1.3 Phylogeny and Modern Taxonomy

(P. 21 - 25)

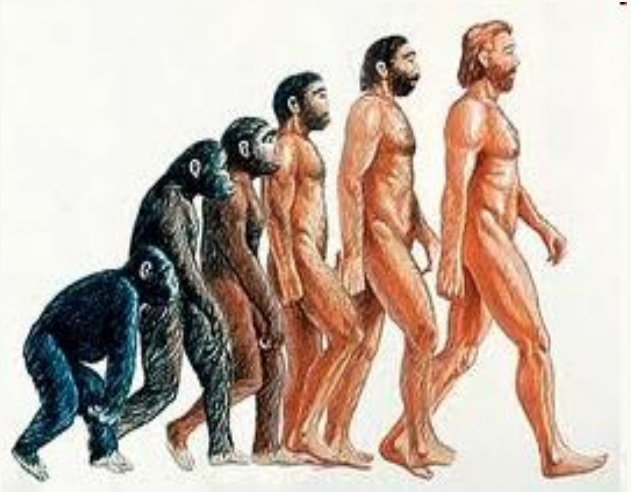
Recall: Taxonomy

Taxonomy: the classification, identification, and naming of organisms

- aims to group organisms according to a set of criteria (e.g. how closely related a species are - phylogeny)

The leopard shares many characteristics with the lion—which belongs to the same genus—but far fewer characteristics with snails, sponges, or earthworms, though they are all members of the animal kingdom.

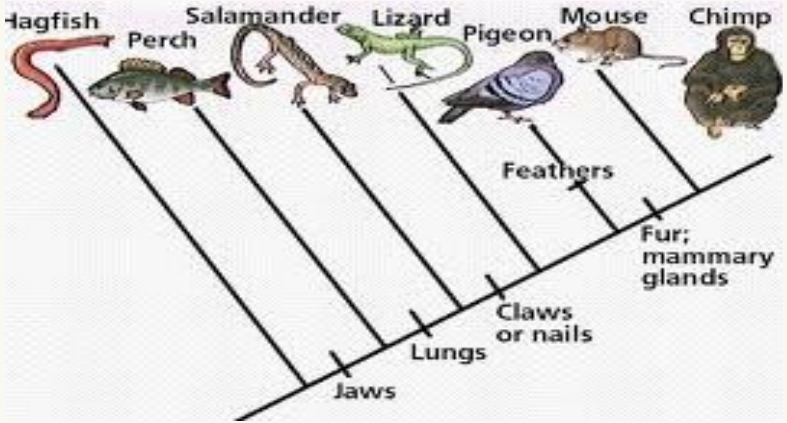
The Theory of Evolution & Phylogeny



The theory of evolution states that **all living things** are descended from a **common ancestor**

- Therefore, another way we can classify organisms (type of taxonomy) is based on their **evolutionary relatedness**

Phylogenetics



Phylogenetics: the study of the evolutionary relatedness between, and among, species (entire populations of individuals) whether extant (present today) or extinct

