CLASSIFICATION of living things

CLASSIFICATION

Classify= to group things according to similar/different features (structures) that they share

Imagine a grocery store-

How is it organized?

What would happen if it was NOT organized?

Why do Scientists Classify?

Nearly 2 million species on Earth!

-keeping them organized makes it easier to study the Earth's life (like keeping a grocery store organized makes it easier to shop).

Taxonomy= the =scientific study of how living things are classified.
Useful because once classified, scientists will know a lot about an organism.

WHAT'S IN A NAME?

- Scientists have a system for naming all the living organisms on earth.

- The system was created by a Swedish scientist named Carolus Linnaeus
- Developed over 200 years ago
- Linnaeus designed Binomial Nomenclature

Bi= two **Nomial= name**

Binomial Nomenclature

Each species of a living thing is given a DOUBLE NAME- known as **Latin Name or Scientific Name**.

First Name (Genus)

-Tells which group of similar species the living thing belongs to

Second Name (Species)

-Tells the name of the one particular species in that genus

What's in a Name?

English= dog

French= chien

Hebrew=kelev

Mandarin= gou

Japanese= inu

German= hund

Hindi=kutta

Scientific name=
Canis familiaris

Why Bother with Scientific Names?

- Scientific names are universal among all countries.
- Common names differ among regions
- Common names are not specific (example: lilies, lizards, salamanders, there are many different species of each.)

Catamount

Mountain Lion

Scientific Name: *Puma concolor*

Cougar

Puma

Panther

Linneaus' System of Scientific Names

Example:

Scientific Name for a dog	*Canis familiaris*
Scientific Name for a Timber Wolf	*Canis lupus*
Scientific Name for a Coyote	*Canis latrans*

- Notice that the word Canis is used in all of these names. This is the Latin word for DOG.
- It is used as the genus name because these animals are all dog-like animals
- The second name, species, indicates the particular type of dog

Rules of Binomial Nomenclature

1. First letter of the first word (genus name) is always capitalized.

2. First letter of the second word (species name) is never capitalized.

3. BOTH words are either *italicized* **or** <u>underlined.</u>

Example: *Canis familiaris* <u>Canis</u> <u>familiaris</u>

If underlining, do NOT underline the space between genus and species name.

Example of Binomial Nomenclature Rules

Common Name: Human

Genus: Homo

(Derived from the Latin word Hominid, meaning “man”)

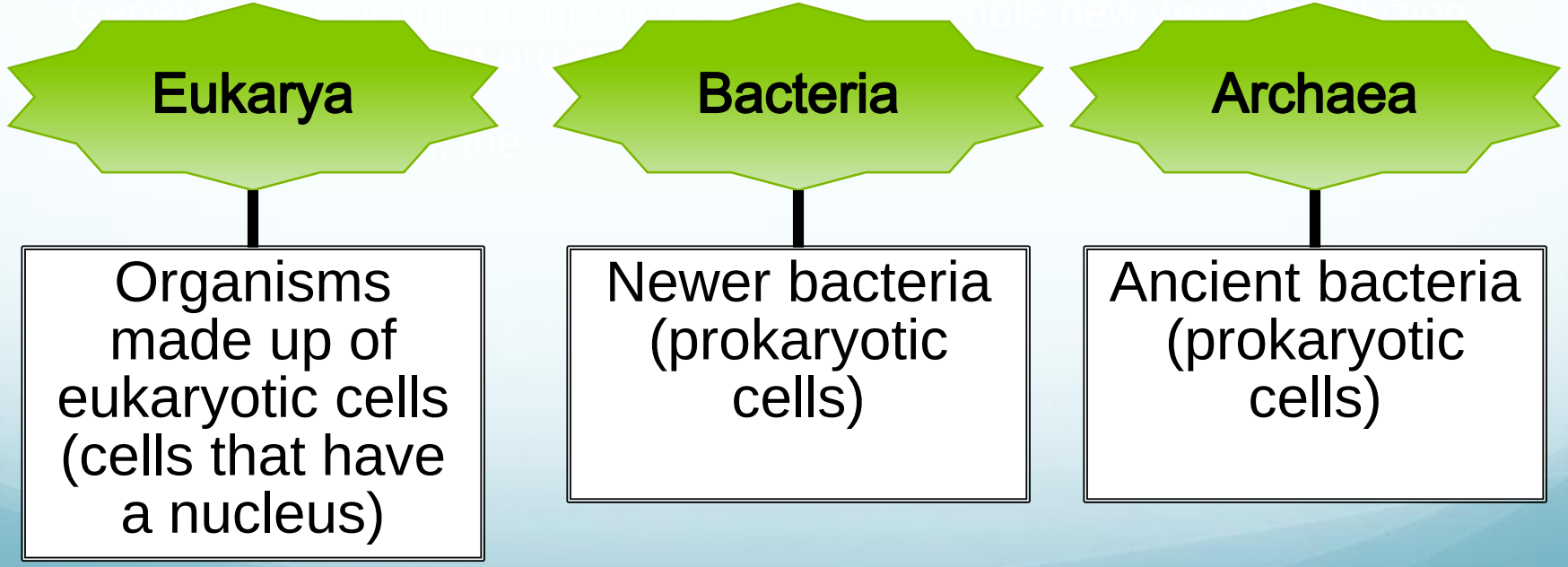
Species: Sapien

(The Latin word for “wise”)

Scientific name: ***Homo sapien*** or Homo sapien

Domains

A domain is the most general type of classification (primarily based on cell type)- domains are currently the highest rank of classification.



