

UNIT 3 PART 2 BIODIVERSITY

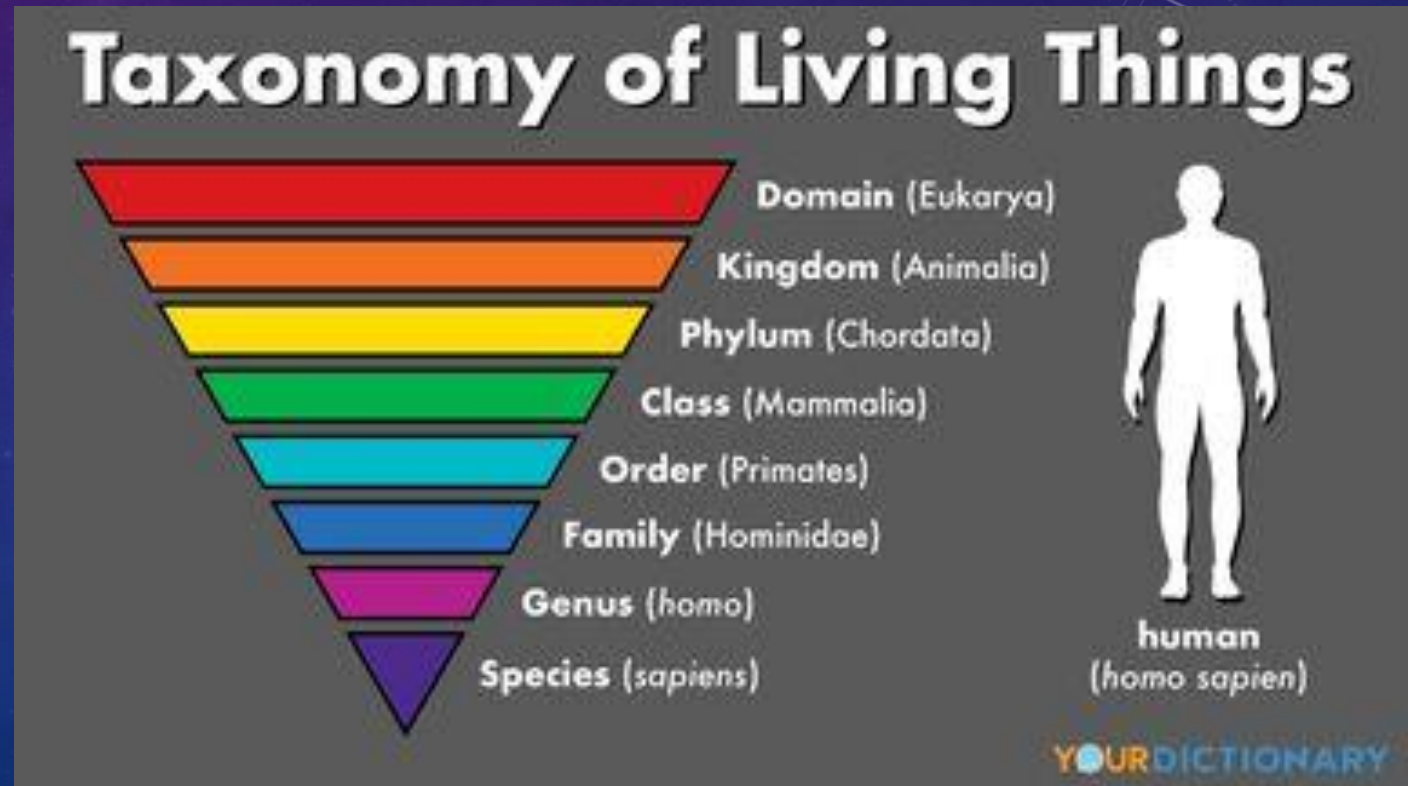
MR. GILLAM

HOLY HEART



EARTH'S BIODIVERSITY CLASSIFICATION

- Earth's biodiversity can be explained both by genetic changes in populations over time and by major evolutionary changes that produce new species
- Earth's biodiversity can be classified into **taxa** - taxon (plural taxa) one of a series of progressively smaller groups made when subdividing the three domains and six kingdoms.
- Domain
- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- species



bi diversity

KINGDOM: Animalia



PHYLUM: Chordata



CLASS: Mammalia



ORDER: Carnivora



FAMILY: Canidae



GENUS: *Canis*



SPECIES: *Canis lupis*

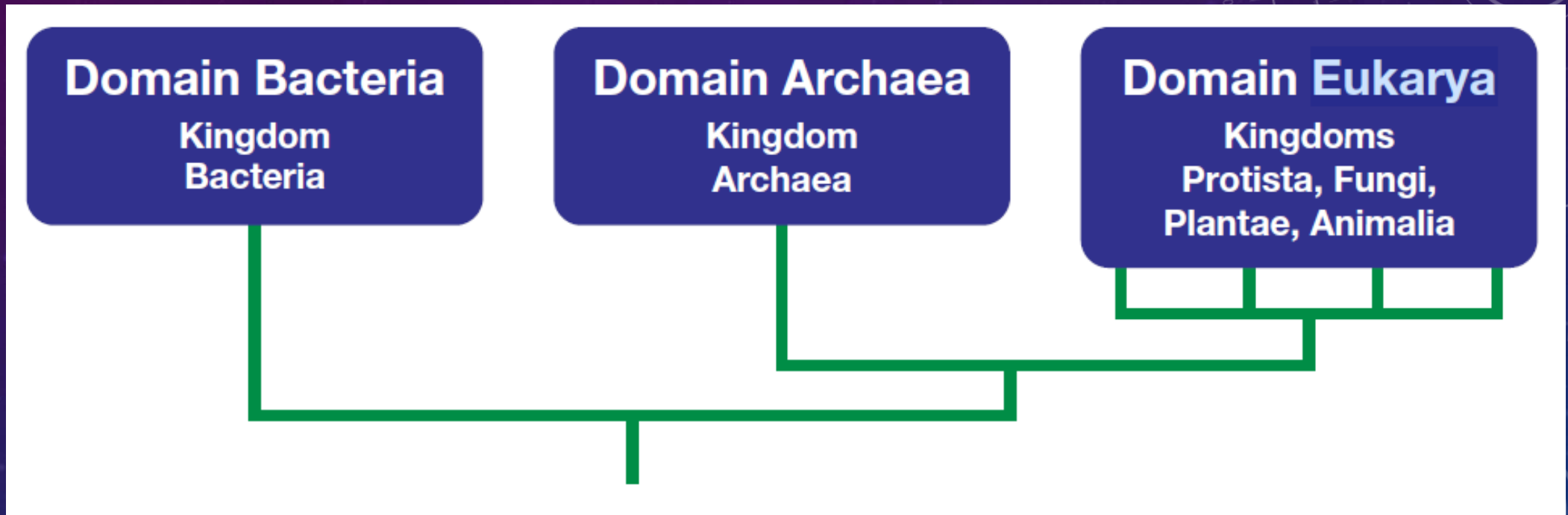


Biodiversity

- **binomial nomenclature** system of using a two-word name for each species, the **genus and species** together.
- The first word is the name of the **genus** (plural genera) in which the organism is classified. The first letter of this name is capitalized. Because a genus may contain more than one species, there may be several species with the same first name. **For example, the genus Canis includes Canis lupus (wolf), Canis latrans (coyote), and Canis familiaris (domestic dog).**
- **This system is used to avoid confusion of common names such as starfish (not a fish) and catfish (not a cat). As well as a panther being called a puma, cougar and mountain lion.**

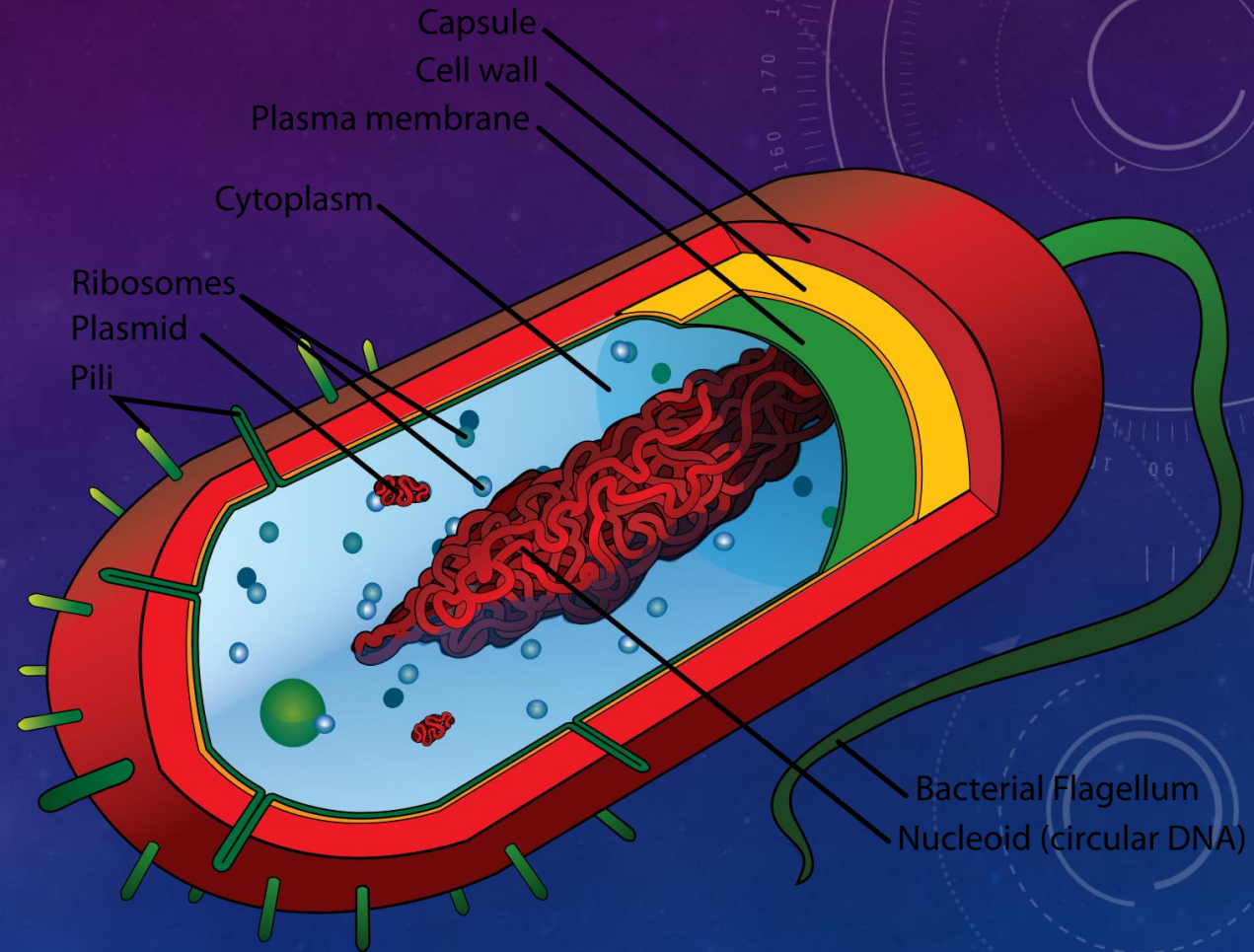


THE THREE DOMAINS – BACTERIA, ARCHAEA AND EUKARYA



DOMAIN BACTERIA

- **Bacteria are Prokaryotic**
- **Prokaryote** a microscopic **single-celled** organism that has neither a distinct nucleus with a membrane nor other specialized organelles.
- They have a cell wall made of peptidoglycan
- **Cell wall** a rigid layer of polysaccharides lying outside the plasma membrane of the cell. In bacteria it is made of **peptidoglycan**



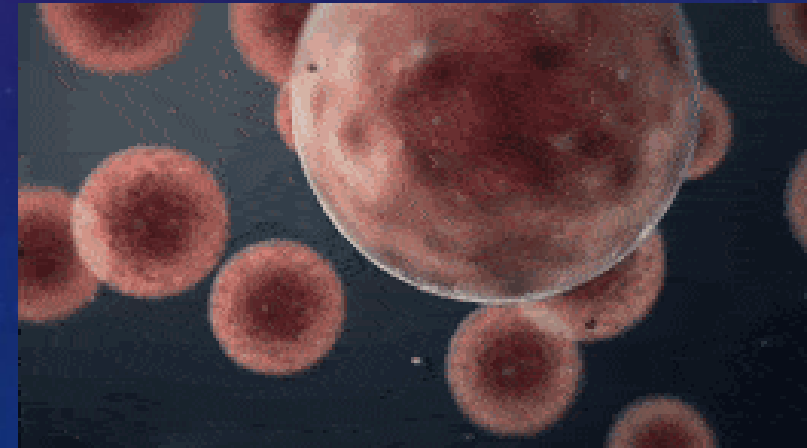
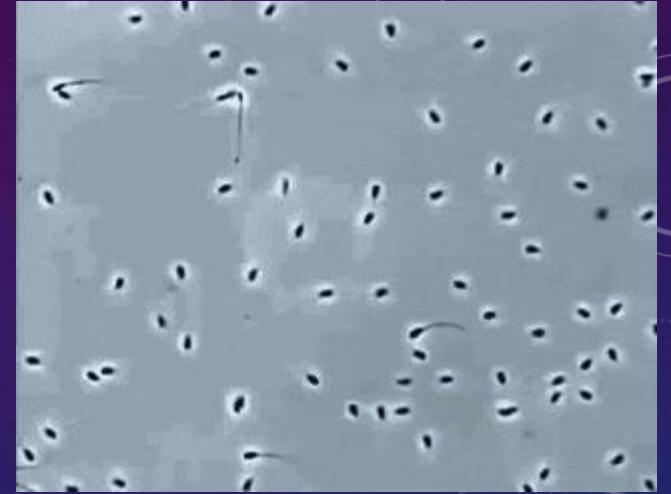
biobiodiversity

- Most bacterial species are **heterotrophic**
- The largest number of bacteria are saprobic, meaning that they feed on dead or decaying organic matter.
- A few bacterial species are **parasitic**; these bacteria live within host organisms and cause disease.
- Certain bacteria are **autotrophic**, meaning they synthesize their own foods. Such bacteria engage in the process of photosynthesis.

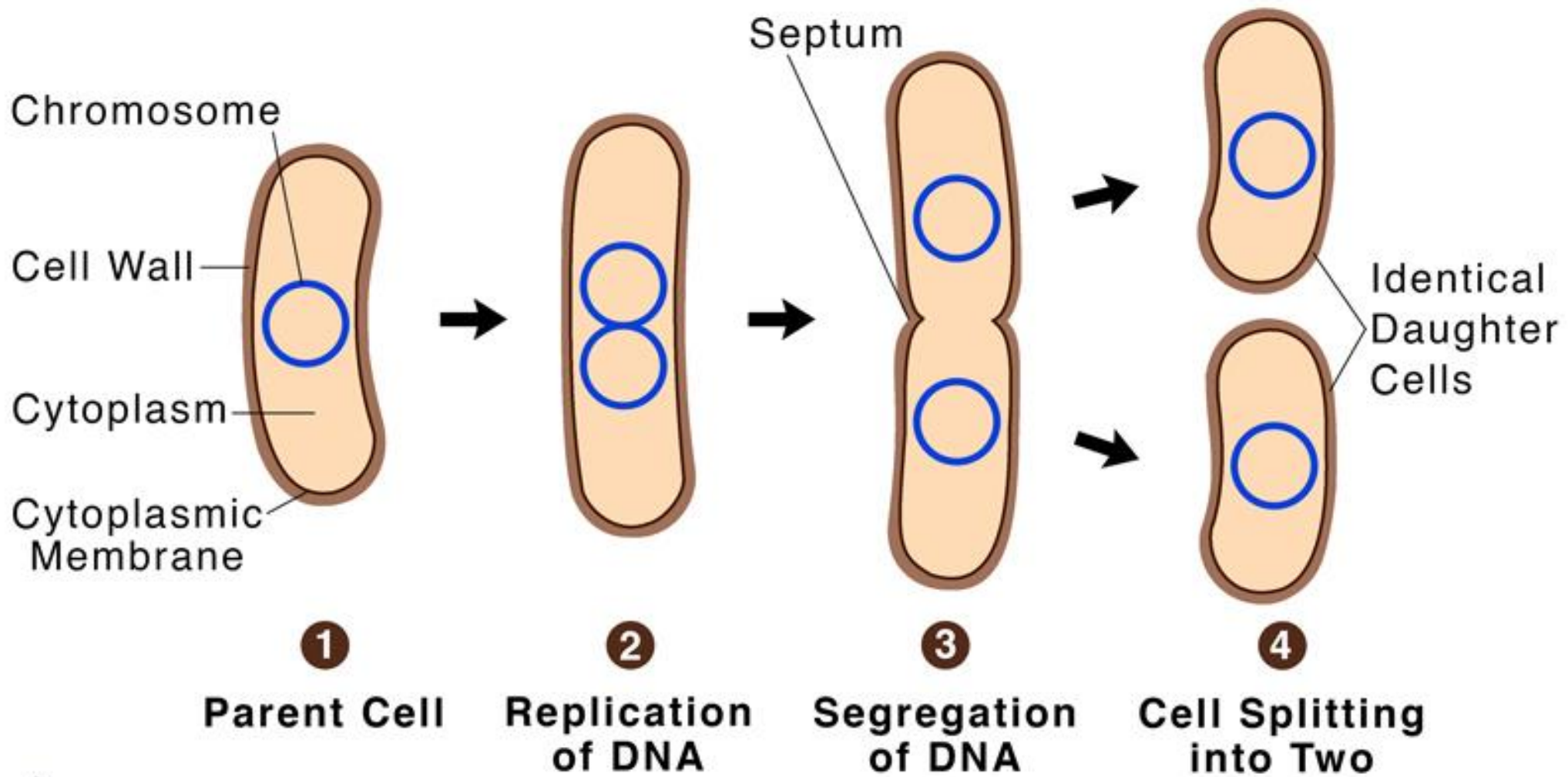


biodiversity

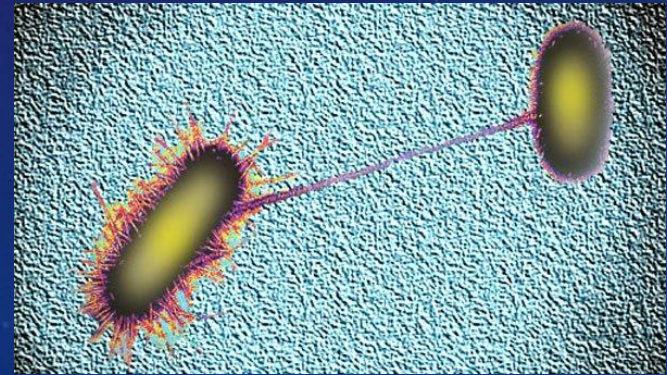
- Bacterial movement (**motility**) depends on the use of different appendages to propel.
- Swarming and swimming movements are both powered by rotating **flagella**.
- Bacteria reproduce by **binary fission**.
- In this process the bacterium, which is a single cell, divides into two identical daughter cells.
- Binary fission begins when the DNA of the bacterium divides into two (replicates).
- The bacterial cell then elongates and splits into two daughter cells each with identical DNA to the parent cell. Each daughter cell is a clone of the parent cell.



