Classification – WHY?

Classification

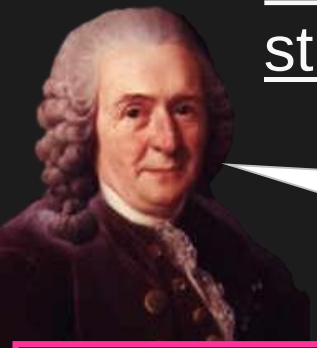
- : Finding Order in Diversity
  - How living things are organized
  - Binominal Nomenclature
  - Linnaeus's System of Classification
- : Modern Evolutionary Classification
  - Evolutionary relationships
  - Cladistics
  - Comparing dissimilar organisms
- : Kingdoms and Domains
  - 6 kingdoms of Life
  - 3 Domain system of classification

Finding Order In Diversity

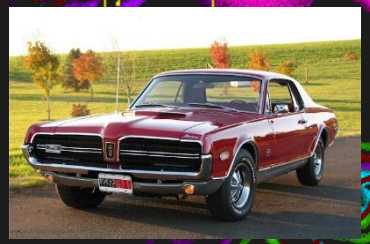
- What is a species?
  - A population of organisms that share similar characteristics and can interbreed freely and produce fertile offspring
- Biologists have identified 1.5 million species, and they estimate 2-100 million species have yet to be identified
- Order out of chaos?
- Classification
  - A system to name and group organisms in a logical order, used to study diversity of life
- Taxonomy
  - Classifying organisms and giving them a universally accepted name

Scientific Name? Common Name?

- Using common names is confusing
  - Mountain lion, cougar, catamount, puma, panther
- 18th century scientists agreed to use a single name for each species, and to use Latin as the common language
- Carolus Linnaeus- a Swedish botanist (mid 1700's) who developed the binominal nomenclature system of naming organisms
  - Binominal Nomenclature = 2 word naming system we still use today



Carolus Linnaeus



Rules of the Binomial Nomenclature System

1. Written in italics or underlined
2. First word is Genus which is capitalized, second word is species which is lower case

Panthera leo	**Lion**
Drosophila melanogaster	**Fruit fly**
Canis lupus	**Wolf**

Scientific Names

Scientific Names of bears:

All bears are NOT alike- but they are all bears.

Common Name*:* Grizzly Bear
Scientific Name*:* *Ursidae*
Ursus arctos

Common Name*:* Polar Bear
Scientific Name*:* *Ursidae*
Ursus maritimus

Common Name*:* Black Bear
Scientific Name*:* *Ursidae*
Ursus americanus

Common Name*:* Panda Bear
Scientific Name*:* *Ursidae*
Ailuropoda melanoleuca

Common Name: Sloth Bear
Scientific Name: *Ursidae*
Melursus ursinus

What are the reoccurring words?

Scientific Names

Common Name*:* Grizzly Bear
Scientific Name*:* *Ursus arctos*

- For a grizzly bear, *Ursus* is the genus name and *arctos* is the species name
- Species names are unique to that individual group of organisms and are usually a description of an important trait or an indication of where that organism lives
- *Ursus maritimus*, where does he live?
  - *Maritim* means to live near the sea

Common Name*:* Polar Bear
Scientific Name*:* *Ursus maritimus*

Felis domesticus, cat
what does “domesticus” mean?

Domesticus = “of the house”

