# Taxonomic Classification

BI 201 Natural History of Guam

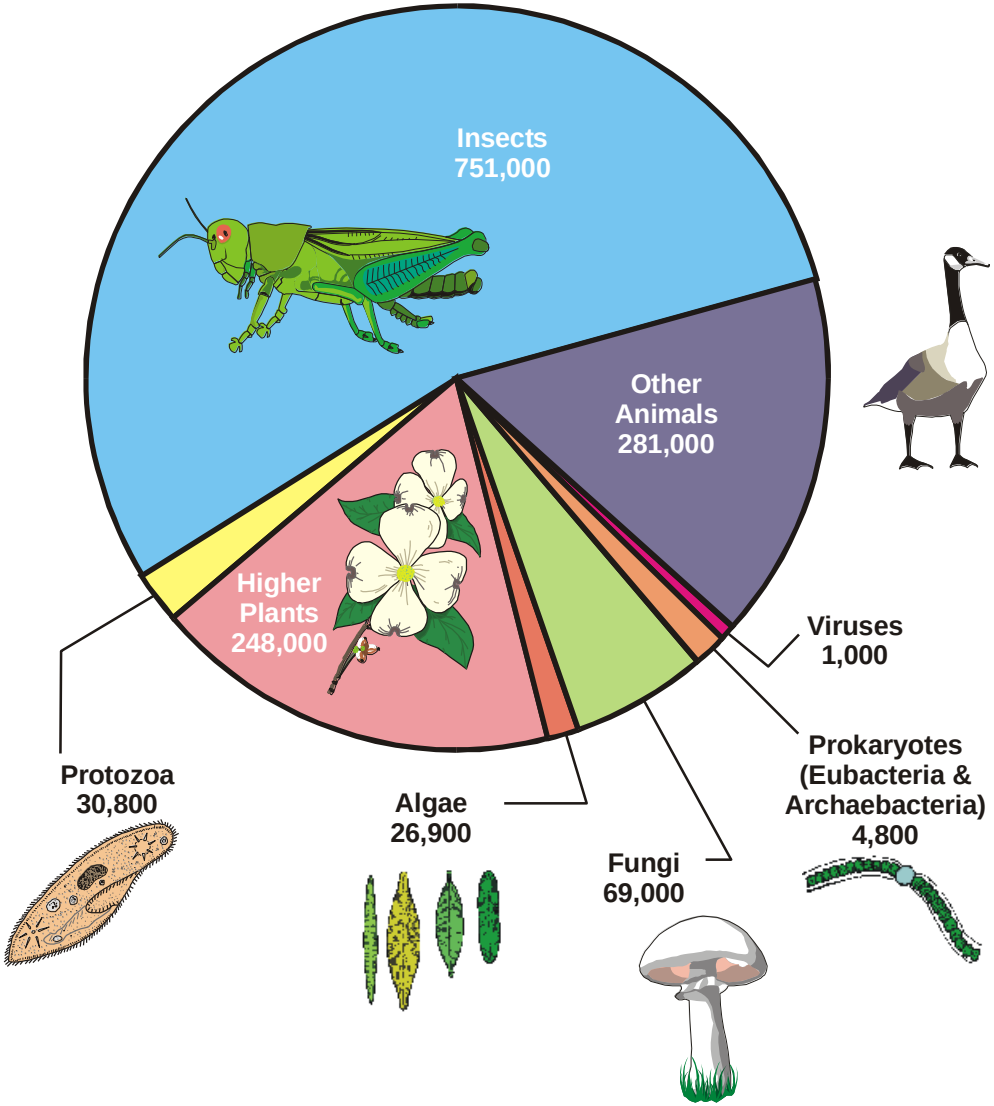
Class Presentation 25

# II. Taxonomic Classification

- **Taxonomy**
  - Taxonomy is the branch of biology devoted to naming and describing organisms
    - Any particular group of organisms is called a **taxon**
    - For example, all snails belong to the taxon known as the Class Gastropoda