Binary Fission

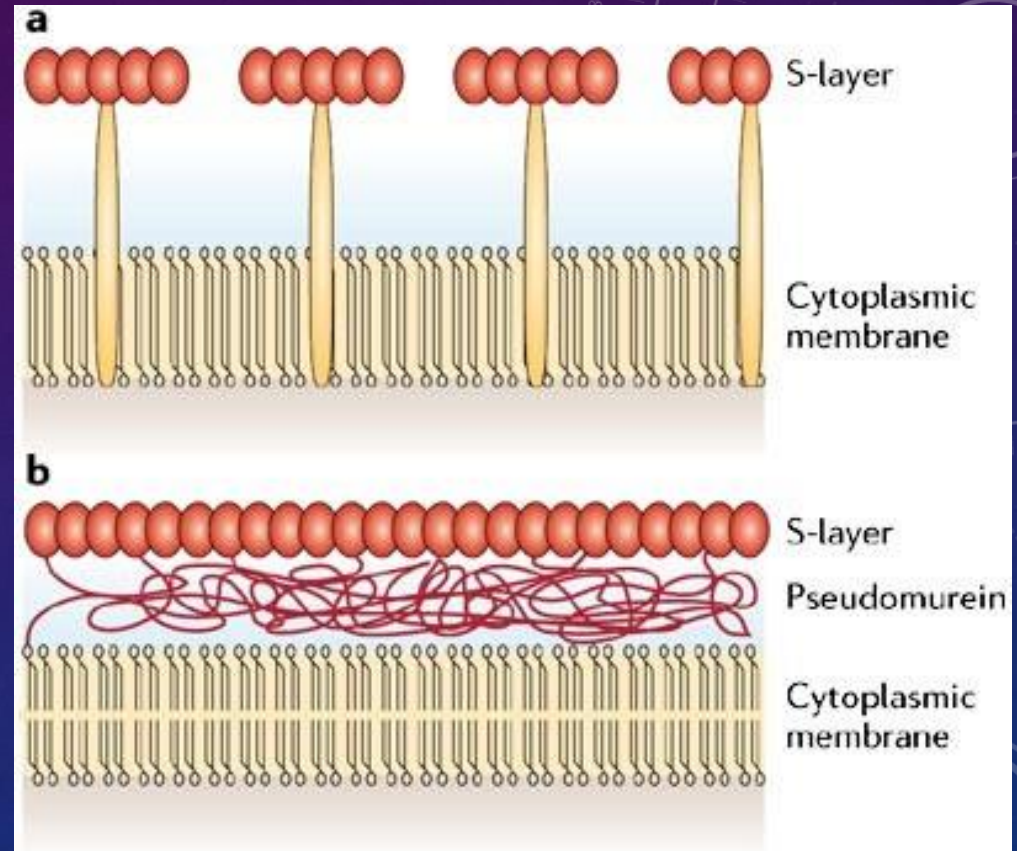


- **Bacterial Conjugation** is often regarded as the bacterial equivalent of sexual reproduction or mating since it involves the exchange of genetic material.
- However, it is not sexual reproduction, since no exchange of gamete occurs, and indeed no generation of a new organism: instead an existing organism is transformed.
- The genetic information transferred is often beneficial to the recipient.
- Benefits may include antibiotic resistance, xenobiotic tolerance or the ability to use new metabolites.
- Other elements can be detrimental and may be viewed as bacterial parasites.



DOMAIN ARCHAEA

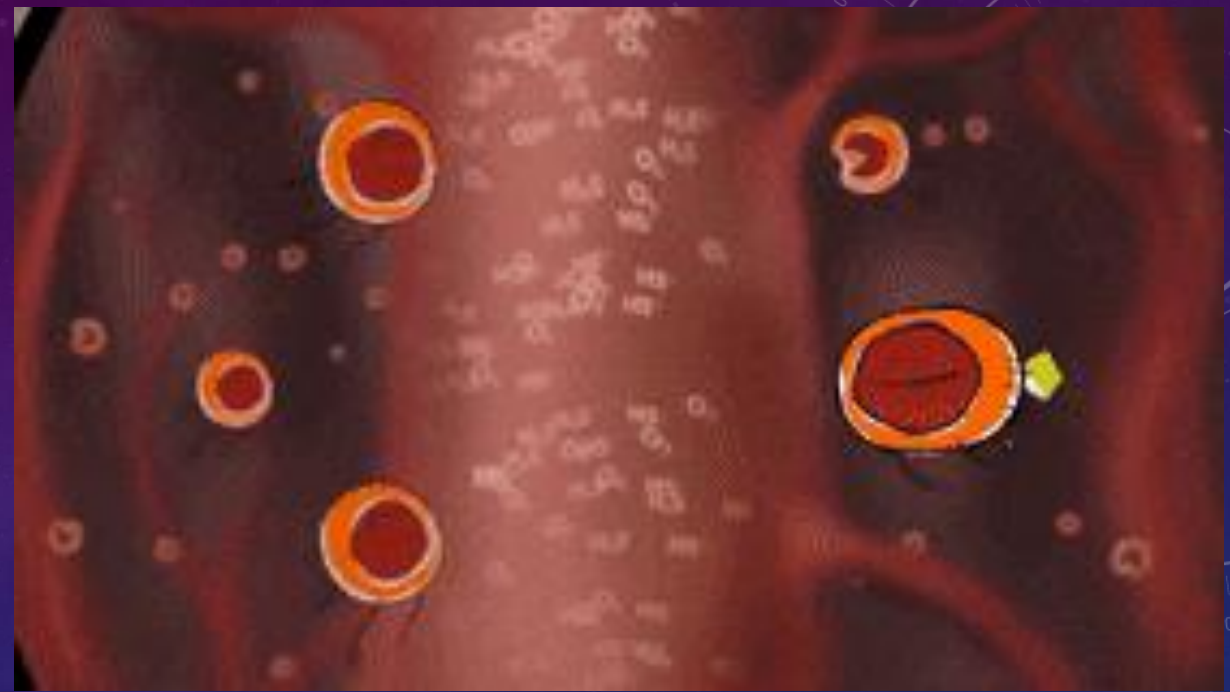
- Are also **prokaryotic unicellular** organisms lacking a true nucleus.
- The cell wall of archaea is composed of **S-layers and lack peptidoglycan** molecules
- **S-layer** a paracrystalline protein surface layer, present in nearly all archaea described to date.



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biodiversity

- Most archaea are **chemotrophs** and derive their energy and nutrients from breaking down molecules in their environment.
- A few species of archaea are **photosynthetic** and capture the energy of sunlight.
- No known parasitic archaea

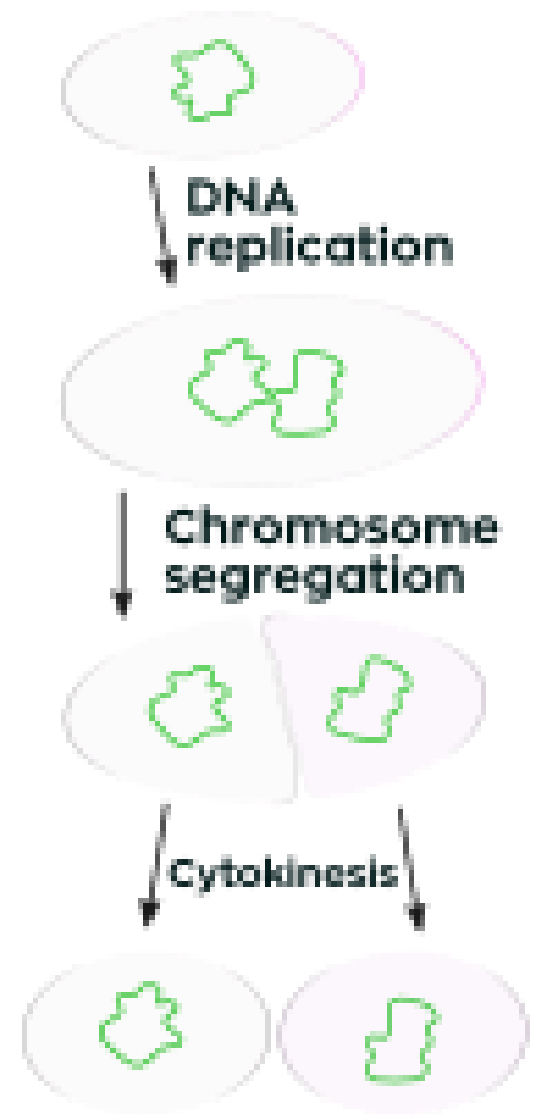


- Archaea use a IV pili for **swimming motility**
- motion is achieved by rotation.



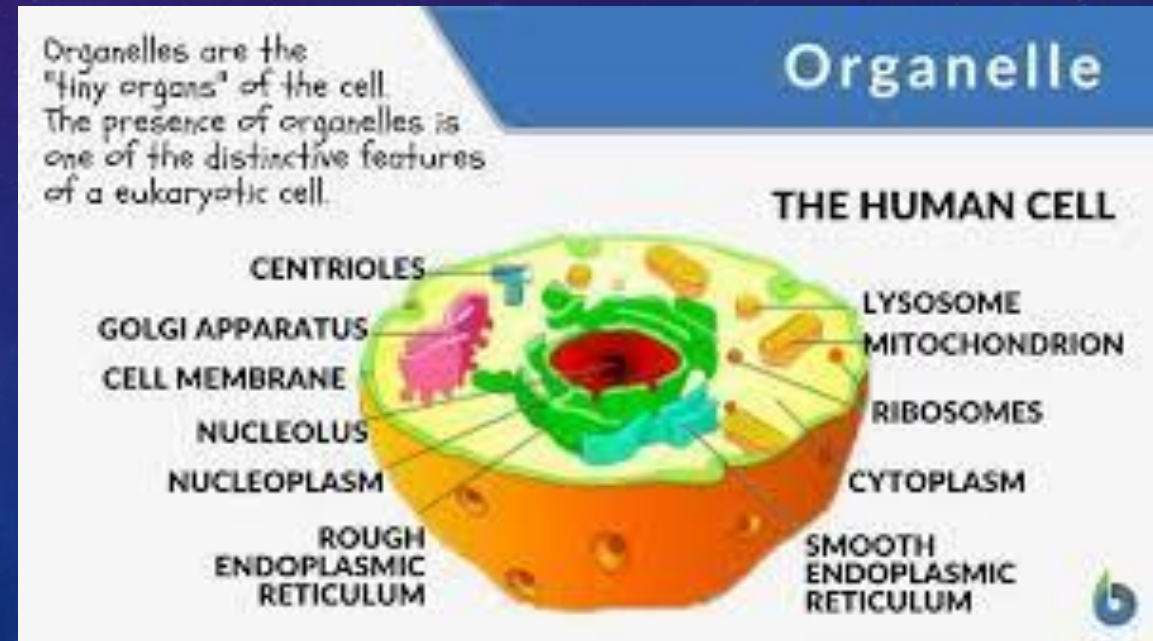
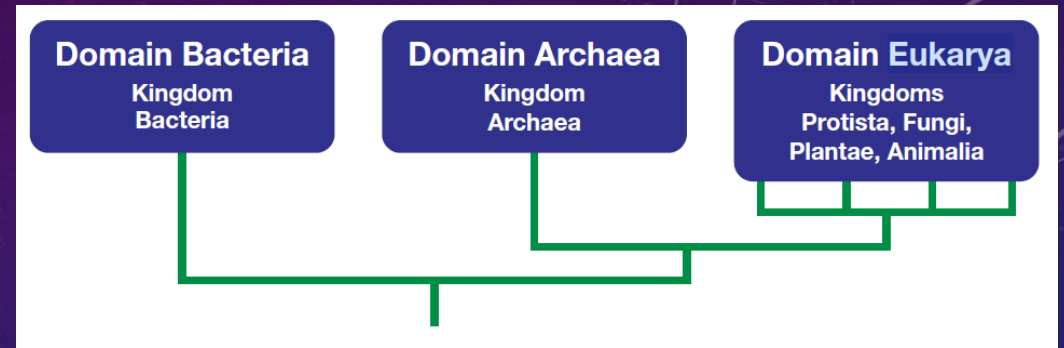
- Archaea procreate using a process called **binary fission**.
- In this binary fission process, archaeal DNA replicates, and the two strands are pulled apart as the cell grows.

Binary fission



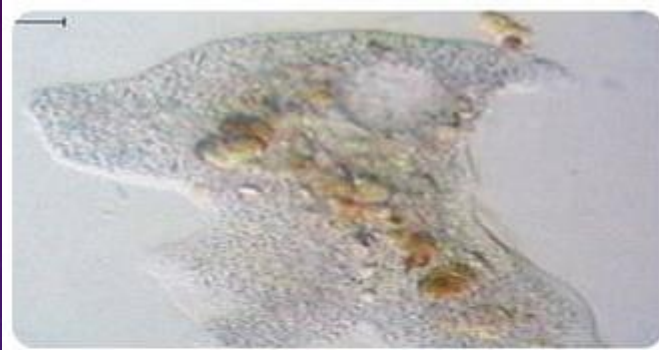
DOMAIN EUKARYA

- **Domain Eukarya**
- a domain of organisms having cells each with a distinct **nucleus** within which the genetic material is contained and membrane bound organelles.
- **Organelle** a specialized cellular part (such as a mitochondrion, chloroplast, or nucleus) that has a specific function inside the cell
- **Kingdoms**
- **Protista, Fungi, Plantae and Animalia**



KINGDOM PROTISTA

- Protista is kingdom of simple eukaryotic organisms. They can be animal-like, plant-like, fungus-like
- The vast majority of protists are **unicellular** or form colonies consisting of one or a couple of distinct kinds of cells
- There are **multicellular** protists among brown algae and certain red algae.



"Animal-like" *Chaos diffluens*



"Plant-like" *Eupodiscus radiatus*

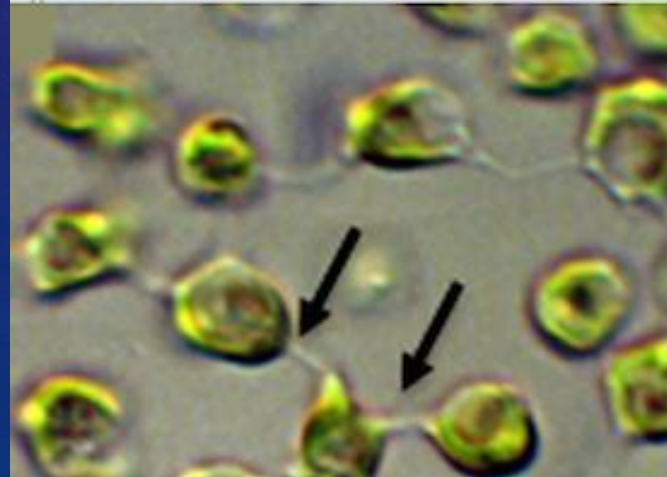
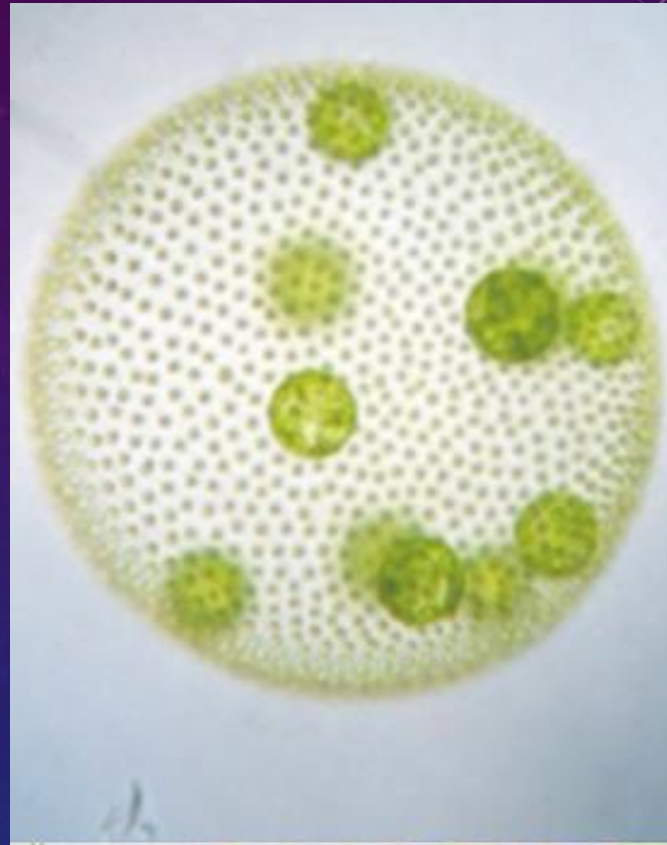


"Fungus-like" *Fuligo septic*

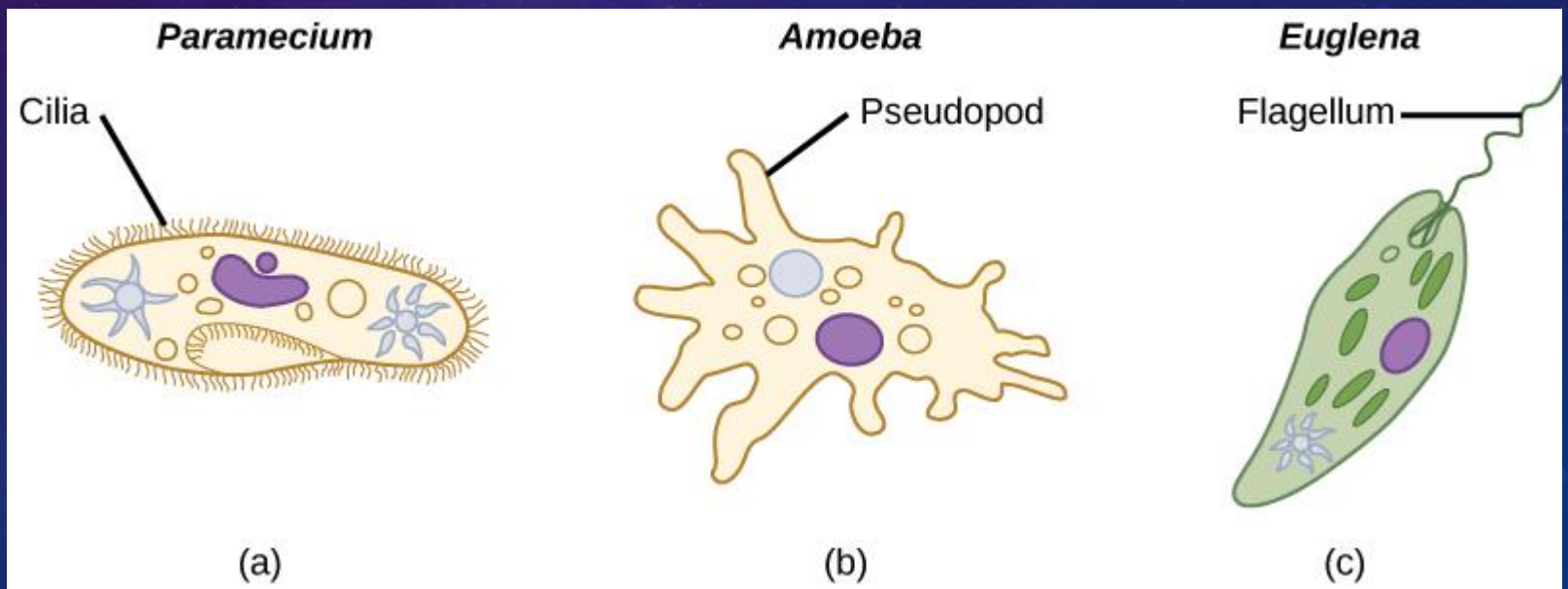


Multi-cellular seaweed *Fucus vesiculosus*

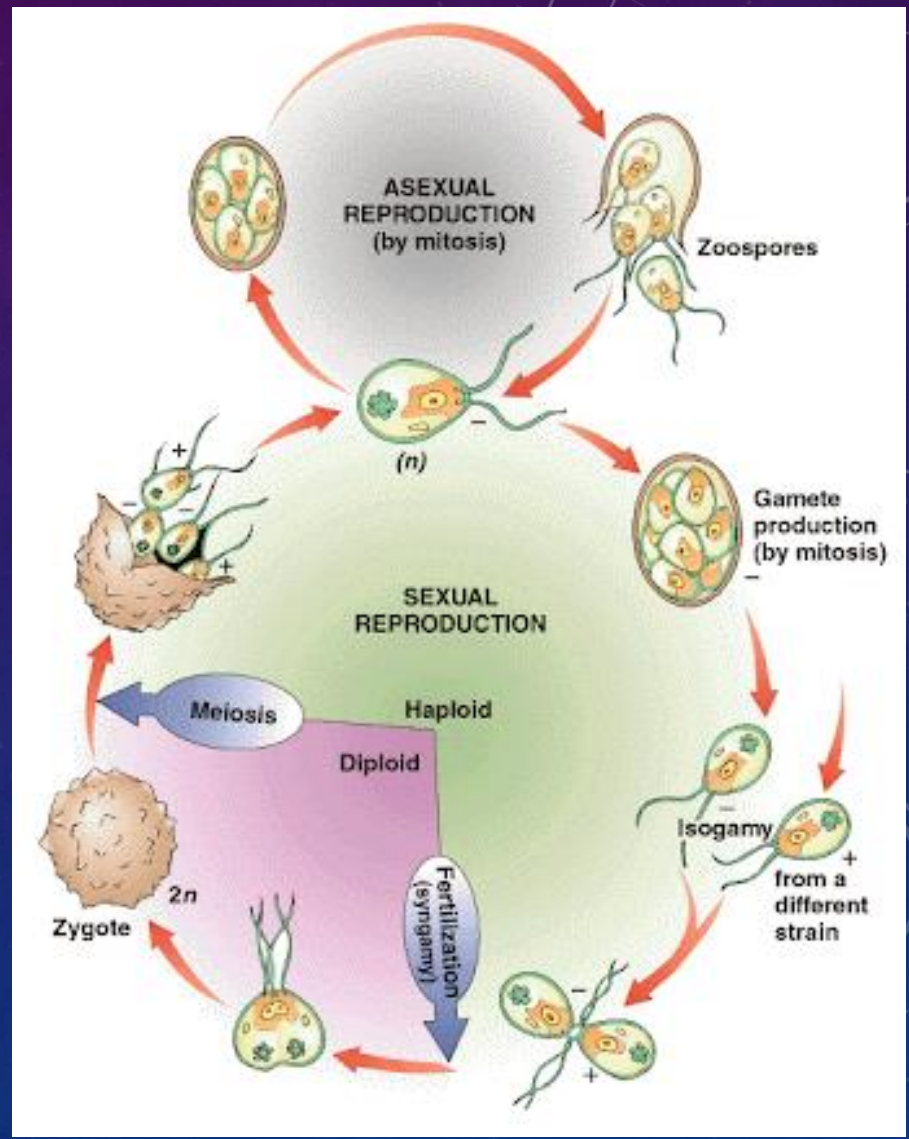
- Plant like Protista have cell walls made of **cellulose**. Others do not have cell walls.
- Some are **heterotrophic** and some are **autotrophic**.



