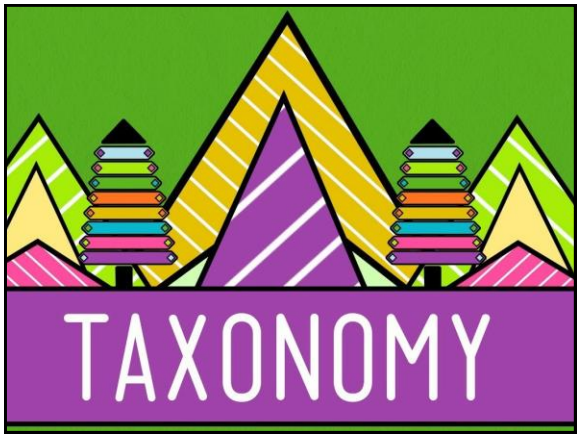
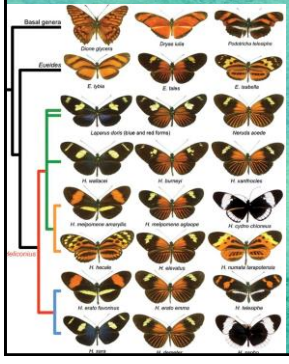


Groups and Names

- As humans, we tend to group things together
- What are some ways we can group these shapes?

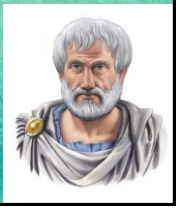
Taxonomy



- The science of naming and classifying organisms is called **taxonomy**.
- A **taxonomist** is a scientist that studies organisms and tries to determine their *relationships* with others.

History of Taxonomy

- **Aristotle** (384-322 B.C.) developed the first widely accepted classification system.
- He grouped plants and animals into basic categories according to their *structural* similarities.
- He classified:
  - Plants:
    - Herb; Shrubs; Trees
  - Animals:
    - According to habitat & physical differences



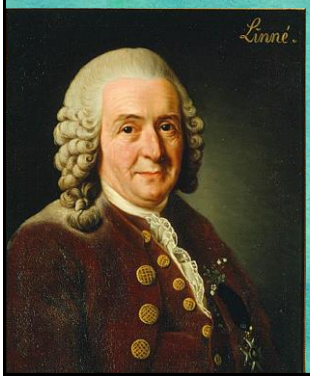
More History

- Later Greeks and Romans grouped plants and animals into basic categories
  - Example: oaks, dogs, horses
- They called each a **genus** (or group)
- In the Middle Ages, genera were named in *Latin*.
  - Biologists used descriptive phrases to classify each genus (sometimes up to 12 words long!!!)

Scientific Names in the Middle Ages

- The European honeybee was called:
  - *Apis pubescens, thorace subgriseo, abdomine fusco, pedibus posticis, gladbis, untrinque margine ciliatus*

There *had* to be an easier way!



- **Carolus Linnaeus** (1707-1778), a Swedish *botanist*, developed a system of grouping organisms that we still use today
- His system used an organism's **form** and **structure** to group it with other similar organisms.
  - ****Things they have in common****

Binomial Nomenclature

- Instead of a long polynomial name, Linnaeus used a ***two-word*** Latin name.
- Most of the organisms that he named are still called by the names he gave them over 200 years ago!
- This two-word system is called **binomial nomenclature**.

Back to that *CRAZY* honey bee

- Remember…the European honeybee was called:
  - *Apis pubescens, thorace subgriseo, abdomine fusco, pedibus posticis, gladbis, untrinque margine ciliatus*
- Linnaeus on the other hand called it:
  - *Apis mellifera*

Scientific Names Today

- The **first** word is the **genus**, which consists of a group of closely related organisms.
- The **second** word is the **species** name.
- **Species** names sometimes refers to:
  - A characteristic of the organism
  - The name of the person who discovered it
  - Or someone they name it after

Example

- ***Quercus*** - genus that contains oak trees
- ***Quercus rubra*** - red oak (rubra=red)
- Notice that the *genus* is **CAPITALIZED** but the *species* is **NOT**.
- Scientific names should be underlined or in *italics*
- You can also shorten it to *Q.rubra* (after you have spelled it out one time first)

Another way to think about it…

- **Genus** is like your **last name**
  - It tells what family you are in.
- The **species** is like your **first name**
  - It tells you apart from your family members.

