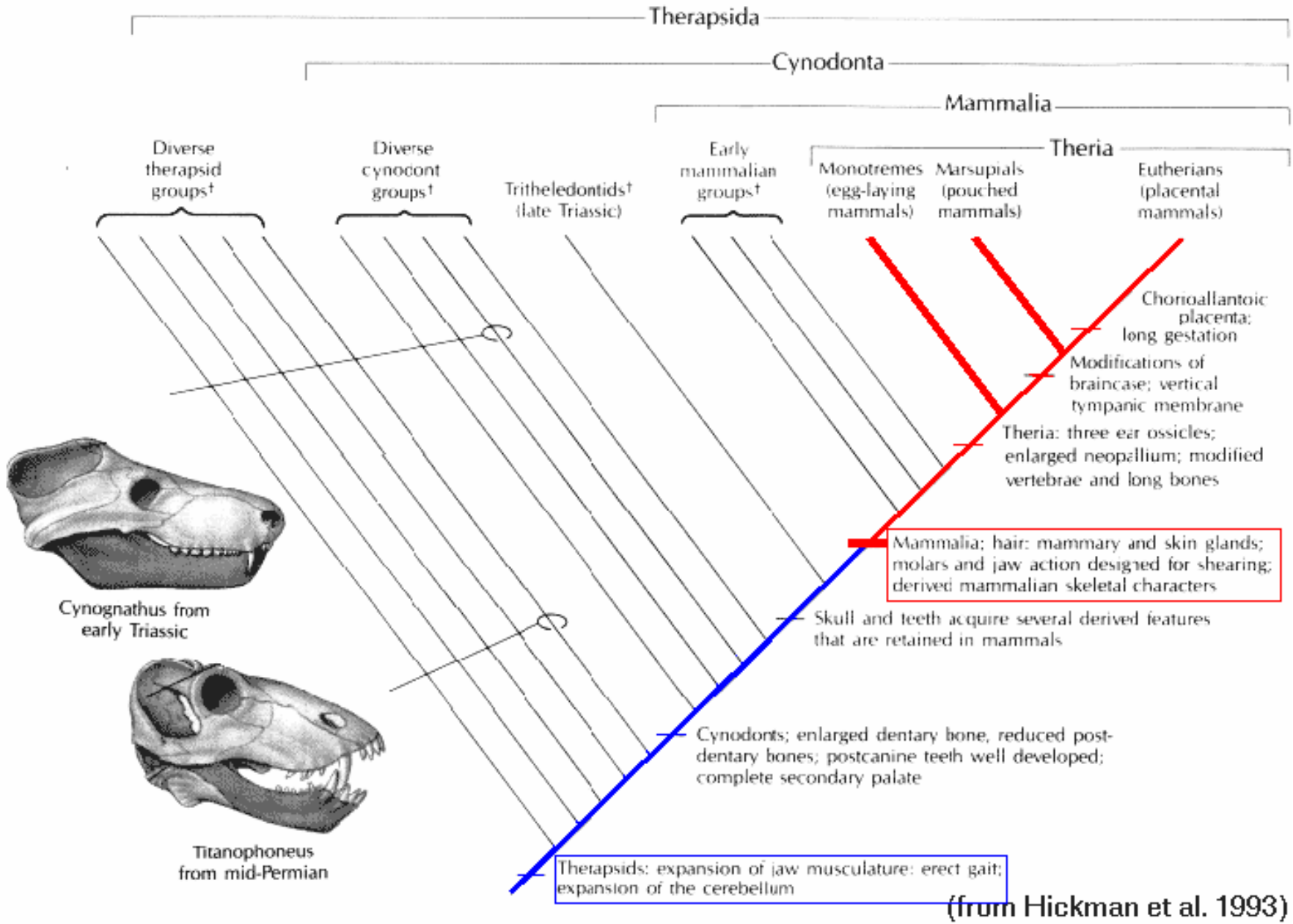
- **Class Myxini**
- **Class Cephalaspidomorphi**

Superclass Gnathostomata (jawed vertebrates)

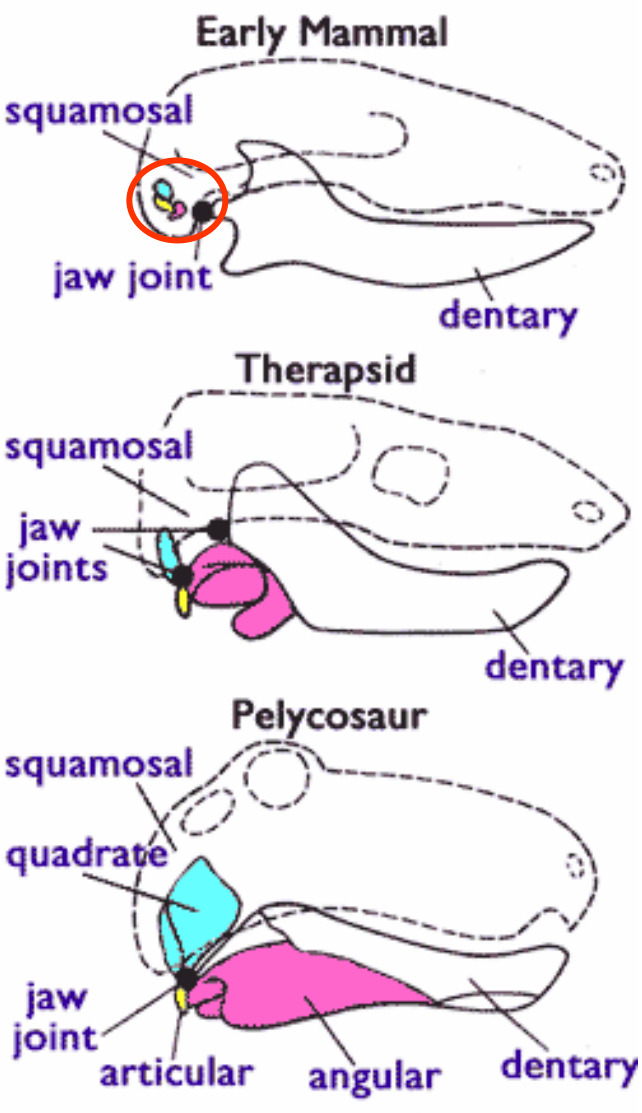
- **Class Chondrichthyes**
- **Class Osteichthyes**
- **Class Amphibia**
- **Class Reptilia**
- **Class Aves**
- **Class Mammalia**

Class Mammalia

the mammals

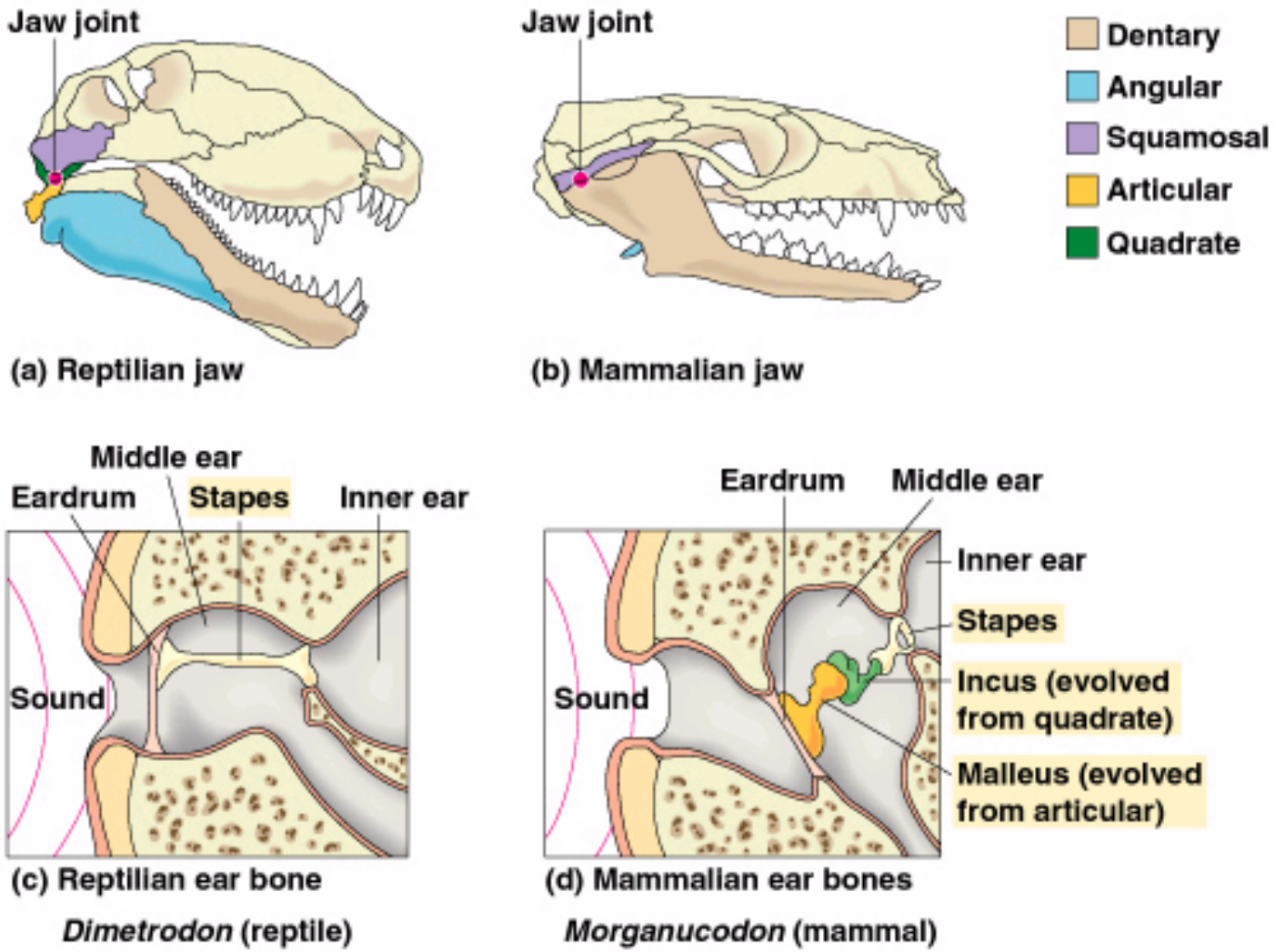


(from Hickman et al. 1993)



The evolutionary transition between Therapsid reptiles and mammals is well documented in the fossil record.

It involves a reduction in the size and number of bones in the skull.



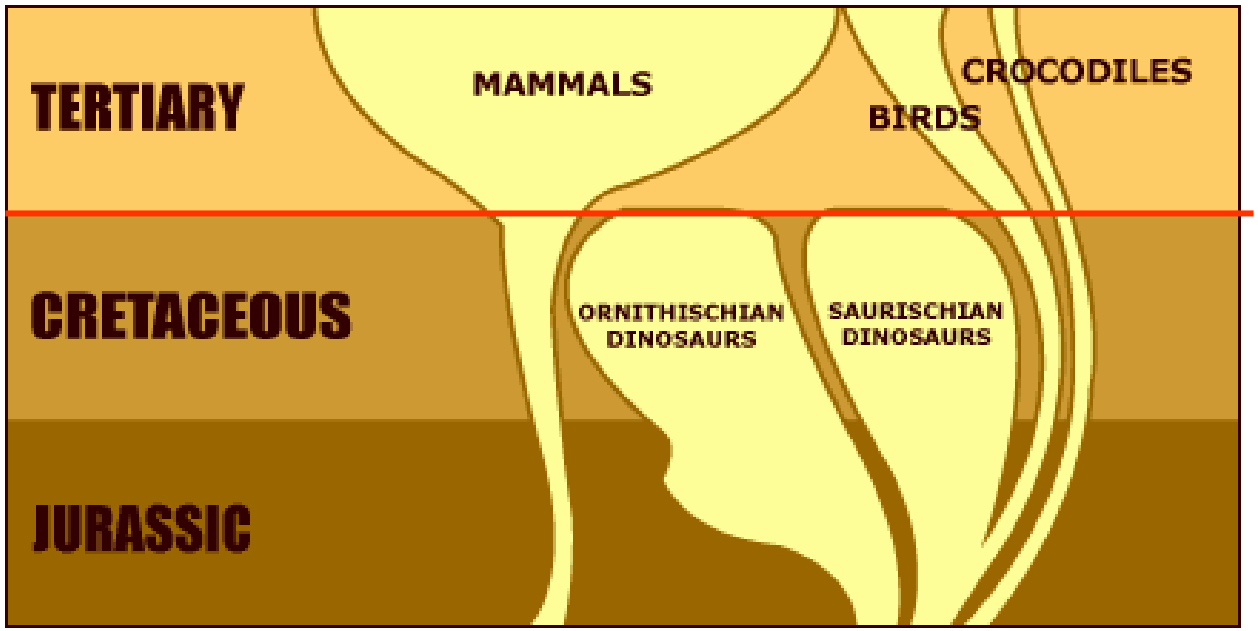
Class Mammalia

- 4,600 species
- mostly bony skeleton
- 4 limbs (tetrapods)
- body covered by hair (can be modified into quills)
- many glands (e.g. mammary, sweat, scent…)
- four chambered heart
- respiration exclusively by lungs
- embryos develop in uterus or amniotic egg
- young are nourished with milk
- endothermic