QUIZ

The Wood Lice, *Armadillidium vulgare* , is most closely related to the

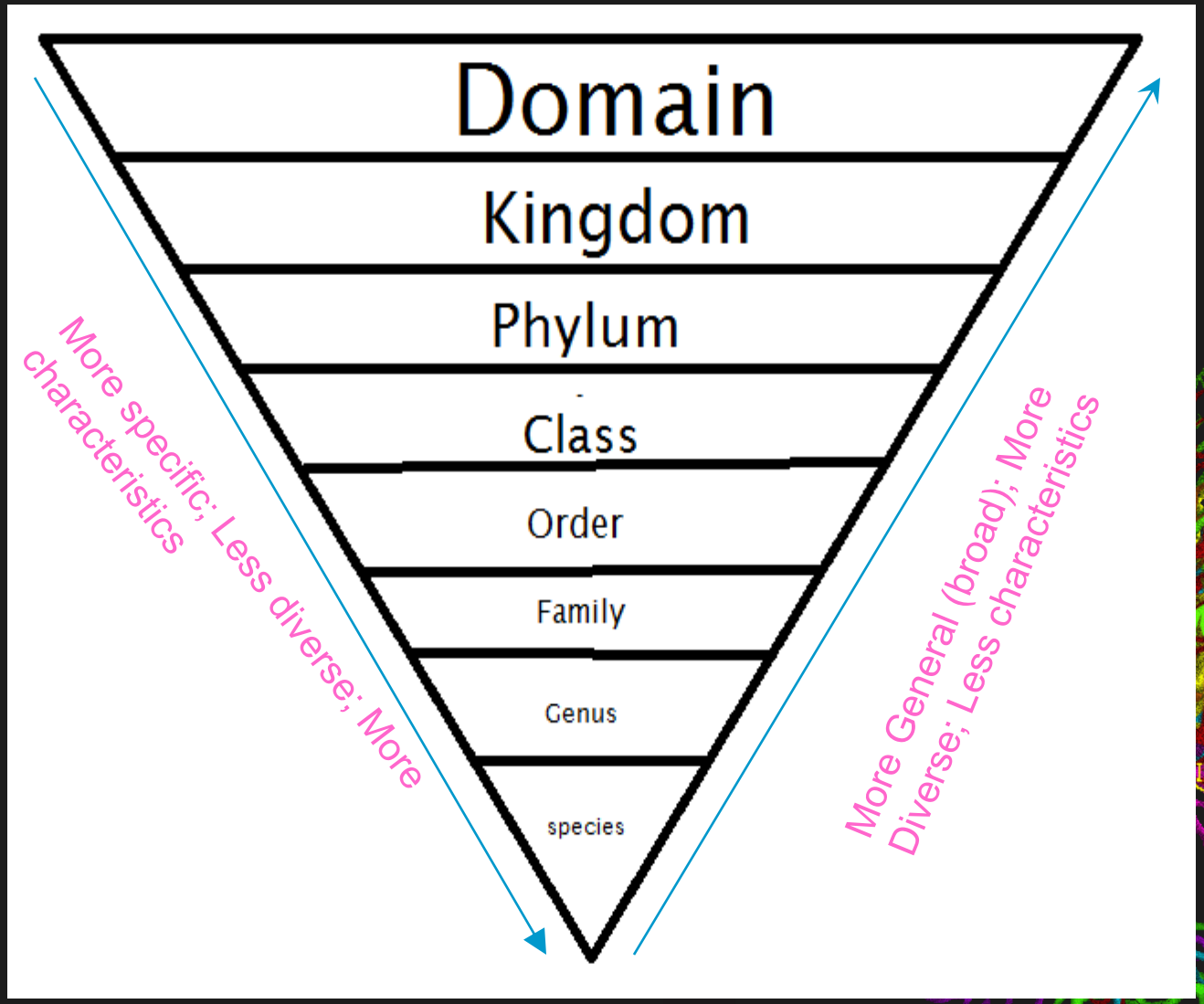
A Head Lice,
Pediculus humanus

B Wood cockroach,
Parcoblatta pensylvanica

C Roly Poly,
Armadillidium pallidum

8 taxa of classification

- Linnaeus's system is hierarchical, it now includes 8 levels (largest to smallest)



Linnaeus's System of Classification

Example: Humans

Domain — Eukarya

Kingdom — Animalia

Phylum — Chordata

Class — Mammalia

Order — Primates

Family — Hominidae

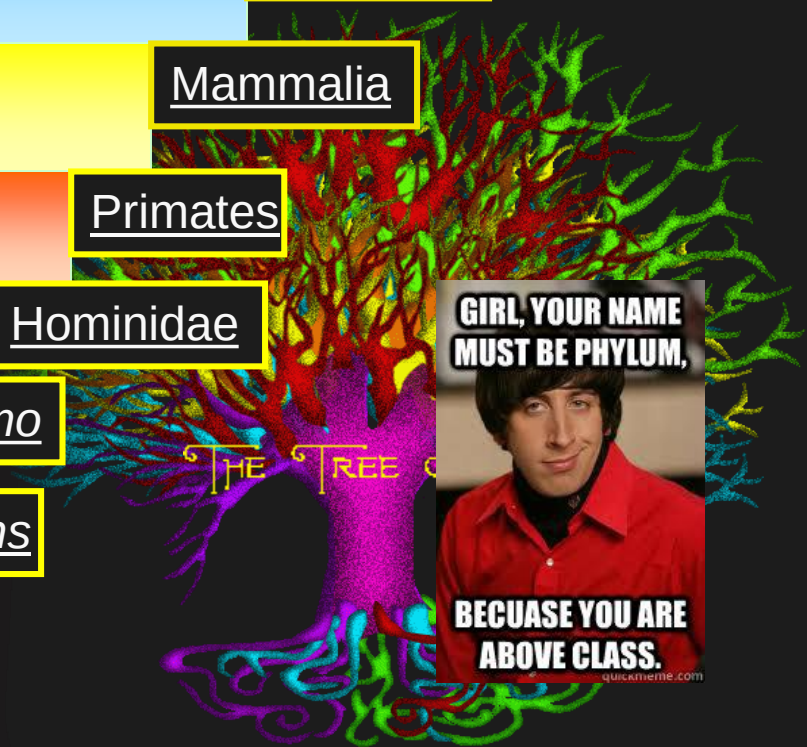
Genus — *Homo*

Species — *sapiens*

Smallest

Did Katy Perry Come Over For Group Singing?

FUN!



Bear Classification as an Exa

Duh, it's the fox.

Grizzly bear	Black bear	Giant panda	Red fox	Squirrel	Coral snake	Sea star

KINGDOM Animalia

PHYLUM Chordata

CLASS Mammalia

ORDER Carnivora

FAMILY Ursidae

GENUS Ursus

SPECIES *Ursus arctos*

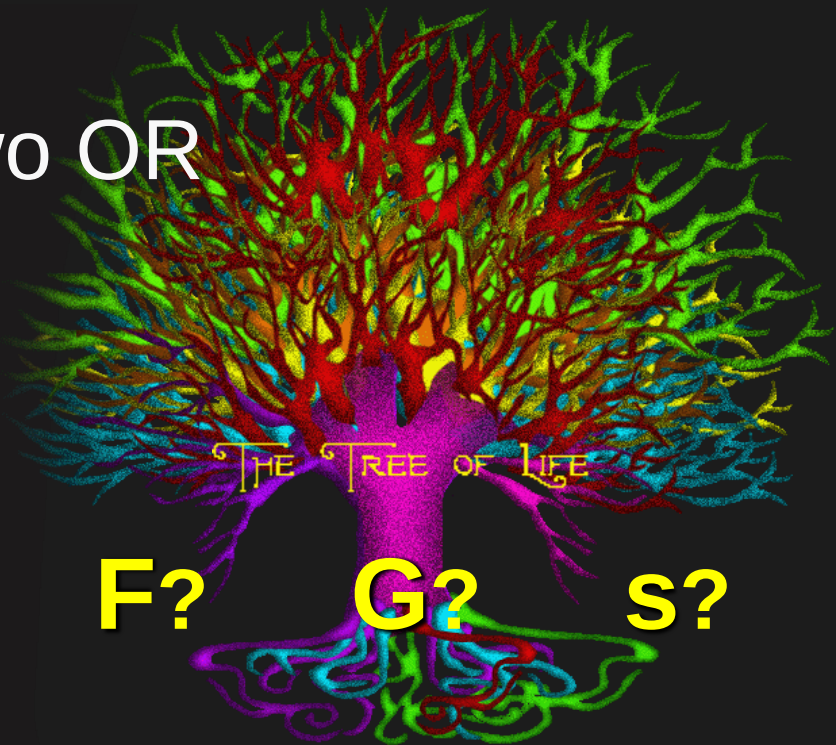
Question:
Which organism is more closely related to the polar bear, the squirrel or the fox?