- Need for Classification
  - Scientists need to communicate the results of their research
  - They must be sure that everyone understands exactly which species was studied in their research
  - There are more than 1 million species of animals described and about 250,000 plant species described

## ALL ORGANISMS: TOTAL SPECIES 1,413,000



- The number of undescribed species may be as many as 99 million
- Therefore, scientists must be able to arrange life forms into a workable classification scheme

- History of Classification
  - Over the centuries, several classification schemes have been proposed
  - All are hierarchical—reflecting different degrees of similarity among organisms, i.e., similar organisms are placed together in the same taxon
    - In the early years, similarity in appearance was believed to be a result of common ancestry, but there were some exceptions

- Modern classification dates from mid-eighteenth century
  - Carolus Linnaeus (1707–1778) is considered the Father of Modern Taxonomic Classification
    - Linnaeus was a Swedish medical student studying in Belgium
      - His real name was Carl Ingemarsson
    - To help pay his tuition costs, Linnaeus was contracted by wealthy Dutch patrons to catalog all species in their curio cabinets

- Linnaeus adopted a system of **binomial nomenclature**
  - He assigned a unique, two-part scientific name derived from Latin or Greek to each kind of organism
  - Therefore, each organism is called by its Genus and species names

- Conventions of Linnaean taxonomy:
  - A scientific name is always *italicized* or underlined
  - A genus name begins with UPPERCASE, while a species name is lower case, e.g., *Homo sapiens* or *Boa constrictor*
  - The genus is a noun, and the specific epithet is an adjective that must agree with its noun in both number and gender
- When a binomial designation has been published, then it cannot be used for any other species
  - Why?
    - Binomials are unique to eliminate confusion that often arises from regional differences in common names

- For example, what is a skipjack?
- In Guam, a skipjack is a young trevally
- In Hawaii, a skipjack is a tuna

***Caranx melampygus***

***Kasuwonus pelamis***




**Common names can create confusion**

- Linnaeus began his work on zoological classification with publication of the first edition of *Systema Naturae* in 1735 (at age 28!)
  - He subsequently published twelve editions of the *Systema* in all, but modern zoological taxonomy dates from the 10th edition, published in 1758
- Botanical classification dates from Linnaeus' *Species Plantarum* published in 1753
- Linnaeus was such a proponent of his binomial system that he Latinized his own name, changing Carl to Carolus and adopting a new last name based on a huge linden tree that grew near his father's home

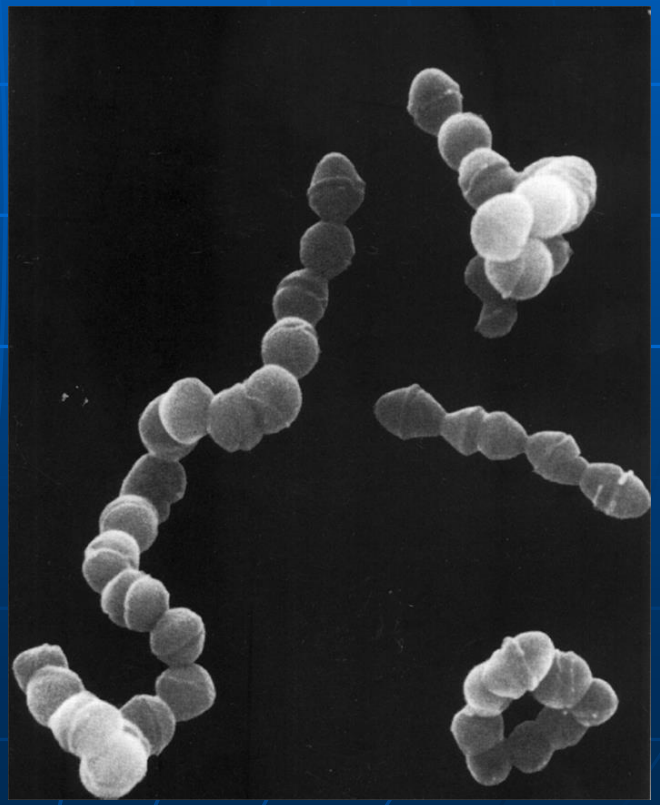
- Learning scientific names
  - Learning scientific names is not difficult, and can even be amusing
  - In fact, you already know some scientific names