Class Mammalia

Unique mammalian characteristics:

1. Hair
2. 4 chambered heart with a functional left aortic heart.
3. Red blood cells lack nuclei
4. Mammary glands
5. Diaphragm

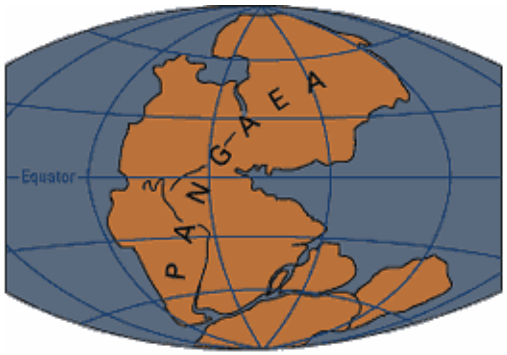


KT extinction

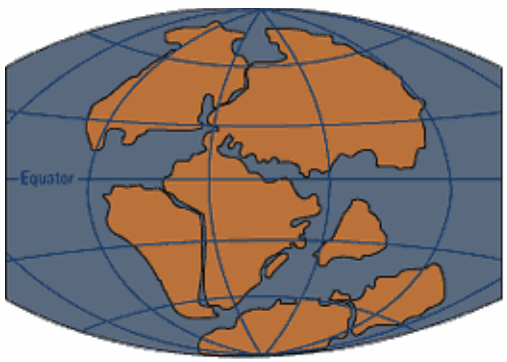
Most of the novel mammalian characteristics had evolved 150 million years before the KT extinction. Why did the mammals only radiate after the mass extinction?

Why did the mammals only radiate after the mass extinction?

1. The extinction of the mesozoic reptiles opened up a lot of niches
2. The break up of Pangea allowed for different lineages to diversify in genetic isolation.

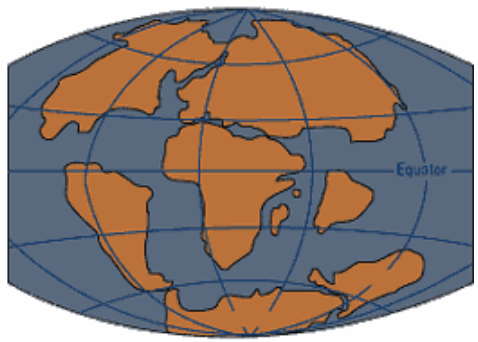


Permian Period
225 million years ago



Jurassic Period
135 million years ago

Triassic Period
200 million years ago



Cretaceous Period
65 million years ago

Class Mammalia

3 groups of mammals:

- **monotremes (echidna and platypus)**
  →oviparous

- **marsupials**
  →Viviparous, altricial young that complete development in a pouch outside the uterus

- **eutherians**
  → viviparous, young complete development in the uterus

Monotremes

Duckbilled platypus:

Spiny anteater (echidna)

Monotremes retain several reptilian characteristics:

1. Monotremes have a cloaca (a single urogenital opening)
2. Montremes lay eggs with a rubbery shell.
3. Monotremes have several bones in their pectoral girdle that other mammals do not have, but that therapsid reptiles did have

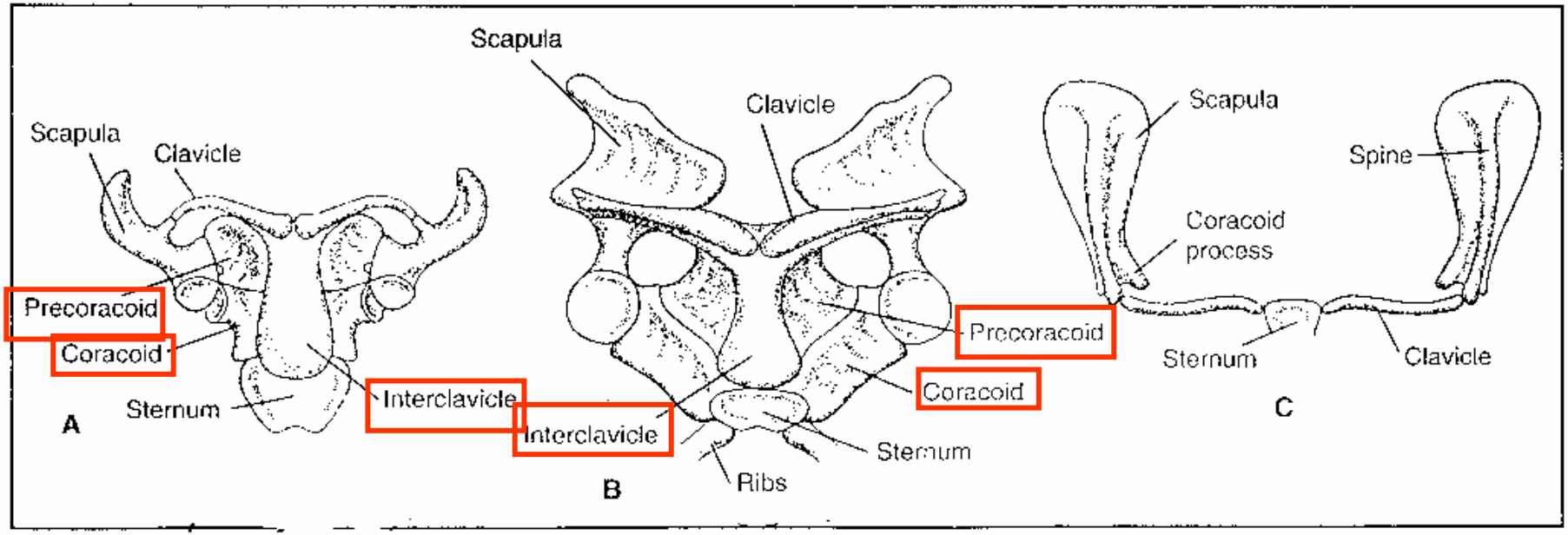


Figure 10.2 **Reptilelike pectoral girdle in monotremes.** Comparison of the pectoral girdles in a (A) therapsid reptile, (B) short-beaked echidna, and (C) muskrat, a eutherian mammal. Monotremes have pectoral girdles very similar to ancient reptiles.

Monotremes retain several reptilian characteristics:

1. Monotremes have a cloaca (a single urogenital opening)
2. Montremes lay eggs with a rubbery shell.
3. Monotremes have several bones in their pectoral girdle that other mammals do not have
4. Monotremes have a low body temperature.
5. Chromosome structure: monotremes have both micro and macro chromosomes
6. Monotremes have filiform sperm
7. Monotremes have no teeth

Class Mammalia

3 groups of mammals:

- **monotremes (echidna and platypus)**
  →oviparous

- **marsupials**
  →Viviparous, altricial young that complete development in a pouch outside the uterus

- **eutherians**
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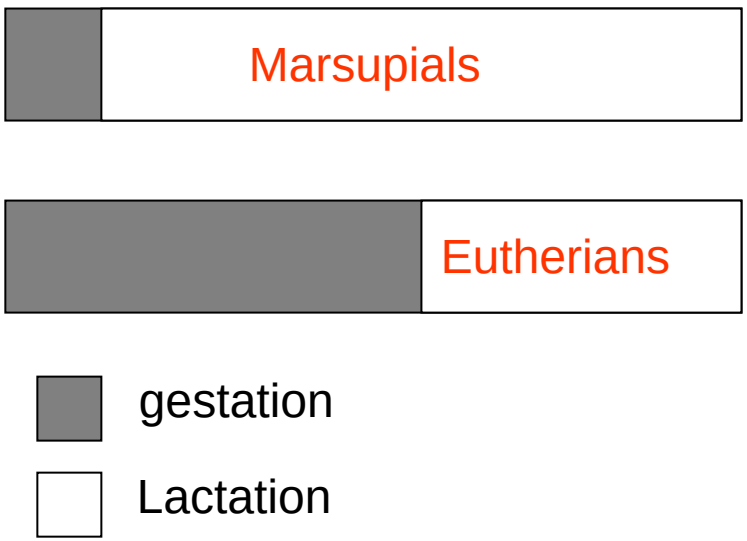
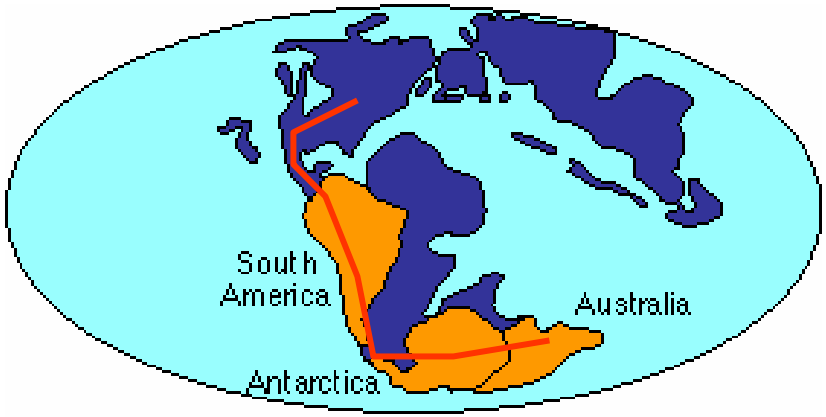


Marsupials

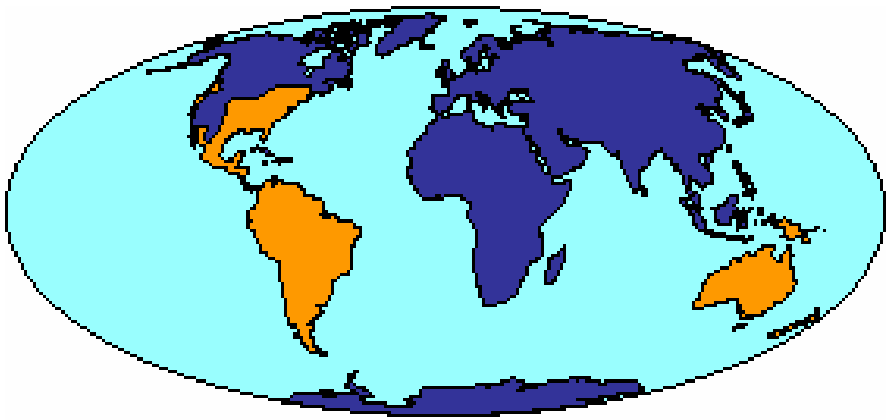
Marsupials can be separated by other mammals based mainly on reproductive characteristics:

1. Marsupials invest little in offspring prior to birth; marsupial litters weigh < 1 % of the females body mass. In contrast, some rodents have litters the weigh 50 % of the maternal body mass.
2. Postnatal investment (lactation) is greater in marsupials than in other mammals.
3. Several skeletal characteristics.

** The presence of a pouch is not a unique characteristic of Marsupials; some Marsupials lack a pouch and some Monotremes have a pouch.