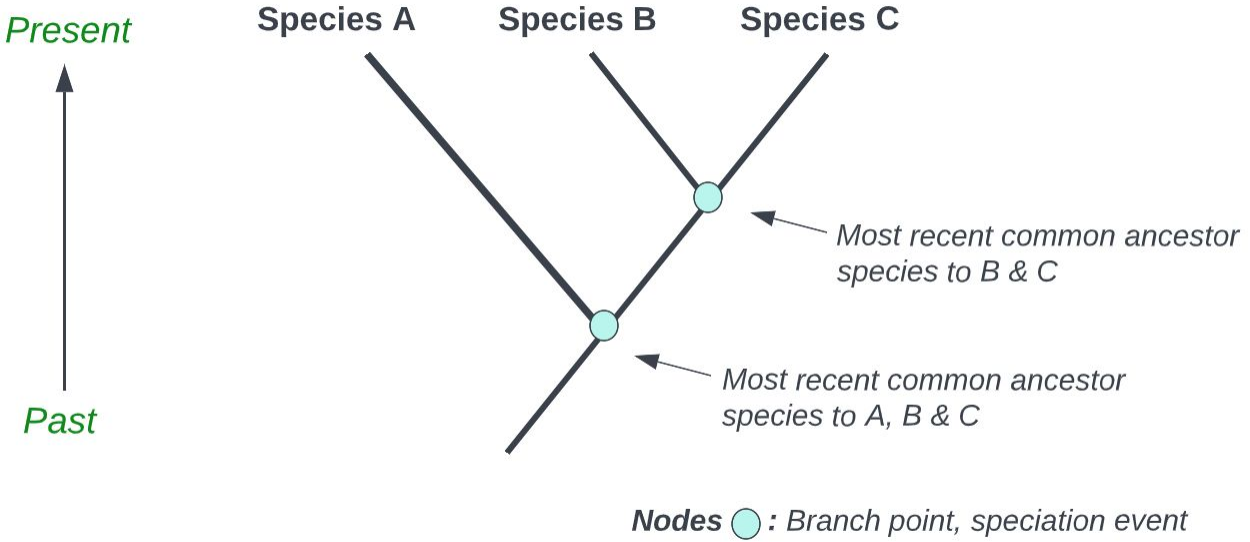
- these relationships are similar to a **large family tree**, but instead of tracing relationships between family members, phylogeny tracks relationships between ***entire species***

Phylogenetic Tree/ Cladogram

Phylogenetic tree: a branching diagram used to show evolutionary relationships between different species or groups

- **Cladistics:** the principles that guide the production of phylogenetic trees, a.k.a., **cladograms**

How to Read a Phylogenetic Tree



Clade

- In a phylogenetic tree, species are grouped into **clades**
- A clade is a **taxonomic group** that **includes** a **single ancestor** species and **all of its descendants**.

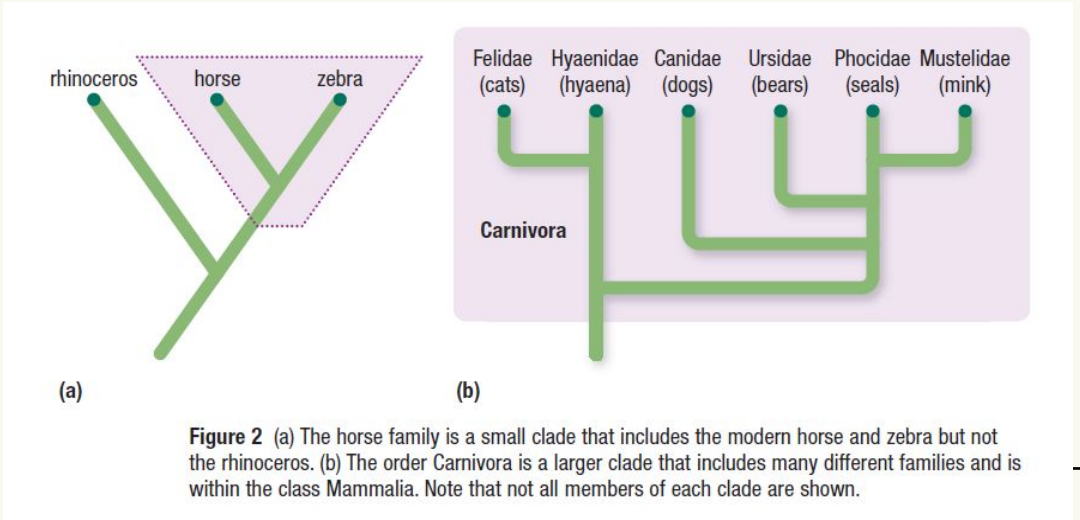
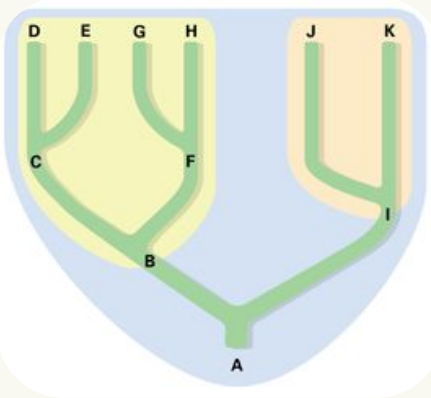


Figure 2 (a) The horse family is a small clade that includes the modern horse and zebra but not the rhinoceros. (b) The order Carnivora is a larger clade that includes many different families and is within the class Mammalia. Note that not all members of each clade are shown.