- *Homo sapiens* is sapient (wise or aware) man
- But, what is *Cocos nucifera*?
  - the coconut tree

    *nuc* = nut + *fera* = carrying

- What about *Streptococcus pneumoniae*?
  - This is the bacteria that causes serious throat and lung infections, e.g., strep throat and pneumonia
    - *strepto* = twisted

      \+ *coccus* =berry



- What is *Vibrio cholerae*?
  - This is the bacteria that causes cholera

- He named this species *Distorsio anus* because of the shape of the aperture

- He named this species *Crepidula fornicata*, based on its unusual life history and sex reversal

- Other anatomical parts, some ribald, were used as well
  - He named the butterfly pea *Clitoria ternatea* because of its resemblance to human female anatomy

- Male anatomy was not ignored, either
- He named the stinkhorn mushroom *Phallus impudicus*

- Other scientists have revealed a sense of humor, as well
  - Alan Solem enjoyed a good pun
    - He described a new species of land snail that he found near the village of Ba in Fiji
    - The new species did not belong to a recognized genus, so Solem described a new genus, *Ba*, as well
    - The new species?

      *Ba humbugi*

- He also wanted to name the species that came first when all species were listed in alphabetical order, so he described *Aaadonta* (to precede *Aardvark*), but he as been displaced by the genus *Aa*
- He also wanted to name the last species in alphabetical order, so he described *Zyzzyxdonta*, which interestingly enough is the extreme opposite in shell characters as *Aaadonta*

- Professor Emeritus Lucius Eldredge named a new tunicate after his favorite drink, *Didemnum gintonicum*
- Surprisingly, the author of a new genus of clams that he called *Abra* did not describe the first species as *Abra cadabra,* but another scientist did later

- Not all taxonomy is frivolous, and there are rules governing the naming of new species
  - Rules are established by international bodies, e.g., the International Commission on Zoological Nomenclature and the International Commission on Botanical Nomenclature

http://www.iczn.org/iczn/index.jsp

- Higher-Level Classification
  - Linnaeus also categorized the natural world into higher taxa of kingdoms and classes
    - He recognized three kingdoms: plants, animals, and minerals
    - Within the animal kingdom, he recognized six classes: mammals, birds, amphibians, fish, insects, and worms
  - The number of higher taxa has increased to reflect the complexity of living organisms

- Higher systematics include the following taxa in order of increasing similarity and common ancestry

Kingdom
Phylum [Bot. = Division]
Class
Order
Family
Genus
Species

- There may be intermediate taxa between these major categories, e.g., Superclass or Suborder or Infraorder
- The hierarchy is designed to reflect phylogenetic relationships
  - Higher taxa include many organisms that share certain common characteristics and presumably a common ancestor
  - Higher taxa share fewer similarities but include more organisms
  - Lower taxa share greater similarities but include fewer organisms

- Modern Taxonomy
  - Modern taxonomists strive to classify organisms based on **phylogeny** rather than just similar in appearance
    - Phylogeny describes the evolutionary relationships of organisms
    - Therefore, modern classification reflects commonality of descent
    - Therefore, all taxa in any given group have a common ancestral origin, which is usually depicted in a phylogenetic tree

- Taxonomists try to determine phylogeny by analyzing as many **characters** or **character states** as possible
  - Characters and character states may include a diversity of factors, including morphology, anatomy, life history, biogeography, habitat, behavior, protein structure, chromosome structure, gene structure