Jurassic Period – 160 mya



Distribution of marsupials today

Class Mammalia

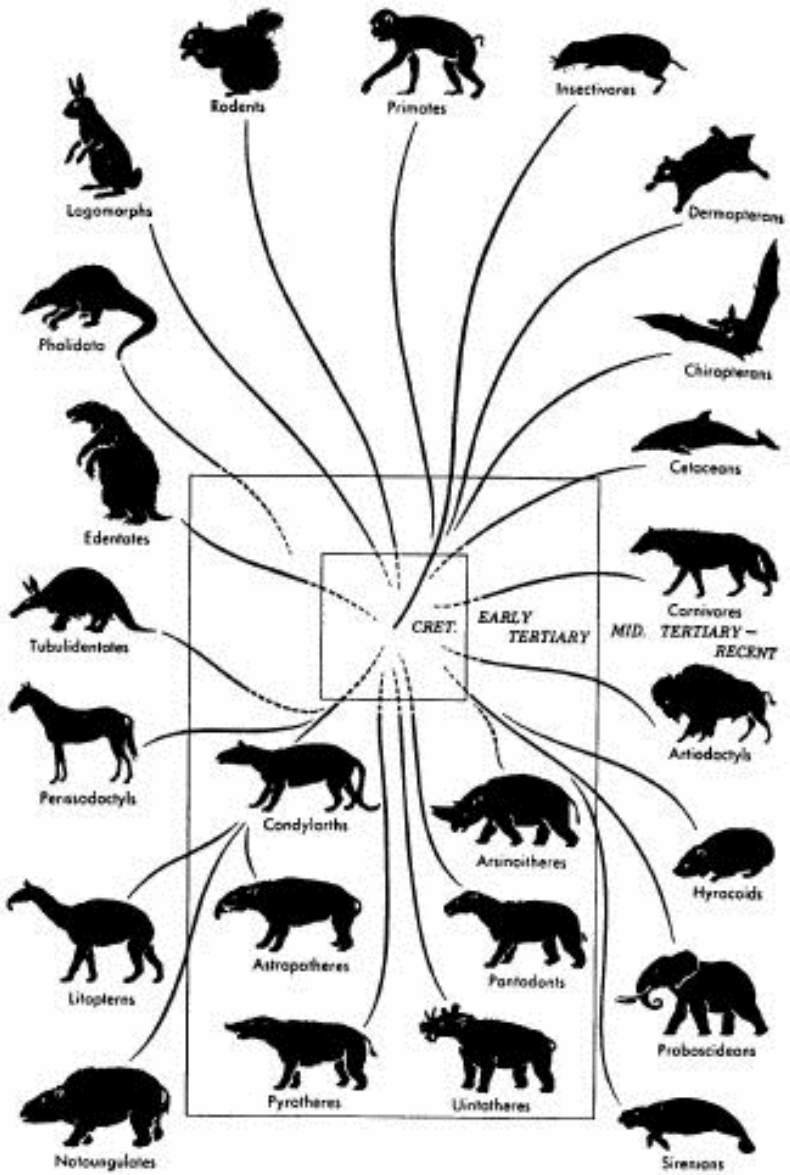
3 groups of mammals:

- **monotremes (echidna and platypus)**
  →oviparous

- **marsupials**
  →Viviparous, altricial young that complete development in a pouch outside the uterus

- **eutherians**
  → viviparous, young complete development in the uterus

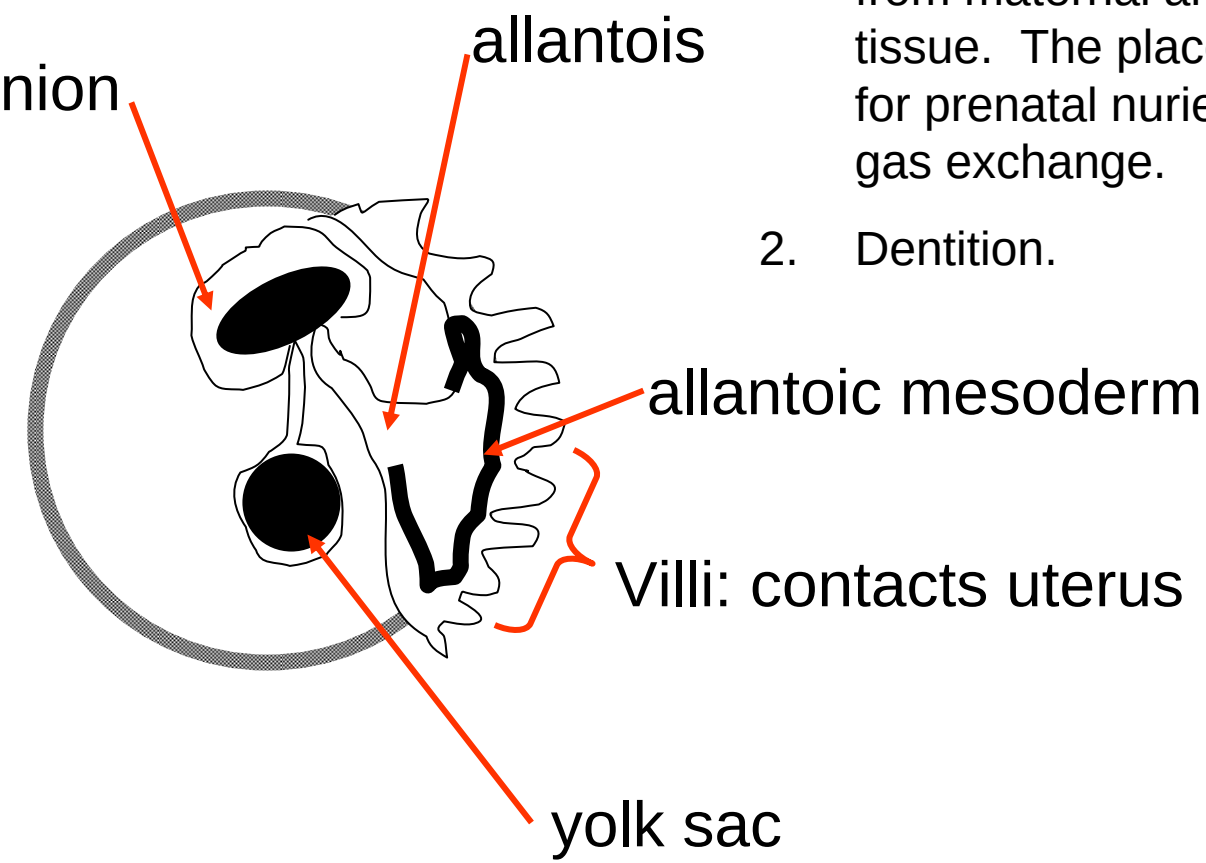
Eutherians: placental mammals

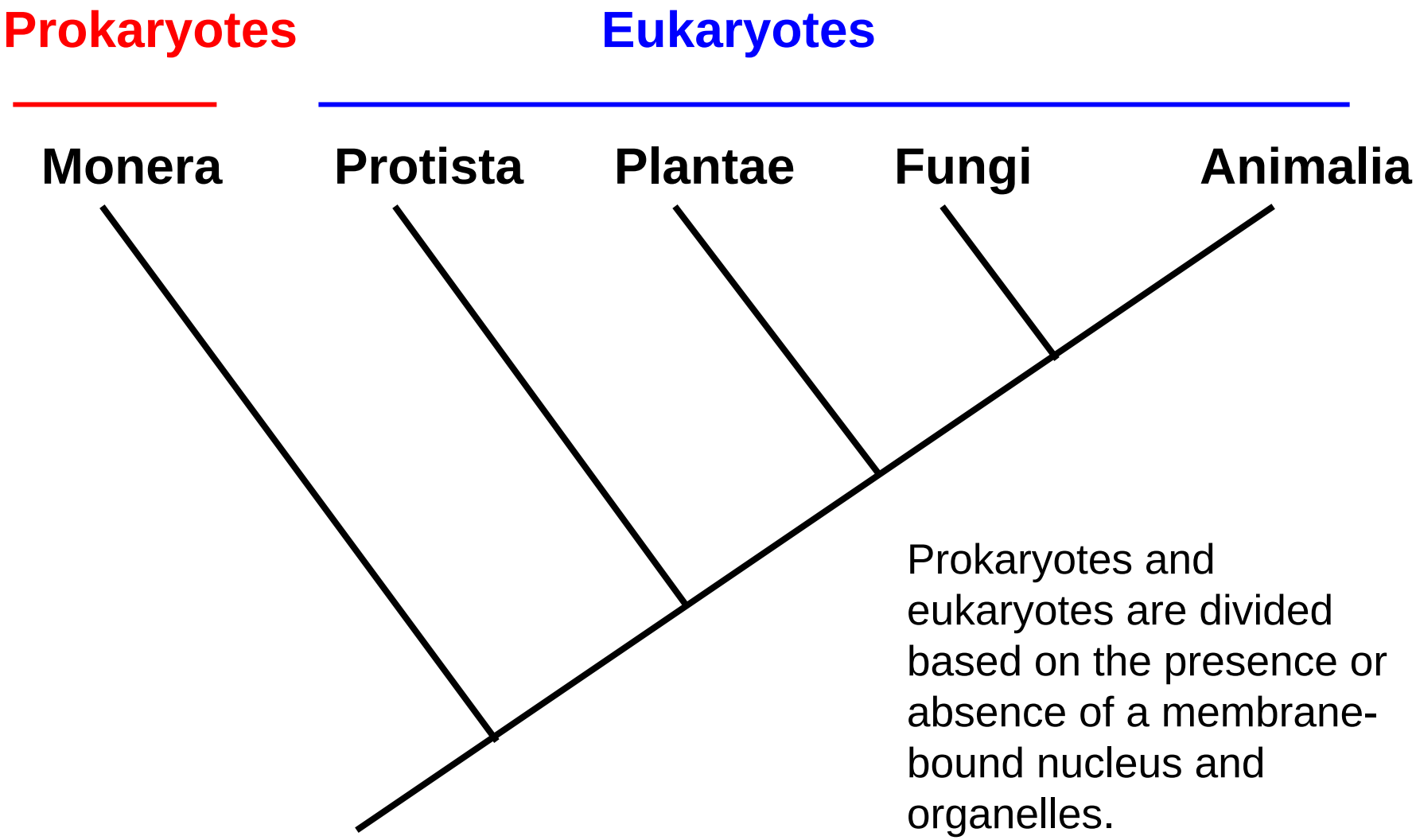


Relationships of the orders of placental mammals.