How Can You Remember the 8 Taxon levels?

- **D**umb **K**ing **P**hilip **C**ame **O**ver **F**or **G**ood **S**oup
- **D**iva **K**aty **P**erry **C**an **O**rder **F**resh **G**reen **S**alad

Or you can combine the two OR

☺ **you come up with your own pneumonic**



D? K? P? C? O? F? G? S?

Evolutionary Classification

- Linneaus grouped organisms based on physical similarities, but Darwin's concept of Descent with Modification changed all that
- Phylogeny = grouping organisms into categories that represent lines of evolutionary descent instead of physical similarities

Barnacles

Limpet

Crab

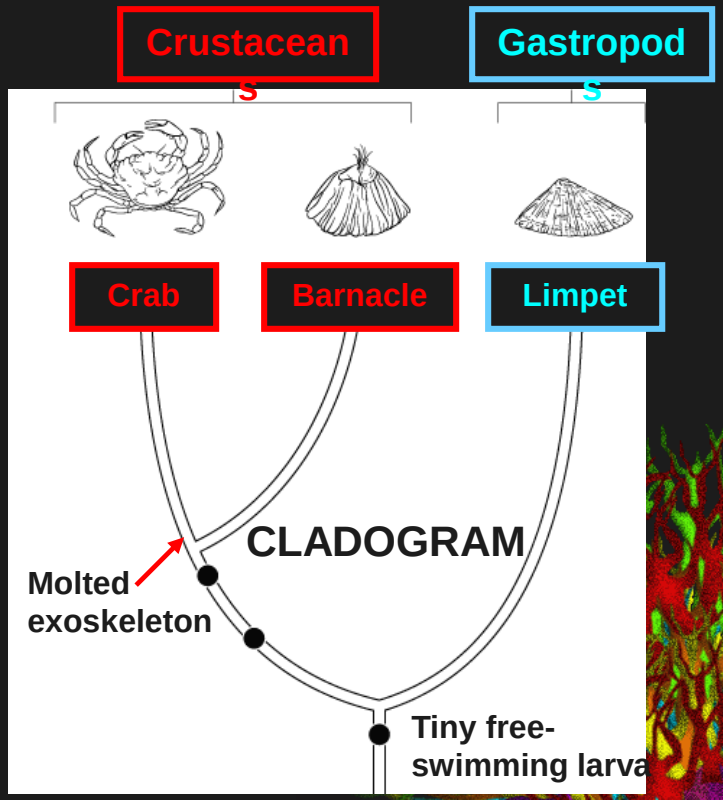
If you had to group these 3 based on what they look like, who is more related?

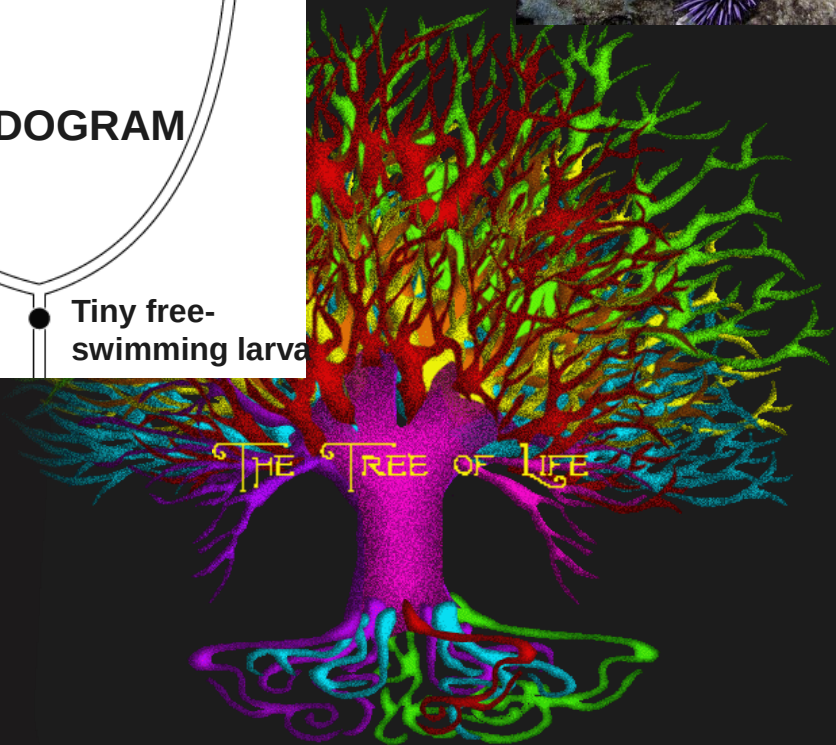
Evolutionary Classification

Actually, crabs and barnacles are more closely related evolutionarily.

This branching shows that crabs and barnacles share a more recent common ancestor.

Derived characteristics in crustaceans =
-Segmented bodies
-Hard external skeleton shed during growth





Cladogram = shows the evolutionary relationships among a group of organisms

QUIZ

Which of these classifications is most specific?

A Family

B Genus

C Phylum

D Order

Organism A	Organism B	Organism C
Animalia	Animalia	Animalia
Insecta	Mammalia	Mammalia
Diptera	Carnivora	Carnivora
Musca domestica	*Canis lupus*	*Felis domestica*

The chart above shows the classification of three organisms. Certain categories are not shown. Which two organisms are most closely related?