Which organisms are more closely related?

- *Keratella cochlearis*
- *Keratella lumholsii*
- *Daphnia lumholsii*

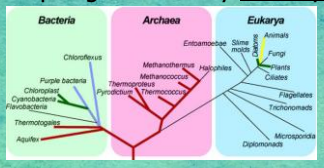
Scientific Names vs. Common Names

- Scientific names are in **LATIN** as a universally accepted language of science
- The Binomial Nomenclature naming system allows biologists to communicate regardless of their native languages

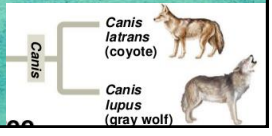
- Common names can be confusing
  - ex. Seahorses are not horses
  - Scientists may have different common names for different organisms

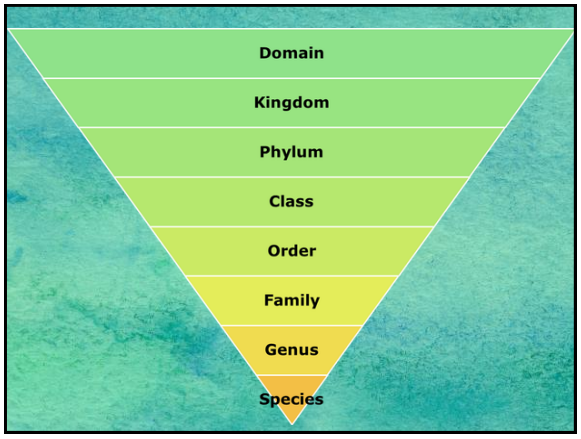
There are 8 ways to classify organisms

- We can group organisms very broadly



- Or very specifically
  - *Canis* is the genus that groups the coyote and grey wolf together

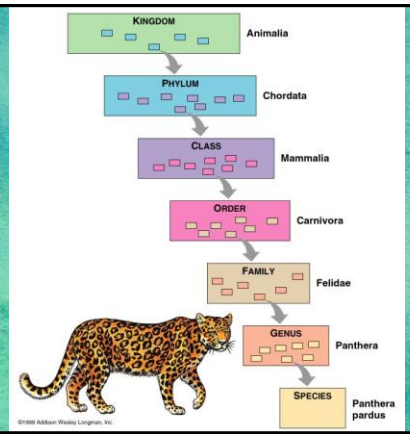




D.K.P.C.O.F.G.S.

◆Domain	Dear
◆Kingdom	King
◆Phylum	Phillip
◆Class	Came
◆Order	Over
◆Family	For
◆Genus	Great
◆Species	Spaghetti

Johnson



Jaguars

Practice Question

- Which taxonomic group would contain organisms that have the ***least*** number of similarities?

Biological Species

- A **biological species** – a group of natural populations that are ***interbreeding*** and that are reproductively isolated from other such groups.
- Sometimes two species are closely related enough to produce **hybrid** offspring (offspring of two different species)
- Some hybrids like **mules** are sterile
- Other hybrids like a **wolf-dog** hybrid can reproduce…because they are VERY similar as they are closely related
  - *Canis familiaris (dog)* and *Canis lupus (wolf)*

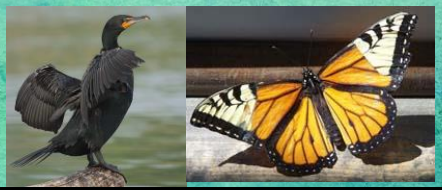
Hybrids

Liger Video

Evolutionary History

- Classification based on **similarities** often does **NOT** reflect an organism's **phylogeny** (evolutionary history)
- This can be deceiving!
  - Wings of birds & wings of insects
    - What type of structures would these organisms exhibit?
  - Fossil and DNA evidence suggests that they evolved independently of one another.

- Organisms of different species that live in similar environments may evolve similar functions (**convergent evolution**).
  - These similarities are called **analogous structures** (Their ancestors experienced similar environmental pressures which caused them to evolve similar characteristics over many generations).

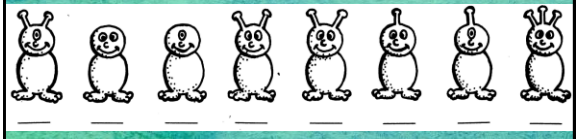


Dichotomous Keys

- A dichotomous key is a tool that allows biologists to determine the identity of organisms in the natural world based on the organism's characteristics
- "Dichotomous" means
  "divided into two parts" -Greek origin
- Dichotomous keys always give two distinct choices in each step, often they are opposites
  - Black/white; pointed/rounded

How to use a Dichotomous Key?