- The majority of protists are **motile**, but different types of protists have evolved varied modes of movement.
- Protists such as euglena have one or more **flagella**, which they rotate or whip to generate movement. Paramecia are covered in rows of tiny **cilia** that they beat to swim through liquids. The Amoeba has feet like structures called **pseudopods**.

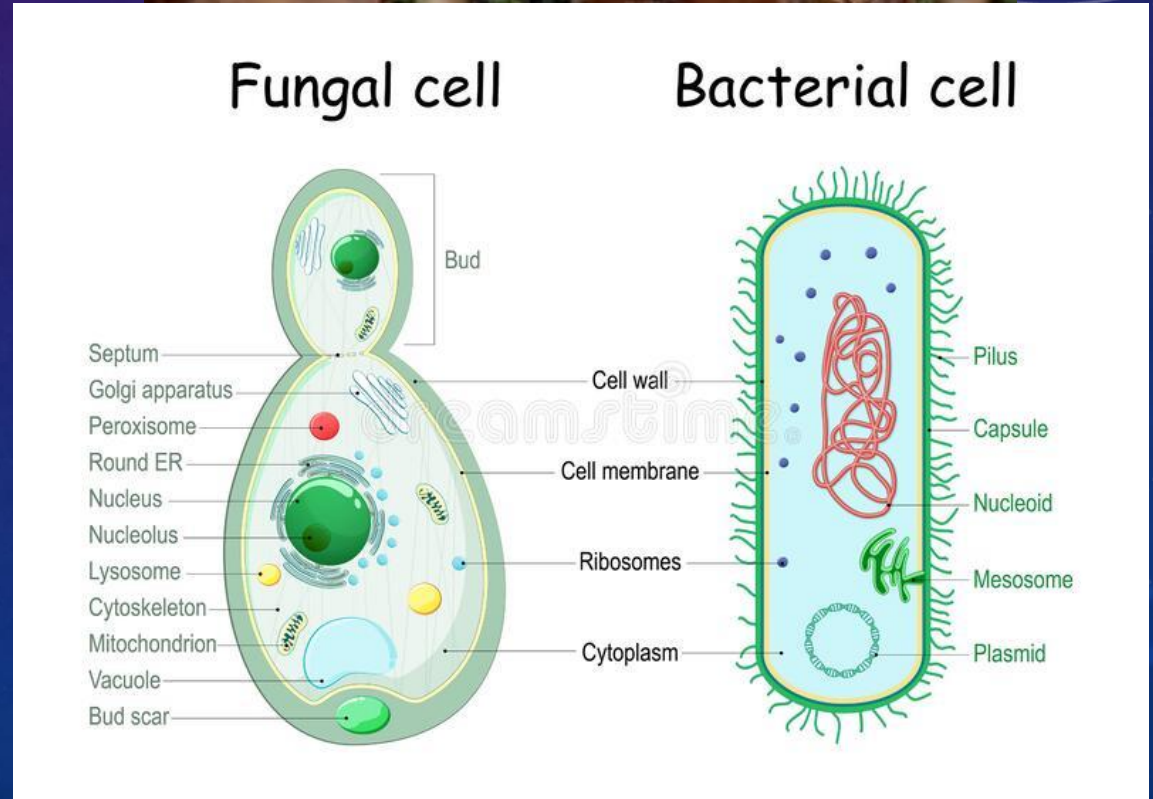


- Protists reproduce by a variety of mechanisms.
- Most undergo some form of **asexual reproduction**, such as **binary fission**, to produce two daughter cells.
- Others produce tiny **buds (budding)** that go on to divide and grow to the size of the parental protist.
- **Sexual reproduction**, involving meiosis and fertilization, is common among protists, and many protist species can switch from asexual to sexual reproduction when necessary.

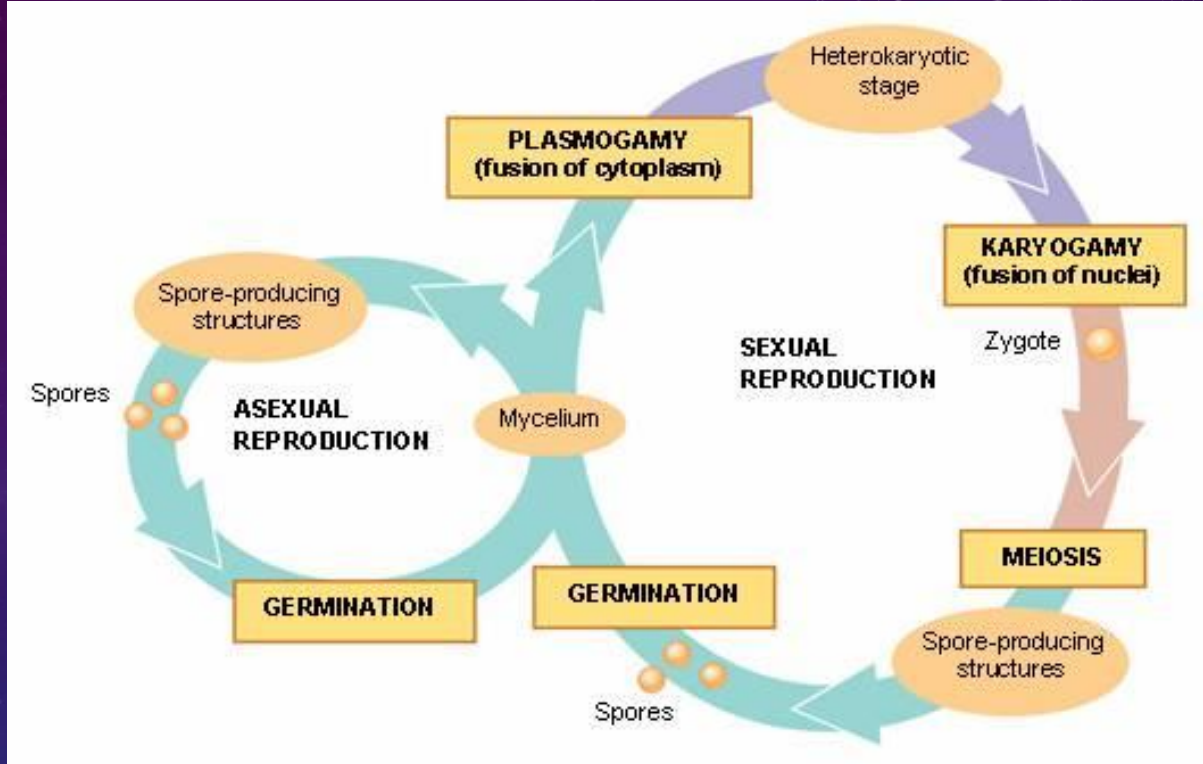


KINGDOM FUNGI

- Fungi are **eukaryotic unicellular** or **multicellular**.
- They have a cell wall composed is composed mainly of **chitin**.
- Fungi are heterotrophs, they are either **saprophytes** or parasites.
- Fungi produce digestive enzymes for breaking down dead organic material into a simple form of food.

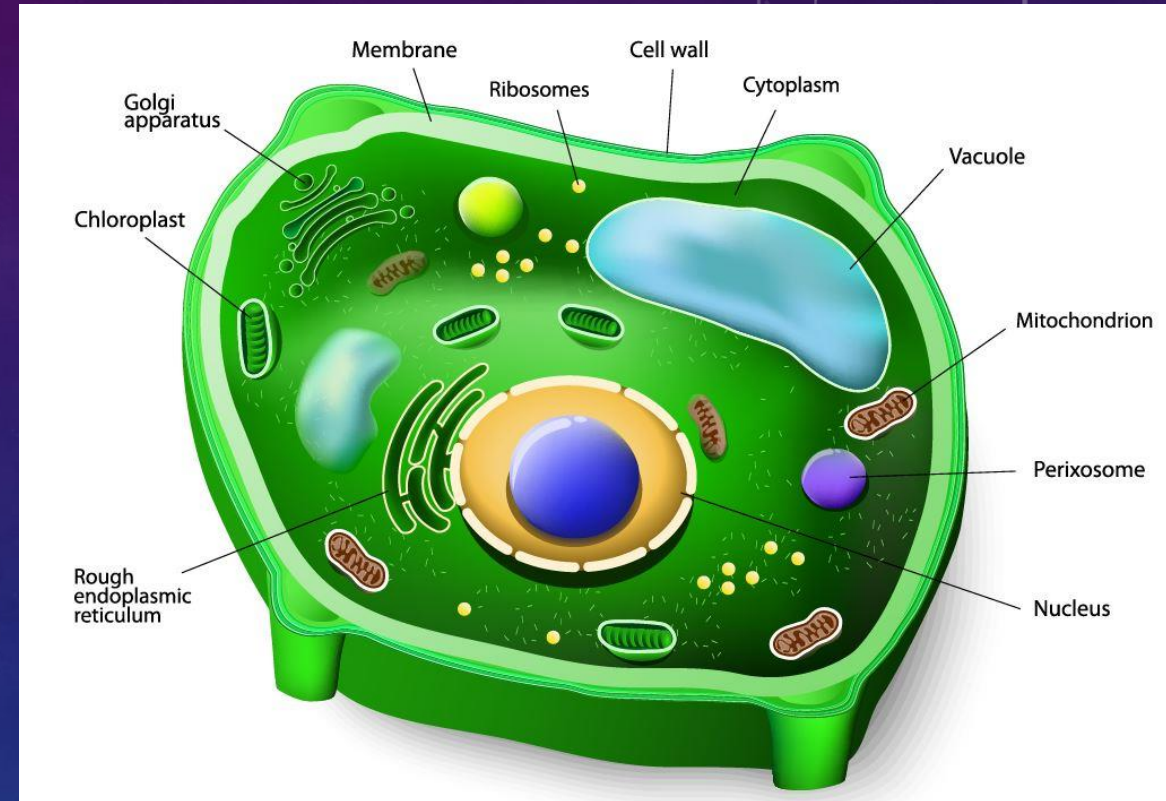


- Fungi are classified as **nonmotile**, BUT their spores can be motile.
- Most fungi reproduce by forming **spores** that can survive extreme conditions such as cold and lack of water. Both **sexual meiotic** and **asexual mitotic** spores may be produced, depending on the species and conditions. Most fungi life cycles consist of both a diploid and a haploid stage.

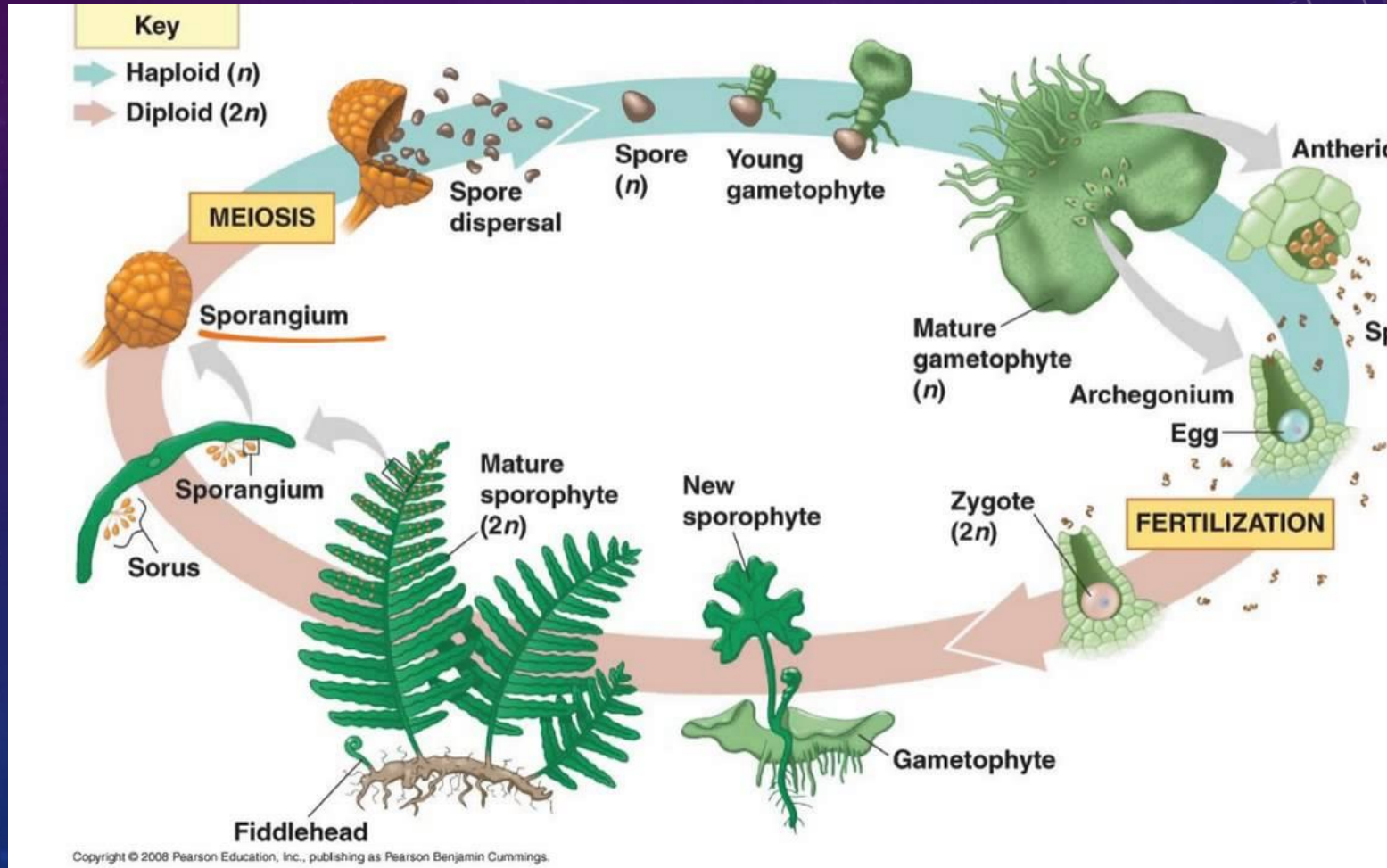
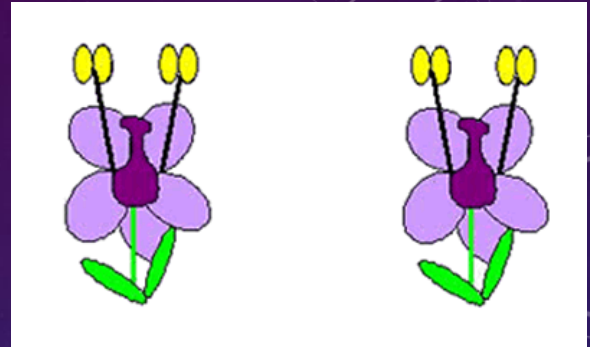


KINGDOM PLANTAE

- Plants are **eukaryotic multicellular** organisms.
- They have a **cell wall** composed of **cellulose** and are **non-motile**, except some forms such as bryophytes have gametes that move using flagella or cilia.
- Plants are autotrophs that can produce their own energy through **photosynthesis**.

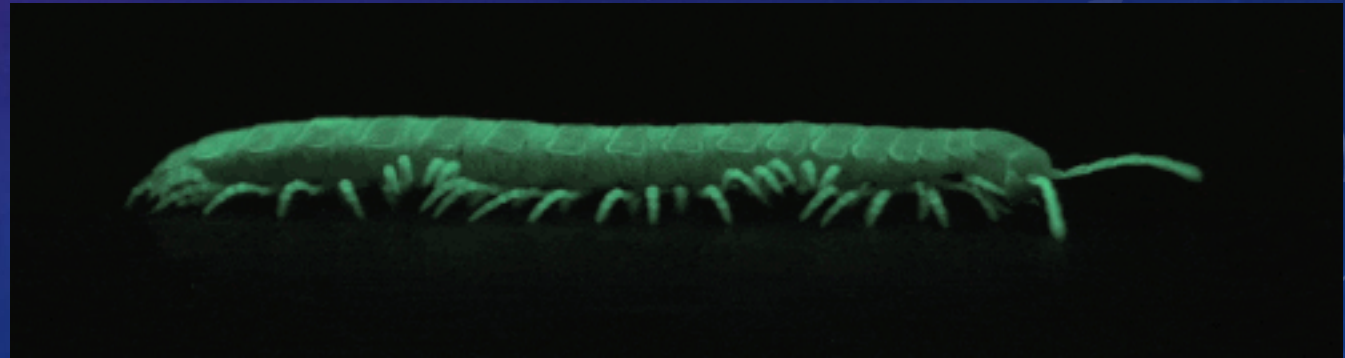
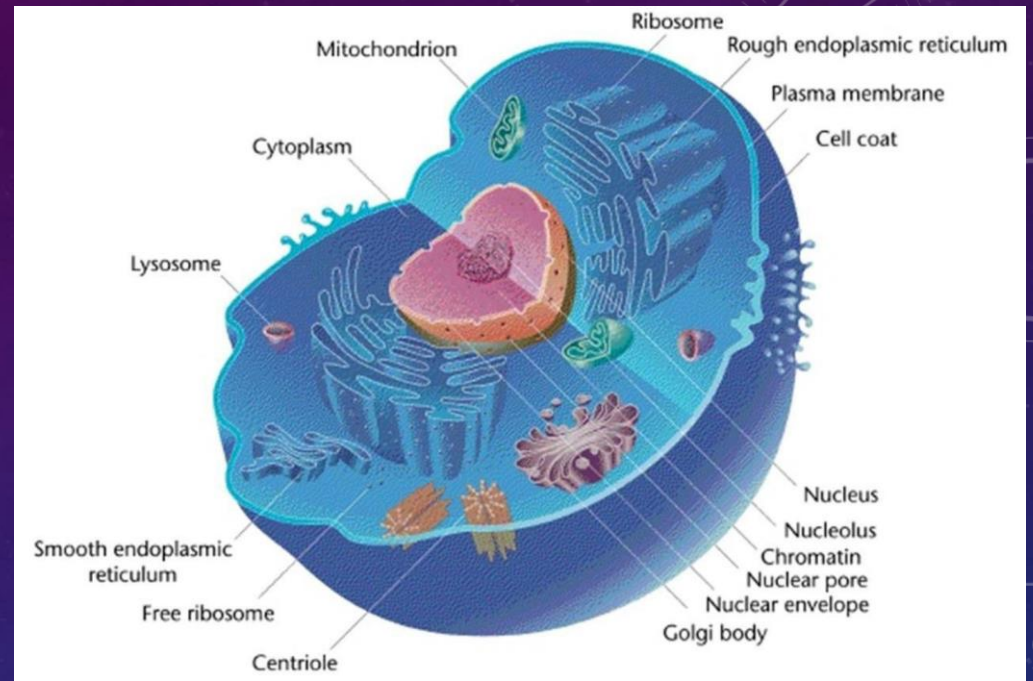


- Plant reproduction can be through **asexual** or **sexual reproduction**.