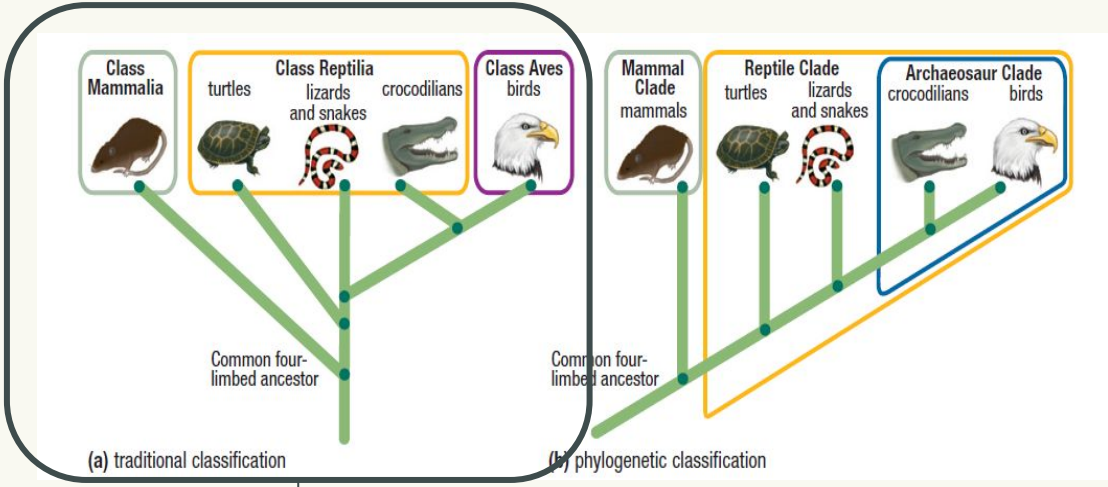
Each shaded area in the phylogenetic tree below highlights one clade. Which two clades are not shaded in?



Traditional Classification

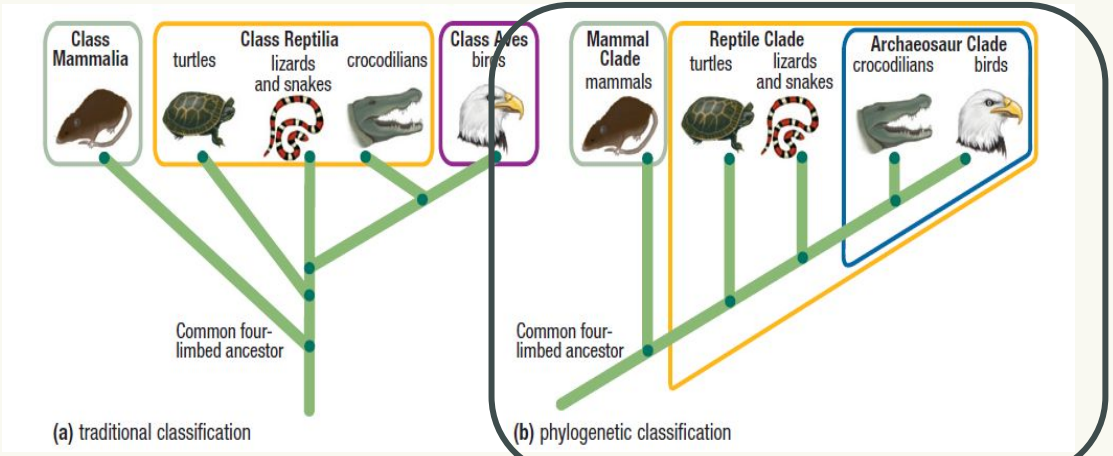
Traditional classification (taxonomic tradition)

- hierarchical classification system by Linnaeus
- groups species primarily by observed morphological (physical) characteristics then arranges them into ranks
  - **pros:** simple and convenient
  - **cons:** no evidence of relatedness