Here are some organisms we don't know…



Lets choose only 1 at a time!

How to use a Dichotomous Key?

- Read steps 1a and 1b
- Decide which statement is true

1 a. The creature has two eyes.
b. The creature has one eye.

How to use a Dichotomous Key?

Then follow the directions after that step.

1 a.	The creature has two eyes.	Go to step 2.
b.	The creature has one eye.	Go to step 5.

Go to step 5!

How to use a Dichotomous Key?

At choice 5, you make another dichotomous choice

5 a.	The creature has one or more antennae.	Go to step 6.
b.	The creature has no antennae.	Its name is "A."

Go to step 6!

How to use a Dichotomous Key?

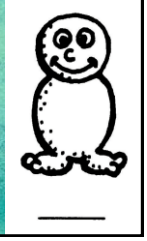
Keep going until you come to a step that gives you the creature's name.

6 a.	**The creature has one antennae**	**Go to Step 7.**
b.	The creature has two antennae.	Its name is "C."

How to use a Dichotomous Key?

What about the other organisms?

- Choose a new organism to identify and **start at step 1a and 1b** again. Continue until you find the organism's name.

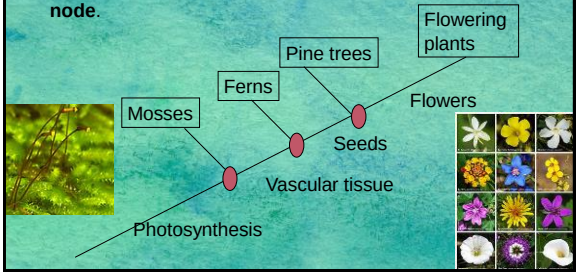


Cladistics

- **Cladistics** is a method of analysis that reconstructs phylogenies by inferring relationships based on shared characteristics.
  - Shows the order in which derived characteristics are evolved
- There are two types of characteristics that are used in cladistics.
  - **Ancestral Characteristics** - evolved in a common ancestor of both groups
  - **Derived Characteristics** - evolved in an ancestor of one group, but not the other

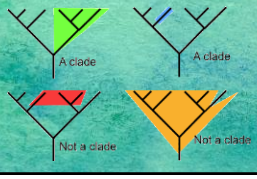
Cladograms

- Biologists use *branching diagrams* called a cladogram to group organisms as well as to separate them.
- All groups on a cladogram share a **common ancestor**.
- Branches divide further into 2 branches at a point called a **node**.

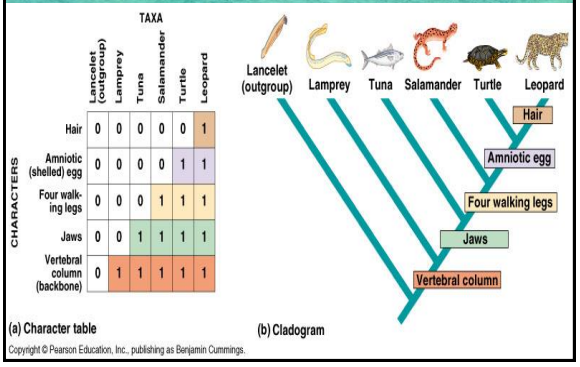


Cladograms

- **A clade** includes a single common ancestor and all of its living and extinct descendants
  - Organisms in the same clade are more closely related than organisms in different clades
  - May be different from a group in Linnaean taxonomy (kingdom, phylum, class etc.)
    - Class Reptilia is different from clade Reptilia
- Individual branches of cladograms are also called clades



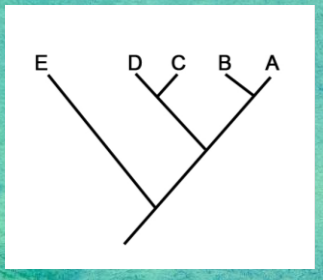
Cladogram



Phylogenetic Tree

- Scientists use **phylogenetic trees**, which are different from cladograms because they give **varying degrees of importance** to characteristics
  - Example: They might separate birds from reptiles because feathers are considered to be important enough to separate them into a completely separate group.