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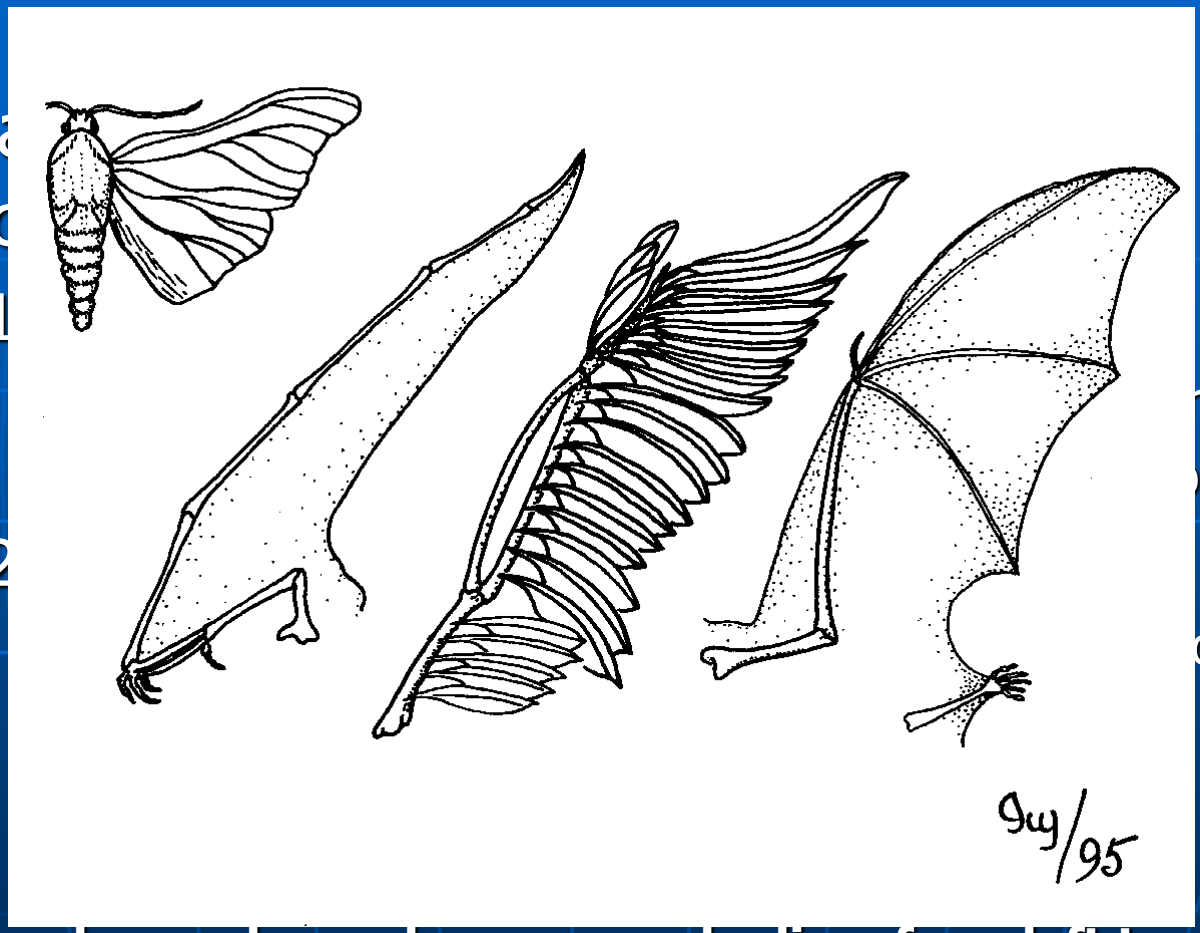

**Homologous bones have same shading, from left to right: horse, man, whale, crocodile, and bird. (Patterson, 1997)**

**Analogous structures: wing of an insect, bird bat and pterosaur**

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- Therefore, natural sel
  adaptations
  - e.g., fins of fishes and
  - e.g., shells of sand-dw augers and turritellas and ceriths