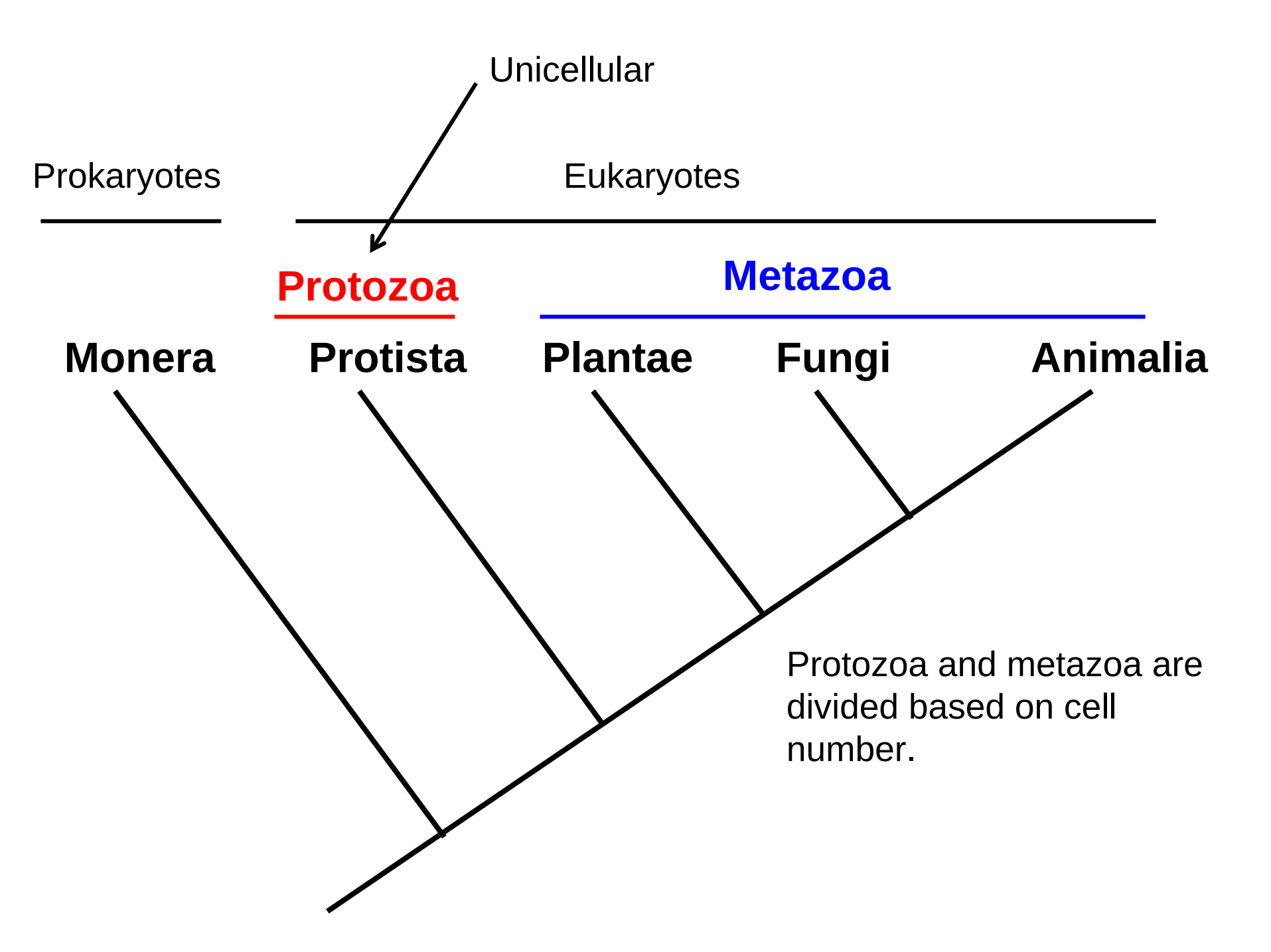
Eutherians

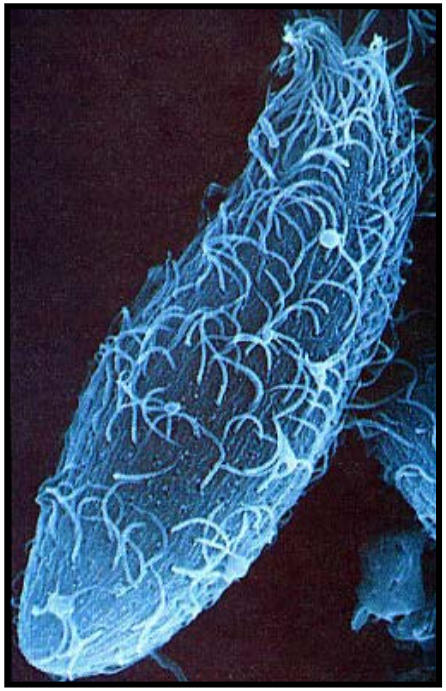
1. Eutherians have a placenta: a highly vascularized endocrine organ developed during gestation from maternal and embryonic tissue. The placenta is responsible for prenatal nurient transfer and gas exchange.
2. Dentition.





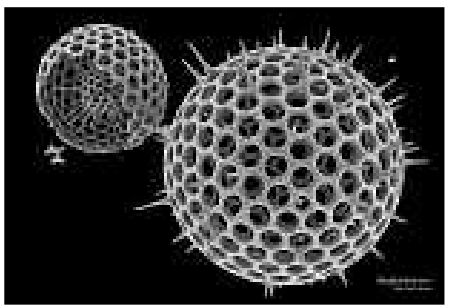
Prokaryotes and eukaryotes are divided based on the presence or absence of a membrane-bound nucleus and organelles.


Unicellular
Prokaryotes
Eukaryotes
Protozoa
Metazoa
Monera
Protista
Plantae
Fungi
Animalia
Protozoa and metazoa are divided based on cell number.



Kingdom Protista

the “protists”



Kingdom Protista

Unicellular

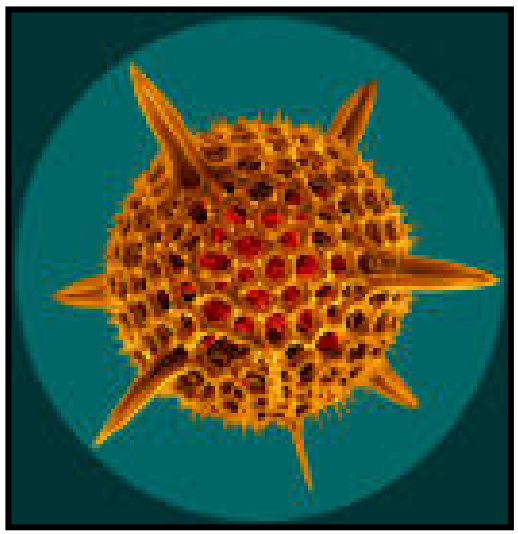
Microscopic

No germ layers

Kingdom Protista

All types of symmetry

asymmetrical

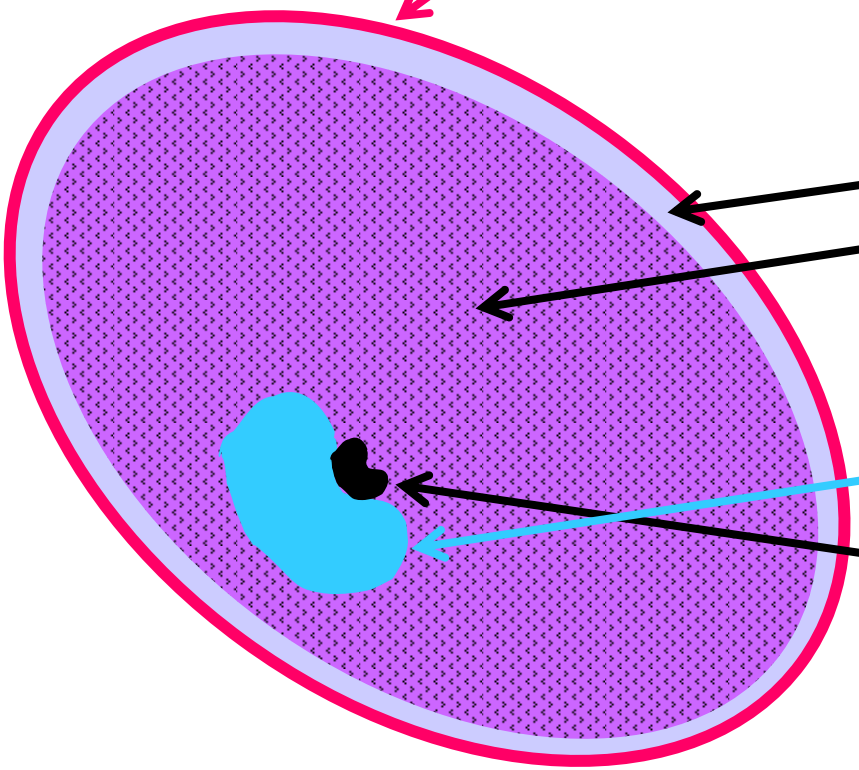


radial symmetry

bilateral symmetry

Kingdom Protista

Structure & Organelles



<u>Cell membrane</u> = Plasma membrane = Plasmalemma

<u>Cytoplasm (protoplasm):</u>
ectoplasm = outer semi-solid region
endoplasm = inner fluid region (granular)

<u>Nucleus/nuclei:</u>
***Macronucleus = large nucleus involved in controlling metabolic activities**
***Micronucleus = small nucleus involved in reproductive activities**

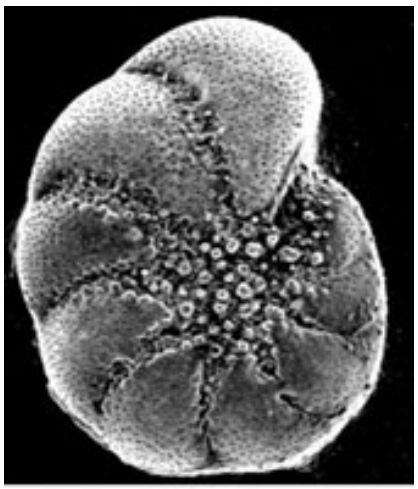
*** Not all protists have both types of nucleus**

Kingdom Protista

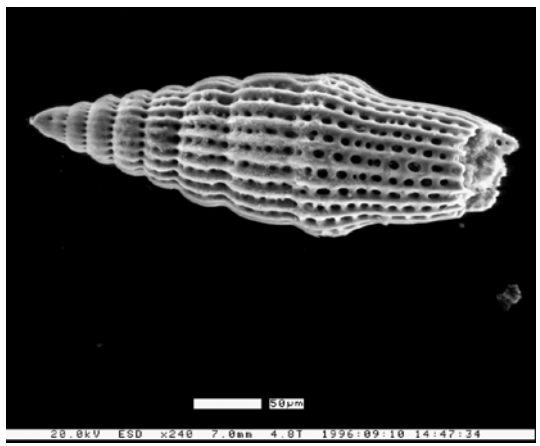
Structure & Organelles

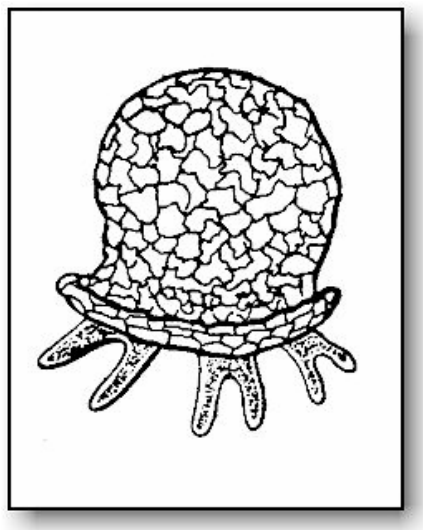
Shells & Skeletons:

- **naked**
- **secreted shell composed of organic or inorganic materials (i.e. $CaCO_3$, SiO_2)**
- **shell composed of small particles cemented together**



An example of the foram species Ephidium, which is found in Santa Monica Bay.





Kingdom Protista

All types of nutrition/feeding

1. Autotrophic:

- **capable of making their own food**
- **have chloroplasts for photosynthesis**

2. Heterotrophic:

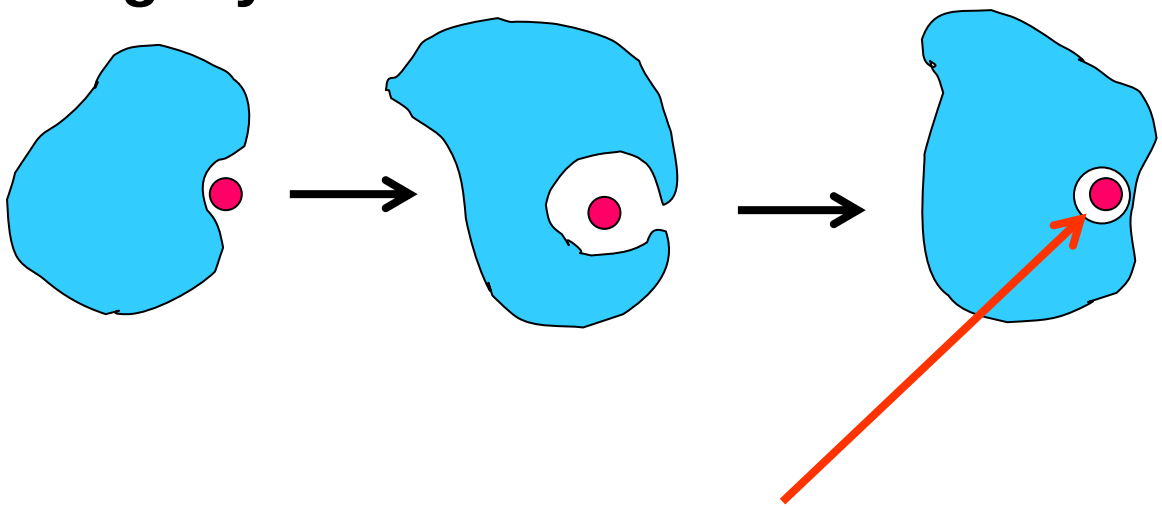
- **incapable of making their own food and must ingest pre-formed organic materials**

Kingdom Protista

All types of nutrition/feeding

Feeding:

- **Phagocytosis**



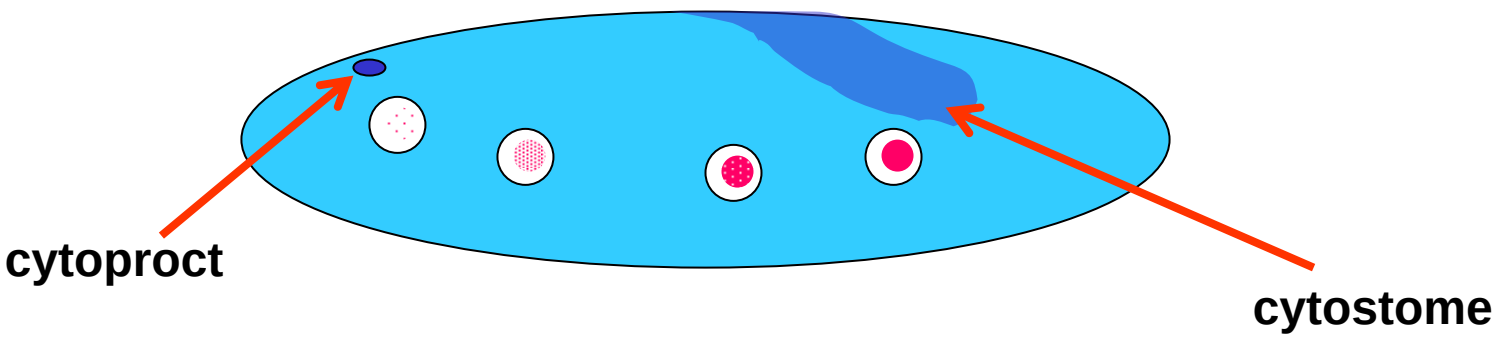
Food vacuole
- intracellular digestive cavity