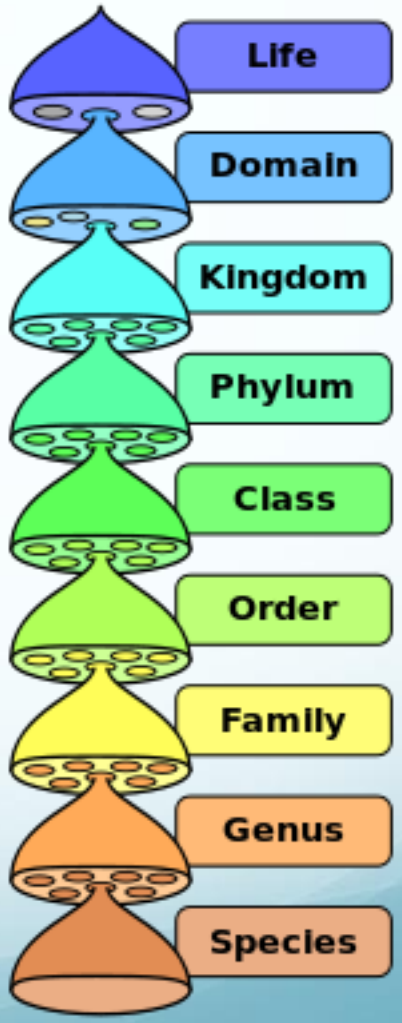
Domains

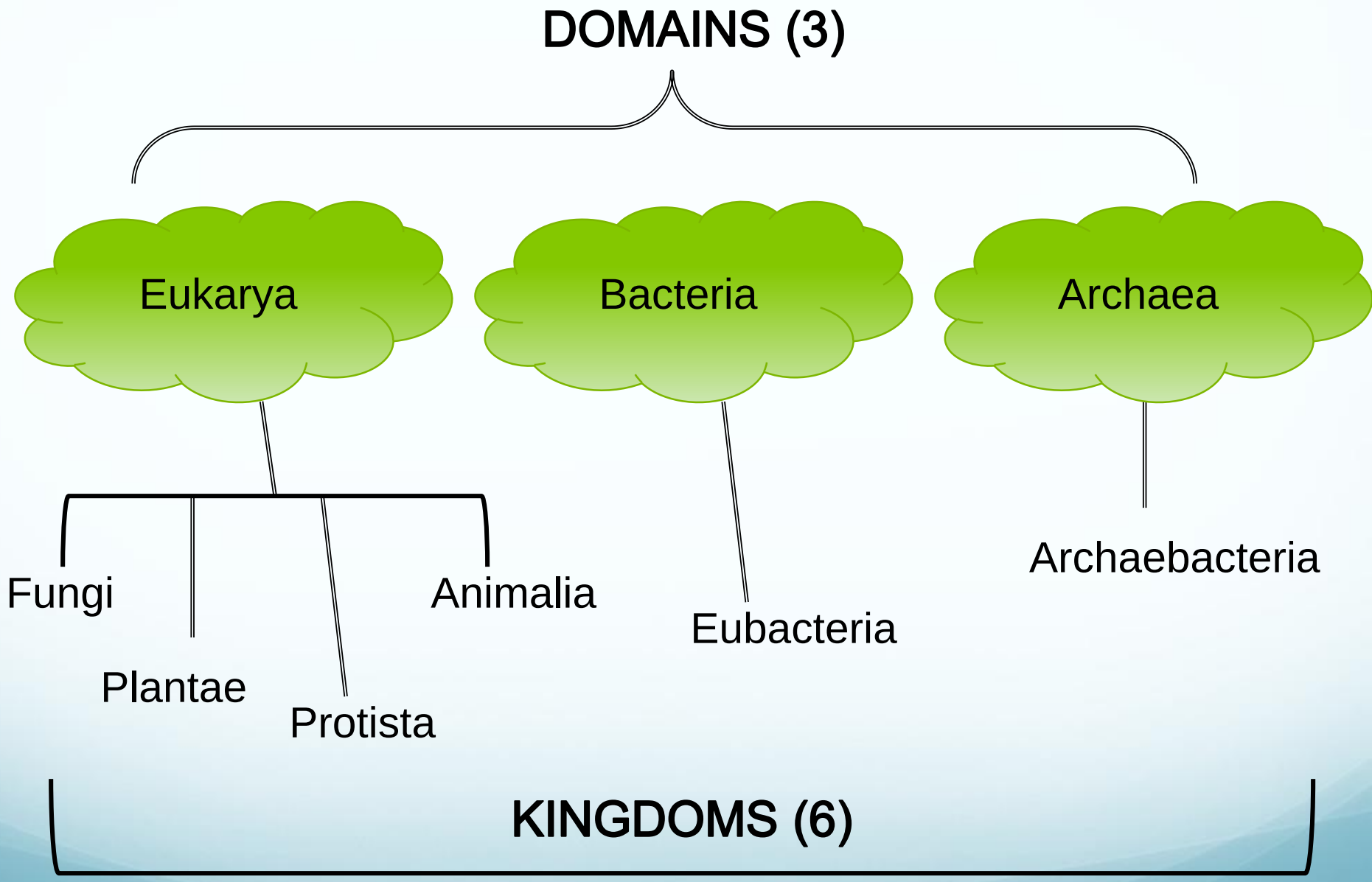
Each of the 6 kingdoms belongs to a domain.

Which domain do you think the plant, animal, and fungus kingdom belong to?

As scientists have learned more about organisms, the classification system has changed.

Domain classification is based primarily on differences among RNA. Use of domains was not introduced until the 1990s.




DOMAINS (3)
Eukarya
Bacteria
Archaea
Fungi
Plantae
Protista
Animalia
Eubacteria
Archaebacteria
KINGDOMS (6)

KINGDOMS

Domain: BACTERIA

Kingdom: Eubacteria ("true" bacteria)

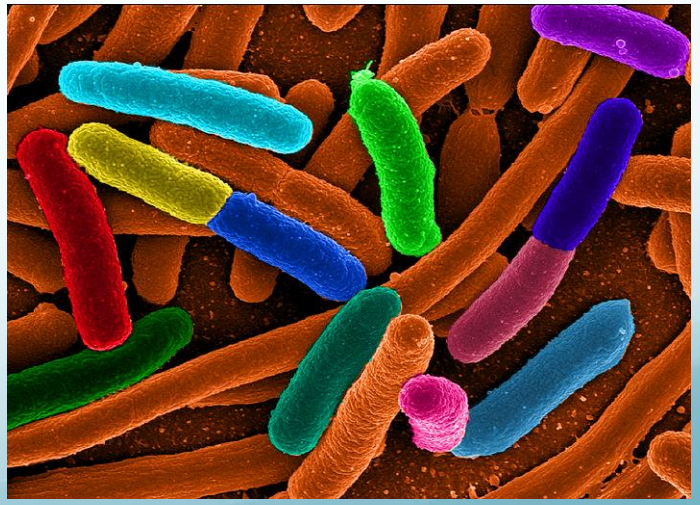
-Prokaryotic cells

-unicellular

-autotroph or heterotroph (depending on species)

-cell walls contain peptidoglycan (that is typically what makes us sick)

Examples: streptococcus, *Escherichia coli*



Kingdoms

Domain: ARCHAEA

Kingdom: Archaebacteria
(Ancient Bacteria)

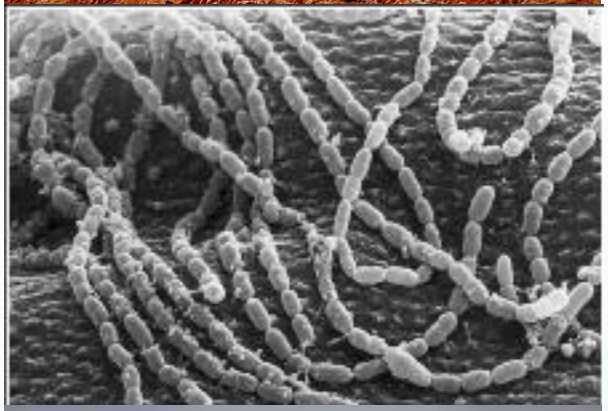
-Prokaryotic cells

-unicellular

-autotroph or heterotroph (depending on species)

-cell walls do NOT contain peptidoglycan

Examples: Extremophiles (love extreme environments such as very hot places); halophiles, methanogens



Kingdoms

Domain: EUKARYA

Kingdom: Protista

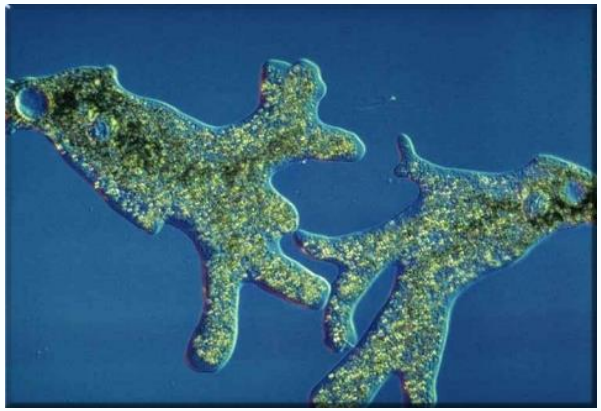
-Eukaryotic cells

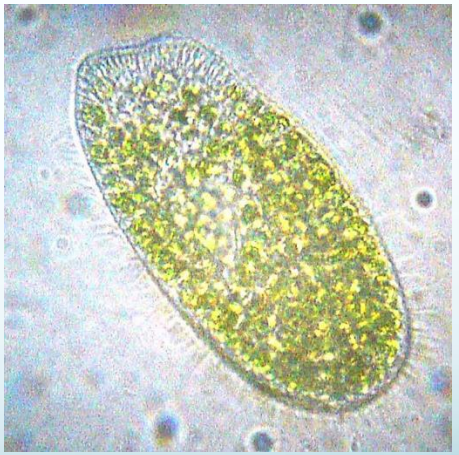
-Most protists are unicellular, some multicellular species

-autotroph or heterotroph (depending on species)