Practice Question



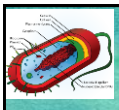
Which organism is most closely related to organism B?

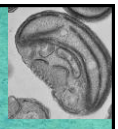
Cladogram vs. Phylogenetic Tree

- The branch points on a phylogenetic tree correspond to **derived traits** and the branch points on a cladogram **correspond to points in time**.
- A phylogenetic tree has **fewer branches** than a cladogram.
- A phylogenetic tree starts with a **common ancestor** and a cladogram starts with an **outgroup organism (reference group/group to compare with).**

The 6 Kingdoms

THE DOMAINS





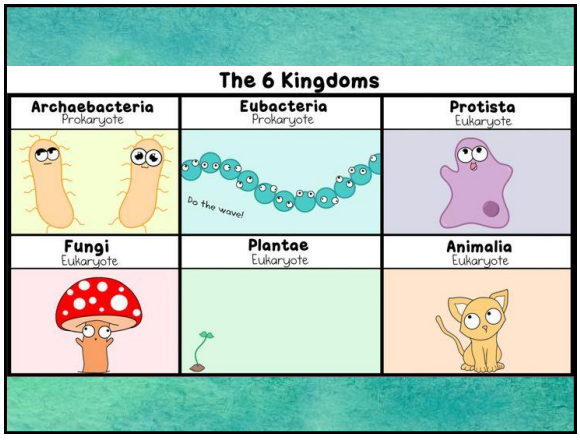
- Up until 1977, scientists recognized only **two** domains of life:
  - Prokaryotes
  - Eukaryotes
- In 1977 Carl Woese and his colleagues proposed that some prokaryotes were SO different from other prokaryotes that they should be in a group all their own.
  - He based this on their RNA- specific base sequences
  - In 1996 a DNA comparison was made and **the three domains became official**

The Three Domains

1. **Bacteria**
   - ❖Contains one Kingdom (Eubacteria)
2. **Archaea**
   - ❖Contains one Kingdom (Archaebacteria)
3. **Eukarya**
   - ❖Contains 4 diverse Kingdoms (Protista, Fungi, Plantae & Animalia)

How are organisms classified?

1) Cell Type: Prokaryotic or Eukaryote?
2) Type of Reproduction: Sexual or asexual?
3) Cell Walls: Absent or Present?
4) Body Type: Unicellular or Multicellular?
5) Nutrition: Autotrophic or Heterotrophic?



Kingdom Archaebacteria

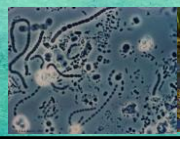
- **Prokaryotic, Unicellular**
- **Asexual Reproduction/Binary Fission**
- Have cell wall & cell membrane
  - Their cell walls **do not contain peptidoglycan** and their lipids are very different from eubacteria and eukaryotes.
- **Autotrophic or Heterotrophic**
- **Free-floating or motile**

Kinds of Archaebacteria

- Extremophiles - Live in extreme environments
  - Methanogens
  - Thermophiles
  - Halophiles
- Nonextreme Archaebacteria

Methanogens

- Found in swamps, in the digestive tracts of mammals, or hot springs
- Found in anaerobic environments (no oxygen)
- They make **methane** gas as a waste product
- They are used in sewage treatments & cleaning oil spills



Thermophiles

Thermophiles – thrive in extremely acidic, hot and moist regions, such as those in and near sulfur hot springs

- If they are in temperatures below 131 degrees F (55 degrees C), they die.

Halophiles

Halophiles - thrive in extremely salty environments

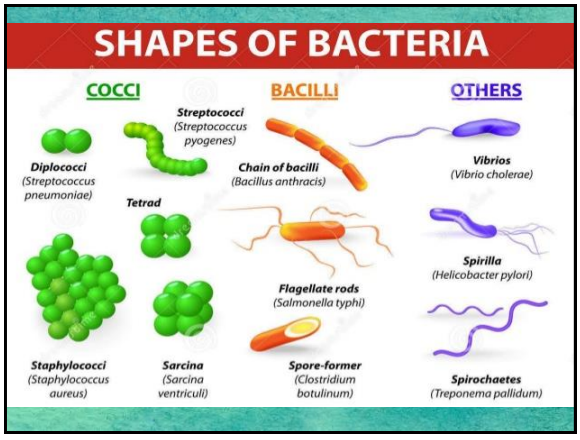
- They make their home in water and soil, as long as there is a very high amount of salt.