Kingdom Protista

All types of nutrition/feeding

Feeding:

- **intake food through a cytostome (cellular "mouth")**
- **eliminate waste through a cytoproct (cellular "anus")**



Kingodom Protista

Osmoregulation & Excretion

Contractile vacuoles:

- **involved in water regulation**
- **pumps excess water out of the cytoplasm**

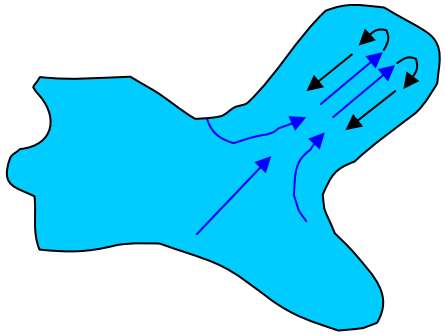
Excretion is via diffusion

Kingdom Protista

Locomotion

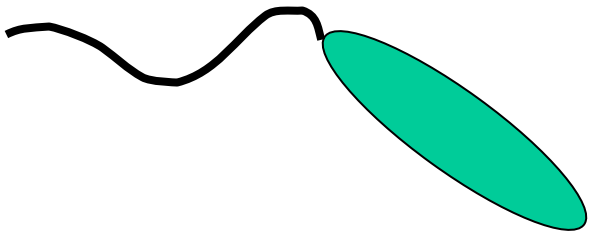
Pseudopodia

“false” “foot”

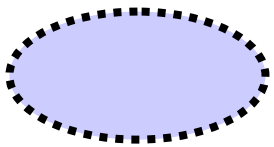


cytoplasmic streaming

Flagella



Cilia

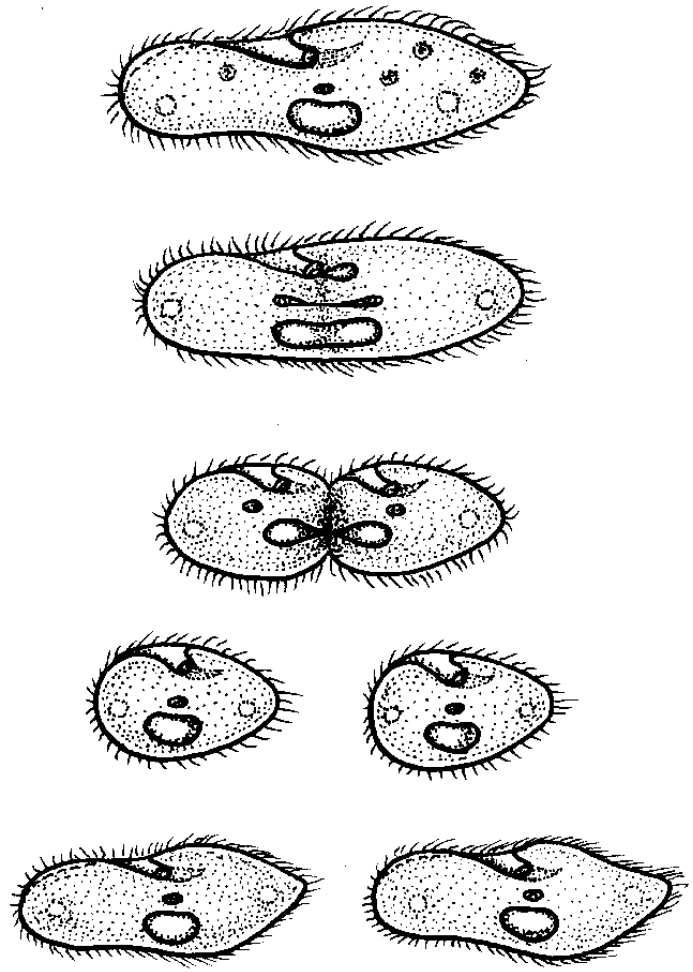


Kingdom Protista

Asexual Reproduction

“fission”:

- **when an individual splits into 2 identical individuals, it is called “binary fission”**
- **if >2 progeny, it is called “multiple fission”**
- **when a smaller individual buds off of the larger parent, it is called “budding”**



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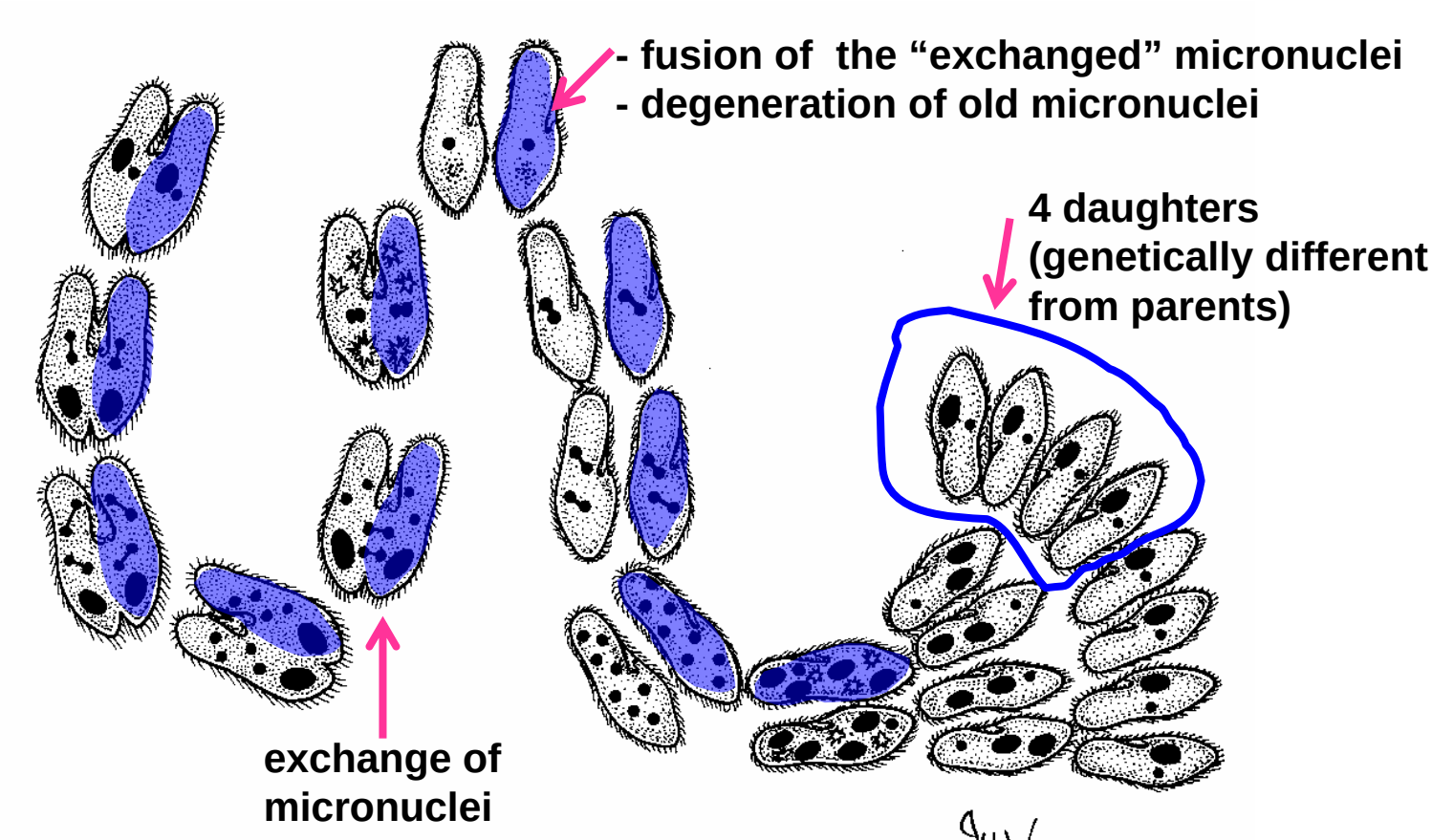
Kingdom Protista

Sexual Reproduction

- conjugation = when 2 individuals exchange micronuclei
- results in genetic mixing and "new" genotypes



Kingdom Protista

Sexual Reproduction

- **syngamy = fusion of male and female gametes (haploid cells)**

- **autogamy = when 1 individual undergoes genetic reorganization and produces daughters that are genetically different from it**

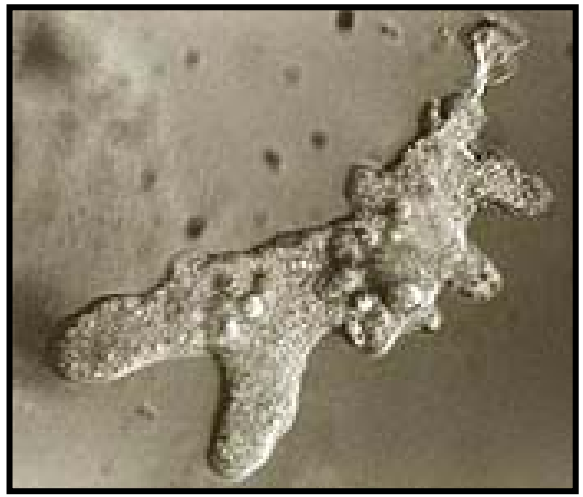
Kingdom Protista

Phylum Sarcomastigophora
- Subphylum Sarcodina
- Subphylum Mastigophora

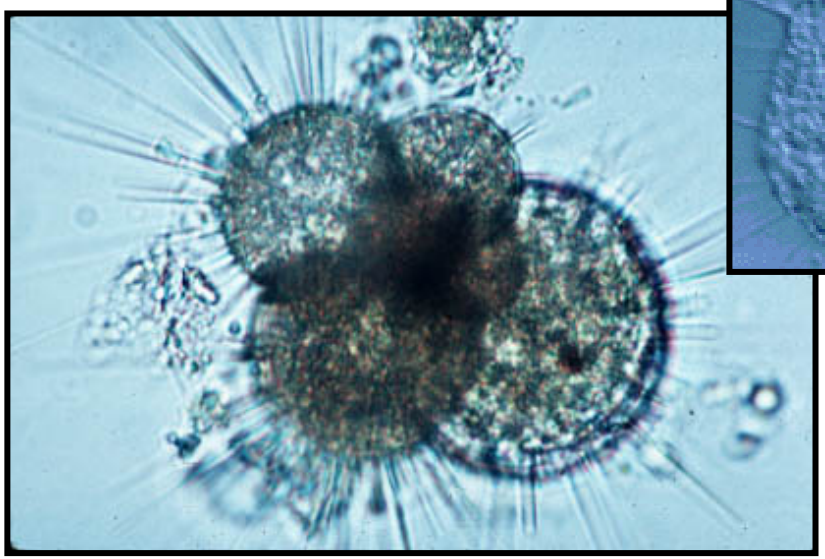
Phylum Ciliophora

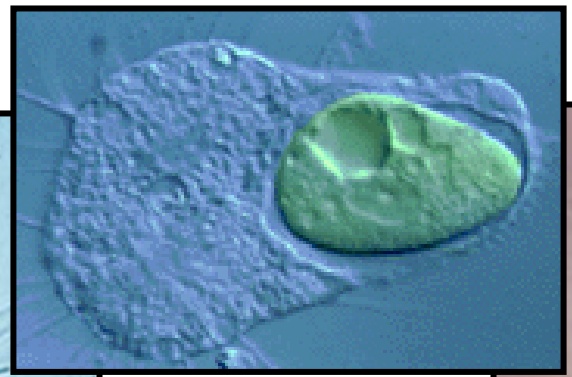
Phylum Sporozoa (Apicomplexa)