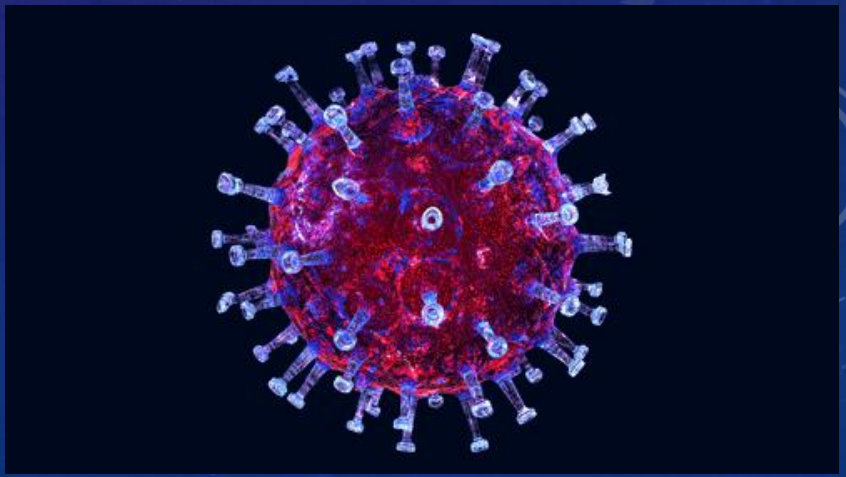
KINGDOM ANIMALIA

- Animals are **eukaryotic multicellular** organisms that do not have a cell wall.
- All animals are considered **motile** at some part of their life cycle.
- All animals are **heterotrophs** and cannot make their own food.
- Animals can reproduce through **sexual** or **asexual reproduction**.




VIRUSES

- Viruses have no cellular structure.
- By this definition, therefore, **viruses are not organisms** and they are **not classified in any kingdom of living things**.
- Viruses have no cytoplasm, organelles, or cell membranes. **They do not carry out respiration or many other common life processes**. Viruses consist of little more than strands of **DNA or RNA** surrounded by a protective protein coat called a capsid.
- They are mobile genes that parasitize cells.
- Viruses attach to specific receptors on the host cell.




SPECIMEN IDENTIFICATION TOOLS

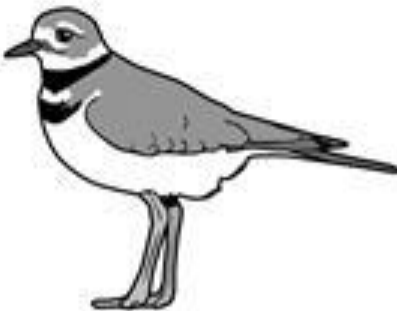
- dichotomous key**
 identification key that uses a series of paired comparisons to sort organisms into smaller and smaller groups.



Bird 1



Bird 2



Bird 3

1. a. Has a short bill (smaller than the head) go to 2
 b. Has long bill (longer than the head) go to 5

2. a. Has a crest on head Tufted titmouse
 b. No crest on head go to 3

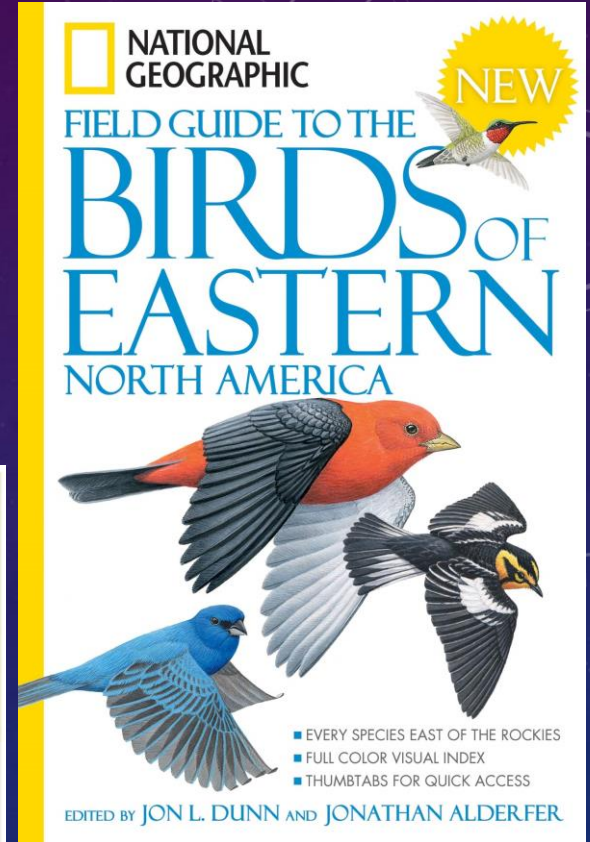
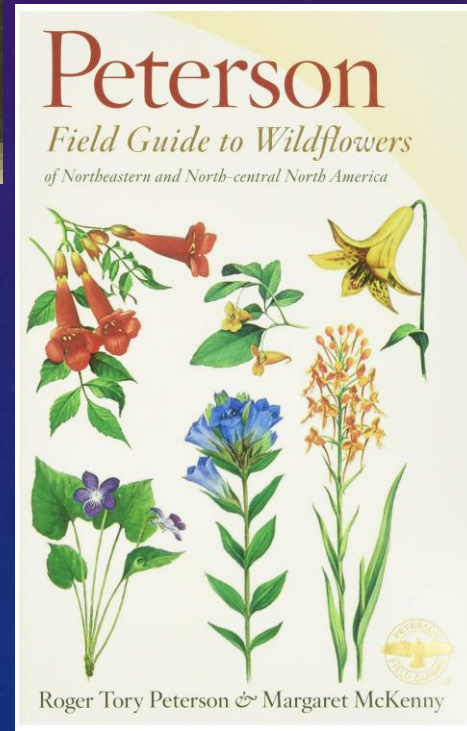
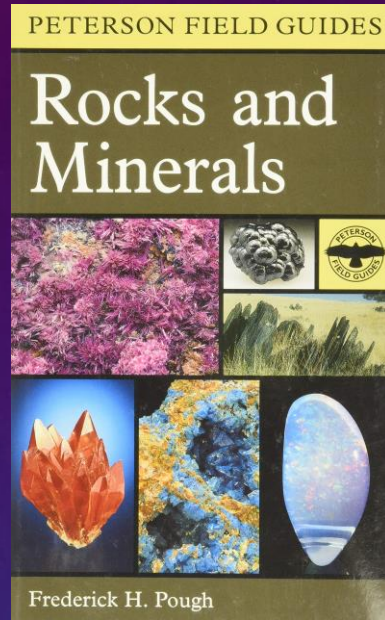
3. a. Bill is straight go to 4
 b. Bill is not straight Red-tailed hawk

4. a. Has two black neck bands Killdeer
 b. Has white eye ring Ovenbird

5. a. Has plumes extending from the head Great blue heron
 b. No plumes extending from the head Ruby-throated hummingbird

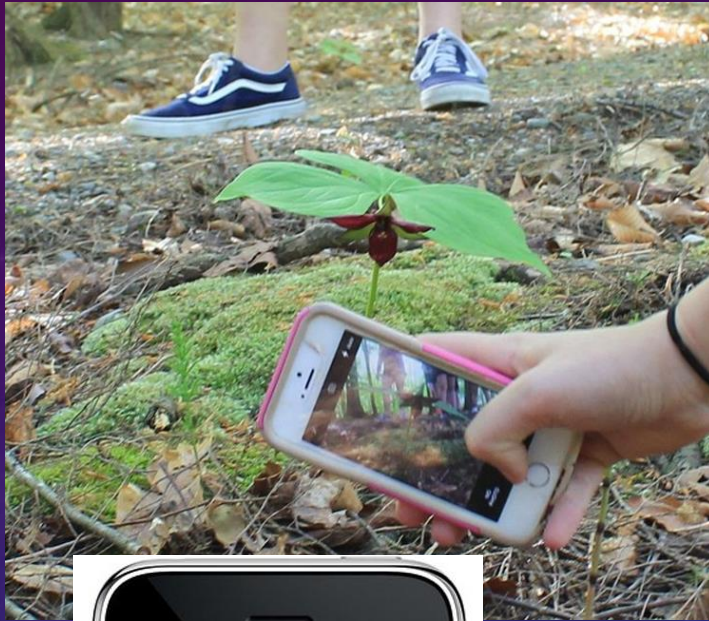
biodiversity

- **Field Guide** a book for the identification of birds, flowers, minerals, or other things in their natural environment.

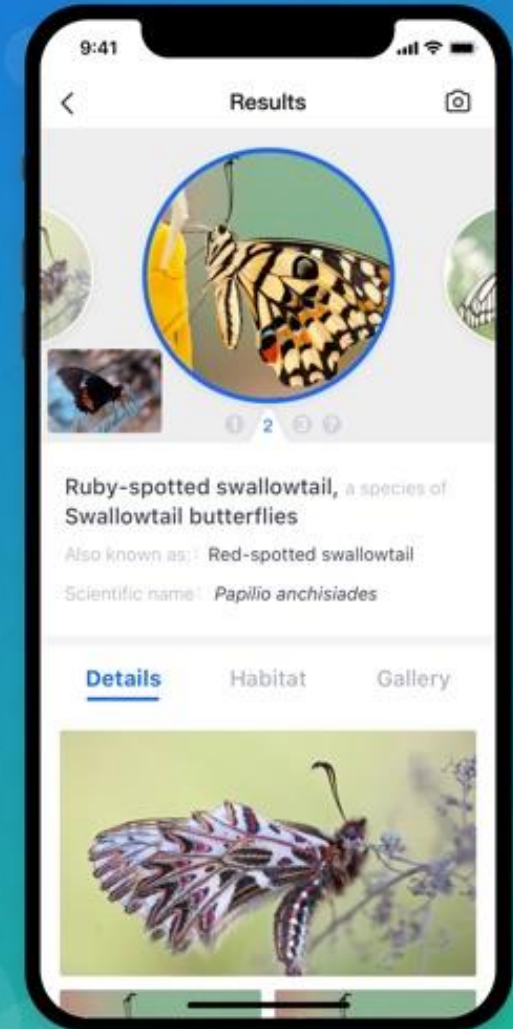


biodiversity

- Mobile device applications can also be used to identify species of organisms.
- Very common for insects and flowers
- There are some apps that do animals as well.



Get accurate results
within seconds












- Lab Using a Dichotomous Key



Biodiversity

- Biological classification systems change as new understandings of organisms emerge
- Often as a result of the invention of a technology.
- **Advances in microscopy, genetic and molecular analyses** revealed key differences among organisms
- Classification systems are then modified to better explain these differences.



Organism	Number of amino acid differences from humans
 Chimpanzee	0
 Rhesus Monkey	1
 Rabbit	9
 Cow	10
 Pigeon	12
 Bullfrog	20
 Fruit Fly	24
 Wheat germ	37
 Yeast	42

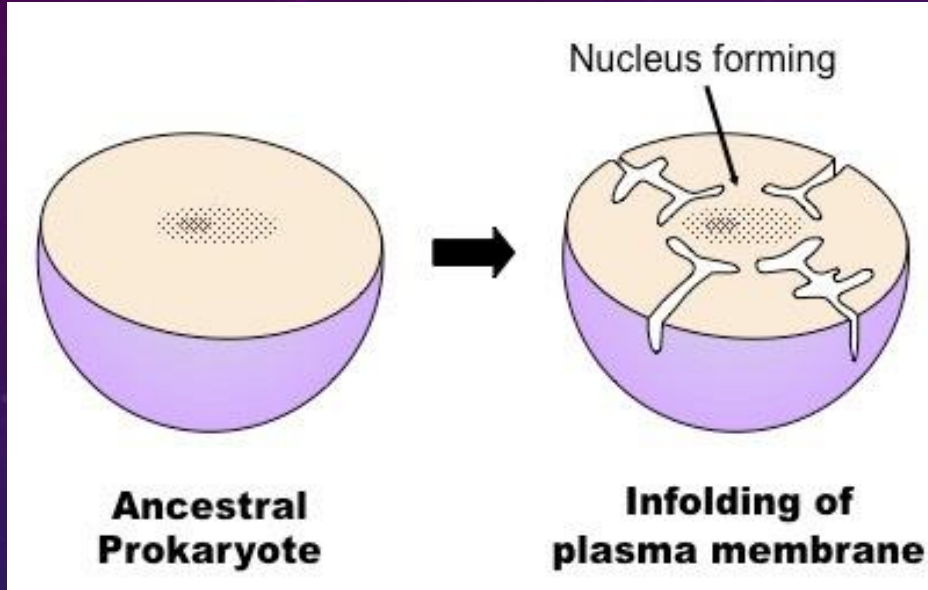
MACROEVOLUTION

- **theory of endosymbiosis**
theory that explains eukaryotic cells arose through a process in which a larger prokaryotic cell engulfed another

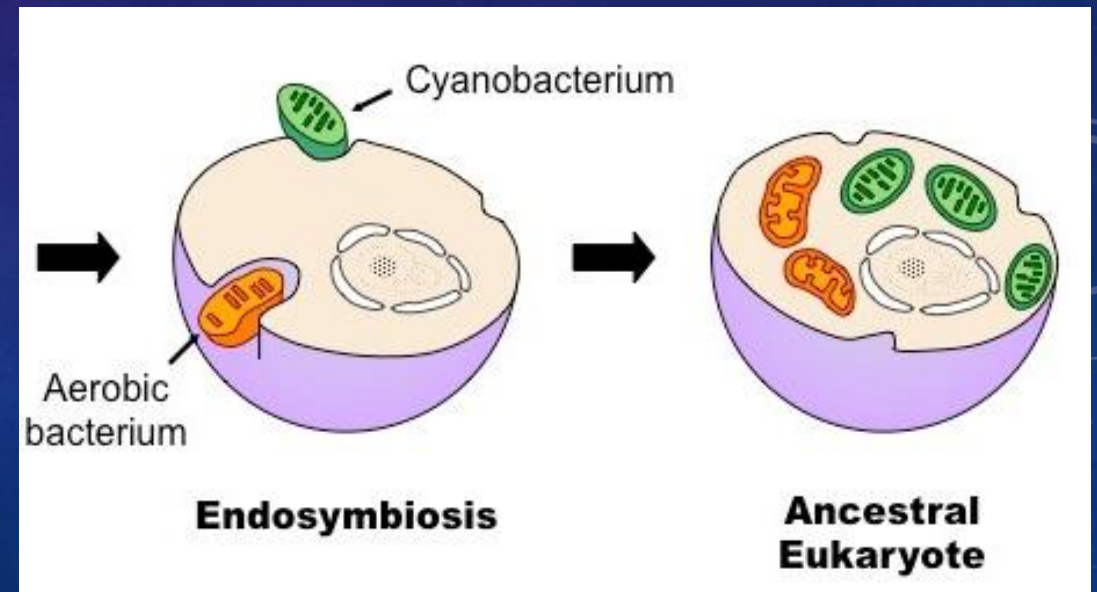


ENDOSYMBIOSIS

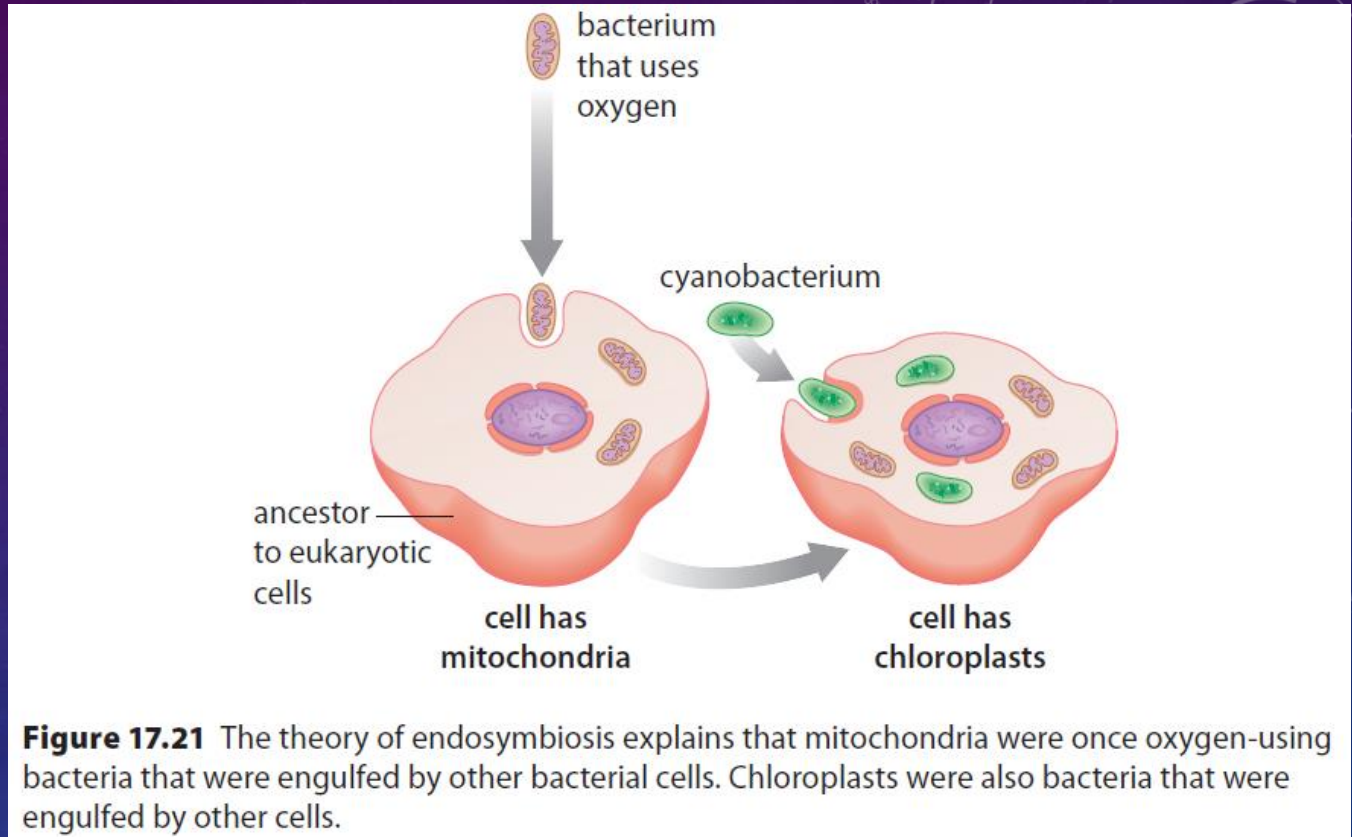
- First – development of nucleus



- Second - Endosymbiosis



- 1.2 Billion years ago a bacterium that uses oxygen begins living inside a common eukaryotic ancestor of animals, plants and fungi to form mitochondria
- 1 billion years ago a bacterium such as cyanobacteria begins living inside of a common eukaryotic ancestor of plants and protists to form chloroplasts.