-Cell walls contain cellulose; cells of some species contain chloroplast

-Examples: Amoeba, paramecia, slime molds, giant kelp





Kingdoms

Domain: EUKARYA

Kingdom: Fungi

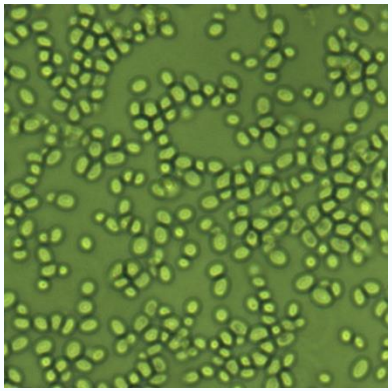
-Eukaryotic cells

-Most fungi is multicellular, some unicellular species

-heterotroph

-Cell walls contain chitin

-Examples: mushrooms, yeast, mold



Kingdoms

Domain: EUKARYA

Kingdom: Plantae

-Eukaryotic cells

-multicellular

-autotroph

-Cell walls contain cellulose; cells contain chloroplast

-Examples: mosses, ferns, flowering plants

Kingdoms

Domain: EUKARYA

Kingdom: Animalia

-Eukaryotic cells

-multicellular

-heterotroph

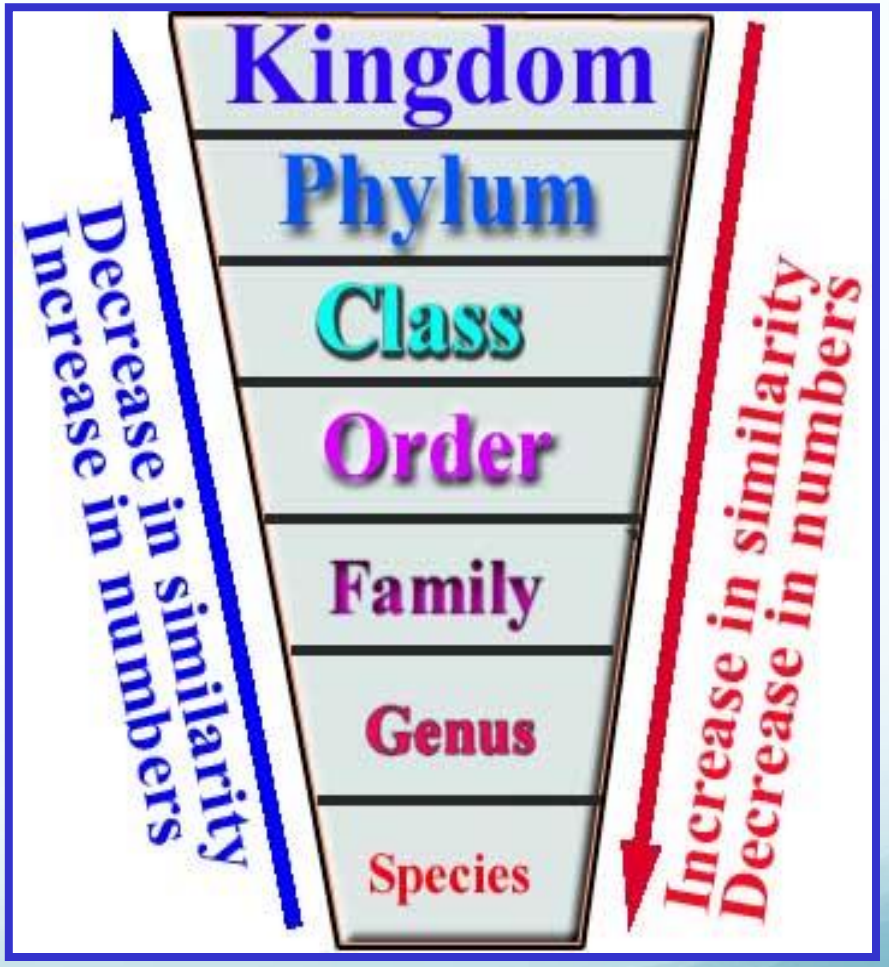
-No cell wall or chloroplast present

-Examples: sponges, worms, insects, fishes, mammals

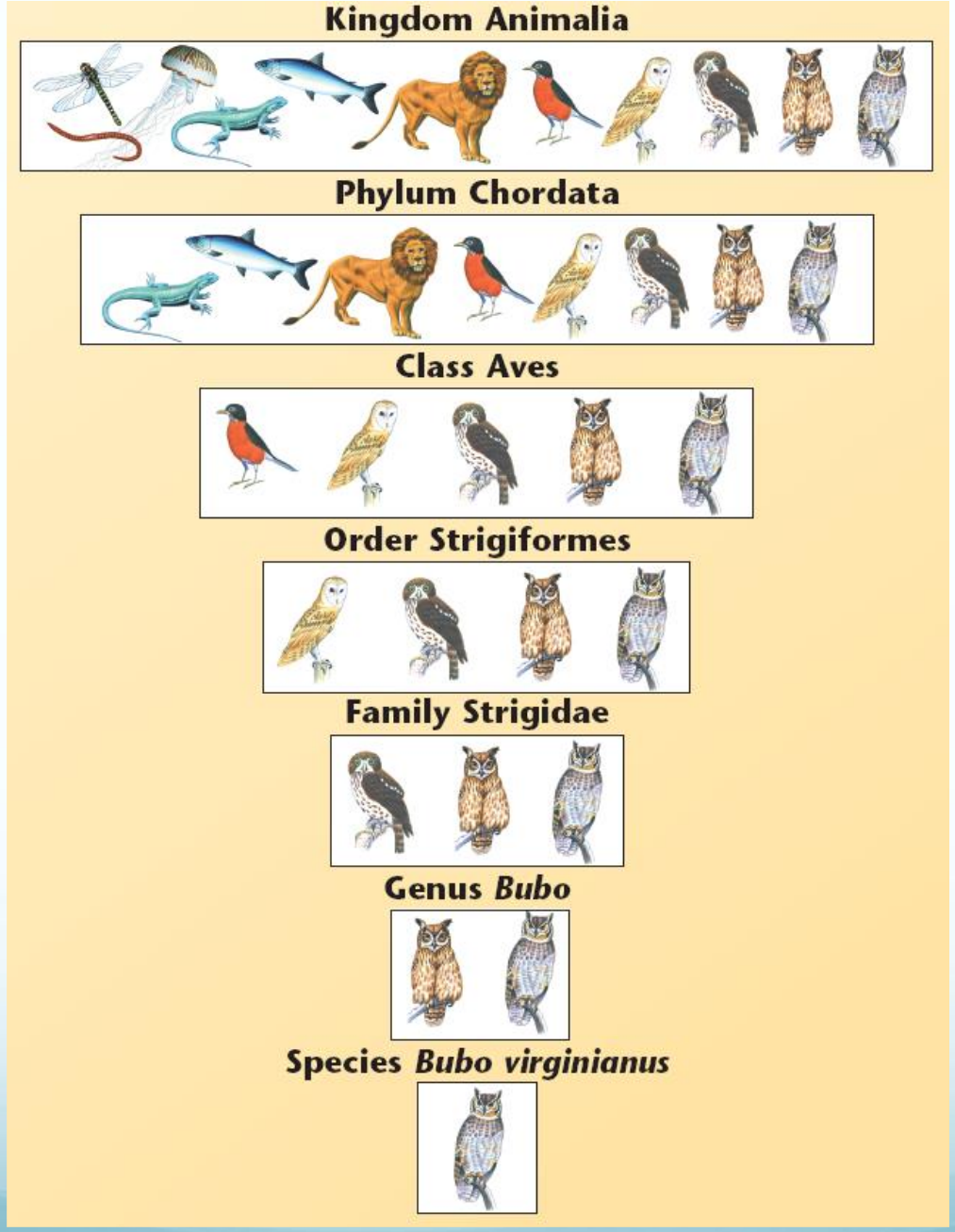
How Are Living Things Classified?

There are 7 levels (not including domains) in the classification system of organisms

As one goes from the Kingdom to the Species (**DOWNWARD**), there are fewer numbers and an increase in the similarity between organisms occurs



More alike



Fewer numbers

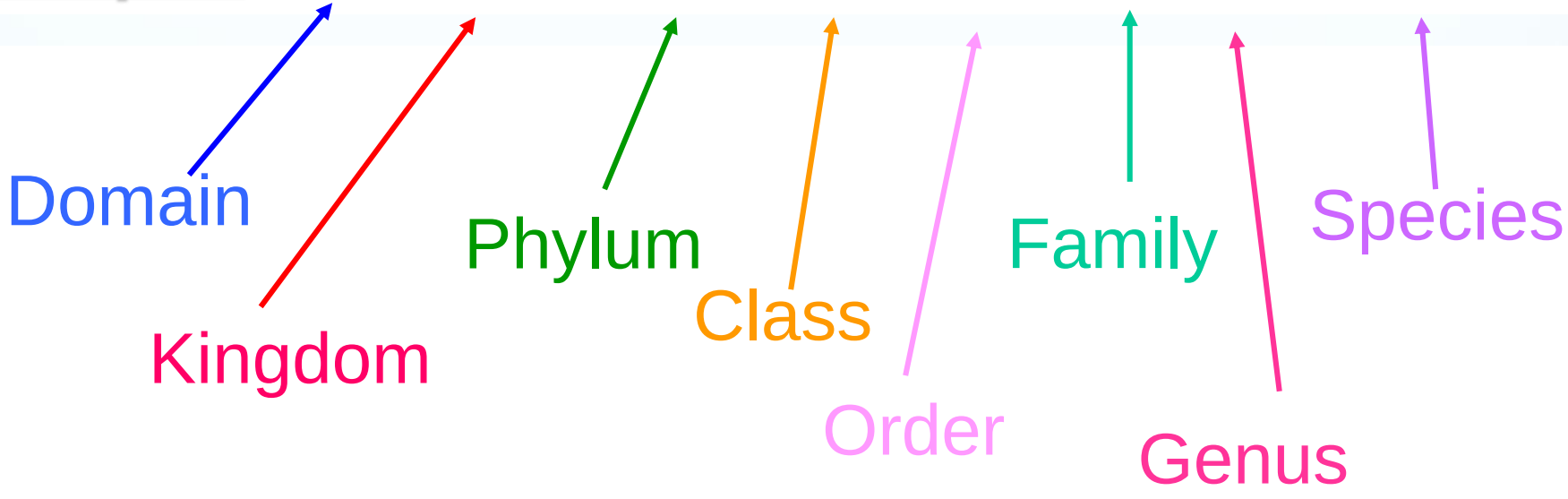
How Are Living Things Classified

- Domain: Highest level of classification (cell type)
- Kingdom: General level of classification
- Phylum: A subdivision of a kingdom
- Class: Each phylum is divided into classes
- Order: Each class is divided into orders
- Family: Each order is divided into families
- Genus: Each family is divided into genera
- Species: Lowest level (represents a single type of organism)

How Are Living Things Classified

Classwork: Write an ***original*** catch phrase for the categories of classification so that each word in the phrase begins with the letter of the category in their correct order from largest to smallest

Example: Dear King Phil came over for good subs



Share your ideas!!