****Note that your textbook has different taxonomic groupings but we will follow the lab**



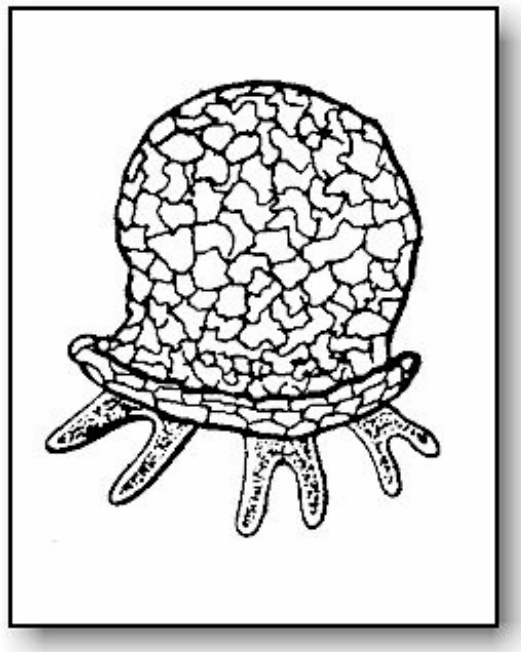
Phylum Sarcomastigophora
Subphylum Sarcodina





Subphylum Sarcodina

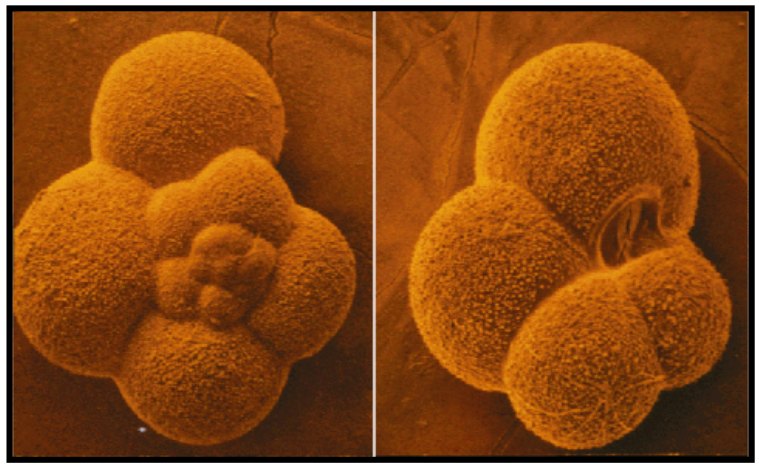
- amoebas that often use pseudopodia for food capture and locomotion
- can be naked, construct a shell of particles, or secrete a shell

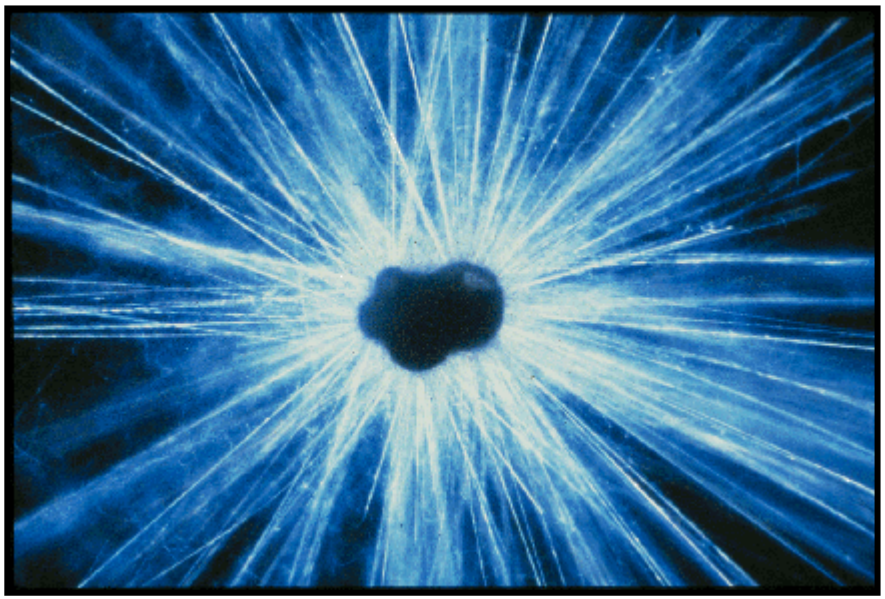


Subphylum Sarcodina

Foraminifera:

- **secrete calcareous ($CaCO_3$) tests or shells that are chambered**

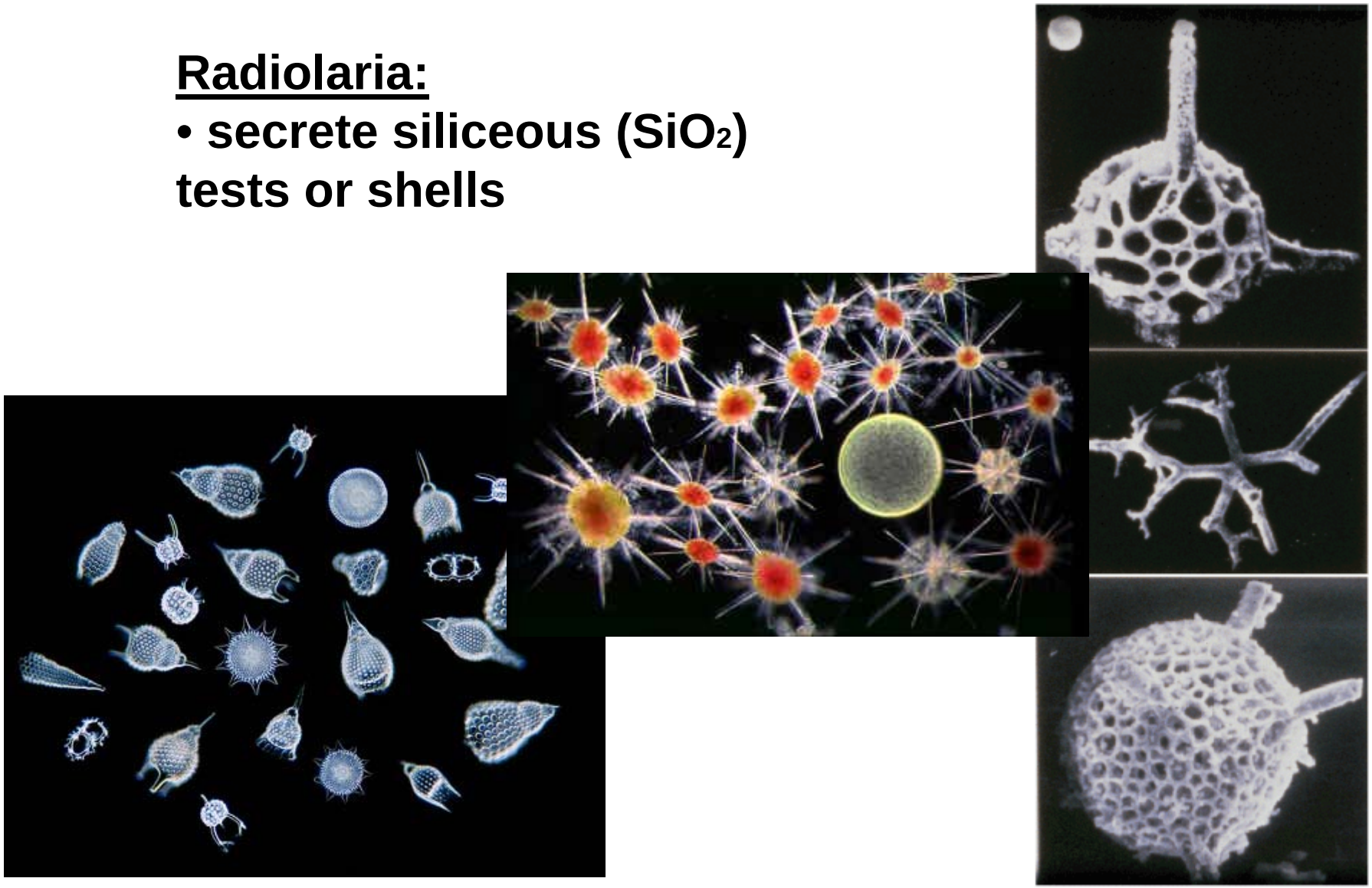




Subphylum Sarcodina

Radiolaria:

- **secrete siliceous (SiO_2) tests or shells**



Subphylum Sarcodina

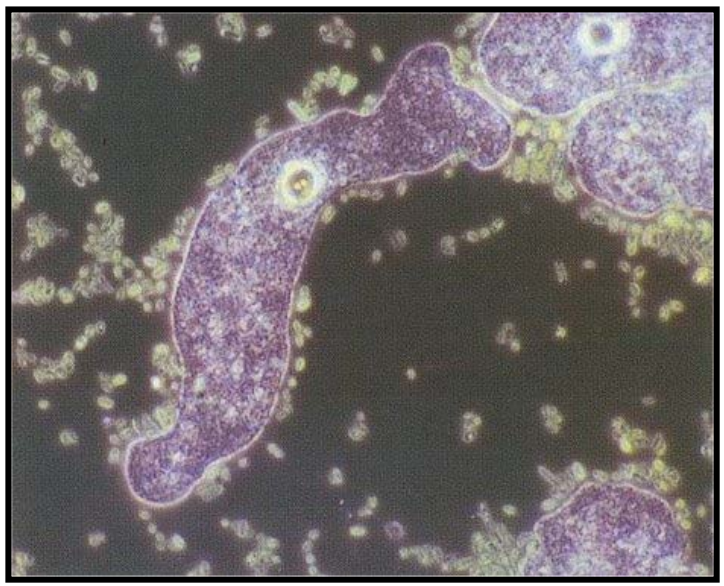
- **Foraminiferans and Radiolarians are some of the oldest Protistans**

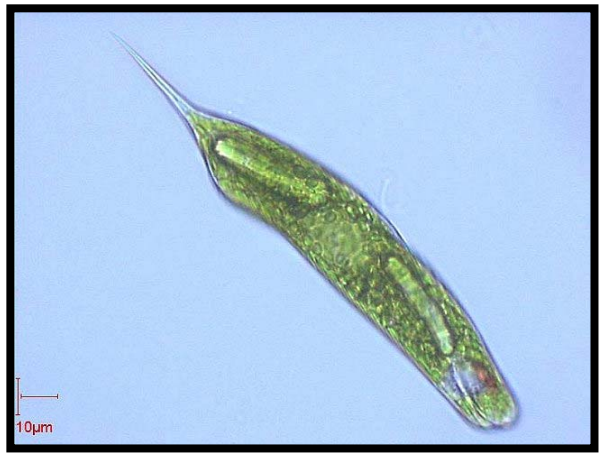
- **Radiolarians are a major component of deep sea sediments that are estimated to be 600- 3600 meters deep**

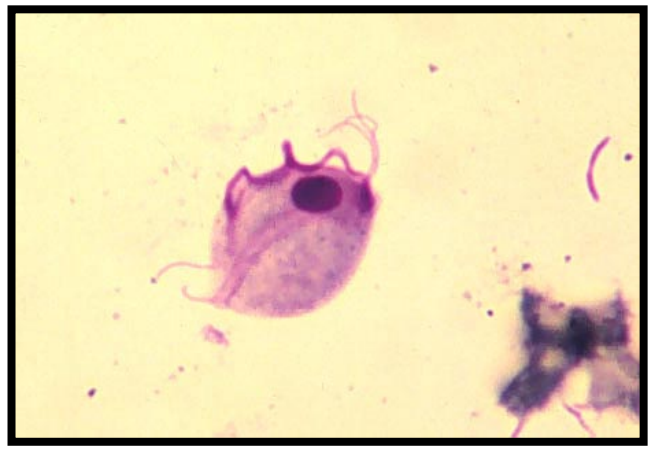
- **these sediments contain ~ 50, 000 radiolarian skeletons per gram of sediment**

Subphylum Sarcodina

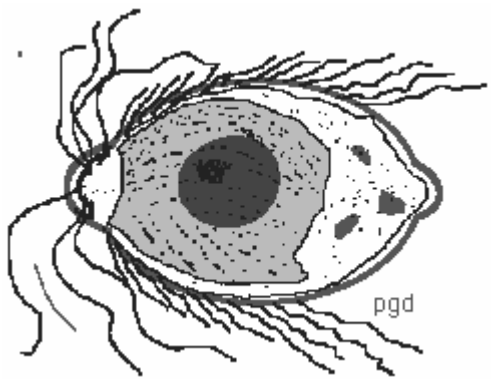
- ***Naegleria fowleri*: a free living amoeba found in lakes and ponds that can cause fatal brain injuries (meningoencephalitis)**