A *A* and *B*

B *B* and *C*

C *C* and *A*

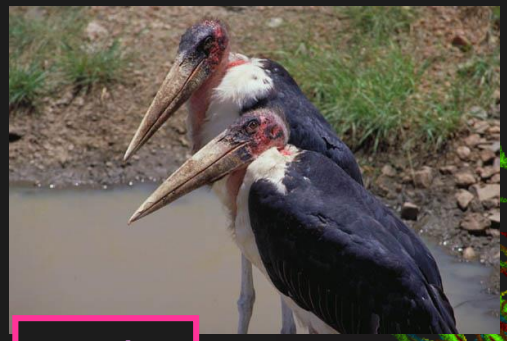
D Not enough information is given.

Similarities in DNA and RNA

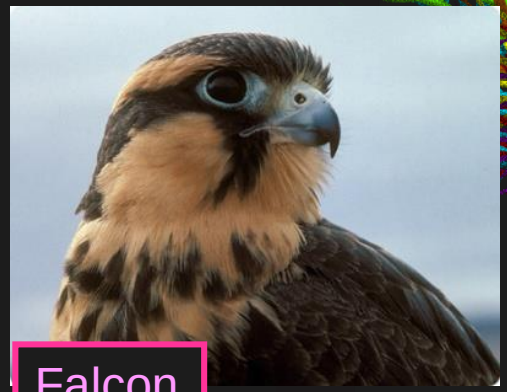
- Genes of many organisms share important similarities at the molecular level
- Similarities in DNA and RNA can help determine classification and evolutionary relationships *(who are the vultures most closely related to?)*

American vulture

African Vulture



Storks



Falcon

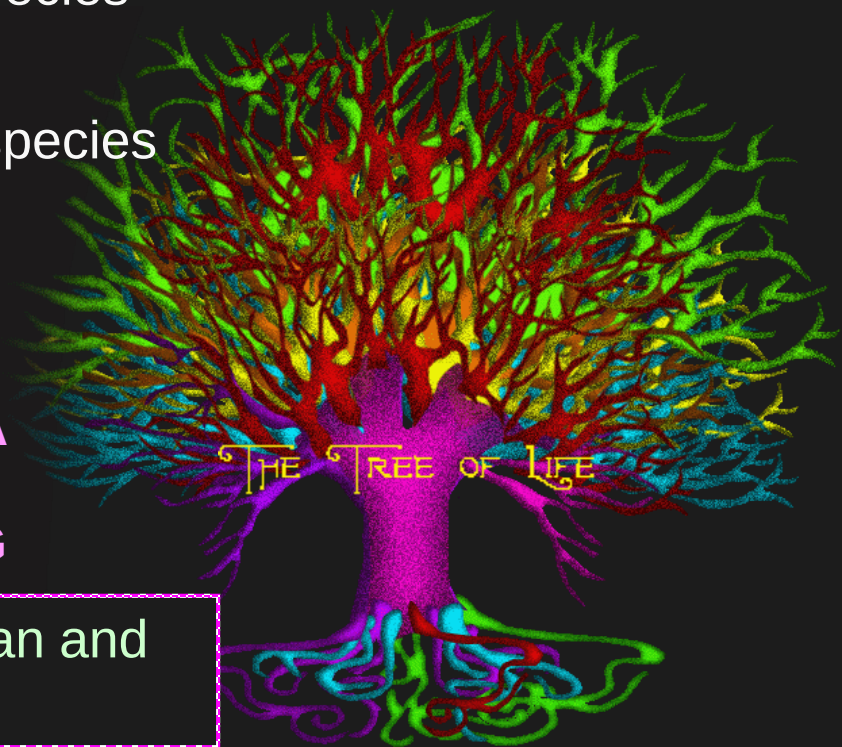
Molecular Clocks

- DNA comparisons can also be used to mark the passage of evolutionary time
- Molecular Clock model uses DNA comparisons to estimate the length of time that 2 species have been evolving independently
  - Looks for mutations that separate 2 species
  - Other changes in DNA
  - Compares DNA sequences between species

Which organisms are more closely related?

Why?