DOMAIN
KINGDOM
PHYLUM
CLASS
ORDER
FAMILY
GENUS
SPECIES

HOW CLASSIFICATION WORKS- Example

Common Name: The ring-tailed lemur

Which of the three domains does the ring tailed lemur belong to?

Eukarya?
Bacteria?
Archaea?

KINGDOMS

<u>There are 6 Kingdoms:</u>

Animalia (Animal Kingdom)

Plantae (Plant Kingdom)

Fungi (Fungus Kingdom)

Archae (Ancient Bacteria)

Eubacteria (Advanced Bacteria)

Protista (Protists)

There are nearly TWO MILLION SPECIES within all the Kingdoms! We must narrow it down to one!

Which Kingdom does the ring-tailed lemur belong to?

PHYLA EXAMPLES

There approximately 40 phyla in the animal kingdom... approximately 800,000 species. (Much better than 2 million, but still a lot!)

Examples of animal phyla:

Porifera- animals that have a porous body

Cnidaria – stemmed from the greek word “cnido”, these are animals that sting.

Chordata- animals with spinal chords

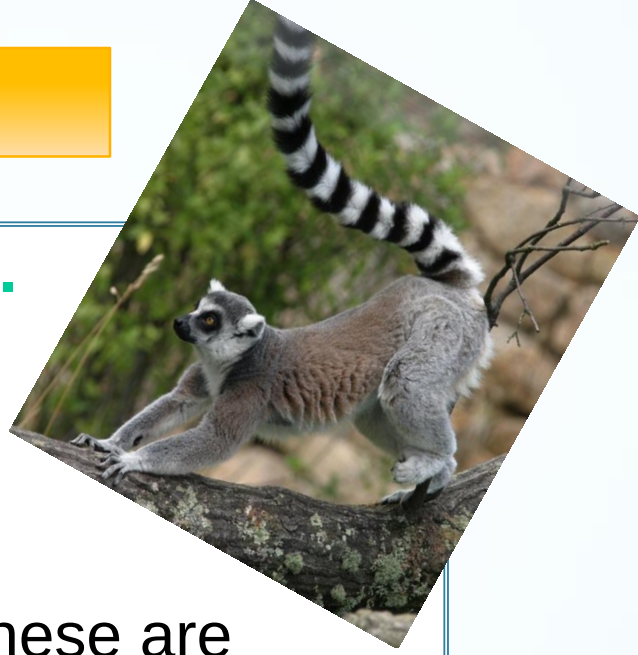
Annelida- the body of the animal is segmented and has no jointed limbs

Echinodermata- these are marine animals that have spiky skin.

Kingdom: Animalia
Phylum: Chordata

What is the next level of taxonomy to determine?

EXAMPLES OF CLASSES



There are 6 classes in phylum chordata.

Class Reptilia- The Latin word Reptili means “creepy”, or animals that crawl.

Class Amphibia- Amphi= double bia=life, these are animals that have life cycles in water AND on land.

Class Mammalia- The Latin word mammali means breast. These are animals that have mammary glands and produce milk.

Class Aves- “Avi” means to fly. These are flying animals.

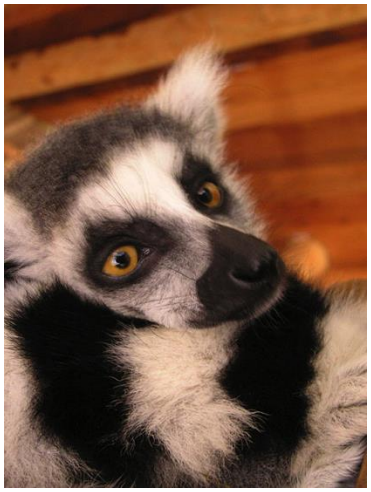
(The remaining two classes are the bony and cartilaginous fishes).

So far the Ring-Tailed Lemur belongs to:

Kingdom- Animalia

Phylum- Chordata

Class- Mammalia



Which taxonomy level comes after class?

ORDER EXAMPLES

In class Mammalia, there are 13 total orders that make up about 5,000 species. Getting closer!

Order Metatheria- the marsupials (development completed in a pouch).

Order Carnivora- This is where the carnivorous mammals belong such as raccoons.

Order Chiroptera- Chiro=hand, ptera= wing. Mammals that use their hands to fly.

Order Rodentia- mammals with teeth designed for gnawing.

Order Primates- mammals that have opposable thumbs and forward facing eyes.

Notice that as we continue to travel down the taxonomy ladder, the similarities among organisms increase.

FAMILIES WITHIN THE PRIMATE ORDER

The primate order consists of 10 families and approximately 350 species.

Hominidae (5 species)- Latin word meaning family of men

Pongidae (28 species)- The Apes

Cebidae (46 species) New world monkeys

Cercopithicidae (48 species)- Old world monkeys

Lemuridae (50 species) The large lemurs, the Latin word Lemur means “spirit”. Chosen for their ghostly faces and (for some) nocturnal habits.

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Primates
Family: Lemuridae

What else is left to find in order to complete the classification?

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Primates
Family: Lemuridae
Genus: Lemur
Species: Catta

Scientific Name: *Lemur catta*

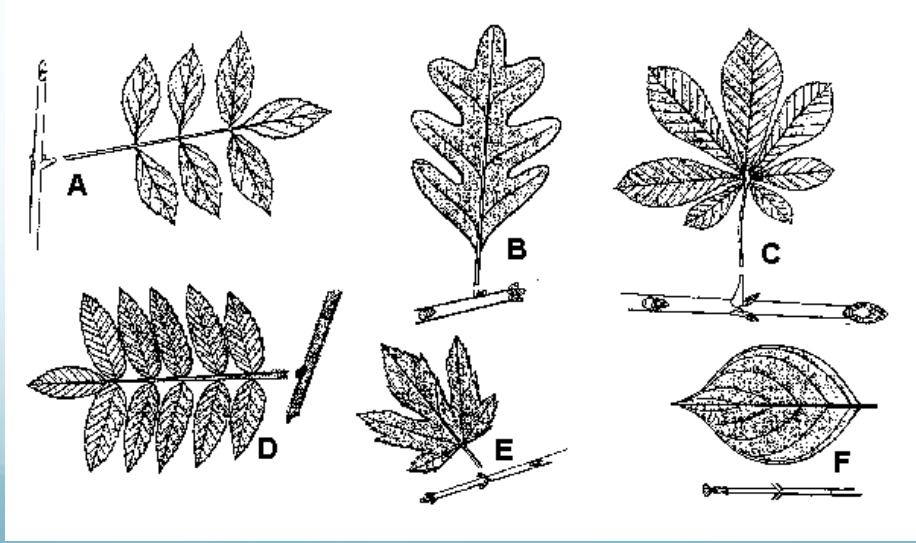
From this classification, we know that this organism:
•is an animal
•Has a backbone
•Has mammary glands
•Has opposable thumbs and forward facing eyes

Had we not been given information about this organism beforehand, we could still gain clues as to what it is from how it's classified!