Crocodiles are grouped with turtles, snakes and lizards based on their **morphology**

Taxonomy Today

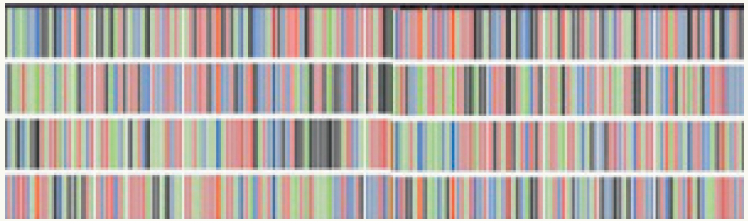


Crocodiles are grouped with birds because they share a more recent **ancestor**

Phylogenetic analyses (cladistic hypotheses)

- modern taxonomy
- organisms are grouped based on evolutionary relatedness /pathways (*not* limited to taxonomic ranks)
  - **pros:** tells us about evolutionary relatedness
  - **cons:** difficult to discover relatedness of fossils that date back millions of years

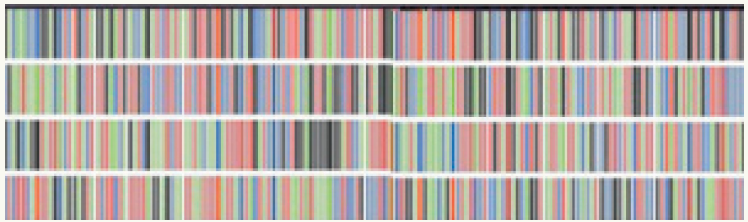
The International Barcode of Life (iBOL)



- Tool to identify species
- Goal of iBOL : DNA technology will be used to create a DNA profile of every species in the form of a barcode
- Project started in 2010 – based out of University of Guelph, Ontario

iBOL

Potential Benefits



- Detecting false labelling of products (e.g. mislabelled fish in markets in North America)
- Controlling the trafficking of products made from endangered species
- Potential for use as an affordable method of sampling and monitoring species diversity in ecosystems

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1.4 Kingdoms & Domains
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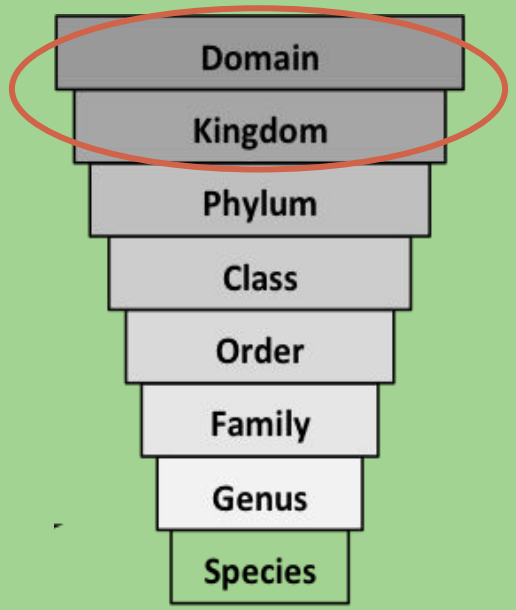
1.4 Kingdoms and Domains (p. 26 - 29)