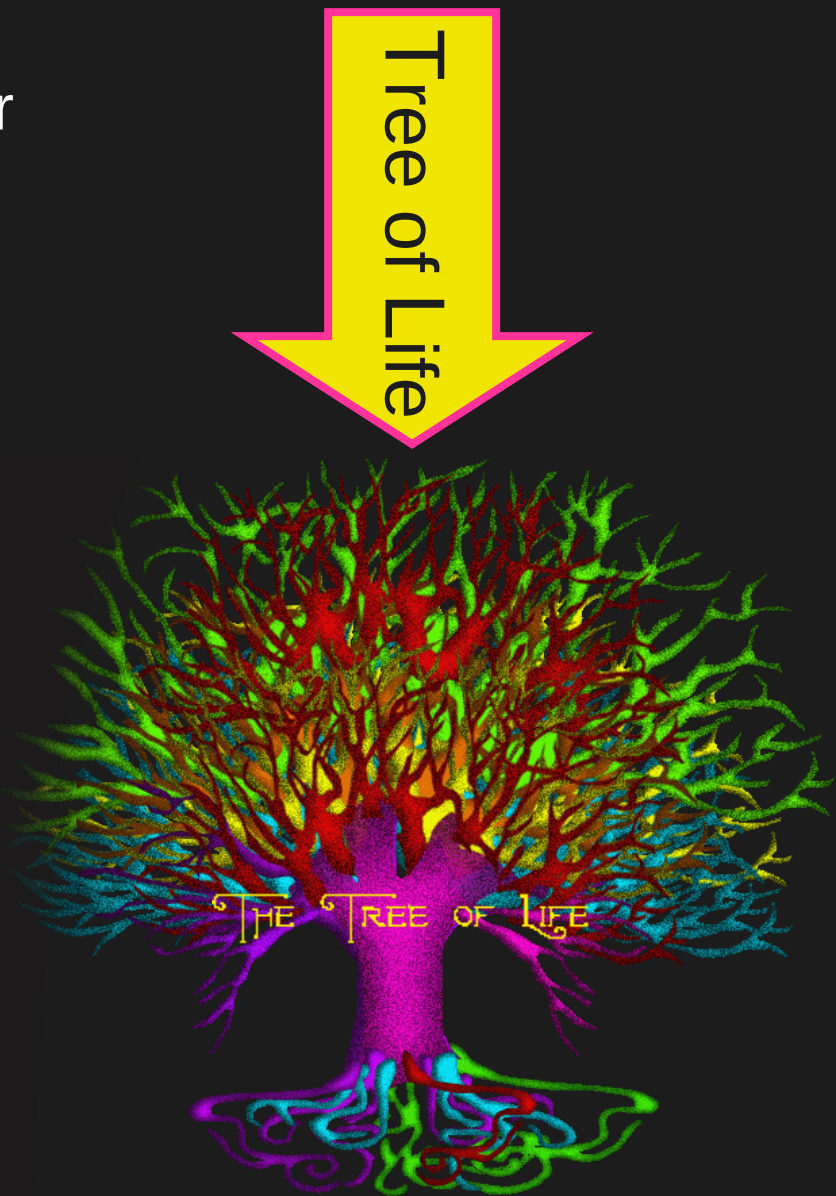
Human:	**CCA**	**TAG**	**CAC**	**CTA**
Pig:	**CCA**	**TGG**	**AAA**	**CGA**
Chimpanzee:	**CCA**	**TAA**	**CAC**	**CTA**
Cricket:	**CCT**	**AAA**	**GGG**	**ACG**



Only 1 mutation separates human and chimp in this portion of the gene

Kingdoms and Domains

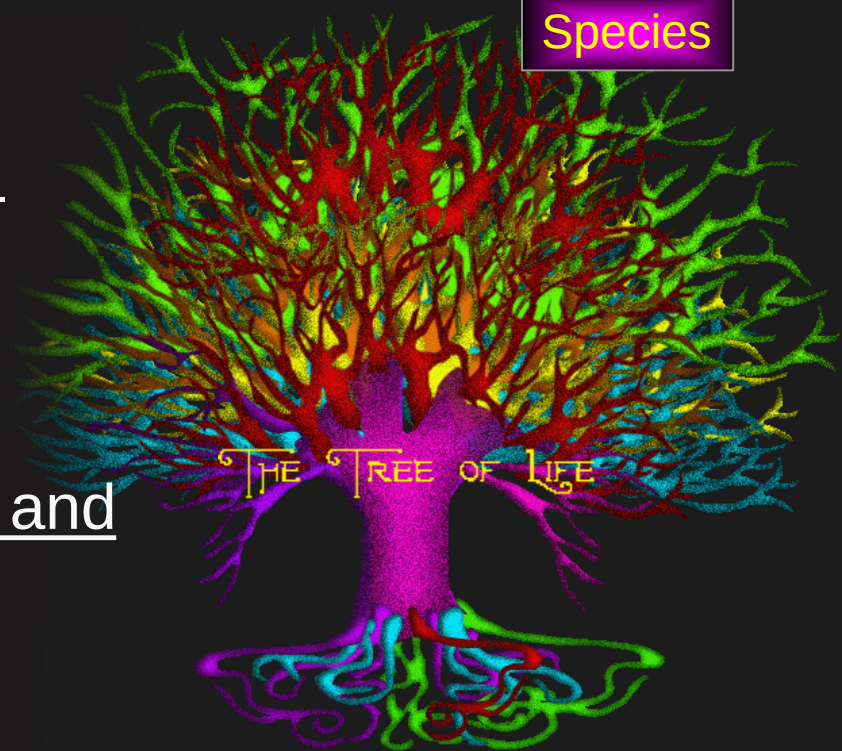
- In Linnaeus's time, life was much simpler. Either you were a plant or an animal.
- Today, classification is more complicated.
  - Protists? Bacteria? Viruses?
- Tree of Life (www.tolweb.org)
- Life is full of Diversity
  - Robert Hooke and Van Leewenhoek – showed us the microscopic world, bacteria, protists, microorganisms
  - Discovering all these microscopic life forms, added branches to the Tree of Life



Three Domain System

- Using a molecular clock, scientists group organisms according to how long they have been evolving independently
- Linnaeus's 7 level system became 8 levels when Domain was added
- Today, we have 3 Domains
  - Bacteria = all bacteria in the kingdom Eubacteria, unicellular, members are Prokaryotes
  - Archaebacteria = includes the kingdom Archaebacteria
  - Eukarya = protists, fungi, plants and animals

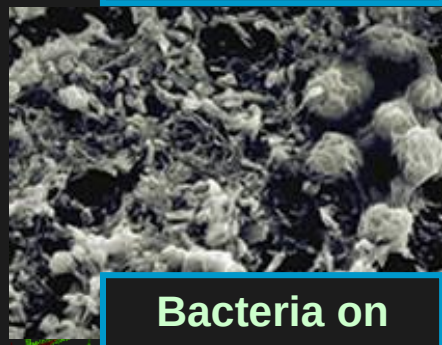
Domain
Kingdom
Phylum
Class
Order
Family
Genus
Species



Domain Bacteria

- Members of Kingdom Bacteria are Prokaryotes
- Prokaryotes = <u>lack a nucleus, no membrane-bound organelles</u> (HAVE RIBOSOMES)
  - So, no mitochondria, chloroplasts, endoplasmic reticulum, golgi apparatus, vacuole

Bacteria on a contact lens



Bacteria on your teeth

Some microbes live on our skin and protect us from many harmful agents. The drier areas, like the back, have few microbes; moist areas, such as under the arm, have many more.