DICHOTOMOUS KEY

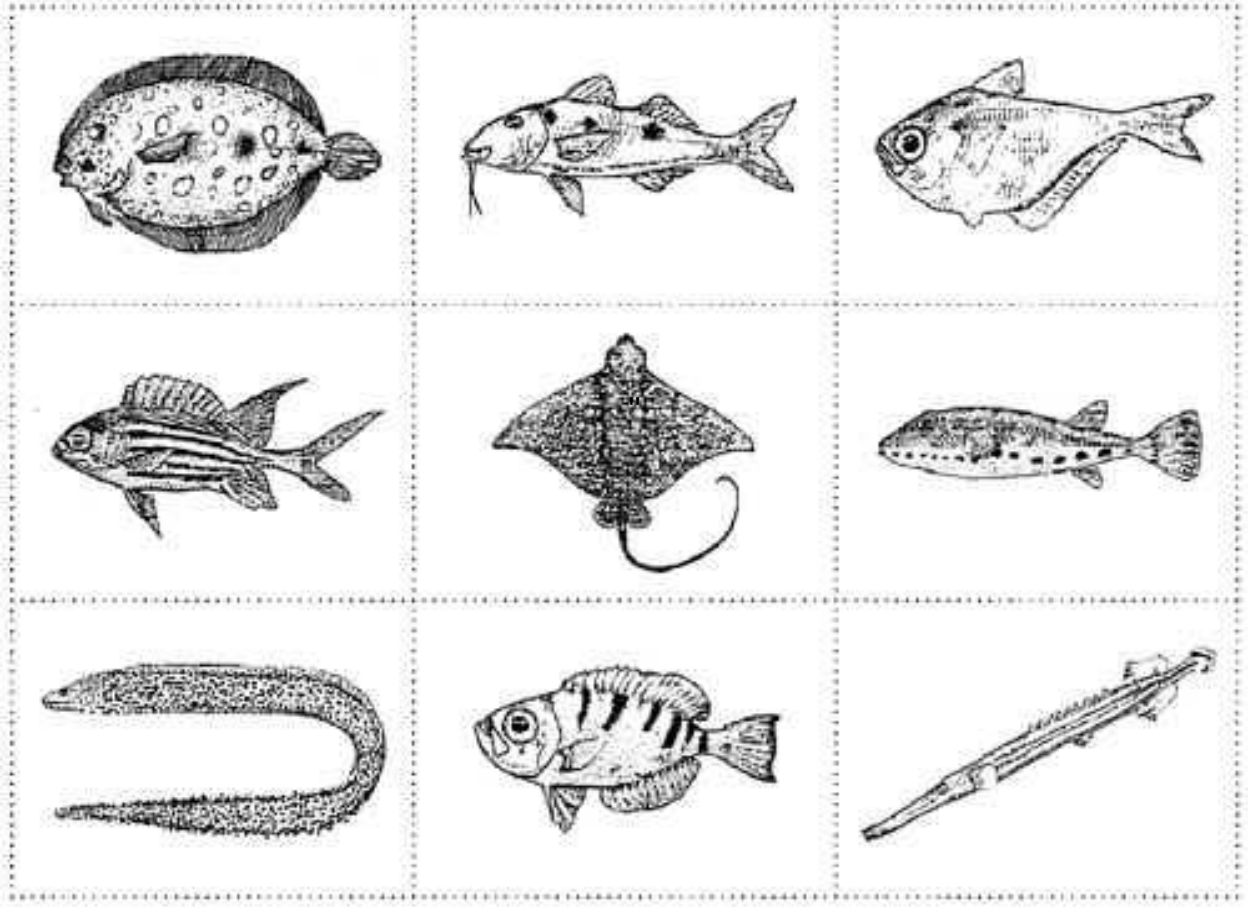
A dichotomous key is a reference tool used to determine the species of an unknown organism.

The key has a series of choices that leads to the identification of the species.



DICHOTOMOUS KEY

Example) Nine unknown species of coral reef fish



DICHOTOMOUS KEY

Step 1 If fish shape is long and skinny then go to step 2 If fish shape is not long and skinny, then go to step 3	**Step 5** If fish has spots, then go to step 6 If fish does not have spots, then go to step 7
Step 2 If fish has pointed fins, it is a trumpet fish If fish has smooth fins, it is a spotted moray eel	**Step 6** If fish has chin "whiskers," it is a spotted goat fish If fish does not have chin "whiskers," it is a band-tail puffer
Step 3 If fish has both eyes on top of the head, then go to step 4 If fish has one eye on each side of the head, then go to step 5	**Step 7** If fish has stripes, then go to step 8 If fish does not have stripes, it is a glassy sweeper
Step 4 If fish has long whip-like tail, it is a spotted eagle ray If fish has short, blunt tail, it is a peacock flounder	**Step 8** If fish has a v-shaped tail, it is a squirrel fish If fish has a blunt tail, it is a glass-eye snapper

ANSWERS

1. Peacock flounder
2. Spotted goat fish
3. Glassy sweeper
4. Squirrel fish
5. Spotted eagle ray
6. Band tail puffer
7. Spotted moray eel
8. Glass eyed snapper
9. Trumpet fish

How Biologists Classify

- Taxonomists= scientists that classify organisms.
  - Taxon= group of particular organisms
- Phylogeny = the evolutionary past of an organism.
- Taxonomists are constantly looking for clues to determine a species' phylogeny.

Taxonomists are like detectives. They look for features to learn about and classify living organisms!

Example: Whale Phylogeny

Why do you suppose whales have an interesting phylogeny (evolutionary past?)

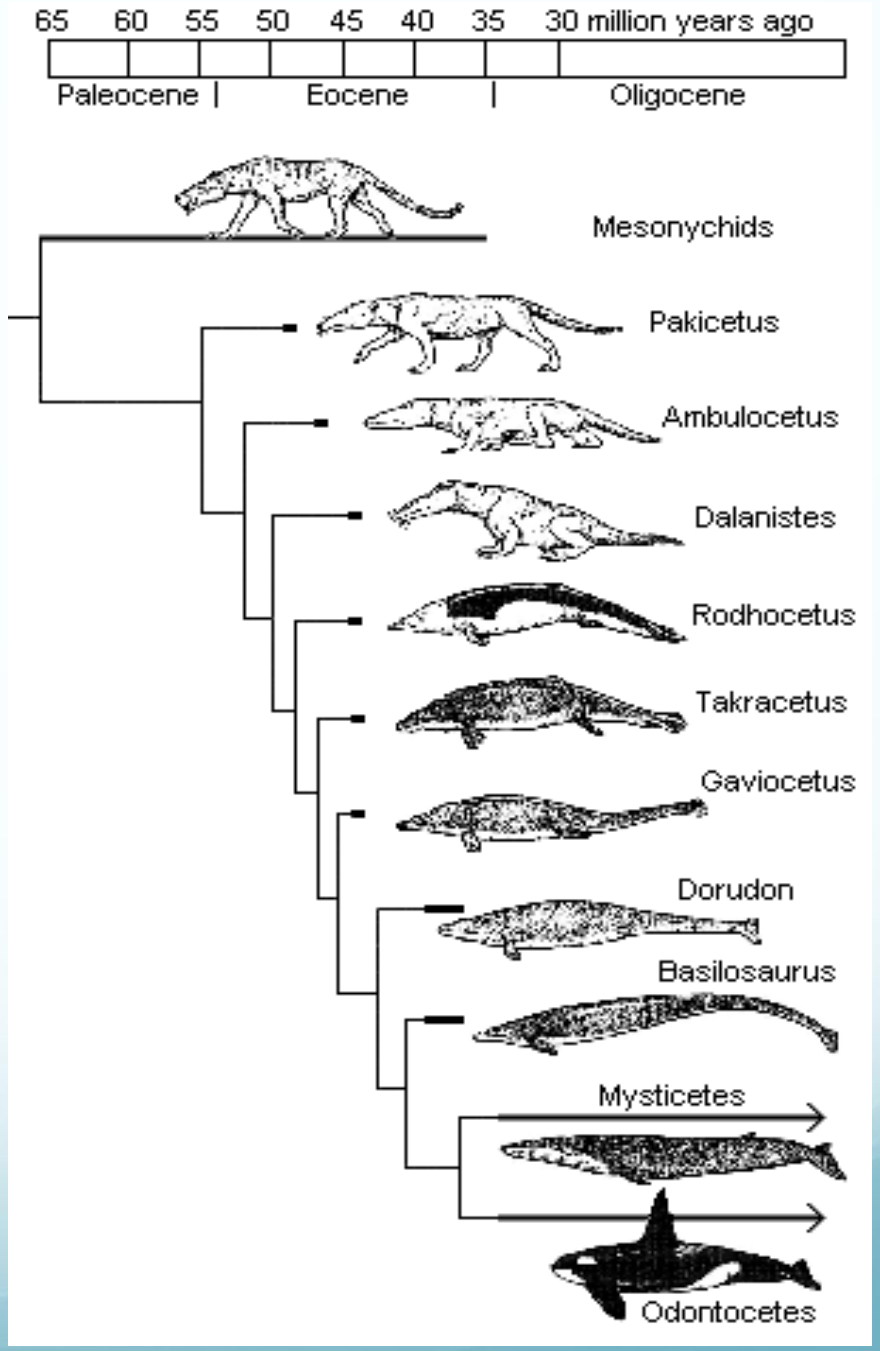
- Vestigial structures- hind limbs
- Live in the ocean
- Give live birth and produce milk (Mammals)