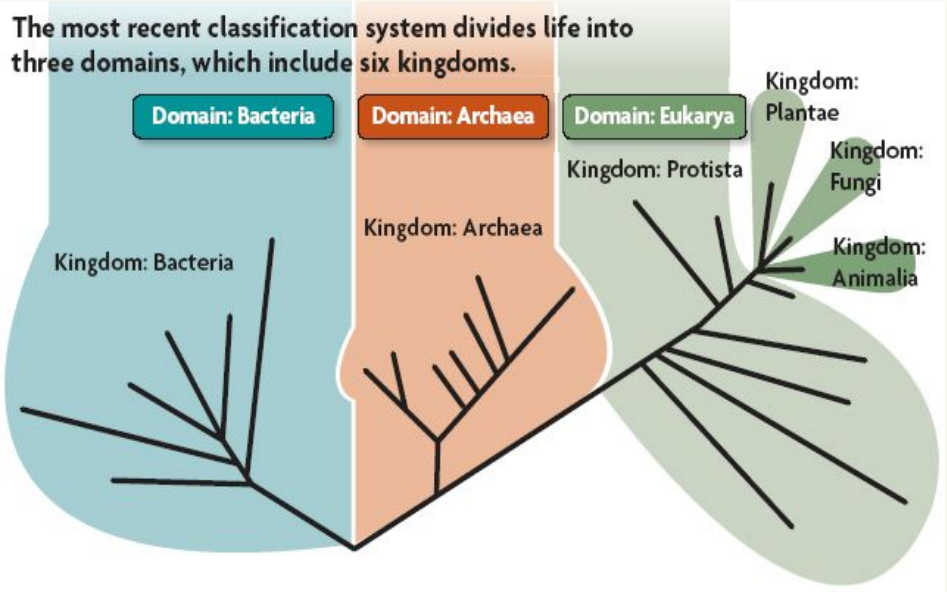


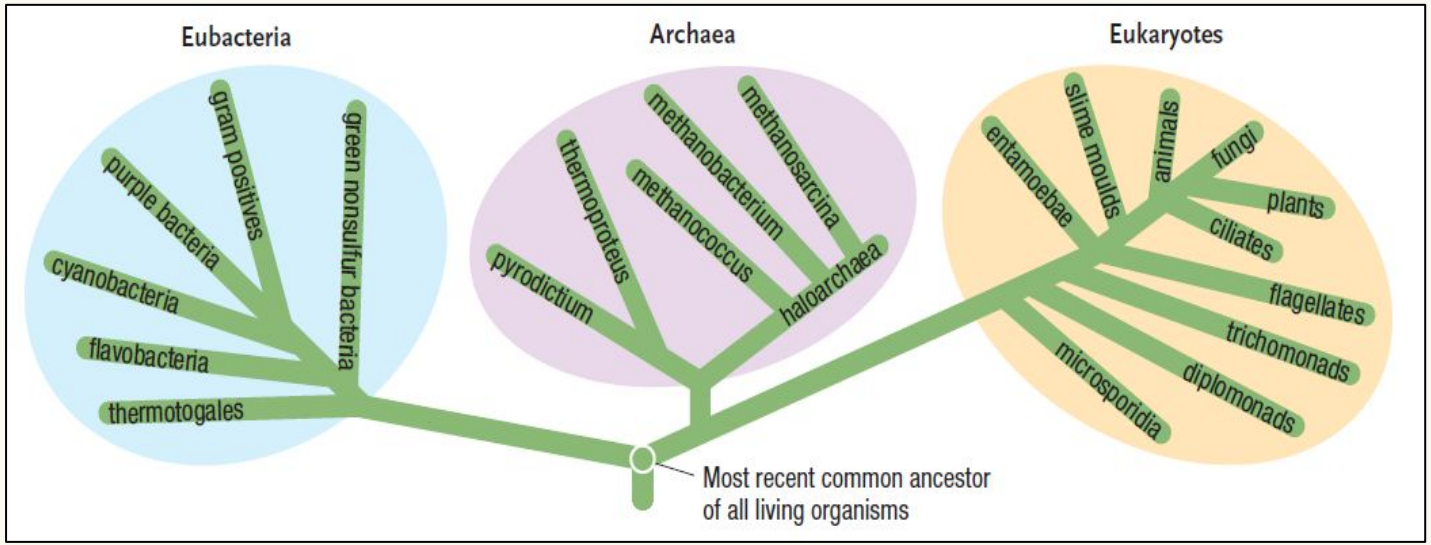
Domains of Life

In 1977, **Carl Woese** found that all organisms could be classified into three distinct groups, called domains.