- Species Concept
  - The most objective biological unit of classification is the species, because it is not an artificial construct
  - A **species** consists of all the organisms that can interbreed, thereby exchanging genetic information, and producing viable offspring

- Important points in the definition of a species
  - Species are genetically isolated from other species
  - Even if different species attempt to mate, there may be incompatibilities in structure of sex organs or in sperm-egg interactions
  - Species are self-perpetuating
  - Species may or may not be morphologically distinct (e.g., sibling species)

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- If viabl d, the **hybrid** (or cro sually sterile
  - e.g.,
    - M uced by mating
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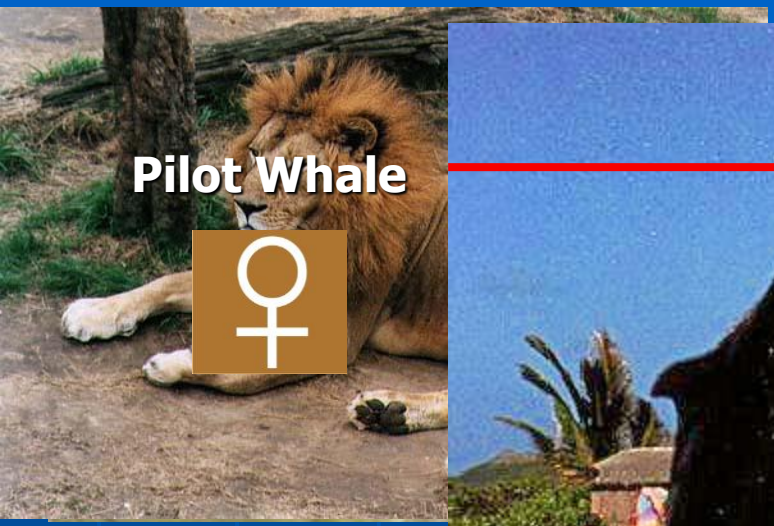
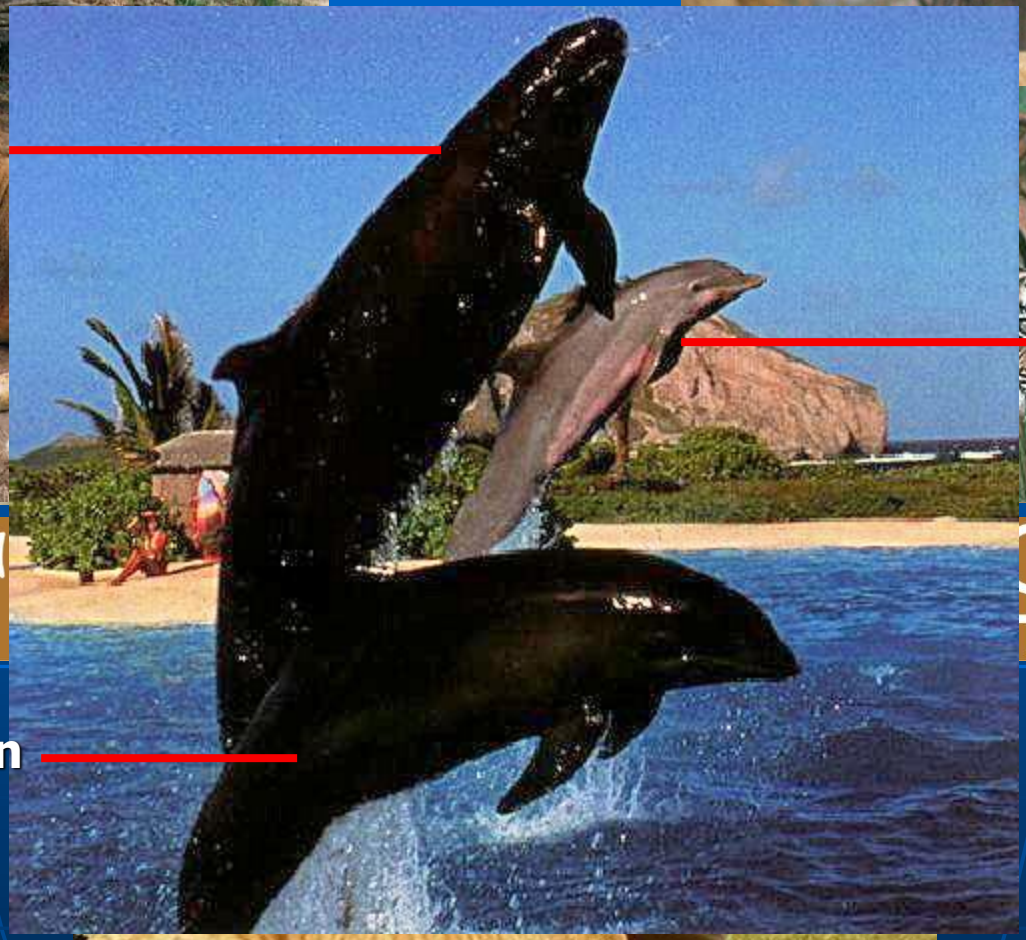
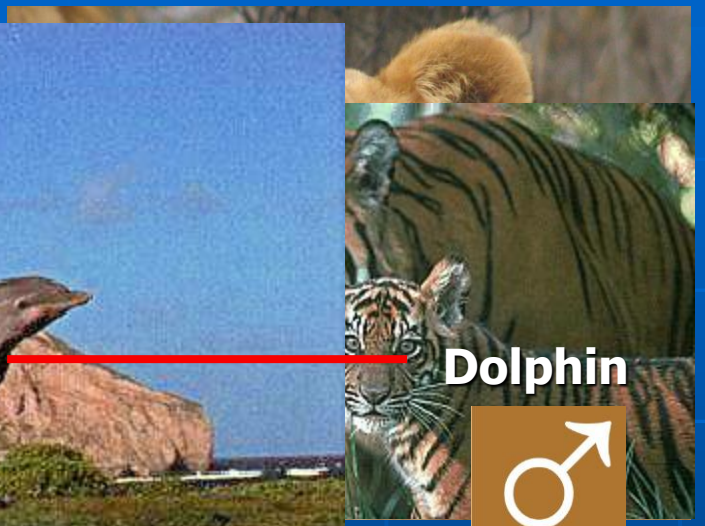