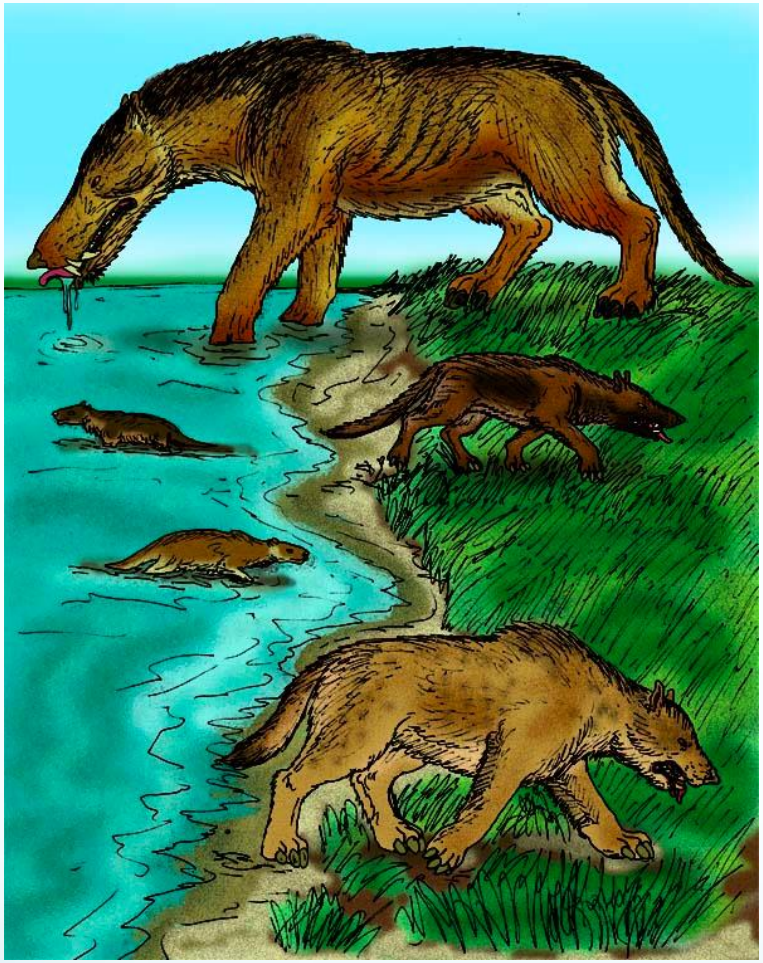
What might these features suggest about the phylogeny of whales?

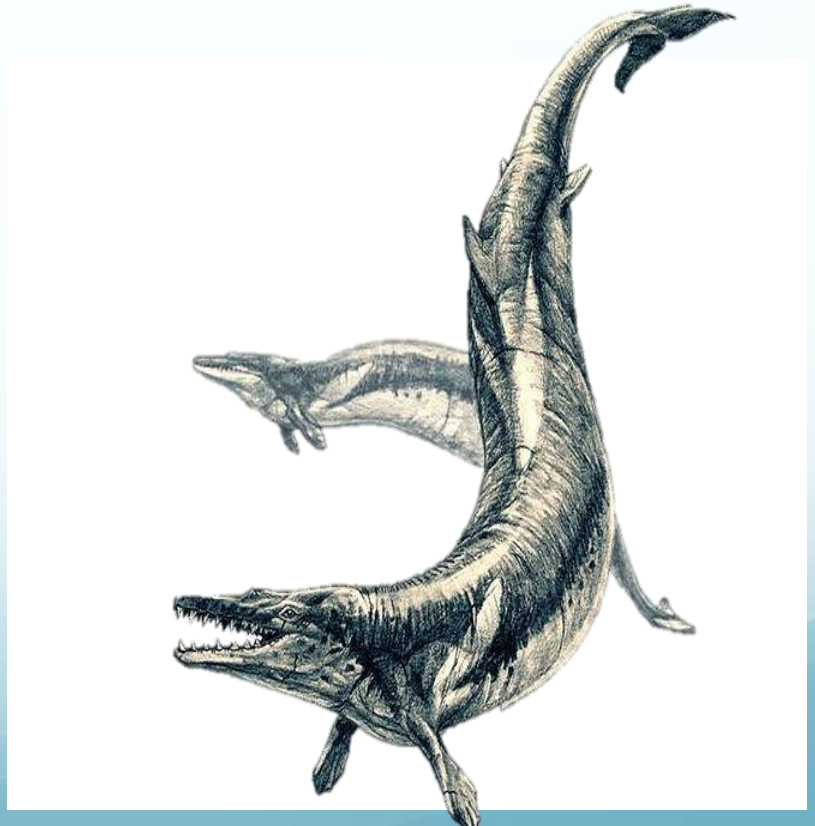
(What might their ancestor have been like)?

Example: Whale Phylogeny

Taxonomists and other types of biologists may have traced the ancestor of whales back to carnivorous land dwellers (mesonychids).







CONVERGENT EVOLUTION

Convergent evolution: A process in which similar features evolve in two completely different organisms due to similar environments.

- Convergent evolution leads to analogous characters- characters that are similar in function, but NOT in structure.

CONVERGENT EVOLUTION

- A frog and a duck are examples of convergent evolution. They both have webbed feet because they live in the water, but they are not closely related.

ANALOGOUS CHARACTERS

- Analogous characters refer to the similar characters found in convergent evolution.
- Example: webbed feet in frogs and ducks
- Example: wings found in birds and butterflies

Present in both groups of organisms.

Same function... Different structure!

DERIVED CHARACTERS

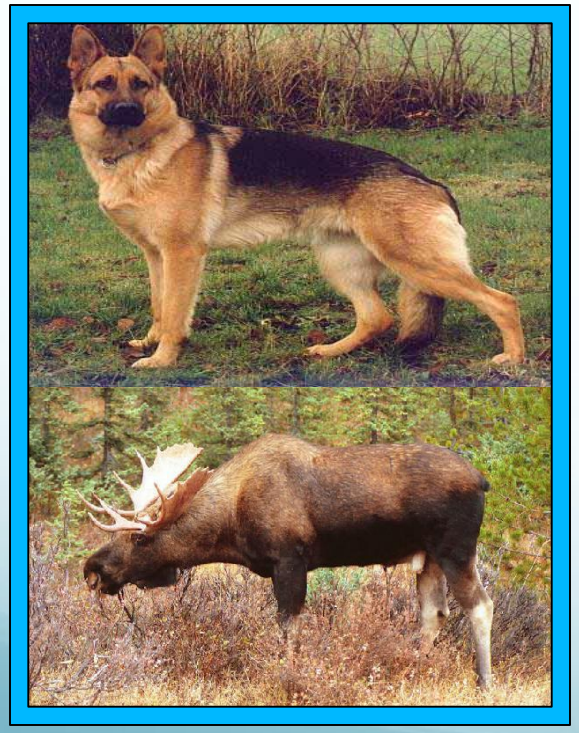
Derived characters are also determined when comparing two or more groups of organisms.

-Evolved in an ancestor of one group, but **not** the other.

Example: A derived character between birds and mammals is feathers.
Feathers evolved in birds, but not Mammals.
(Present in one group, but not the other).

DERIVED CHARACTERS

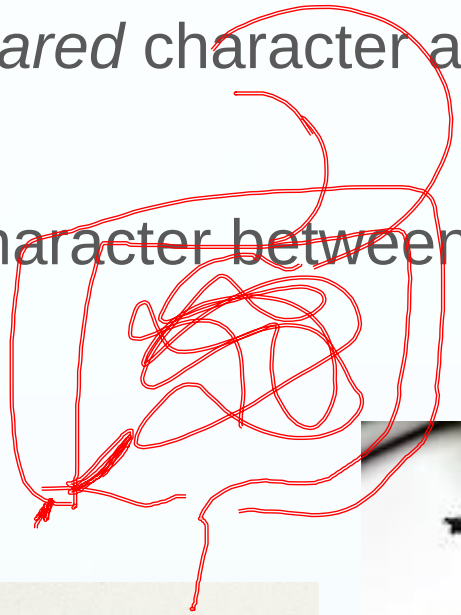
- **The more derived characters seen in two groups of organisms, the more distantly related the organisms are.**

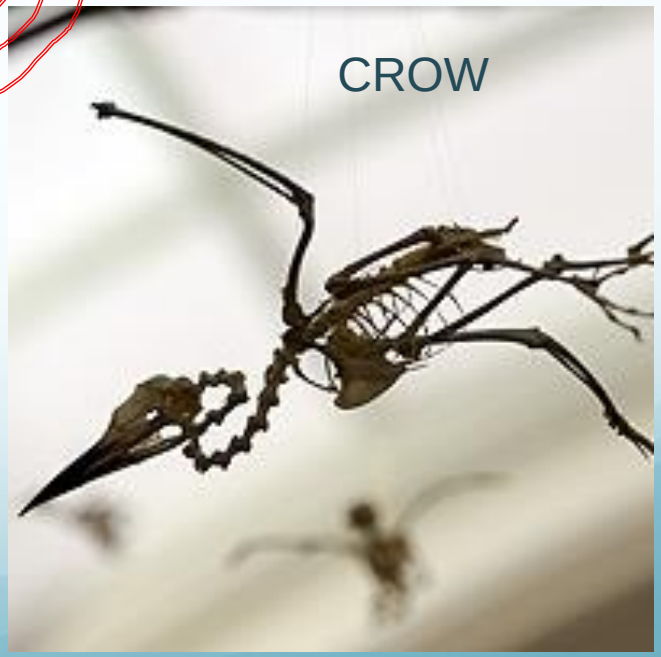


vs.