Domains are the highest taxonomic level. They include:

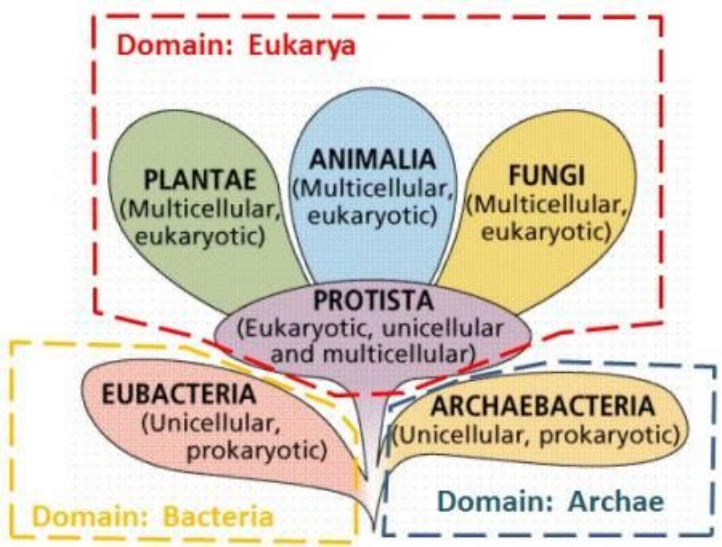
1. *Eubacteria*
2. *Archaea*
3. *Eukaryotes*



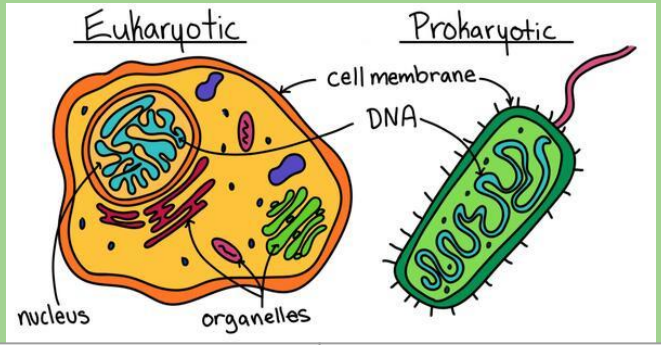


Based on this phylogenetic tree, which are eukaryotes more closely related to?

a) *Eubacteria*
b) *Archaea*

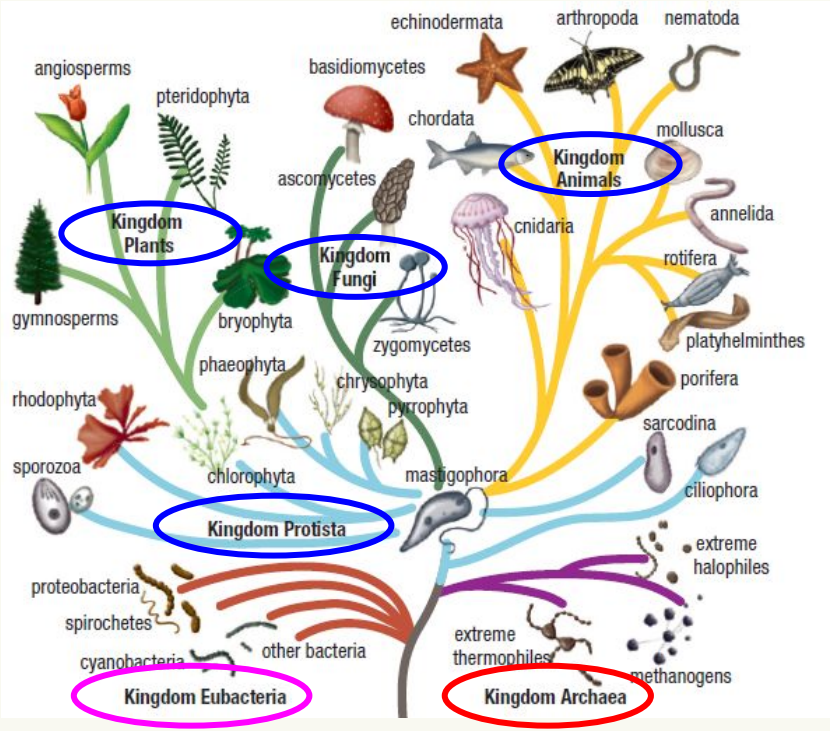


- In the domain **eukarya**, all organisms are **eukaryotic**.
- In the domains **eubacteria** and **archaebacteria**, all organisms are **prokaryotic**.