Pilot Whale





Dolphin

"Baby" Wholphin

Liger

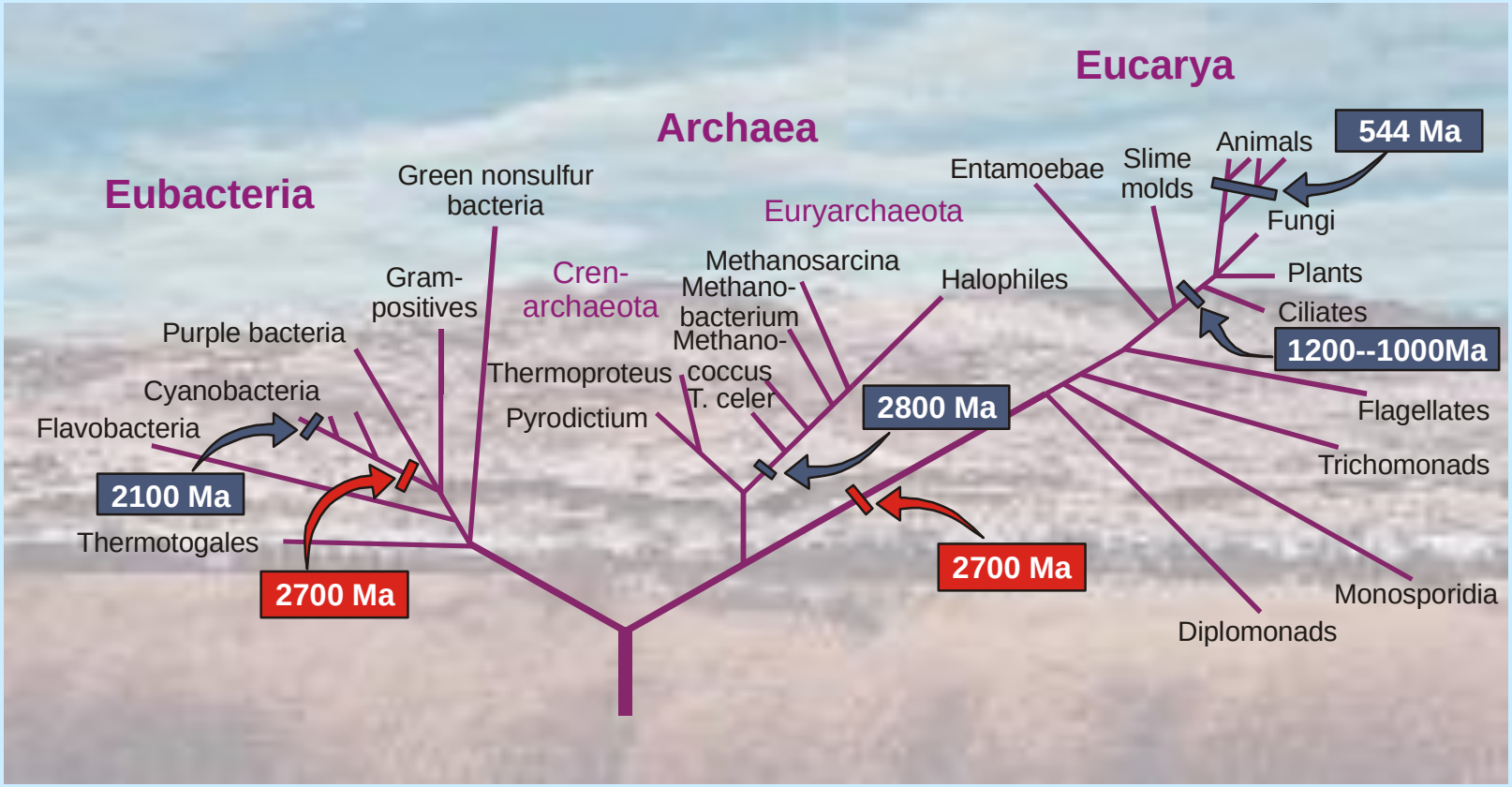
gon

- Subspecies are geographically isolated populations of species
  - They are capable of interbreeding, but they are separated by geographic barriers such as oceans, mountain ranges, etc

- Three Kingdoms
  - Biologists have found that the Archaebacteria are as different from the Eubacteria as they are from all eukaryotes
  - Thus, they suggest that there are three kingdoms: Eubacteria, Archaea, and Eucarya instead of the traditional five kingdoms
    - (N.B.: Many textbooks refer to these as Domains rather than kingdoms)

- **Kingdom Archaebacteria**
  - Archaebacteria inhabit extreme environments, e.g., hot springs, anaerobic muds, saline ponds
  - They are believed to be primitive bacteria, possibly similar to life forms of early evolution
  - This kingdom includes thermophilic bacteria, halophilic bacteria, and methanogens
- **Kingdom Eubacteria**
  - This kingdom includes advanced bacteria and cyanobacteria (or blue-green algae)

- **Kingdom Eukarya**
  - This kingdom includes both unicellular and multicellular organisms that are nucleate and possess complex internal membranes
  - Organisms range from includes protists and green plants to fungi and animals
  - Eukarya may be autotrophic or heterotrophic




**The Universal Tree depicts the phylogenetic relationships of extant organisms, as inferred from sequence comparisons of ribosomal RNA genes. The boxed dates indicate the minimum age of selected branches, based on paleontological and biogeochemical data. New biogeochemical constraints reported by Brocks et al. (1999) are shown in red. [Adapted from Knoll, 1999].**