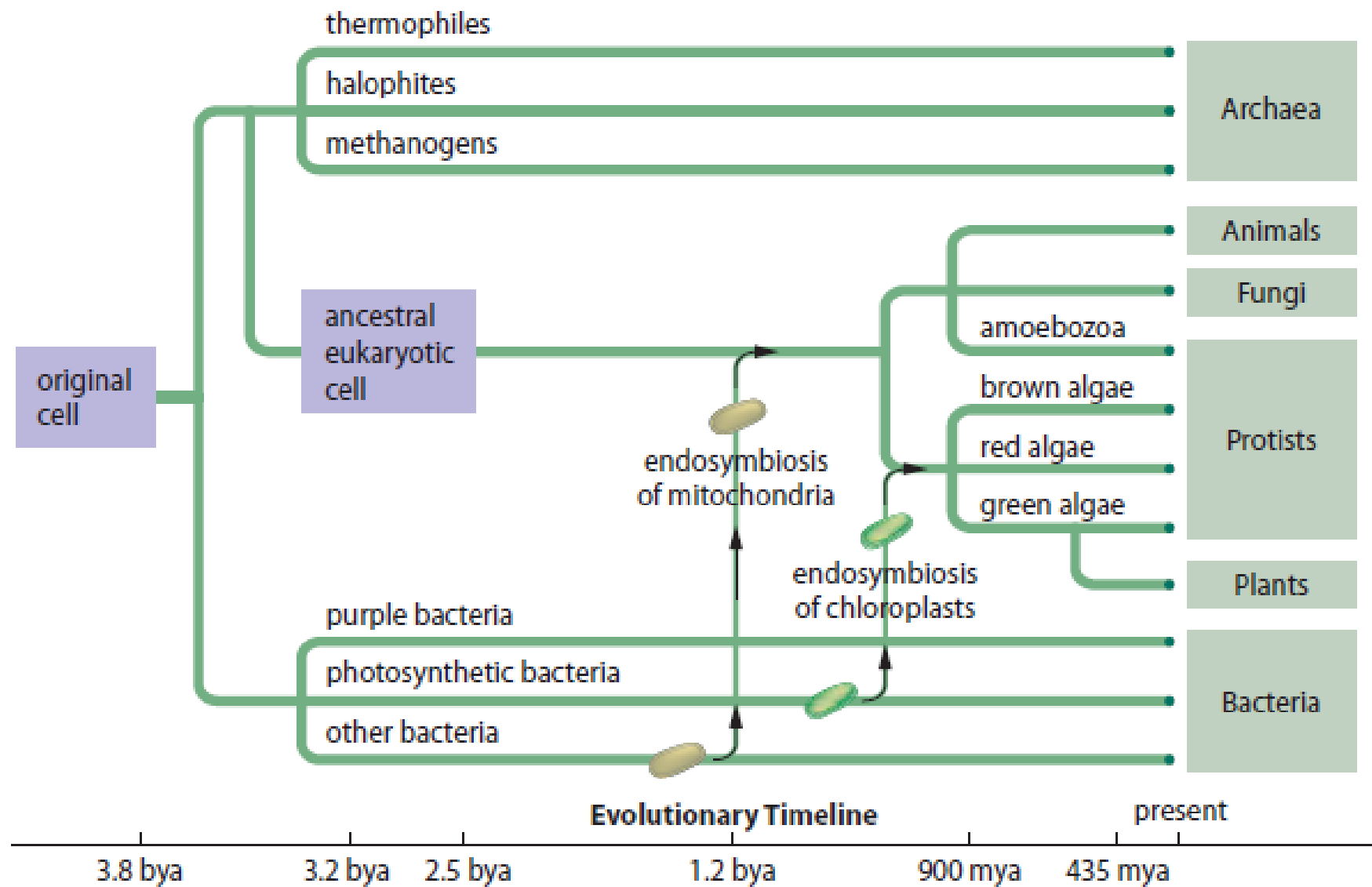
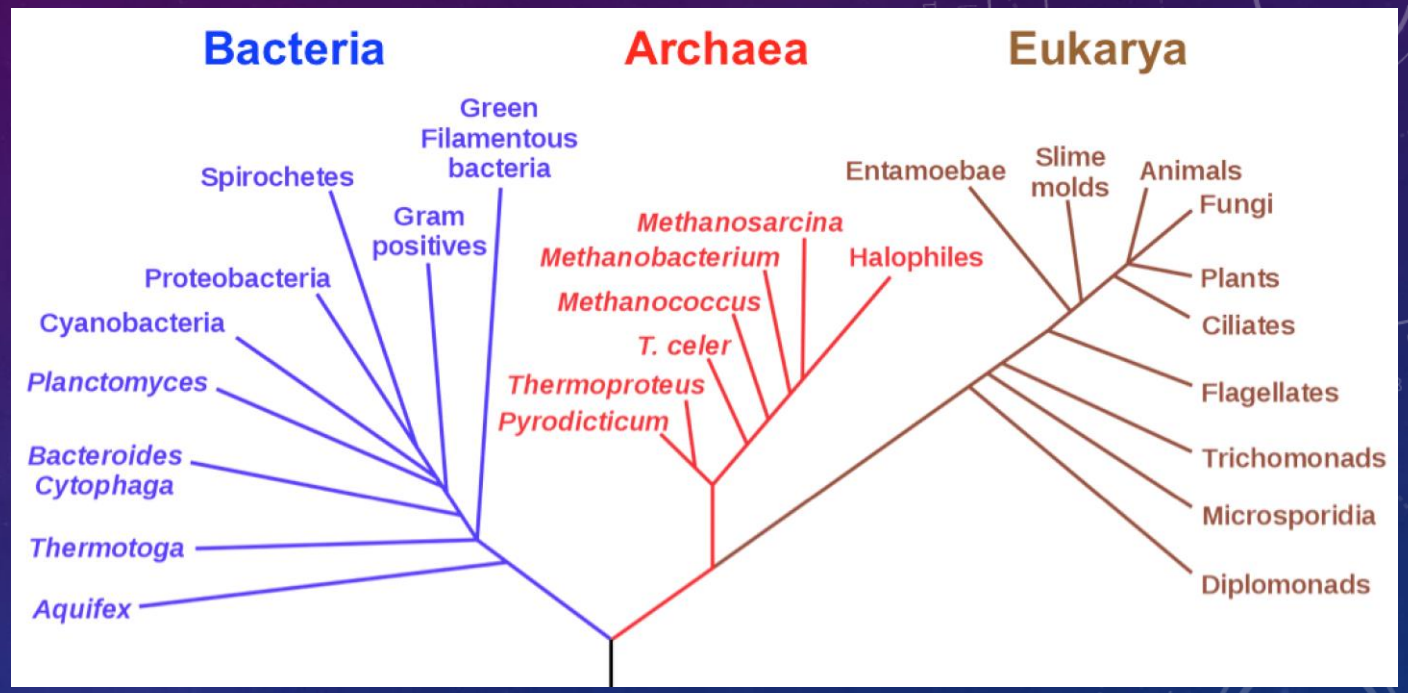


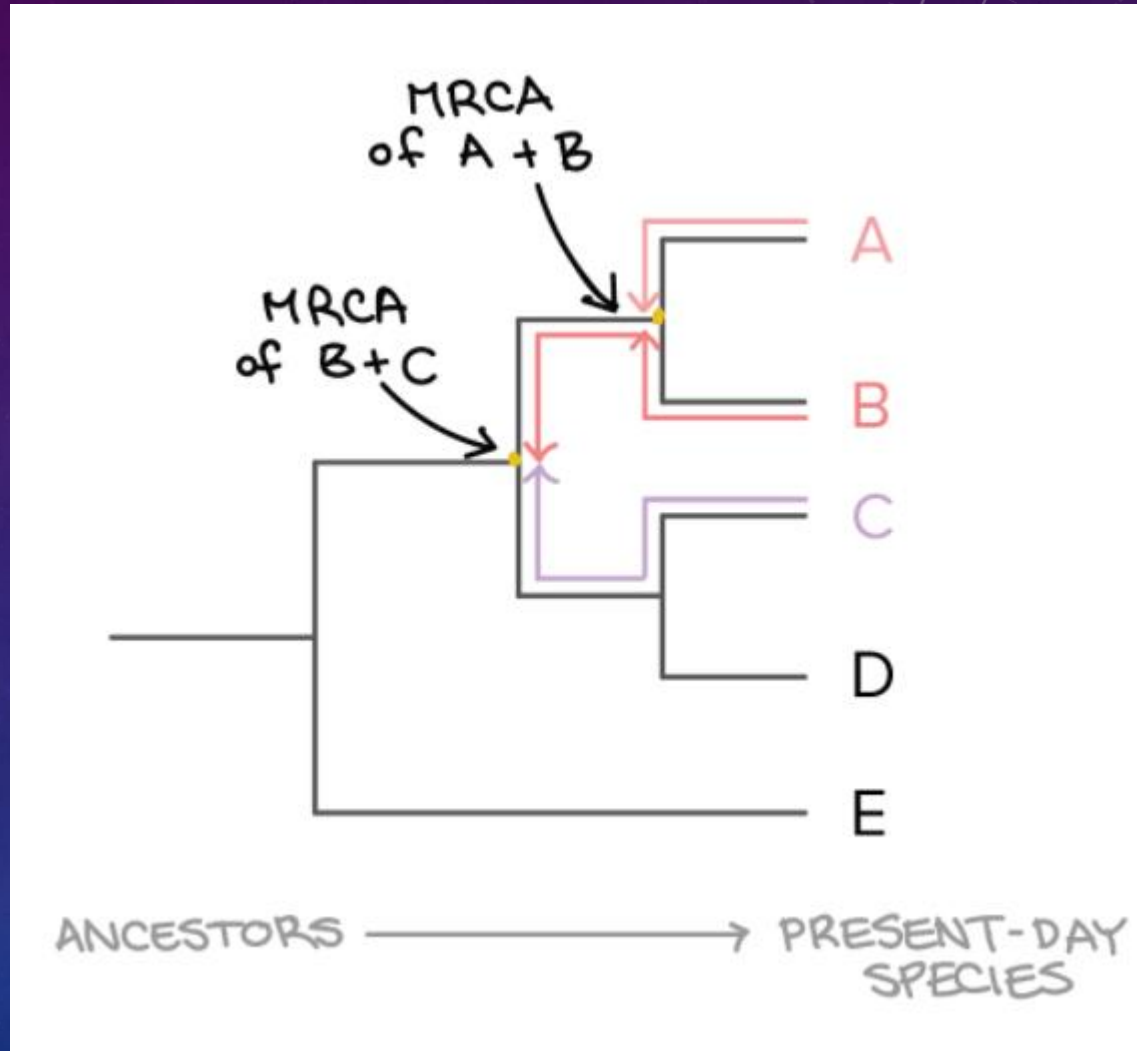
Figure 17.20 Simple single-celled life has existed on Earth since at least 3.5 billion years ago. Eukaryote evolution occurred much later. Eukaryotes share a more recent common ancestor with Archaea than with Bacteria.

- phylogeny evolutionary history of a kind of organism.
- Organisms are classified by:
- Relatedness
- Homologous structures
- Fossil records
- Genetic and molecular analysis

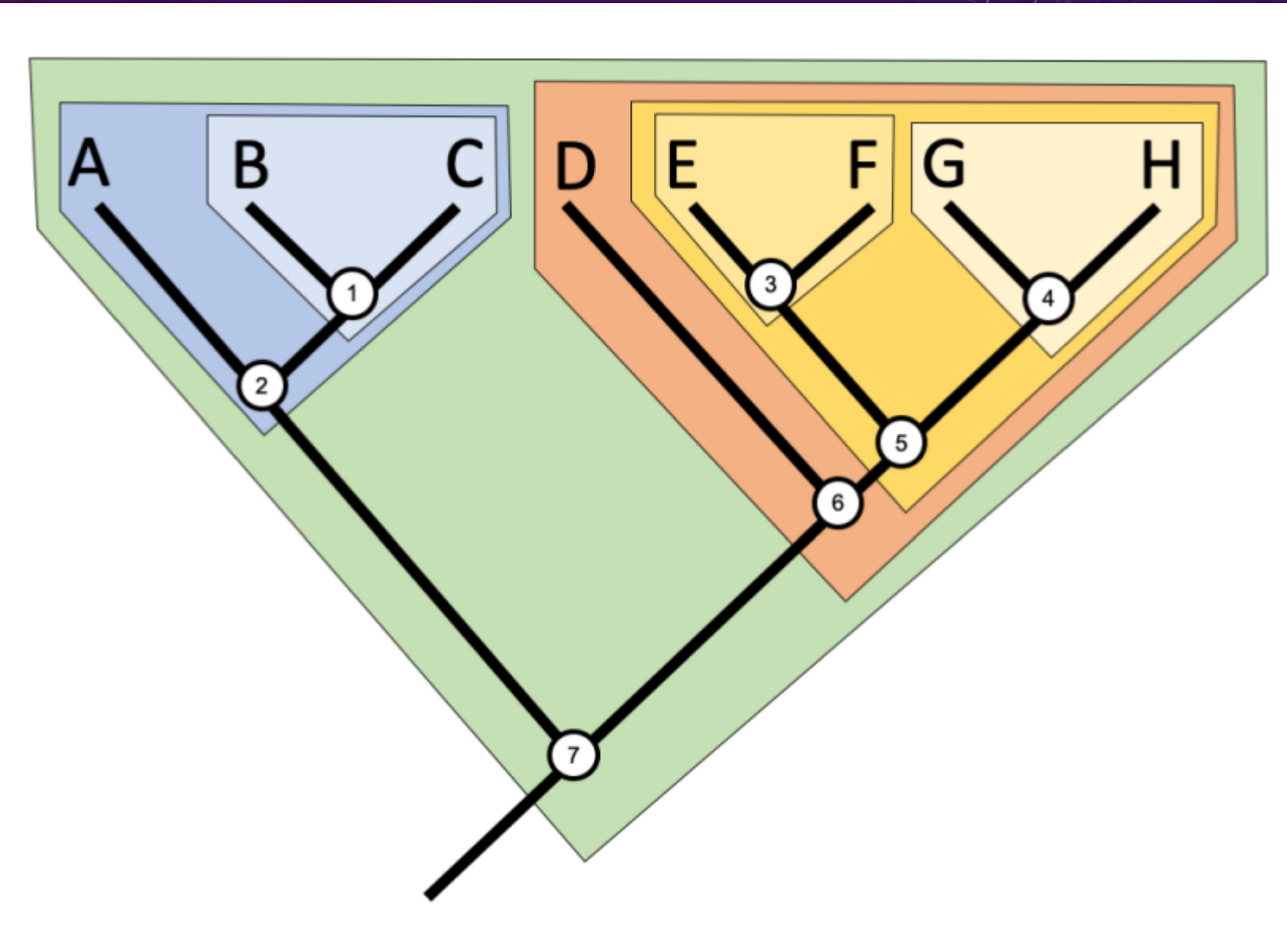


RELATEDNESS

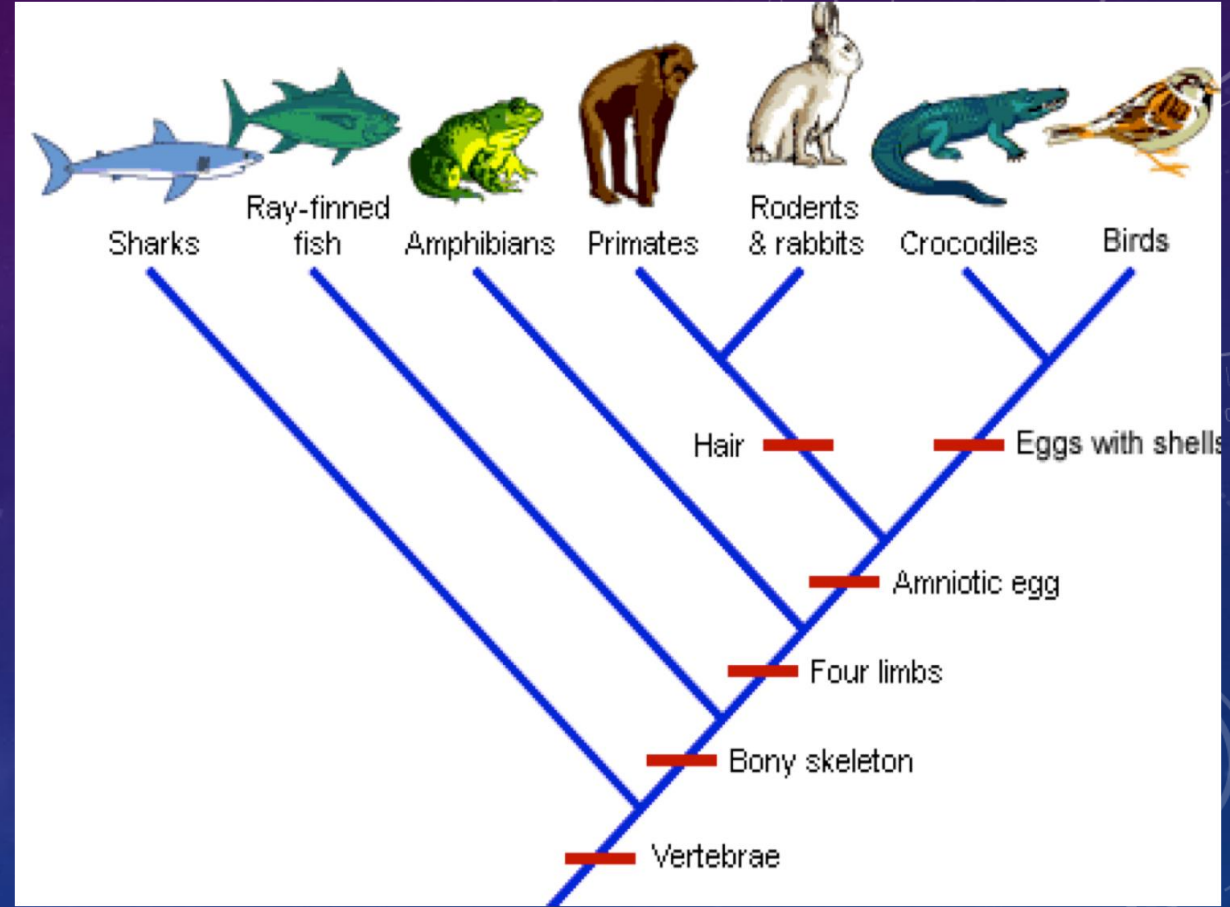
- In an evolutionary tree, the relatedness of two species has a very specific meaning. Two species are more related if they have a more recent common ancestor, and less related if they have a less recent common ancestor.
- A&B are more related than B&C.



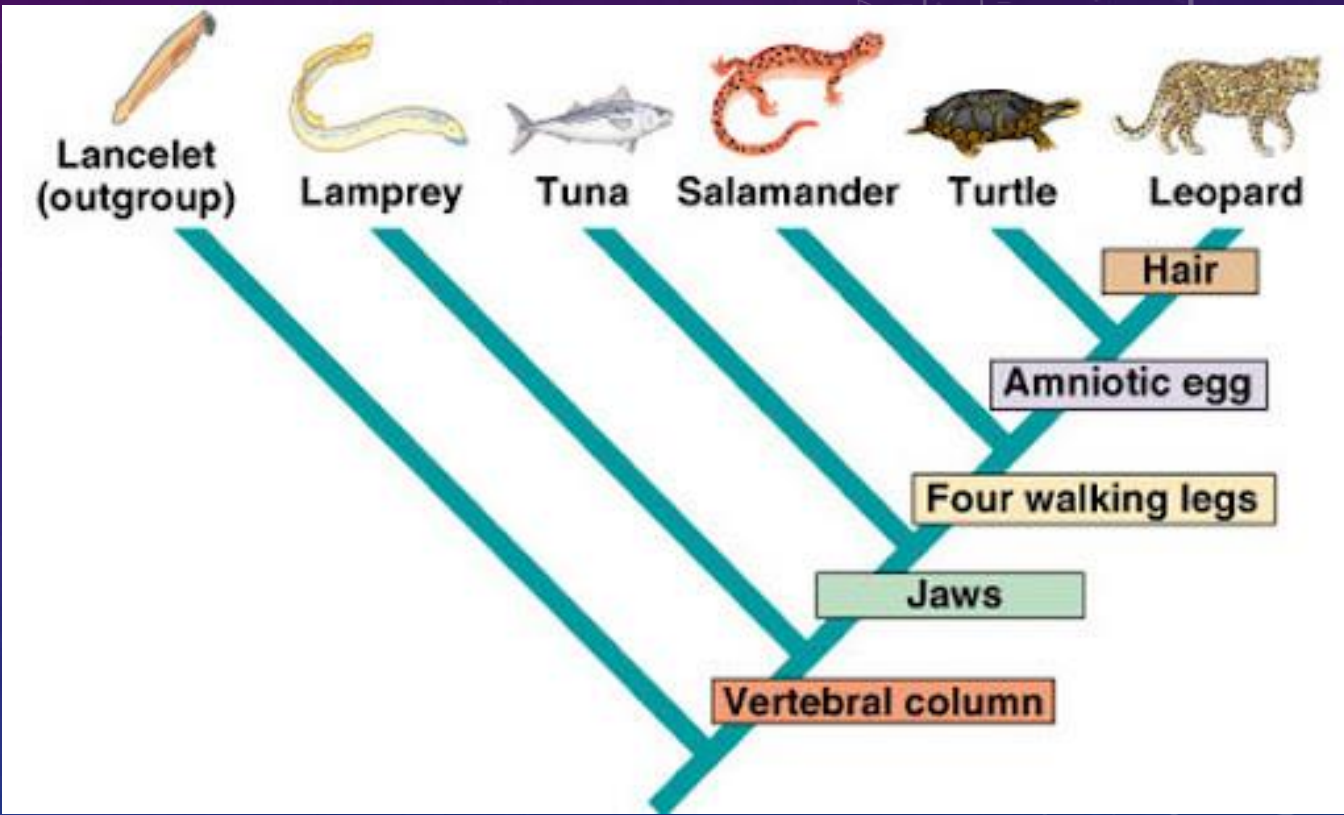
- **clade** group of species that includes one common ancestor and all its descendants



- **Shared derived characteristic** a shared character is one that two lineages have in common, and a derived character is one that evolved in the lineage leading up to a clade and that sets members of that clade apart from other individuals. Shared derived characters can be used to group organisms into clades.