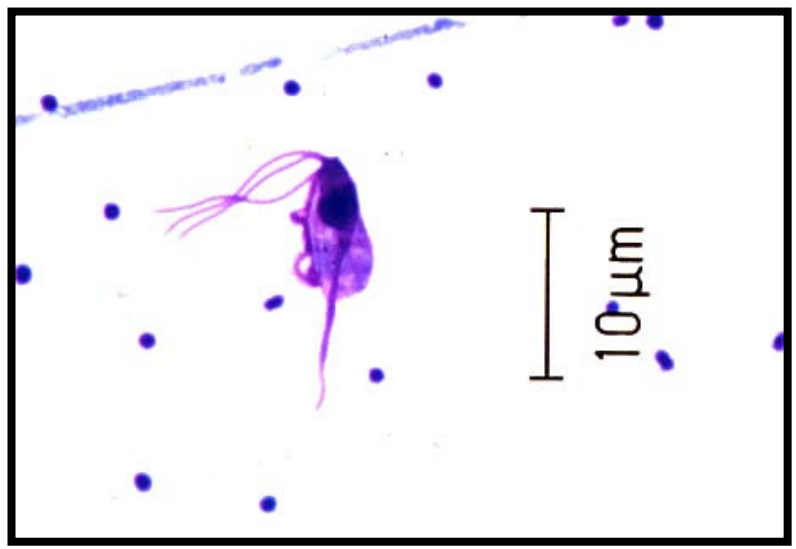






Phylum Sarcomastigophora
Subphylum Mastigophora





Subphylum Mastigophora

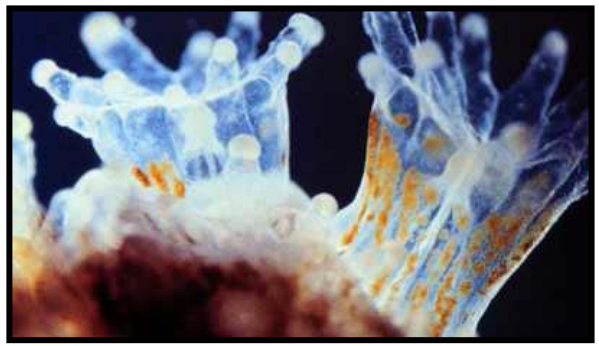
- the “flagellates”
- use one or more flagella for locomotion

- <u>Phytoflagellates</u>:
  - most contain photosynthetic pigments but some are heterotrophic

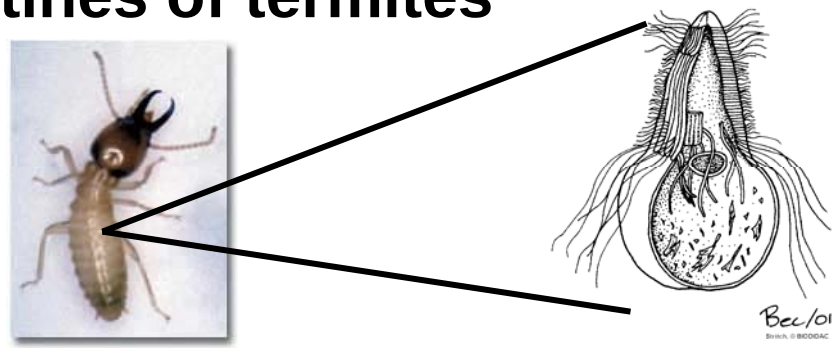
- <u>Zooflagellates</u>:
  - all heterotrophic
  - many are parasitic or commensal
  - none contain photosynthetic pigments

Subphylum Mastigophora

- many flagellates live in mutualistic relationships with other organisms
  - Zooxanthellae provide nutrients to corals



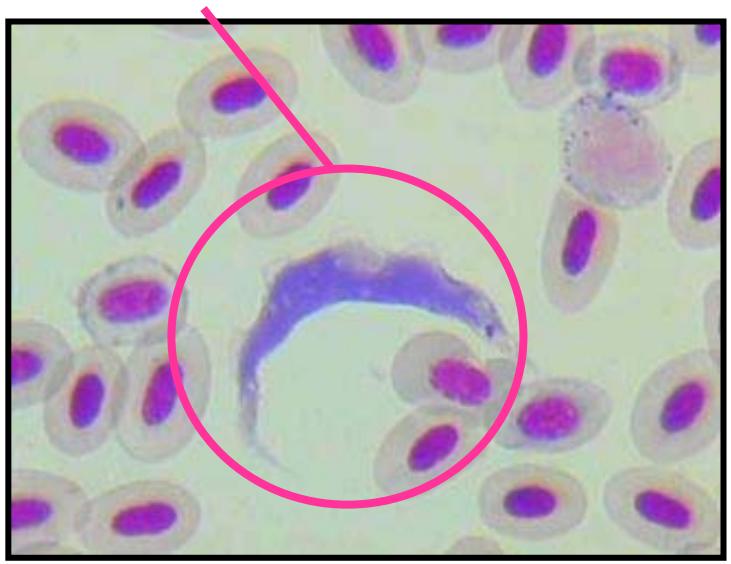
- Trichonympha breaks down cellulose in the intestines of termites



Subphylum Mastigophora

- some flagellates are serious parasites
  - Trypanosomes cause several diseases in Africa (Chaga's disease, and African sleeping sickness)
  - Giardia is an intestinal parasite that commonly infects travelers

Trypanosome

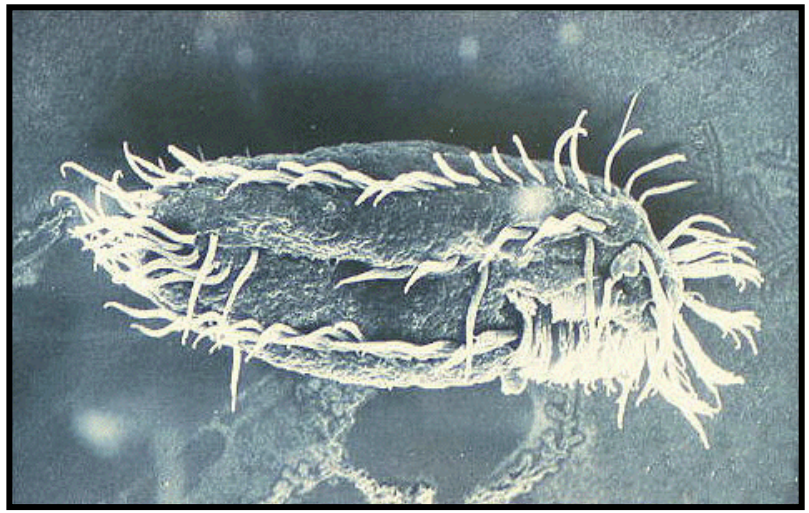


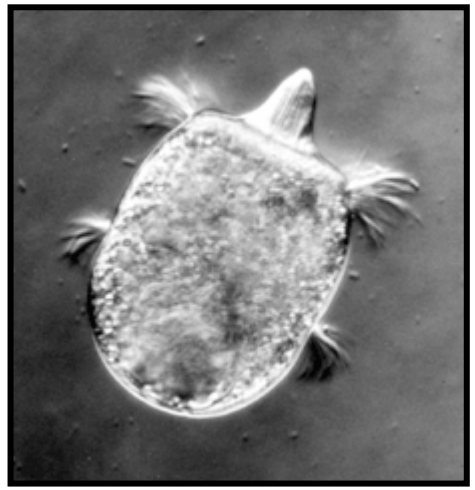
Giardia

Subphylum Mastigophora

Red Tides

- **environmental conditions can cause dinoflagellate populations to explode resulting in red tides**
  - **can cause fish kills**
  - **involved in paralytic shellfish poisoning**

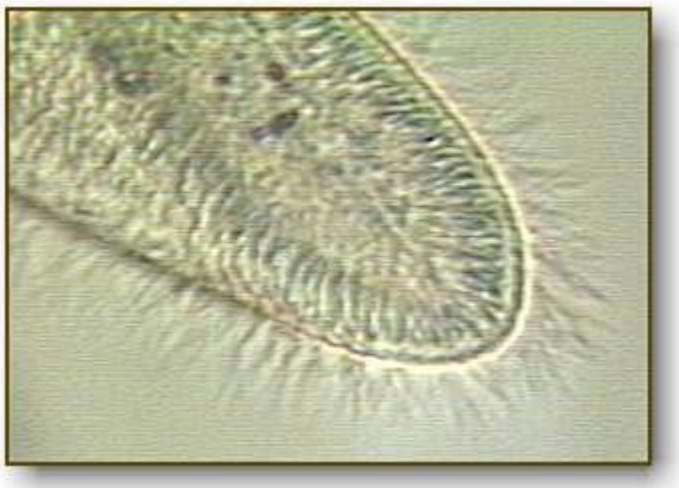


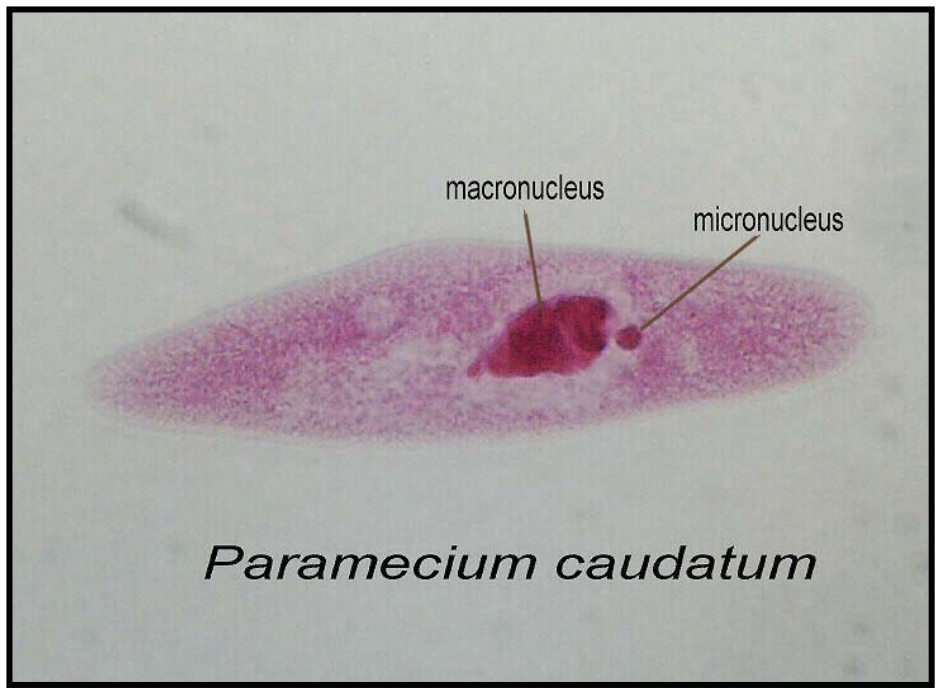


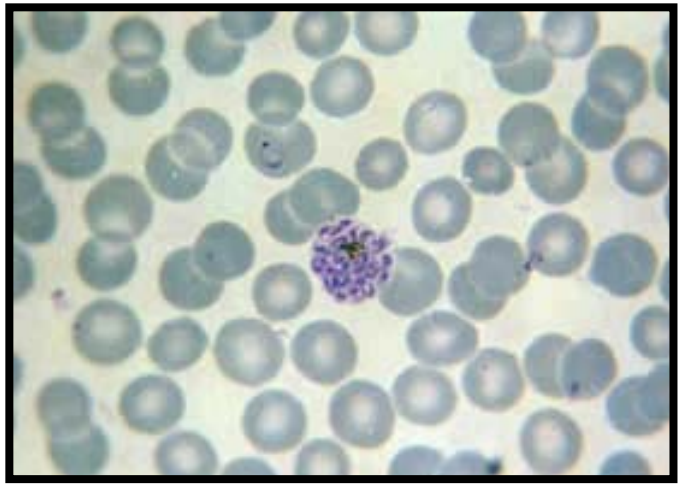
Phylum Ciliophora

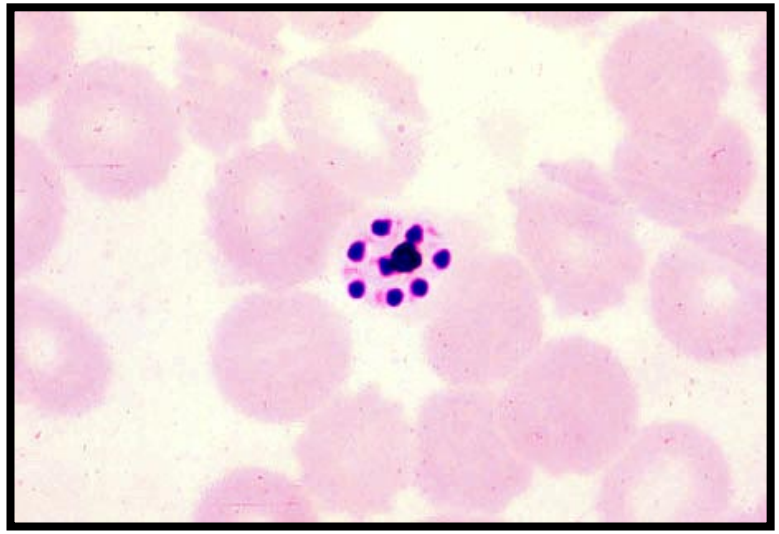
Phylum Ciliophora

- use cilia for locomotion and feeding
- have 2 nuclei
  (a macronucleus and a micronucleus)
- includes paramecia