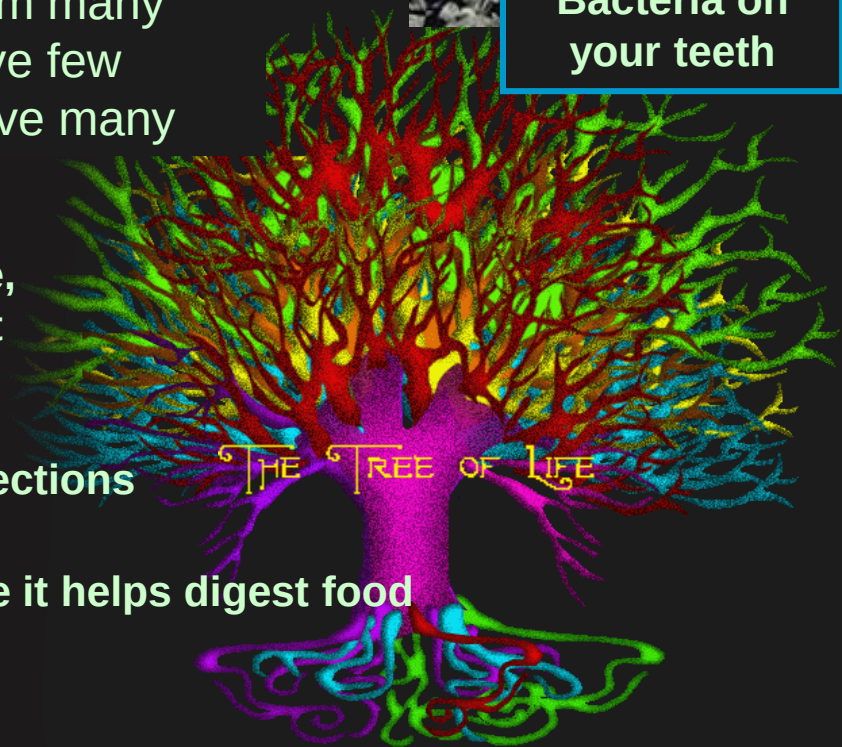
Examples of Bacteria:

Lactobacillus bulgaricus **helps turn milk into cheese, yogurt, and other dairy products. Lactose intolerant anyone?**

Mycobacterium tuberculosis **causes tuberculosis**

Staphylococcus **(a.k.a. *staph*) can cause serious infections and is one of the most drug-resistant bacteria**

Escherichia coli **(a.k.a. *E. coli*) lives in the gut, where it helps digest food**



Domain Archaea

- Archaebacteria are CRAZY bacteria
- Unicellular, Prokaryotic
- Live in the most extreme environments, where only crazy things live
  - Would you live in a swamp or marsh?
  - Or in the boiling water of a hot spring (over 163 ºF)?
  - Or in a “black smoker” (deep sea air vents (very hot!))
  - Or in brine (water with 9X amount of salt as the ocean) and in salt crust?
  - Or how about Mars?? Yes, Mars!

1. Methanogens (methane-producers)--responsible for swamp gas and farts.
2. Extreme Thermophiles--live in hot springs and black smokers.
3. Extreme Halophiles--live in saturated brine and salt crust.

Yellowsprings Yellowstone Park

Owen’s Lake, NV

Black Smoker

Martian

Domain Eukarya

Eu = You, get it?

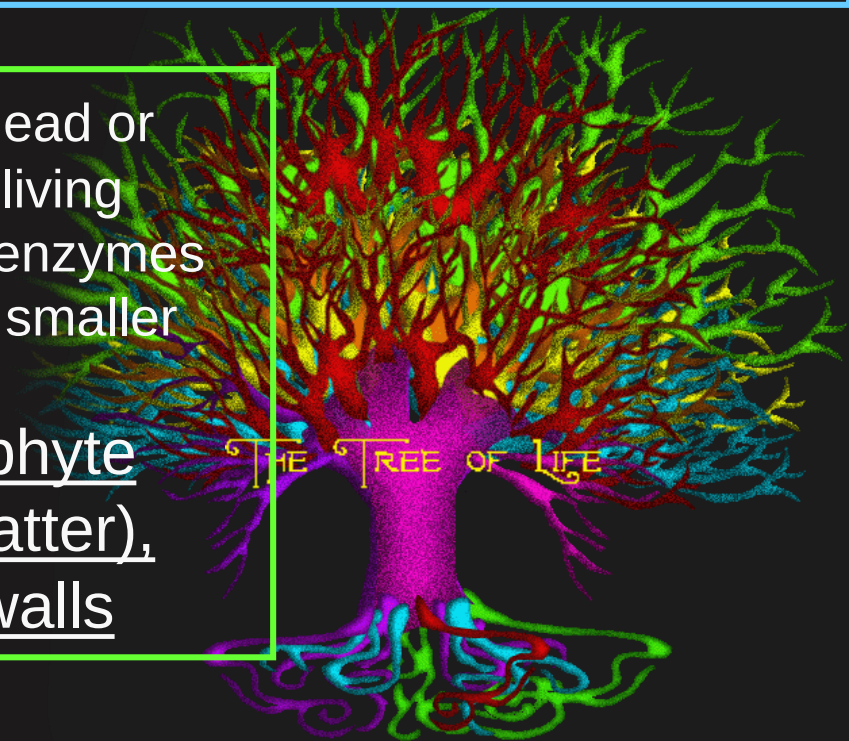
- All organisms whose cells have a nucleus
- Everything that is NOT a bacteria- including YOU!
- Now we get to the last 4 kingdoms in the 6 Kingdom system