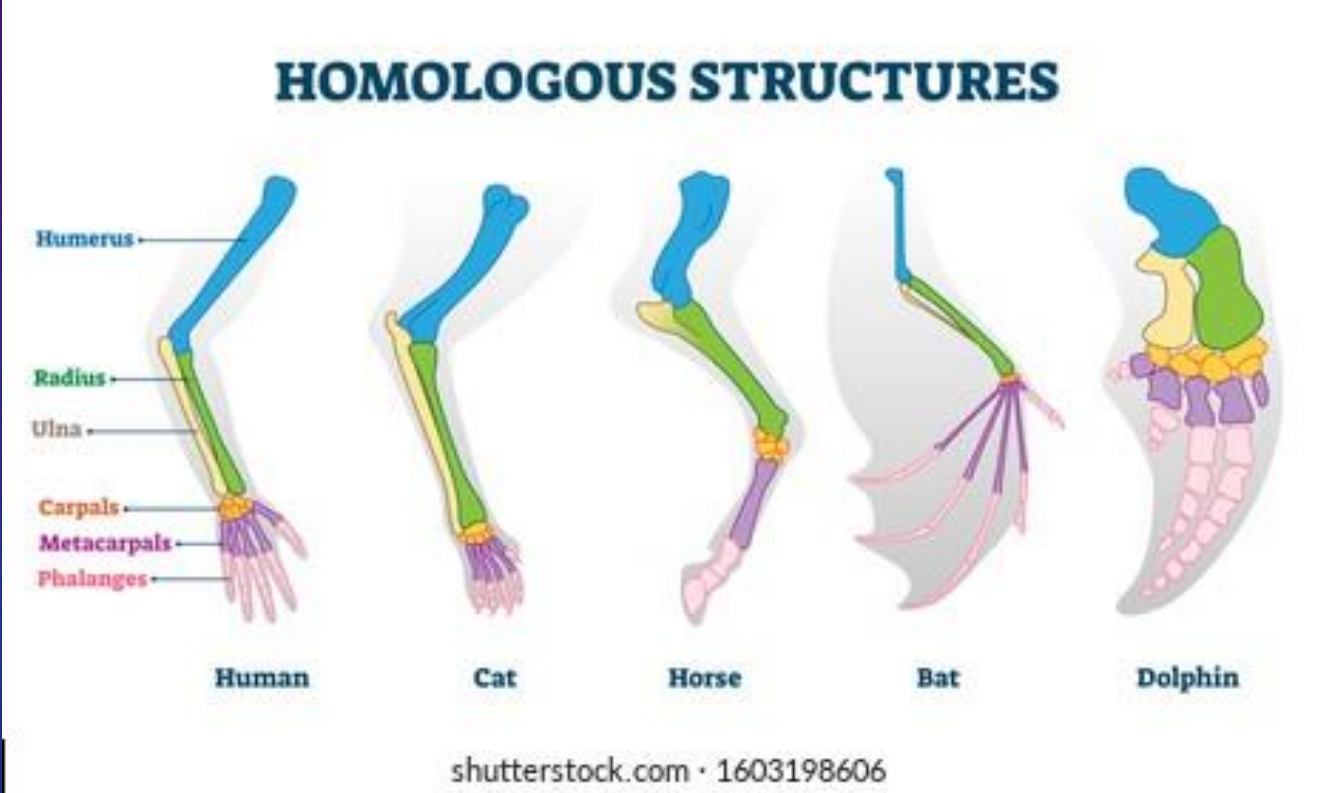


- Two groups that share a recently evolved trait are thought to be more closely related to each other than to groups that do not share the trait.
- Turtles and Leopards both share the amniotic egg as an evolved trait so they are more closely related than the leopard and the salamander.



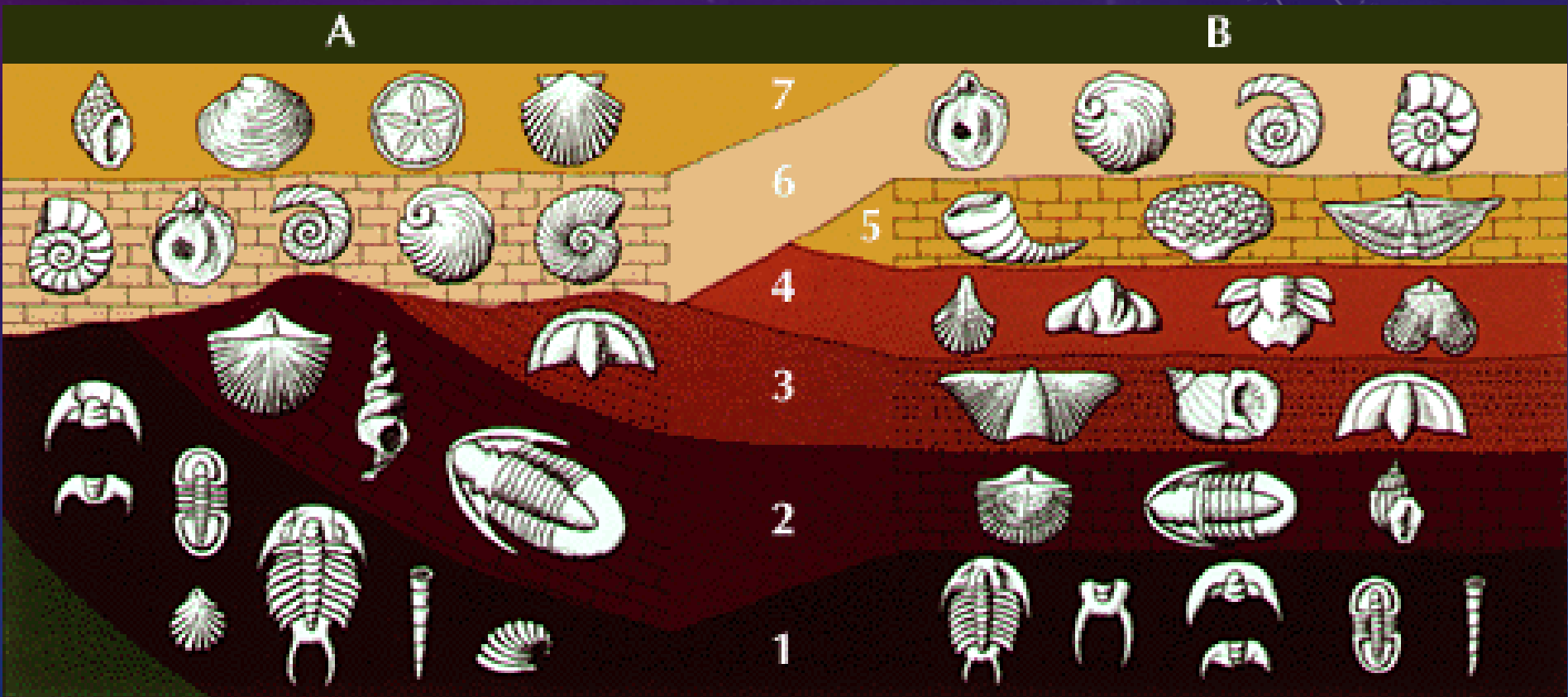
HOMOLOGOUS STRUCTURES

- Remember
- **homologous structures** physical features with the same evolutionary origin and underlying structural elements, but that may have different functions



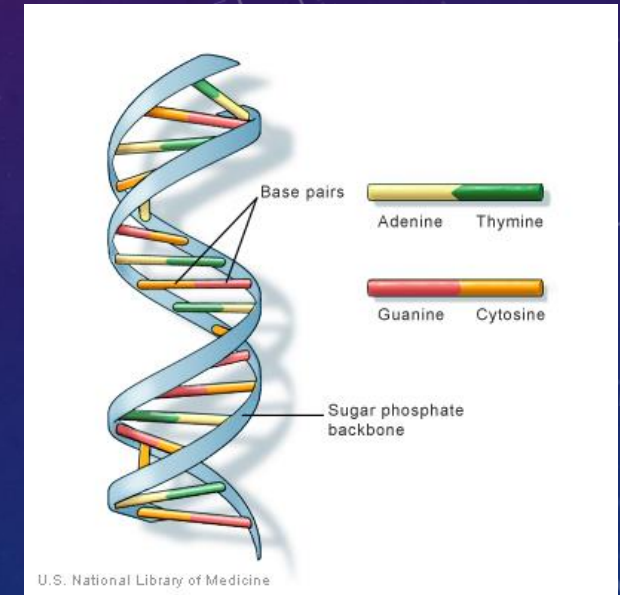
FOSSIL RECORD

- **fossil record** remains or traces of past life preserved in sedimentary rock, which reveal the history of life on Earth



GENETIC AND MOLECULAR ANALYSIS

- **Molecular phylogenetics** is the branch of phylogeny that analyzes genetic, hereditary molecular differences, predominately in DNA sequences, to gain information on an organism's evolutionary relationships.
- From these analyses, it is possible to determine the processes by which diversity among species has been achieved.
- The result of a molecular phylogenetic analysis is expressed in an evolutionary tree
- Molecular phylogenetics is one aspect of molecular systematics, a broader term that also includes the use of molecular data in taxonomy and biogeography.



Genetic characters

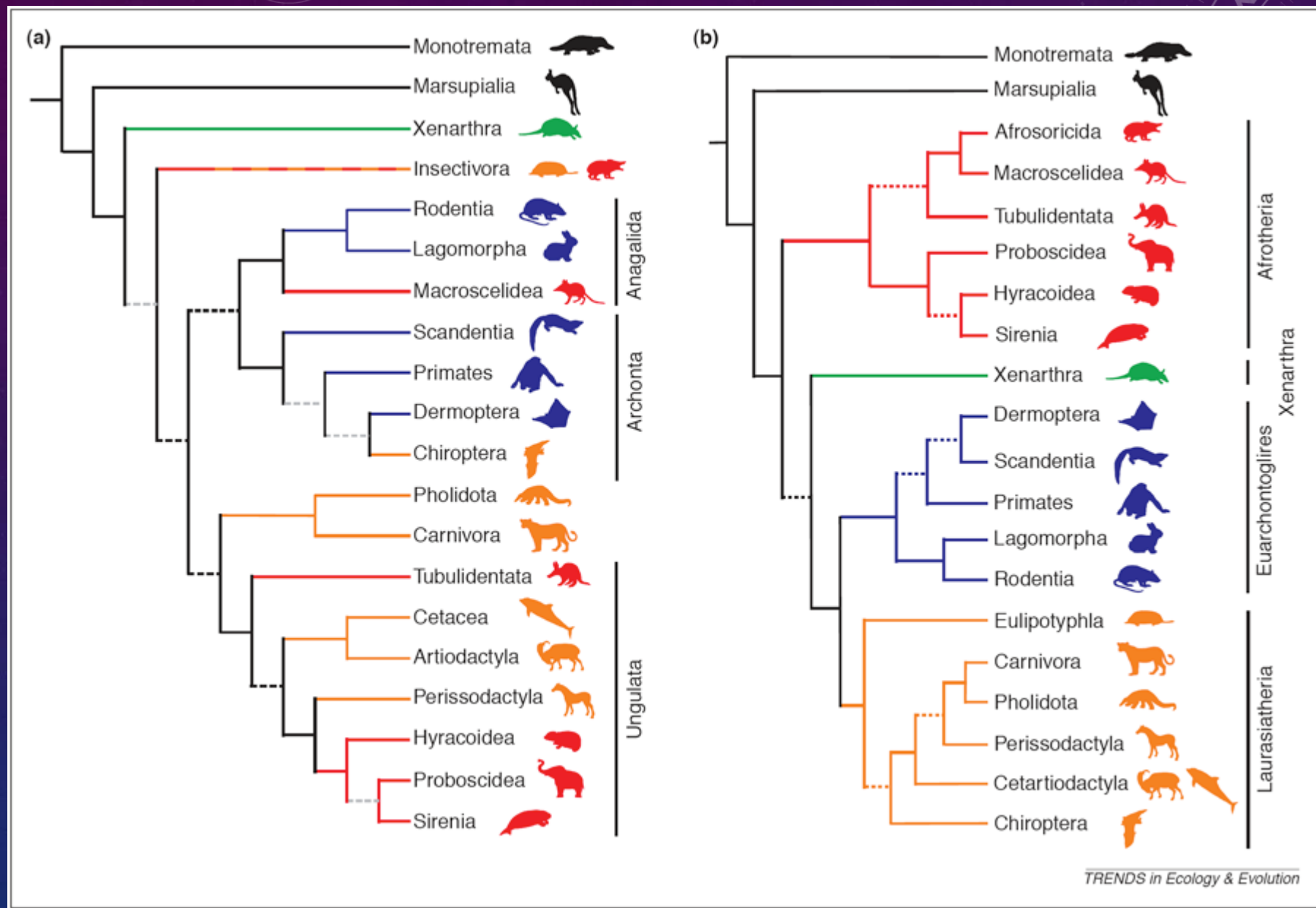
Sequence of portion of chloroplast DNA

Japanese black pine (<i>Pinus thunbergii</i>)	T	A	A	T	A	A	A	G	G	A	G	G	-	-	-	-	-	-	G	A	C	T	T	A	T	G	T	C	A	C
Bhutan white pine (<i>Pinus bhutanica</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	-	-	-	-	-	-	C	T	T	A	T	G	T	C	G	C
Chiapas pine (<i>Pinus chiapensis</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	C	T	T	A	G	A	C	T	T	A	T	G	T	C	A	C
Eastern white pine (<i>Pinus strobus</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	C	T	T	A	G	A	C	T	T	A	T	G	T	C	A	C
Lacebark pine (<i>Pinus bungeana</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	C	-	T	G	A	-	C	T	T	A	T	G	T	C	A	C
Red pine (<i>Pinus resinosa</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	-	-	-	-	-	-	C	T	T	A	T	G	T	C	A	C
Single leaf pinyon (<i>Pinus monophylla</i>)	T	A	A	T	A	A	A	G	G	A	G	G	G	A	-	-	-	-	-	-	C	T	T	A	T	G	T	C	A	C

Morphological characters

	number of vascular bundles per needle	sheath around needle bundle (1=straight, 2=curling back)	number of needles per bundle	seed wing (0=absent, 1=detachable, 2=permanent)
Japanese black pine (<i>Pinus thunbergii</i>)	2	1	2	2
Bhutan white pine (<i>Pinus bhutanica</i>)	1	2	5	1
Chiapas pine (<i>Pinus chiapensis</i>)	1	2	5	1
Eastern white pine (<i>Pinus strobus</i>)	1	2	5	1
Lacebark pine (<i>Pinus bungeana</i>)	1	2	3	2
Red pine (<i>Pinus resinosa</i>)	2	1	2	2
Single leaf pinyon (<i>Pinus monophylla</i>)	1	2	1	0

biodiversity





- Research Project - Activity 17.4

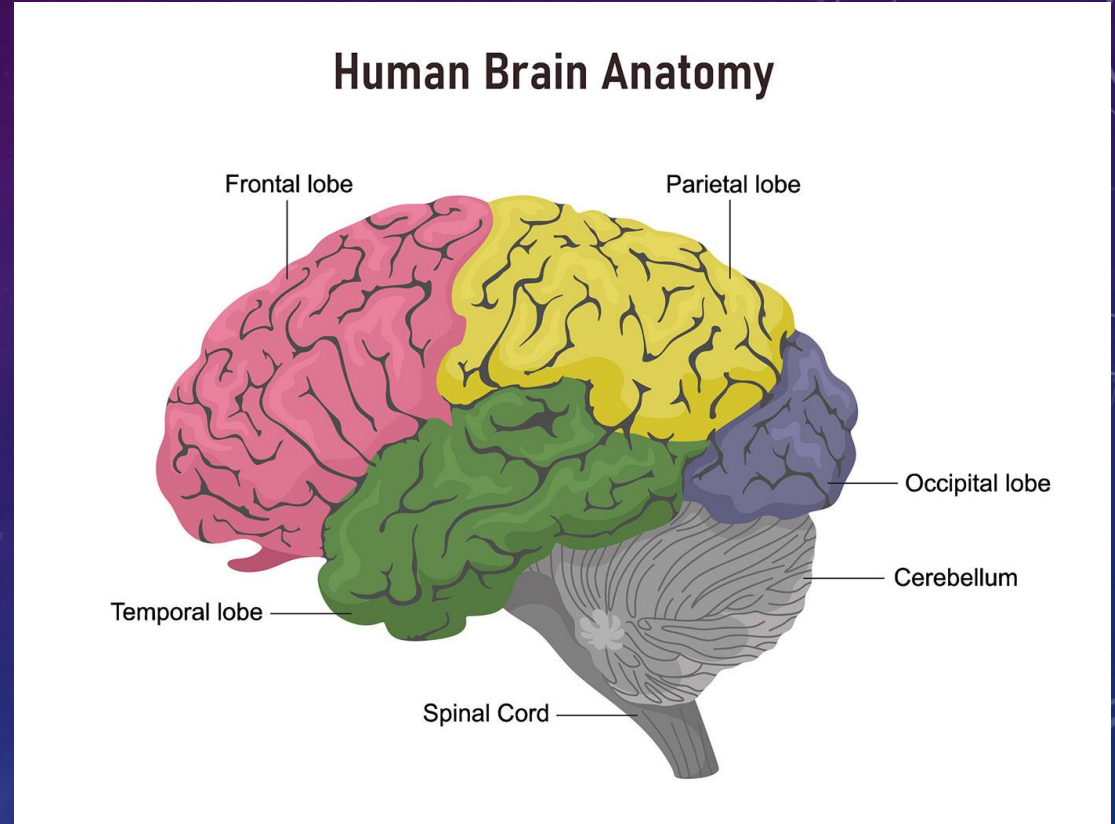


NON-CHORDATES

- Porifera
- Cnidaria
- Platyhelminthes
- Rotifera
- Annelida
- Mollusca
- Arthropoda
- Nematoda
- Echinodermata

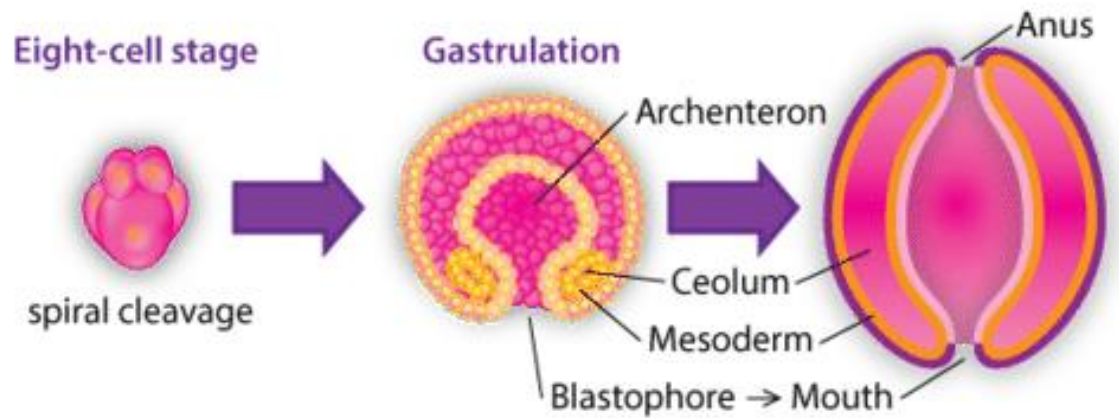


- **Cephalization** the concentration of sense organs, nervous control, etc., at the anterior end of the body, forming a head and brain, both during evolution and in the course of an embryo's development.

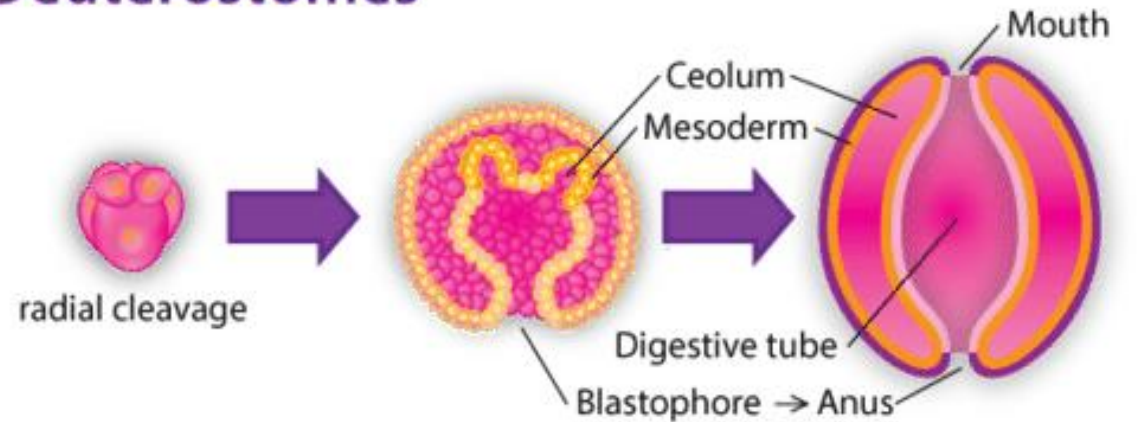


- **Protostome** a multicellular organism whose mouth develops from a primary embryonic opening, such as an annelid, mollusk, or arthropod.
- **Deuterostome** are animals typically characterized by their anus forming before their mouth during embryonic development.