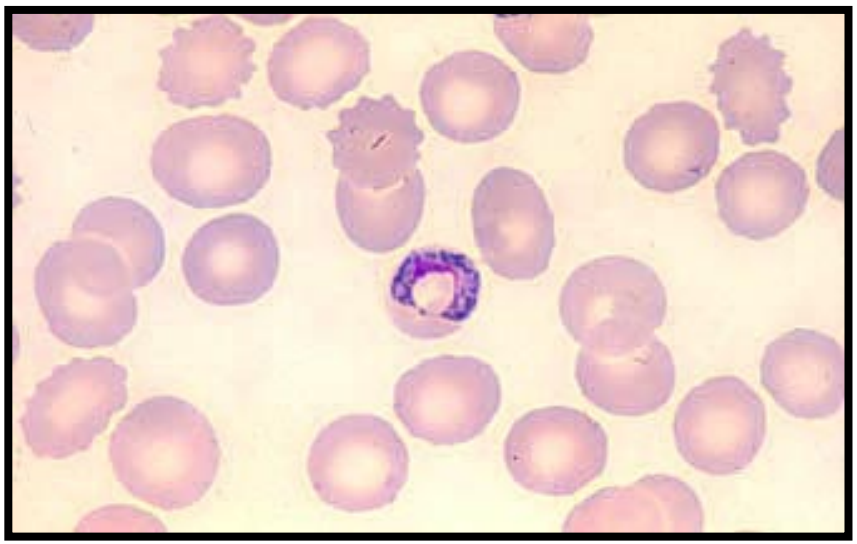


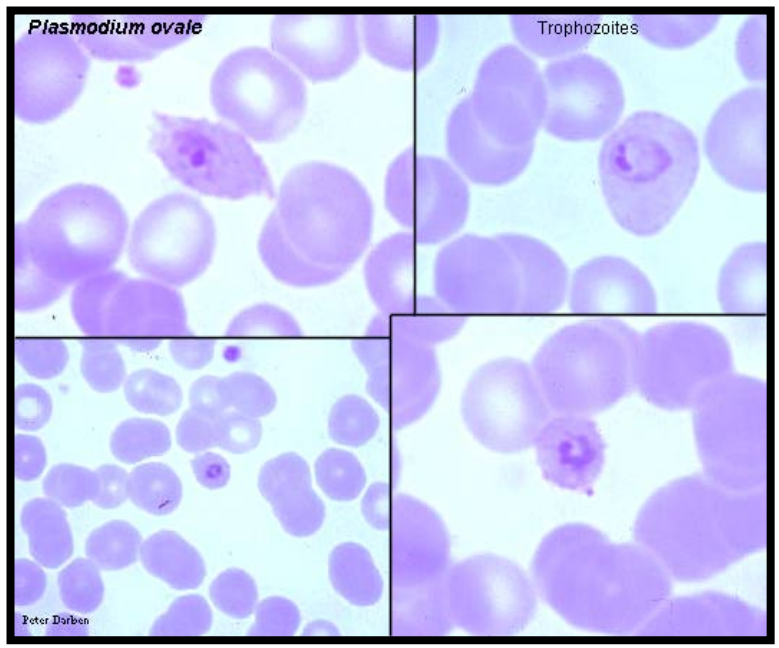






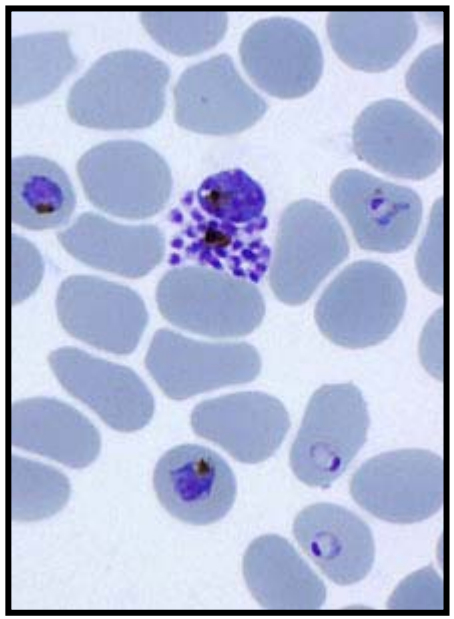
Phylum Sporozoa

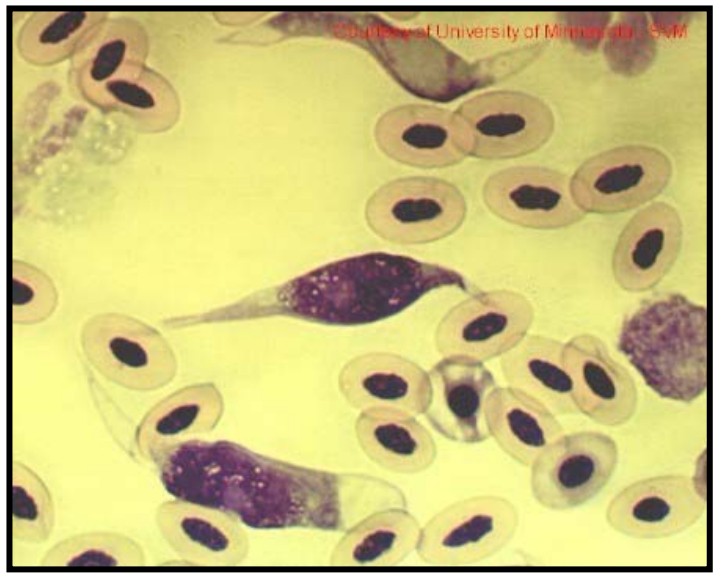




Phylum Sporozoa

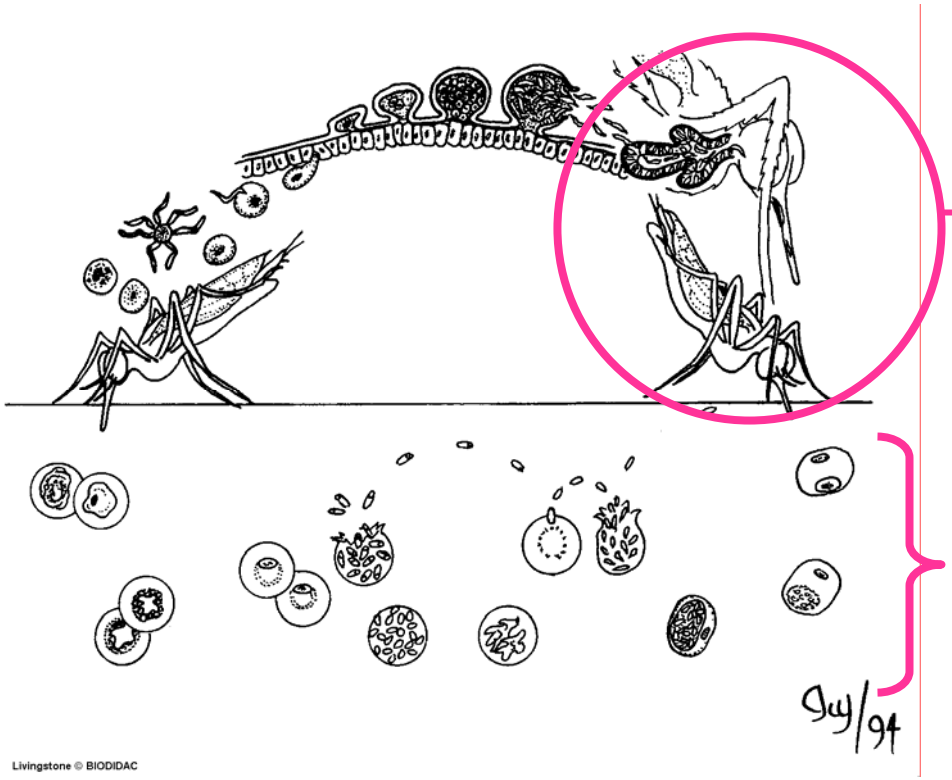
- endoparasites (malaria)
- lack pseudopodia, flagella, and cilia
- have apical organelles that are used for penetrating host tissue (often red blood cells)





Phylum Sporozoa

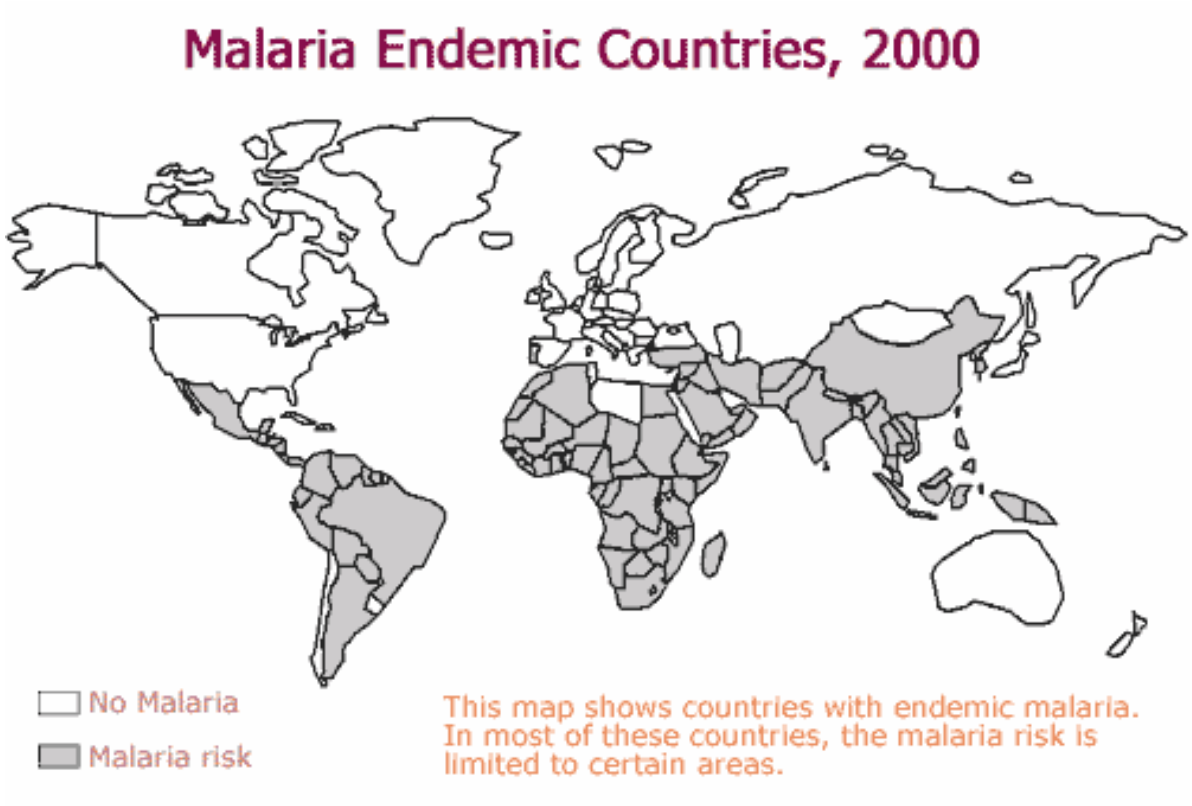
- have complex life cycles



Vector: sexual and asexual reproduction

Host blood: asexual reproduction

Phylum Sporozoa



- **spread by mosquitoes**
- **300- 500 million cases every year (90% of cases are in Africa)**