3. Protista – if it's not a bacteria, plant, fungi or animal, it's a protist, remember that! Live in moist places, like ponds

   Keywords: eukaryote, lives in moist places, hard to classify

4. Fungi – heterotrophs that feed on dead or decaying organic matter (organic = from living organisms), saprophytes – they secrete enzymes that digest and then absorb (not eat) the smaller food molecules, cell walls of chitin

   Keywords: heterotroph, saprophyte (feeds on dead or decaying matter), secretes enzymes, chitin cell walls



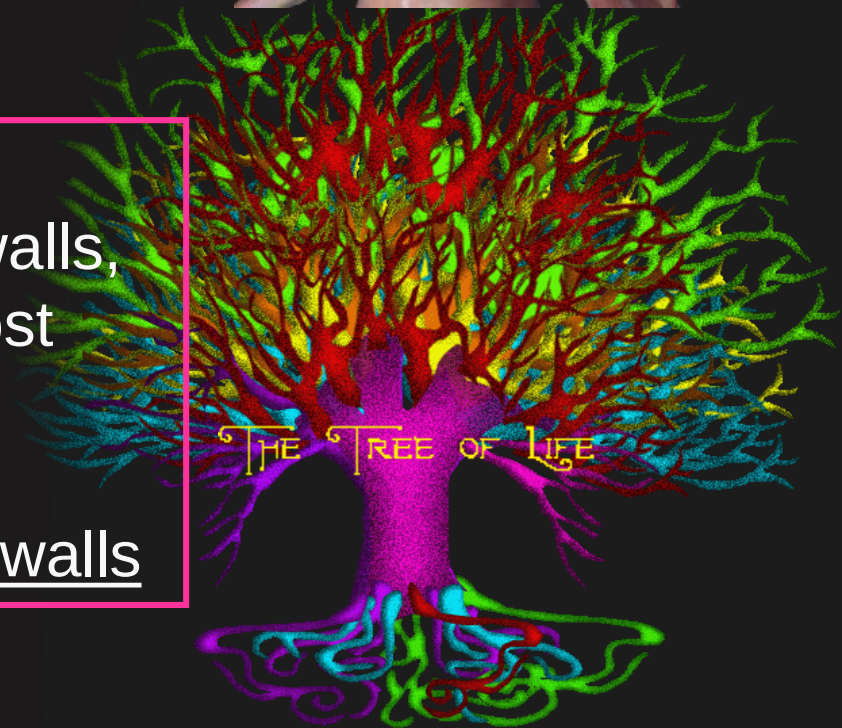
Plantae and Animalia

5. Plantae – multicellular, photosynthetic autotrophs, that don't move, have cell walls with cellulose

   Keywords: autotroph, photosynthesis, cell walls, cellulose

6. Animalia – multicellular and heterotrophic, do not have cell walls, motile (can move), can live almost everywhere

   Keywords: multicellular, heterotrophic, motile, no cell walls

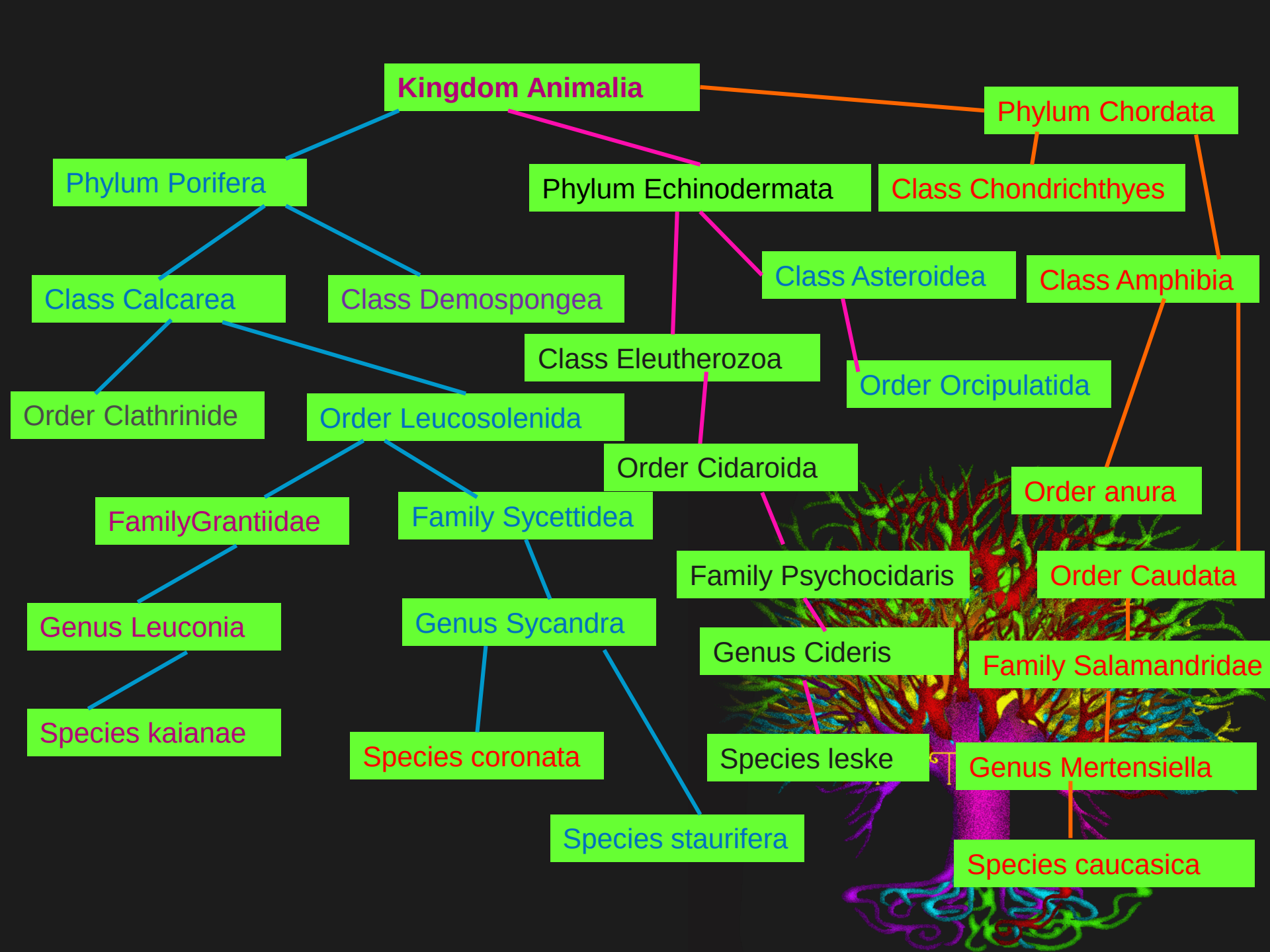


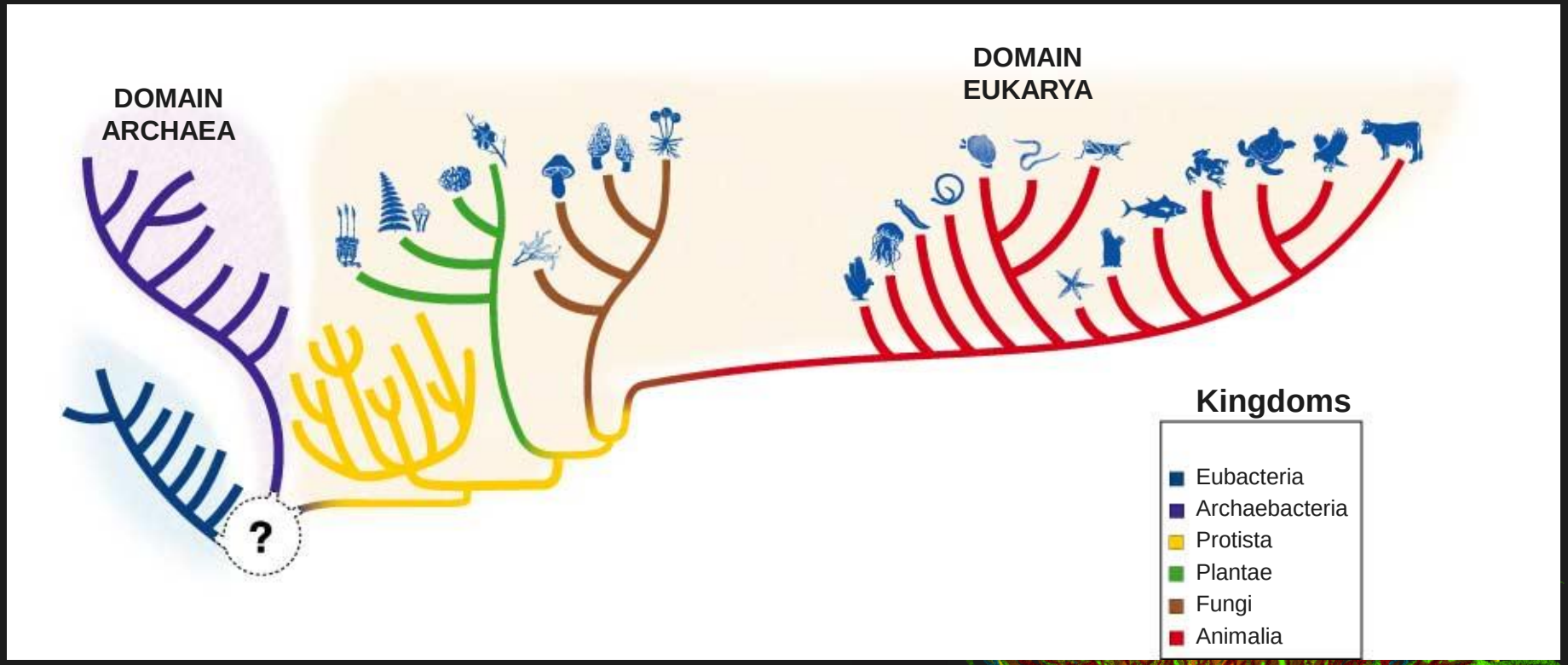
Key Characteristics of Kingdoms and Domains

Fill in the table

Classification of Living Things