Non-extreme Archaebacteria

- Non-extreme Archaebacteria – grow in the same environments that "normal" bacteria do (almost anywhere)
- Although scientists have long known the importance of bacteria in healthy soil, they have only recently begun to understand the importance of nonextreme Archaebacteria in soil!

Kingdom Eubacteria

- **Prokaryotic, Unicellular**
- **Asexual Reproduction/Binary Fission**
- Cell Wall
  - Eubacteria have cell walls containing **peptidoglycan** *(mesh-like layer made of sugars and amino acids)*
- **Can be autotrophic or heterotrophic**
- **Can be free-floating or motile**
- Good, Bad, and Ugly
  - kill thousands upon thousands of people each year, but also serve as antibiotics producers and food digesters in our stomachs
- Examples: E. Coli & streptococcus

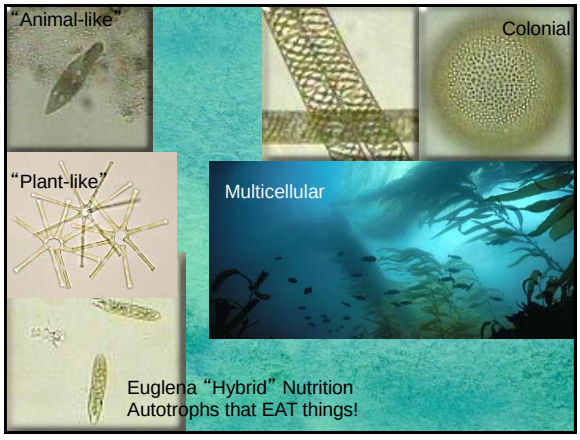


Domain Eukarya

- Highly organized cell interior
  - The organelles and nucleus allow for specialized function within each cell
- Multicellular
  - Not all eukaryotes are multicellular, however, all eukaryotic kingdoms have at least a few multicellular members
- Both Asexual & Sexual Reproduction
  - Yeast and some plants do asexual reproduction

Kingdom Protista

- **Eukaryotic**
- Contains "Animal-like" and "Plant-like" organisms
- MOST are **unicellular** BUT a few are multicellular ***(like kelp)***.
- Some make their own food (autotrophic) others do not (heterotrophic).
- Some have cells walls & some do not.
  - Some that have cell walls are made of cellulose.
- Motile
- Examples: Amoeba, slime molds, kelp & paramecium

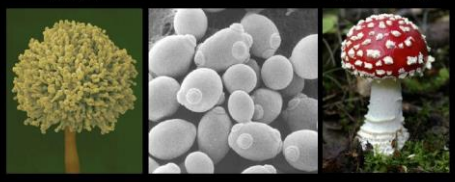


Kingdom Fungi

- **Eukaryotic**
- Cells walls contain **chitin**
- Reproduce asexually & sexually
- Most are **multicellular** BUT some are unicellular.
- ALL are **Heterotrophic**
- **Sessile-** no locomotion
- Examples:
  - Yeasts, mushrooms and molds

Kingdom Fungi

Mold | Yeast | Mushroom



http://www.youtube.com/watch?v=XuKjBIBBAL8

Kingdom Plantae

- **Eukaryotic**
- Cell walls contain **cellulose**
- Reproduce asexually & sexually
- ALL are **multicellular**
- ALL are **autotrophic**
- Sessile- no locomotion
- Includes all kinds of plants from nonvascular plants like moss all the way to daisies and oak trees!

Kingdom Animalia

- **Eukaryotic**
- **Both asexual & sexual reproduction**
- **Do NOT contain cell walls**
- ALL **multicellular**
- ALL **heterotrophic**
- Can be sessile or motile
- Examples:
  - Humans, dogs, fish, etc.

Practice Question

Biologists have found a **unicellular** organism and know that is a **prokaryote**.

To successfully classify the organism into the appropriate kingdom, what would the biologist have to determine?

Practice Question

What should this *eukaryotic organism described below be classified as?*

Experimental Observations

1. Nucleus is present.
2. Cell wall is present.
3. Chloroplasts and mitochondria are both present.

Answer: Plant

Practice Question

A "yes" answer to the following question, would identify an organism as being in what kingdom?

Is the organism complex, and does it have the ability to make its own food from sunlight?