ANCESTRAL CHARACTER

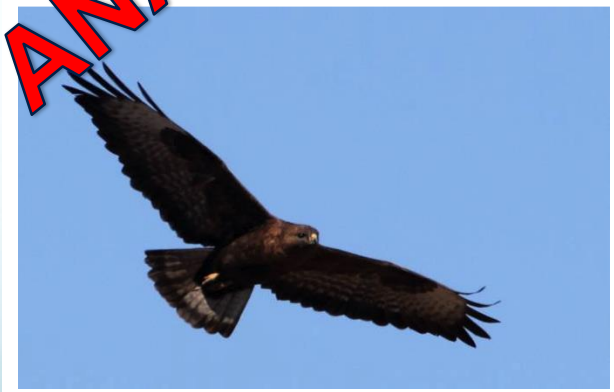
- Ancestral character: A *shared* character among two groups of organisms.
- Example: An ancestral character between birds and mammals is a backbone.





ANALOGOUS, DERIVED, ANCESTRAL?

Horns



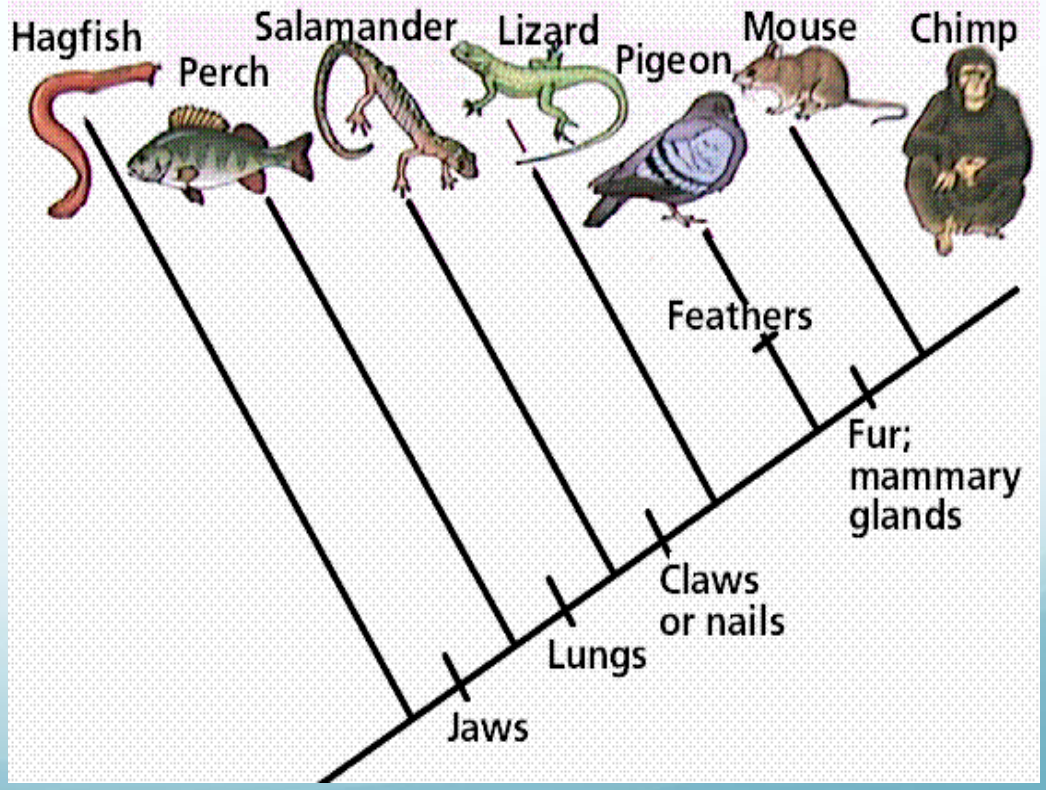
Wings

Wings

CLADISTICS

Cladistics= a method of studying organisms phylogenies by determining relationships based on derived and ancestral characters.

Cladistics uses a tool known as a cladogram to organize information.

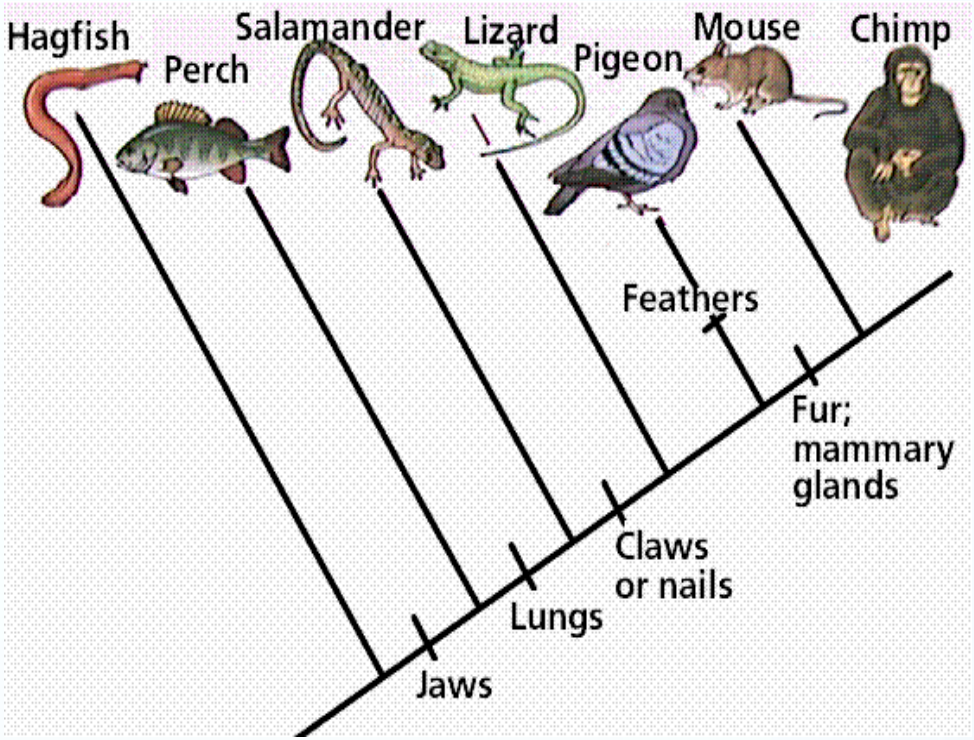


CLADISTICS

- Cladogram= a branching diagram that shows evolutionary relationships based on **derived** and **ancestral** characters.

- The closer two organisms are grouped together on a cladogram, the more closely related they are.
- Cladograms include **clades**- a group that includes an ancestor and all of its descendants.

CLADOGRAM



Notice that the cladogram has derived characters listed toward the bottom.

What are some derived characters?

-Jaws

-Lungs

-Claws or Nails

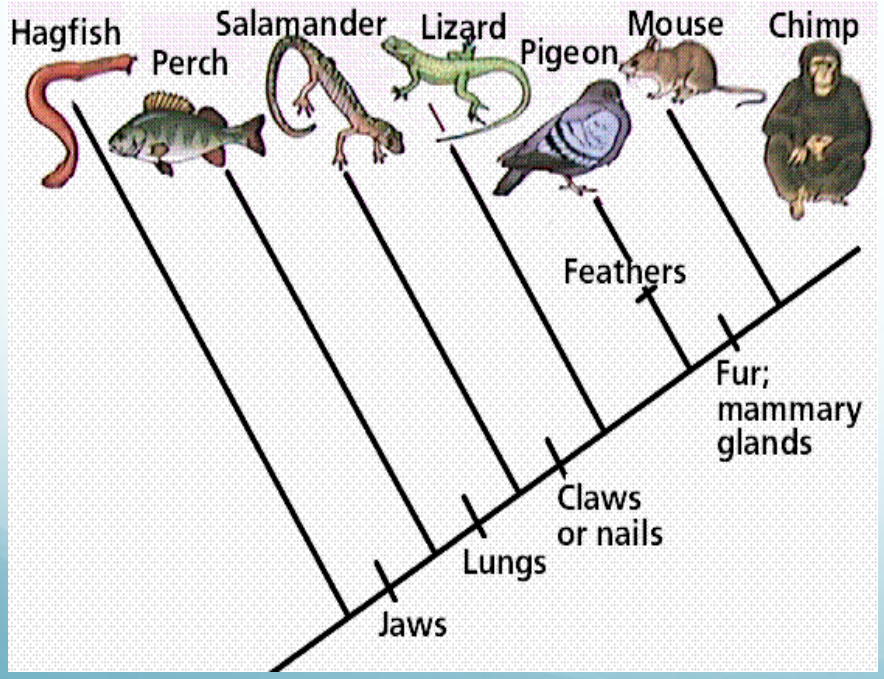
-Feathers

-Fur

-Mammary Glands

CLADOGRAM

- **Out-group:** the distantly related organism seen on a cladogram. The outgroup serves as a base for comparisons with the other organisms seen on the cladogram, which is known as the in-group.