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 has ribosomes	Cell walls without peptidoglycan has ribosomes	May have cell walls of cellulose and/or 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	one unicellular; most multicellular	Multicellular	Multicellular
MODE OF NUTRITION	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or heterotroph	Heterotroph	Autotroph	Heterotroph
EXAMPLES	*Streptococcus, Escherichia coli*	Methanogens, halophiles	*Amoeba, Parameciu m,* slime molds, giant kelp	Mushrooms, yeasts	Mosses, ferns, flowering plants	Sponges, worms, insects, fishes,


Kingdom Animalia
Phylum Chordata
Phylum Porifera
Phylum Echinodermata
Class Chondrichthyes
Class Asteroidea
Class Amphibia
Class Calcarea
Class Demospongea
Class Eleutherozoa
Order Orcipulatida
Order Clathrinide
Order Leucosolenida
Order Cidaroida
Order anura
FamilyGrantiidae
Family Sycettidea
Family Psychocidaris
Order Caudata
Genus Leuconia
Genus Sycandra
Genus Cideris
Family Salamandridae
Species kaianae
Species coronata
Species leske
Genus Mertensiella
Species staurifera
Species caucasica


DOMAIN
ARCHAEA
DOMAIN
EUKARYA
?
Kingdoms
Eubacteria
Archaebacteria
Protista
Plantae
Fungi
Animalia


The Tree of Life