Prokaryote	Eukaryote
• Unicellular • Do not have membrane bound organelles	• Unicellular and multicellular • Have membrane bound organelles

The Six Kingdoms of Life



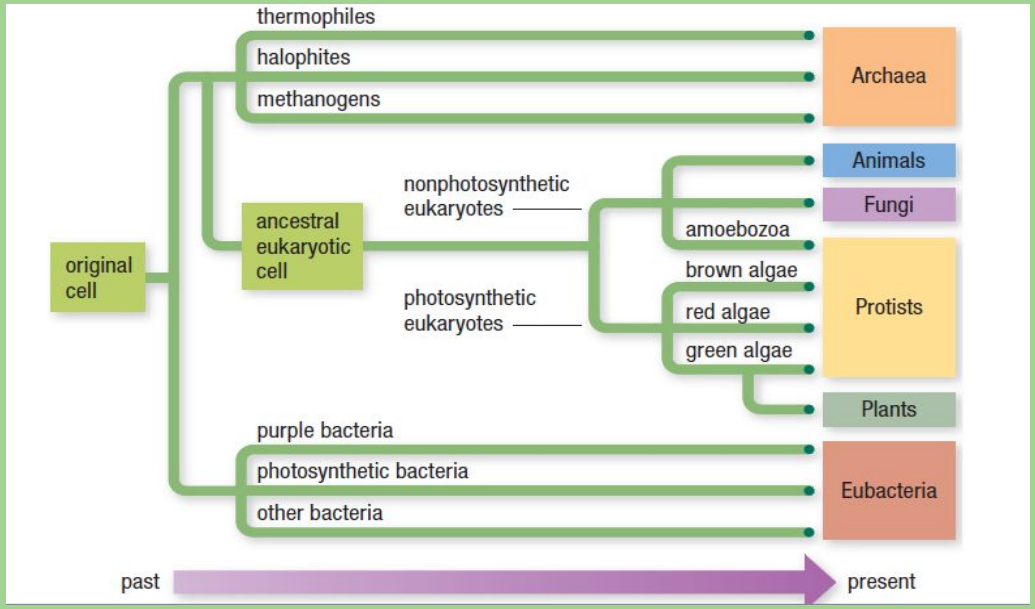
4 Kingdoms within Domain Eukarya:
Most contain all multicellular organisms. Organisms in the kingdom **Protista** however, can be **multicellular or unicellular** (e.g. amoebas and paramecium). Animals, fungi and plants are derived from unicellular protists, which were the first eukaryotes on Earth.

Members of Kingdoms Eubacteria and Archaea are **prokaryotic** and are **hard to distinguish** since they are small in size and lack internal structure.

Fun Facts:
Kingdom Protista

- **Protists** are the **most diverse** group of organisms on Earth
- Protists include the **largest** of all organisms, **kelp**!

Origin of the Six Kingdoms



Note: Protista is the only kingdom that does not represent a complete clade

- **Brown red and green algae are more closely** related to **plants**
- **Amoeboid** protists are more closely related to **fungi and animals**

Review of the Domains and Kingdoms

DOMAIN	Bacteria	Archaea	Eukarya			
KINGDOM	**Eubacteria**	**Archaebacteria**	**Protista**	**Fungi**	**Plantae**	**Animalia**
CELL TYPE	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
CELL STRUCTURES	Cell walls with peptidoglycan	Cell walls without peptidoglycan	Cell walls of cellulose in some; some have chloroplasts	Cell walls of chitin	Cell walls of cellulose; chloroplasts	No cell walls or chloroplasts
NUMBER OF CELLS	Unicellular	Unicellular	Most unicellular; some colonial; some multicellular	Most multicellular; some unicellular	Multicellular	Multicellular
MODE OF NUTRITION	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or heterotroph	Heterotroph	Autotroph	Heterotroph
EXAMPLES	*Streptococcus, Escherichia coli*	Methanogens, halophiles	*Amoeba, Paramecium,* slime molds, giant kelp	Mushrooms, yeasts	Mosses, ferns, flowering plants	Sponges, worms, insects, fishes, mammals