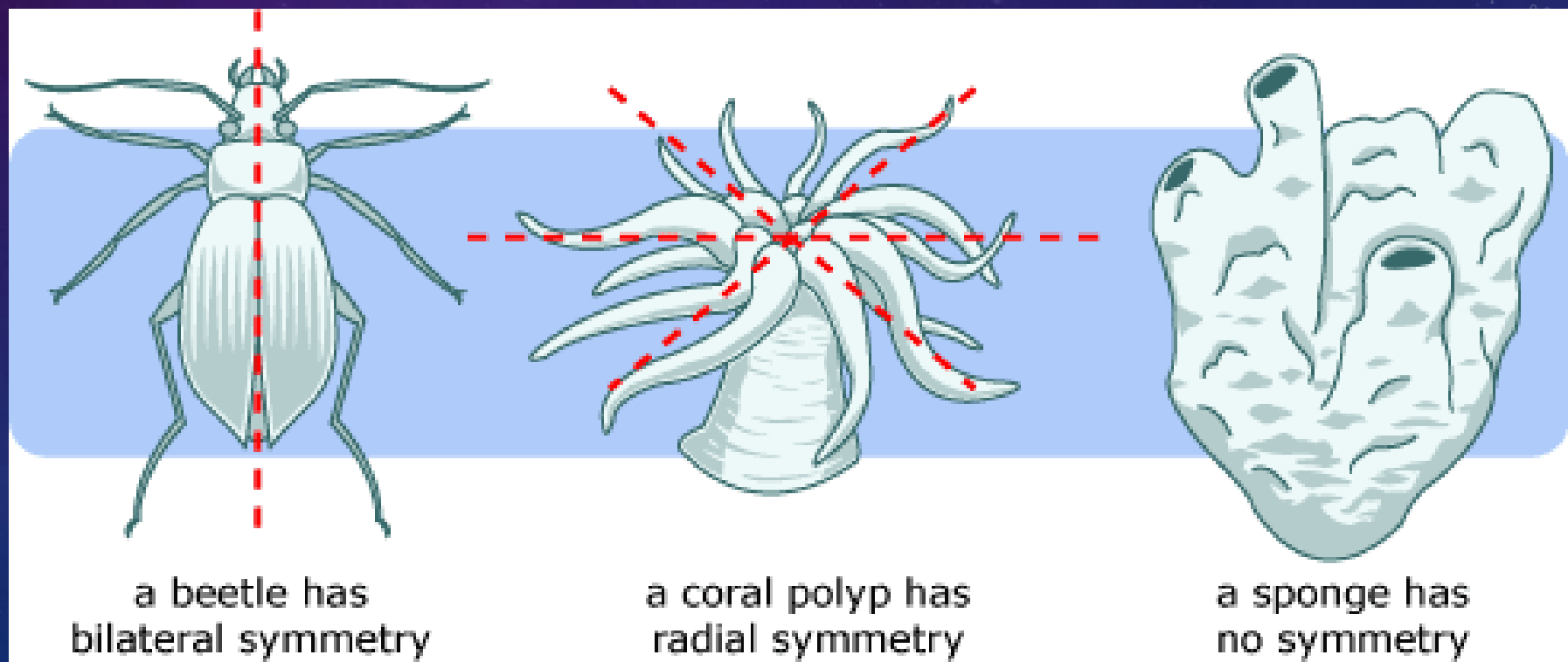
Protostomes



Deuterostomes



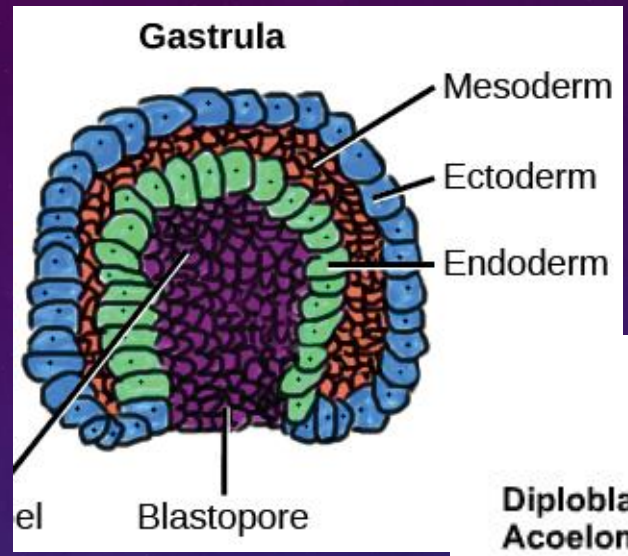
- **Symmetry** in biology is the balanced arrangement of body parts or shapes around a central point or axis.
- Asymmetry – no symmetry
- Radial – round or circular
- Bilateral – split in two



Embryonic Cell Layers

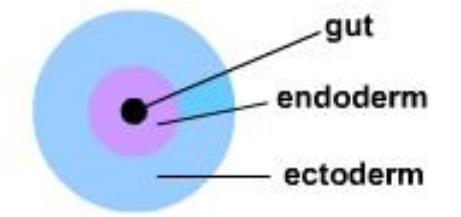
- Ectoderm
- Mesoderm
- Endoderm

- Monoblastic – one layer
- Diploblastic – two layers
- Triploblastic – three layers

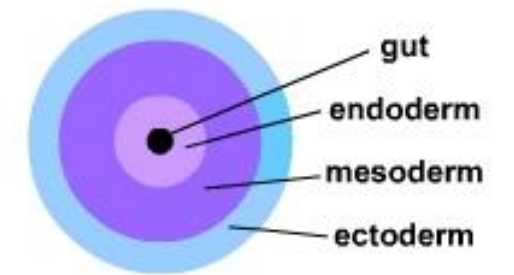


Classification Body plans

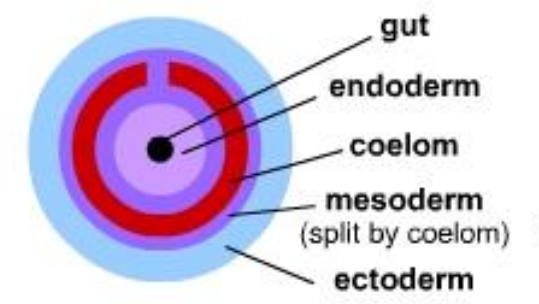
Diploblastic Acoelomate
e.g. cnidarian



Triploblastic Acoelomate
e.g. platyhelminth

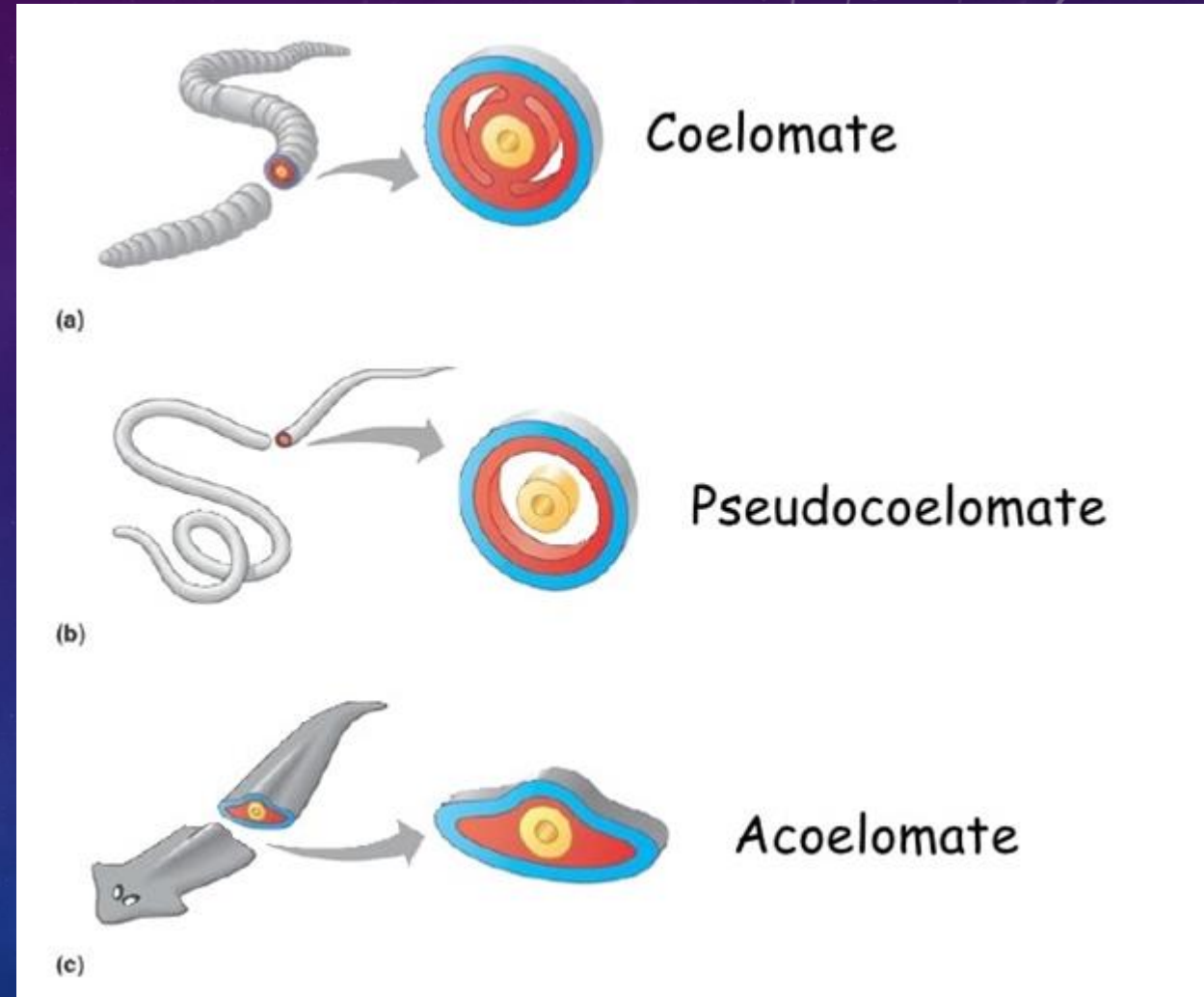


Triploblastic coelomate
e.g. echinoderm
mollusc
chordate



Increasing levels of complexity

- **Coelom** the body cavity in metazoans, located between the intestinal canal and the body wall.
- **Eucoelomate** having a body cavity that is a coelom
- **Pseudocoelomate** an invertebrate (such as a nematode or rotifer) having a body cavity that is a pseudocoel.
- **Acoelomate** an invertebrate lacking a coelom



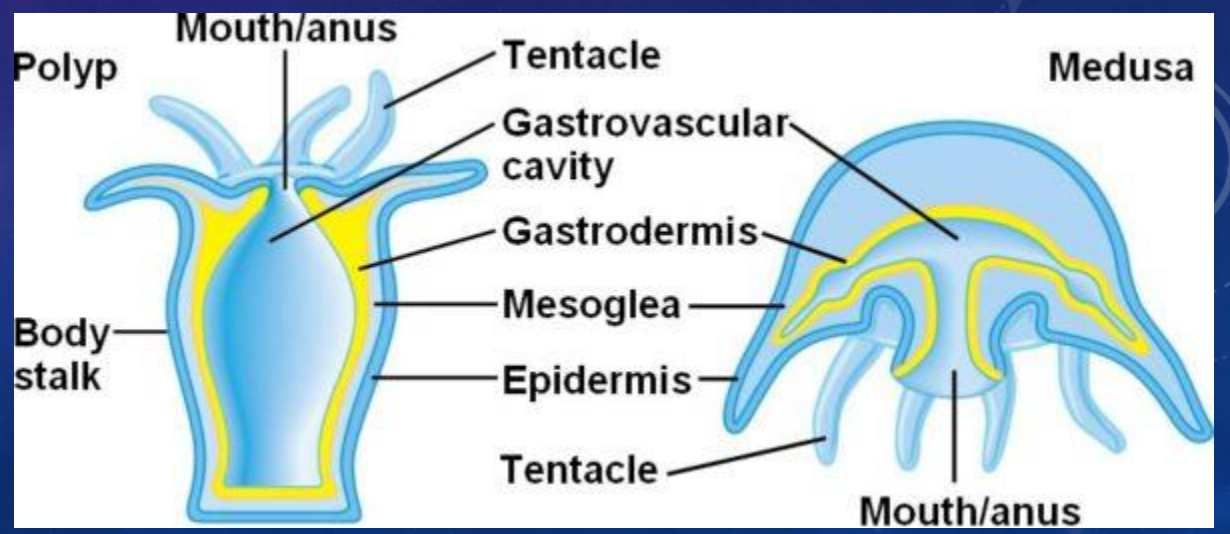
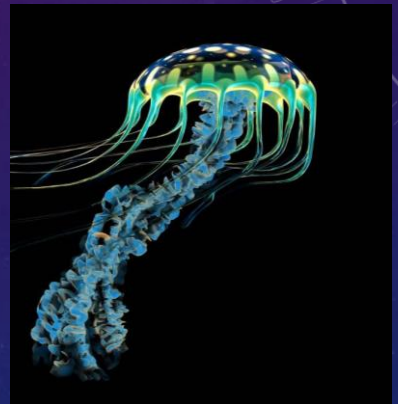
PORIFERA (SPONGES)

- Specialized Tissues: No Nerves
- Body plan symmetry: Asymmetry (no body plan) or sometimes radial (round)
- Embryonic cell layers: None
- Coelom: Acoelomate
- Embryonic Development Pattern: Absent
- Digestive System: None
- Cephalization: not present
- Motility: Larvae can swim but adults are non-motile
- Segmentation: Absent
- Molting: Absent



CNIDARIA (JELLYFISH)

- Specialized Tissues: Nerve Net
- Body plan symmetry: Radial (round)
- Embryonic cell layers: Diploblastic (two layers), ectoderm and endoderm
- Coelom: Acoelomate
- Embryonic Development Pattern: Absent
- Digestive System: Two-way one opening
- Cephalization: not present
- Motility: motile
- Segmentation: Absent
- Molting: Absent



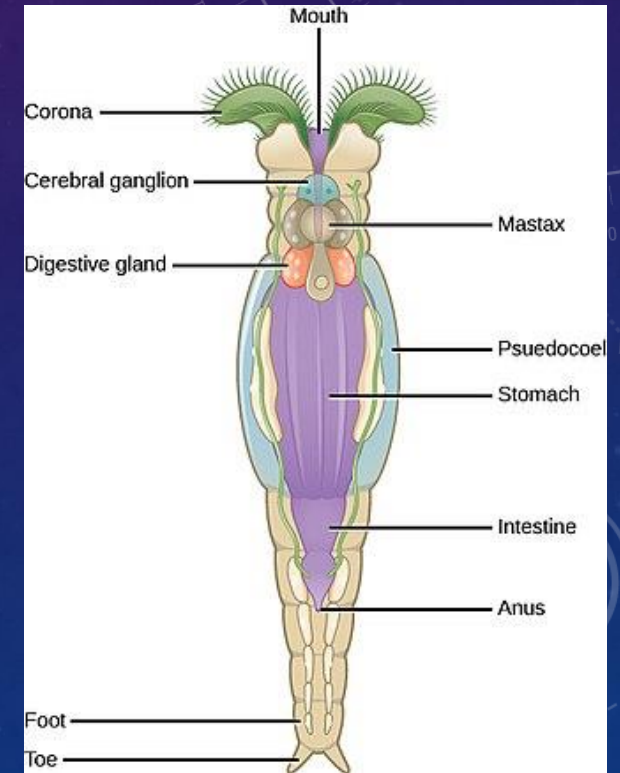
PLATYHELMINTHES (FLATWORMS)

- Specialized Tissues: Present (Brain and Nerve Cords)
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Acoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: motile
- Segmentation: Absent
- Molting: Absent



ROTIFERA (ROTIFERS)

- Specialized Tissues: Present (Brain and Nerve Cords)
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Pseudocoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: Motile
- Segmentation: externally but not internally segmented
- Molting: Absent



ANNELIDA (SEGMENTED WORMS)

- Specialized Tissues: Present (Brain and Nerve Cords)
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Eucoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: Motile
- Segmentation: Segmented internally and externally
- Molting: Absent



MOLLUSCA

- Specialized Tissues: Present
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Eucoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: Motile/Sessile (attached to rocks)
- Segmentation: Segmented internally and externally
- Molting: Absent



ARTHROPODA

- Specialized Tissues: Present
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Eucoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: Motile
- Segmentation: Segmented internally and externally
- Molting: Present



NEMATODA (ROUNDWORMS)

- Specialized Tissues: Present
- Body plan symmetry: Bilateral
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Pseudocoelomate
- Embryonic Development Pattern: Protostome
- Digestive System: One-way two opening
- Cephalization: Present
- Motility: Motile
- Segmentation: Absent
- Molting: Present (four times)



ECHINODERMATA

- Specialized Tissues: Present
- Body plan symmetry: Radial (pentamerous - five)
- Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
- Coelom: Eucoelomate
- Embryonic Development Pattern: Deuterostomes
- Digestive System: One-way two opening
- Cephalization: Absent
- Motility: Motile
- Segmentation: Absent
- Molting: Absent

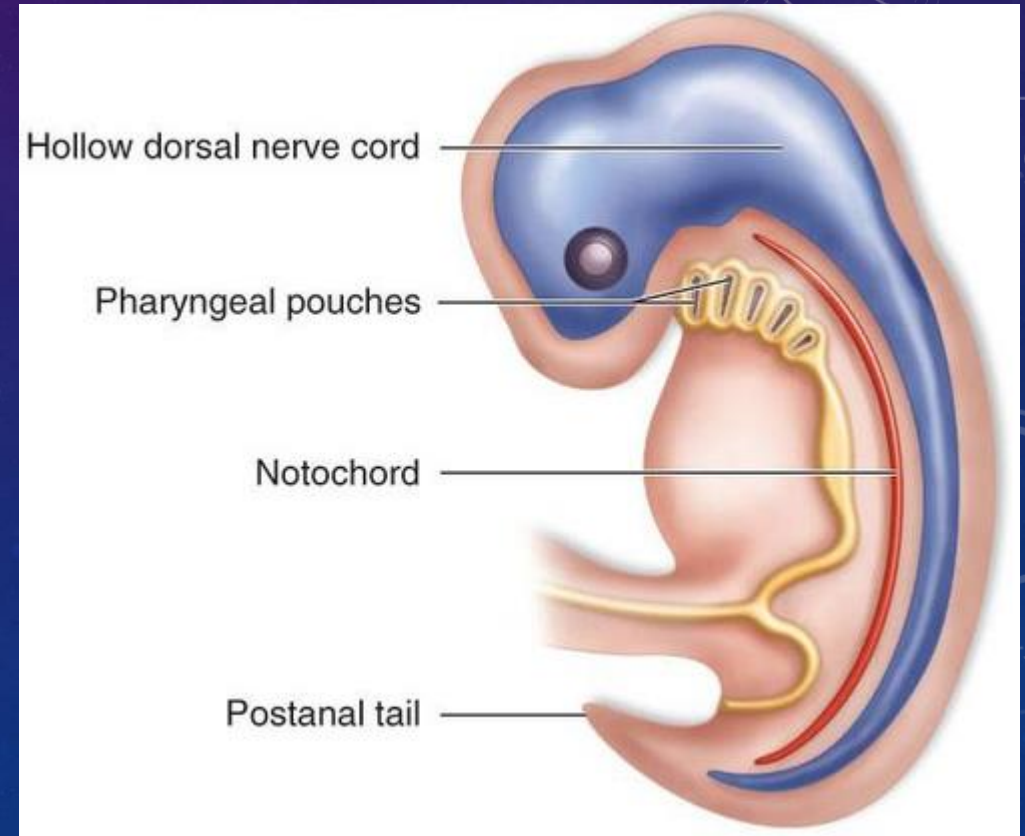


- Anatomy Lab 1



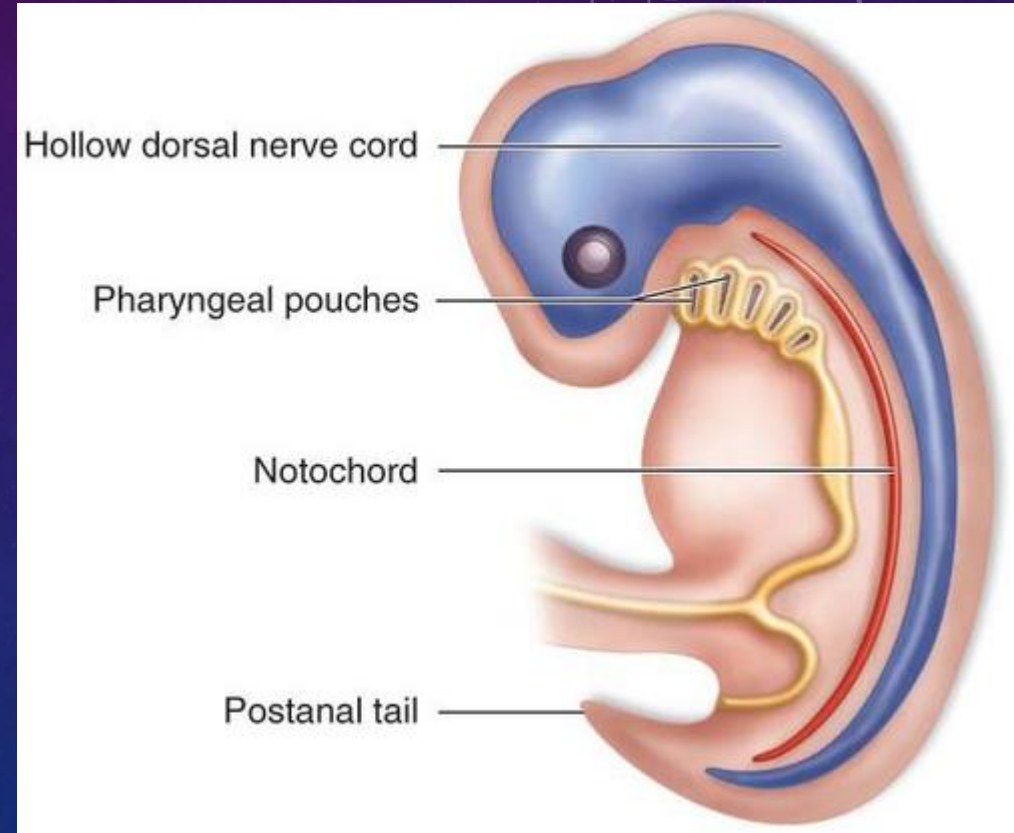
CHORDATA

- All chordates possess primary characteristics, at some point during their larval or adulthood stages that distinguish them from all other taxa. These characteristics include a
 - **Notochord**
 - **Dorsal hollow nerve cord**
 - **Pharyngeal slits (gills),**
 - **Post-anal tail.**