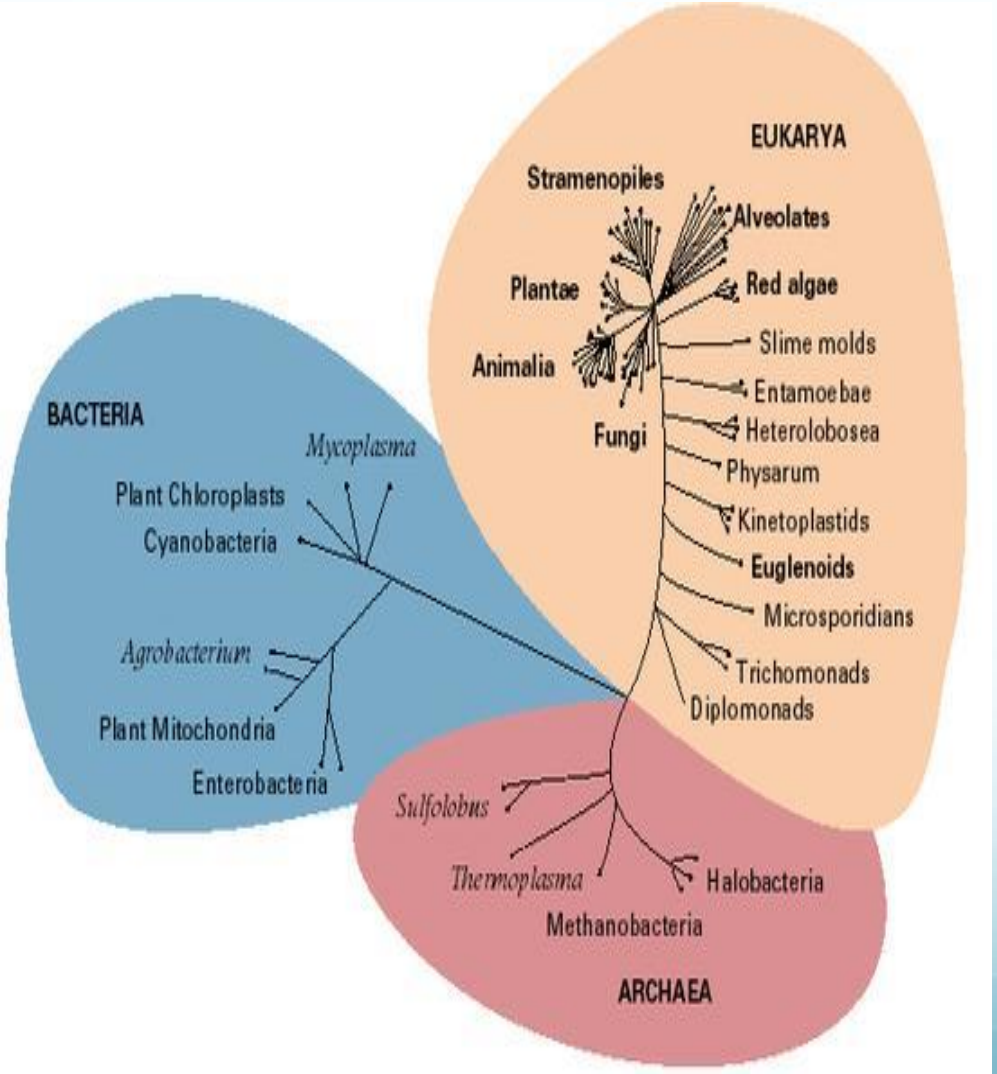
The out-group of this particular cladogram is the hagfish, because it does not contain any derived characters.

EVOLUTIONARY SYSTEMATICS

Evolutionary systematics: an alternative method of studying an organisms phylogeny and evolutionary relationships in which taxonomists assign varying degrees of importance to characters.

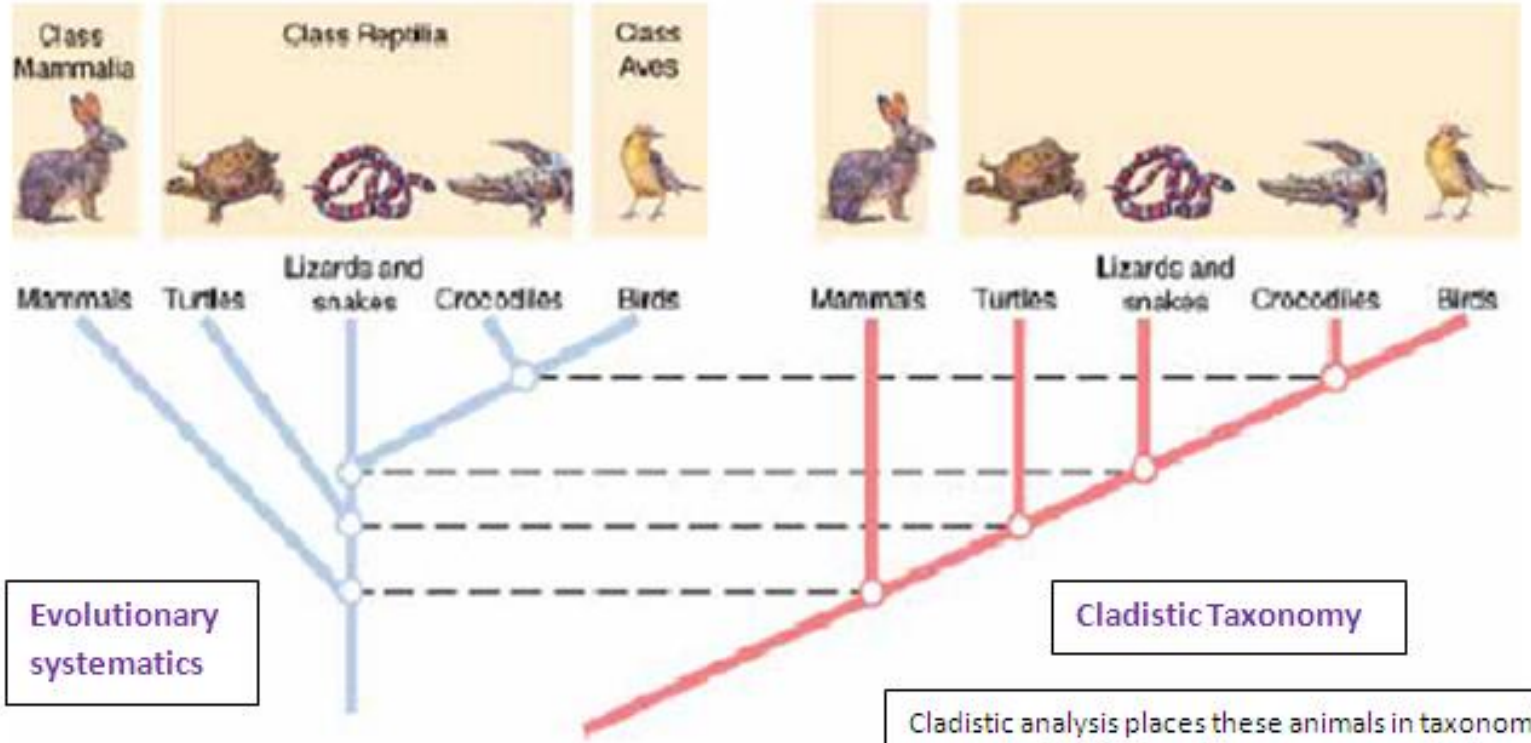
- This method creates a *subjective* analysis of evolutionary relationships.

PHYLOGENETIC TREE



- Evolutionary systematics uses a **phylogenetic tree** to determine evolutionary relationships.
- Phylogenetic trees also incorporate **time.**

Comparing Cladograms and Phylogenetic trees



Evolutionary systematics

Cladistic Taxonomy

Evolutionary systematic places birds in their own class (Aves), giving more importance to their unique characters, such as feathers.

Cladistic analysis places these animals in taxonomic groups that differ from those recommended by evolutionary systematic. For example, crocodiles and birds are grouped closely together because they share many derived characters.

COMPARE!

CLADISTICS

- Uses a cladogram.
- Organize organisms by shared ancestral or derived characters.
- Does **not** consider evolutionary time.
- The closer together organisms are grouped, the more closely they are related.

EVOLUTIONARY SYSTEMATICS

- Uses a phylogenetic tree.
- Organizes evolutionary relationships using unique characters, not necessarily ancestral or derived.
- Does consider evolutionary time.