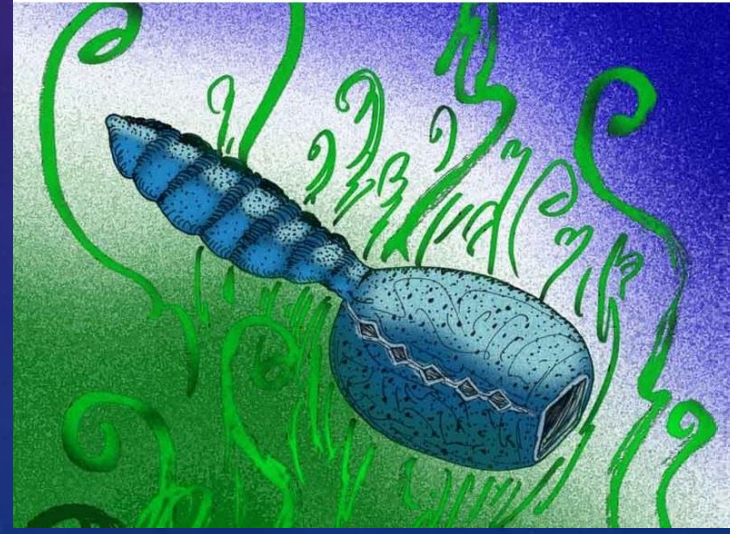
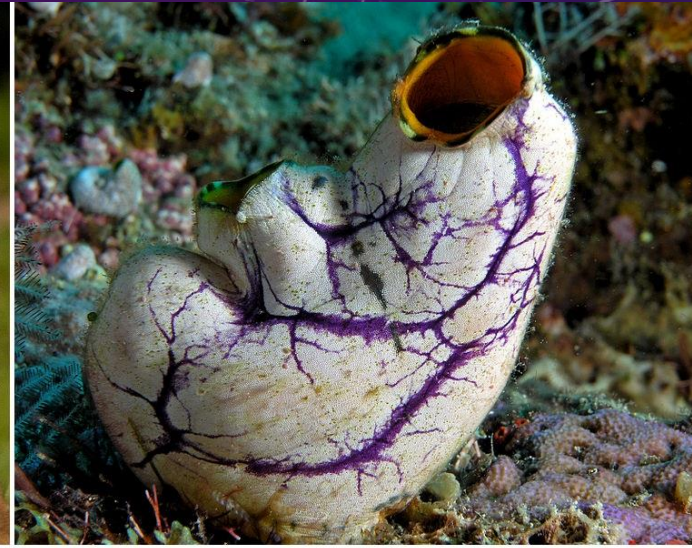
CHORDATA

- **Notochord** a cartilaginous skeletal rod supporting the body in all embryonic and some adult chordate animals.
- **dorsal hollow nerve cord** develops into the central nervous system: the brain and spine.
- **pharyngeal slits** are openings in the pharynx that develop into gill arches in bony fish and into the jaw and inner ear in terrestrial animals.
- **post-anal tail** is a skeletal extension of the posterior end of the body, being absent in humans and apes, although present during embryonic development.



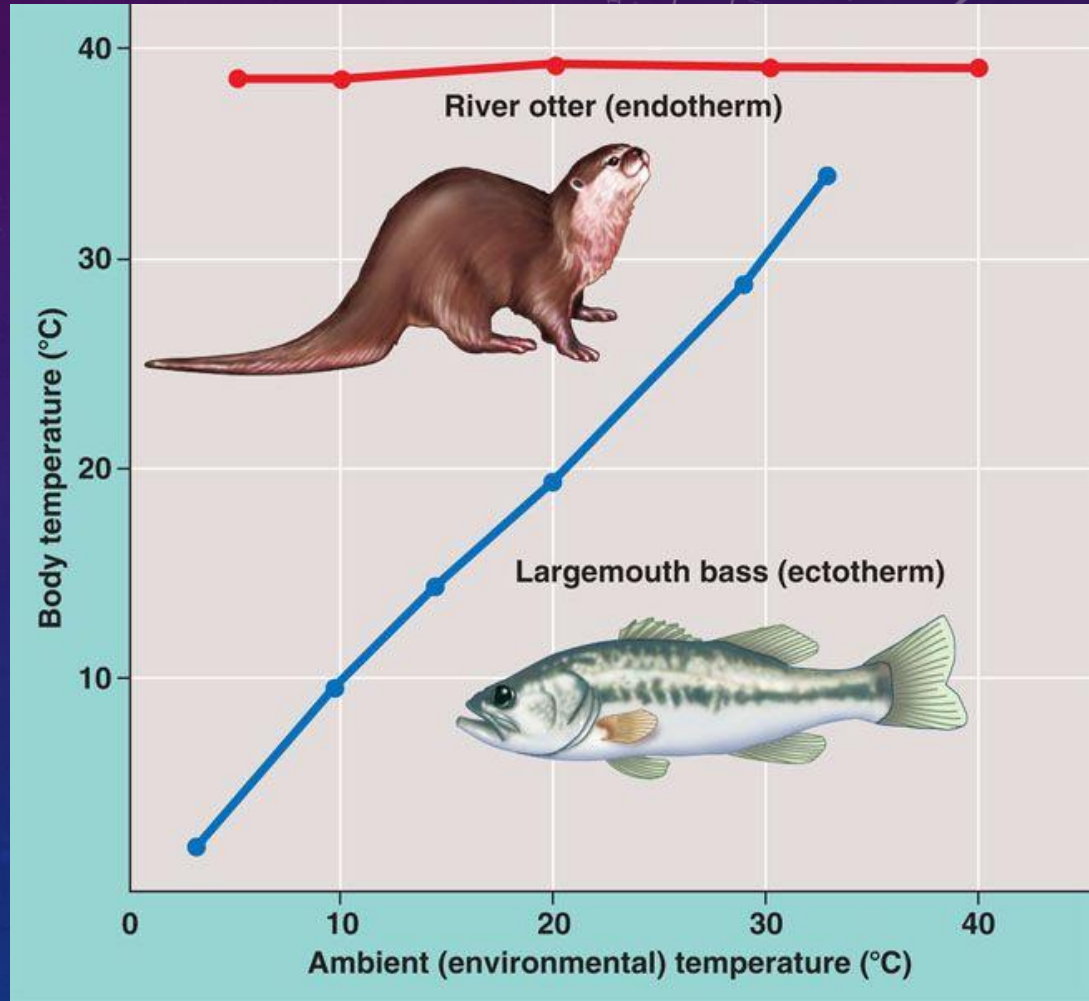
CHORDATA

- Cephalochordata
- Urochordata [tunicata]
- Agnatha
- Chondrichthyes
- Osteichthyes
- Amphibia
- Reptilia
- Aves
- Mammalia



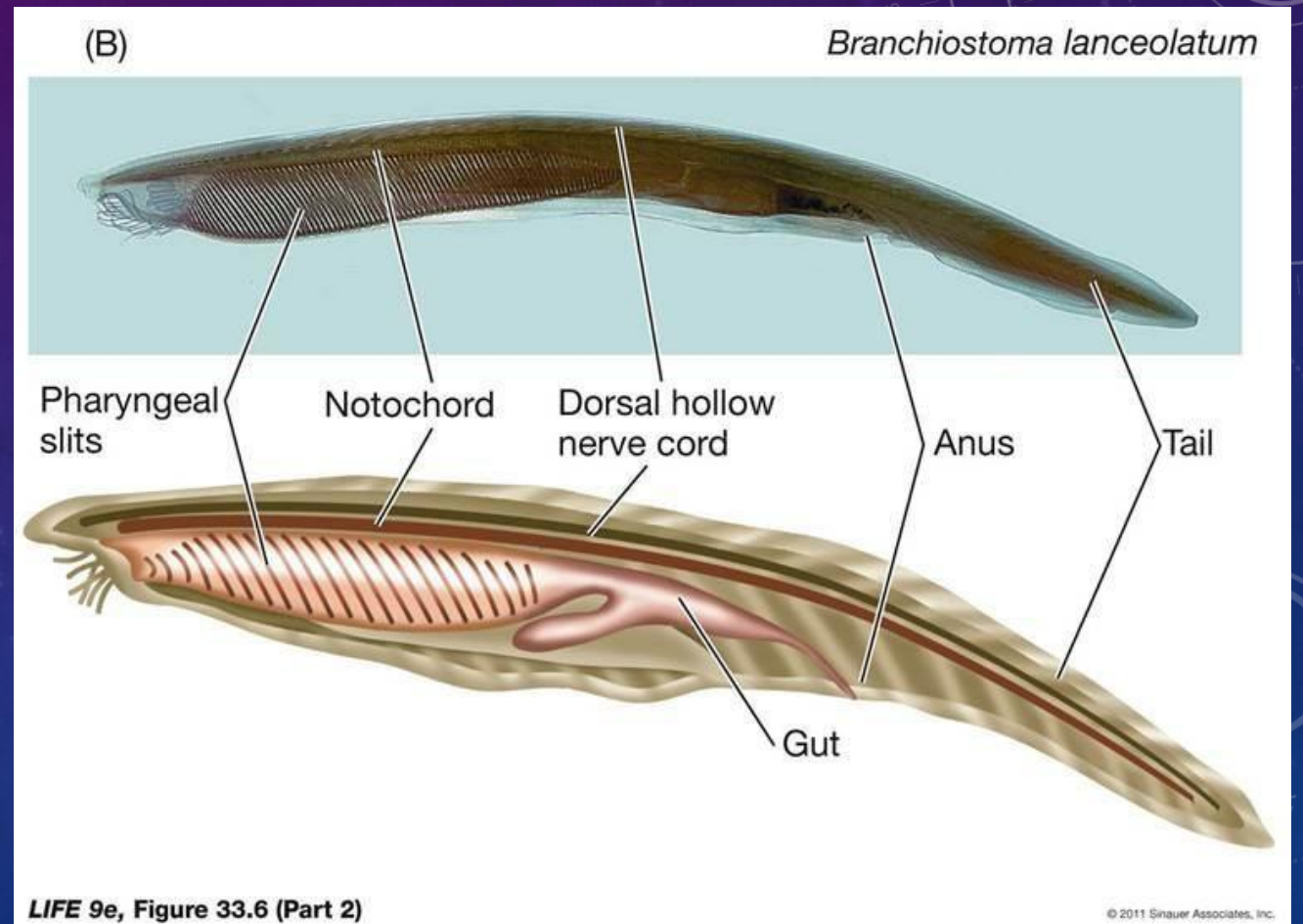
CHORDATA

- **Endotherm** an animal that is dependent on or capable of the internal generation of heat; a warm-blooded animal. **Aves (birds) and Mammalia**
- **Ectotherm** any cold-blooded animal whose regulation of body temperature depends on external sources, such as sunlight or a heated rock surface. The ectotherms include the **fishes, amphibians, reptiles, and invertebrates.**



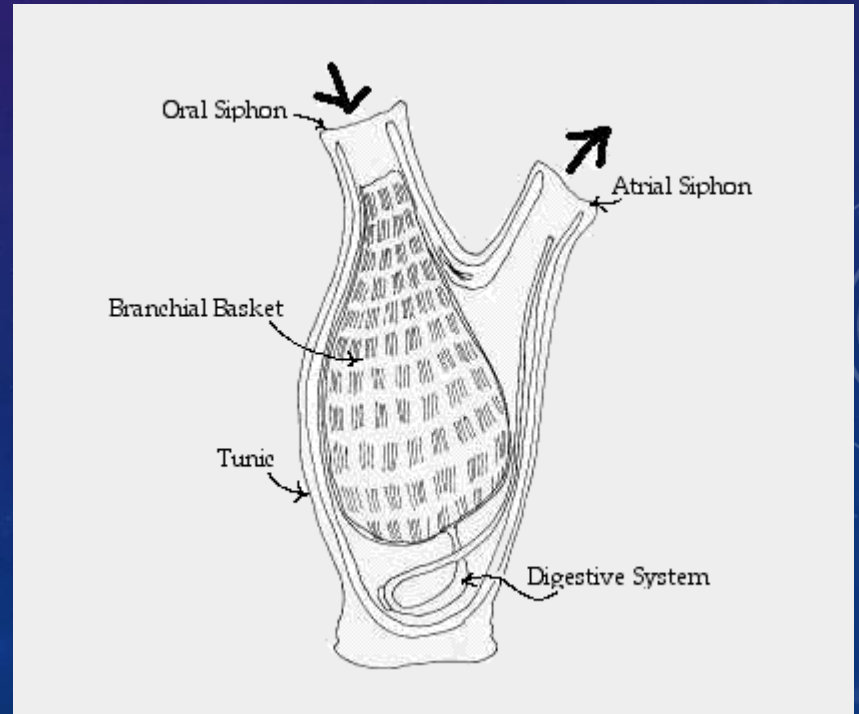
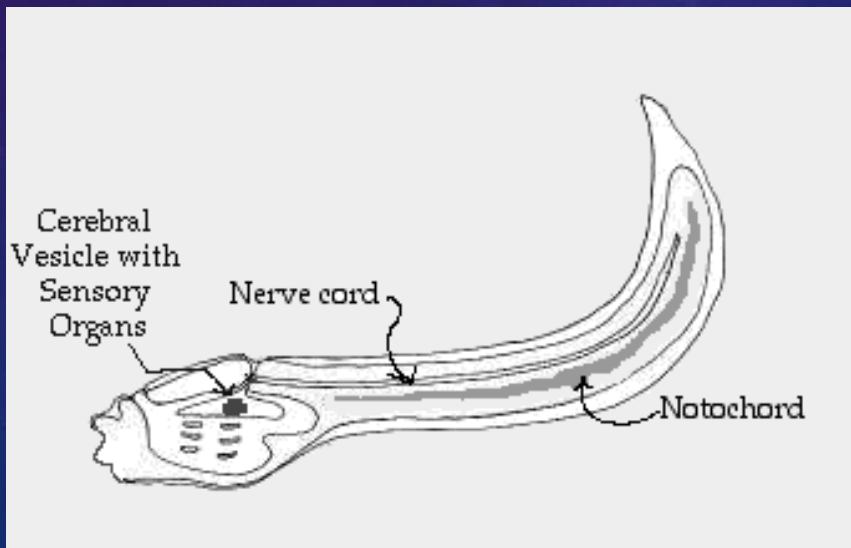
CEPHALOCHORDATA

- a small group of marine invertebrates comprising the lancelets.



UROCHORDATA [TUNICATA]

- They are basically a barrel-shaped sack with two openings or siphons that water passes through. They draw water into their body through one siphon, filter out food like plankton, and expel the remaining water out of the other siphon.
- **Sea Squirts**



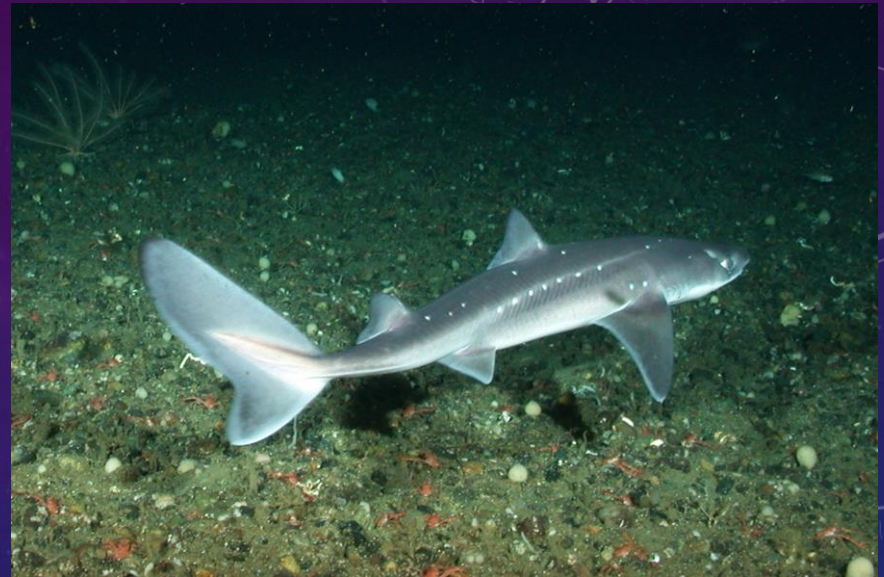
AGNATHA (JAWLESS FISH)

- a group of primitive jawless vertebrates which includes the lampreys, hagfishes, and many fossil fishlike forms.



CHONDRICHTHYES (CARTILAGINOUS FISH)

- any member of the diverse group of cartilaginous fishes that includes the sharks (**dogfish shark**), **skates**, rays, and chimaeras. Most have internal fertilization and development except skates which produce an egg case.



OSTEICHTHYES (BONY FISH)

- Bony fishes share several distinguishing features: a skeleton of bone, scales, paired fins, one pair of gill openings, jaws, and paired nostrils.
- Aquarium fish
- Trout



AMPHIBIA

a class of subphylum Vertebrata comprising forms (**tadpole/frog**, toads, newts, and salamanders)

they are intermediate in many respects between fishes and reptiles

are **cold-blooded**, a **3-chambered heart**, and that have gilled aquatic larvae and air-breathing lunged adults. They can also absorb oxygen directly through their skin.



REPTILIA

These are creeping and burrowing terrestrial animals with scales on their body. They are cold-blooded animals found in most of the warmer regions of the world. Their skin is **dry**, and rough, without any glands. The body is divided into head, neck, trunk, and tail. Few of these shed the scales on their skin as skin cast. The respiration takes place with the help of the lungs. They have two pairs of pentadactyl limbs, each bearing claws. Snakes are an exception. The heart is **3 chambered**. However, crocodiles have a **4-chambered heart**. The nervous system comprises of 12 pairs of cranial nerves. They possess a typical cloaca.



AVES

- Birds are warm-blooded vertebrates distinguished by having the body more or less completely covered with **feathers** and the **forelimbs modified as wings**. They have a four chambered heart, they have internal fertilization and external development.



MAMMALIA

- the highest class of the subphylum Vertebrata comprising humans and all other animals that nourish their young with **milk** secreted by **mammary glands**, that have the skin usually more or less covered with **hair**, a mandible articulating directly with the squamosal, a chain of small ear bones, a brain with four optic lobes, a muscular diaphragm separating the 4 chambered heart and lungs from the abdominal cavity, only a left arch of the aorta, **warm blood** containing red blood cells without nuclei except in the fetus, and embryos developing both an amnion and an allantois, and that **except in the monotremes reproduce viviparously**



- Anatomy Lab 2





- In-Class Assignment

