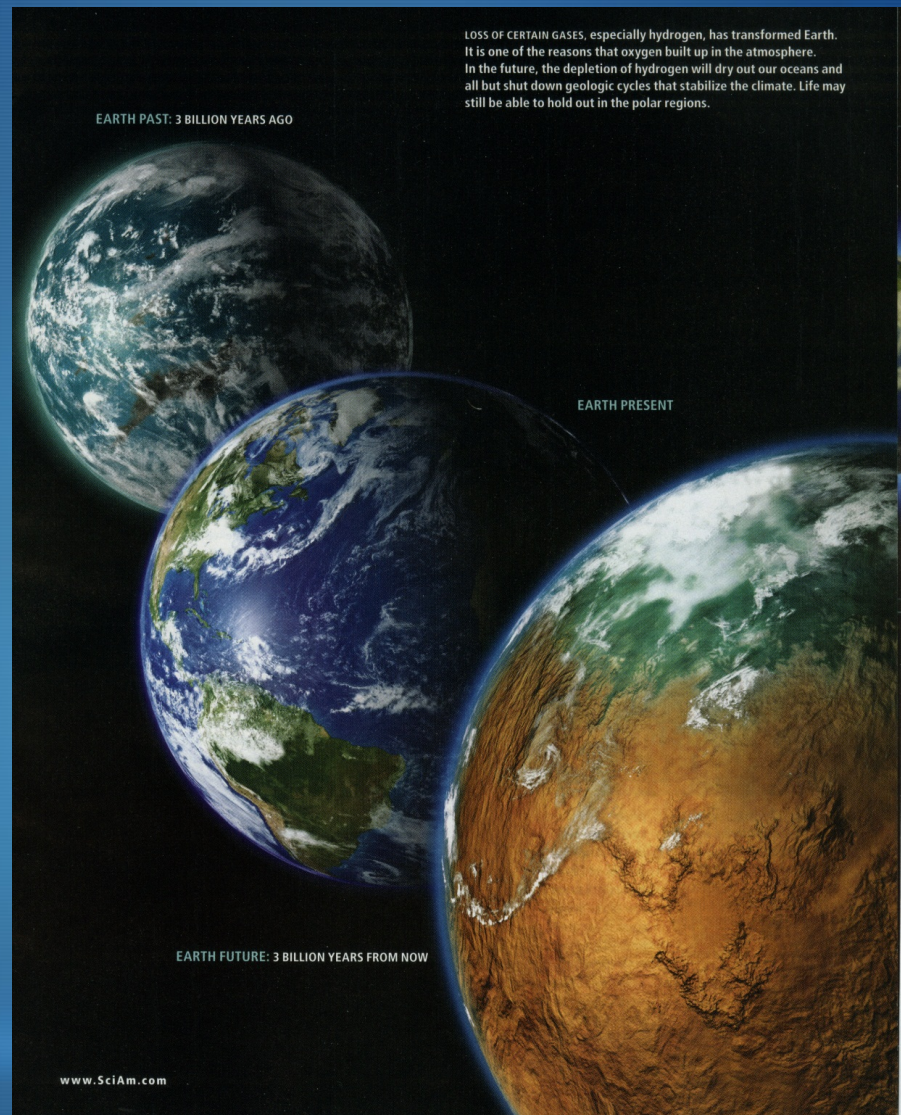


Cells Part 1



It is water that makes our planet unique

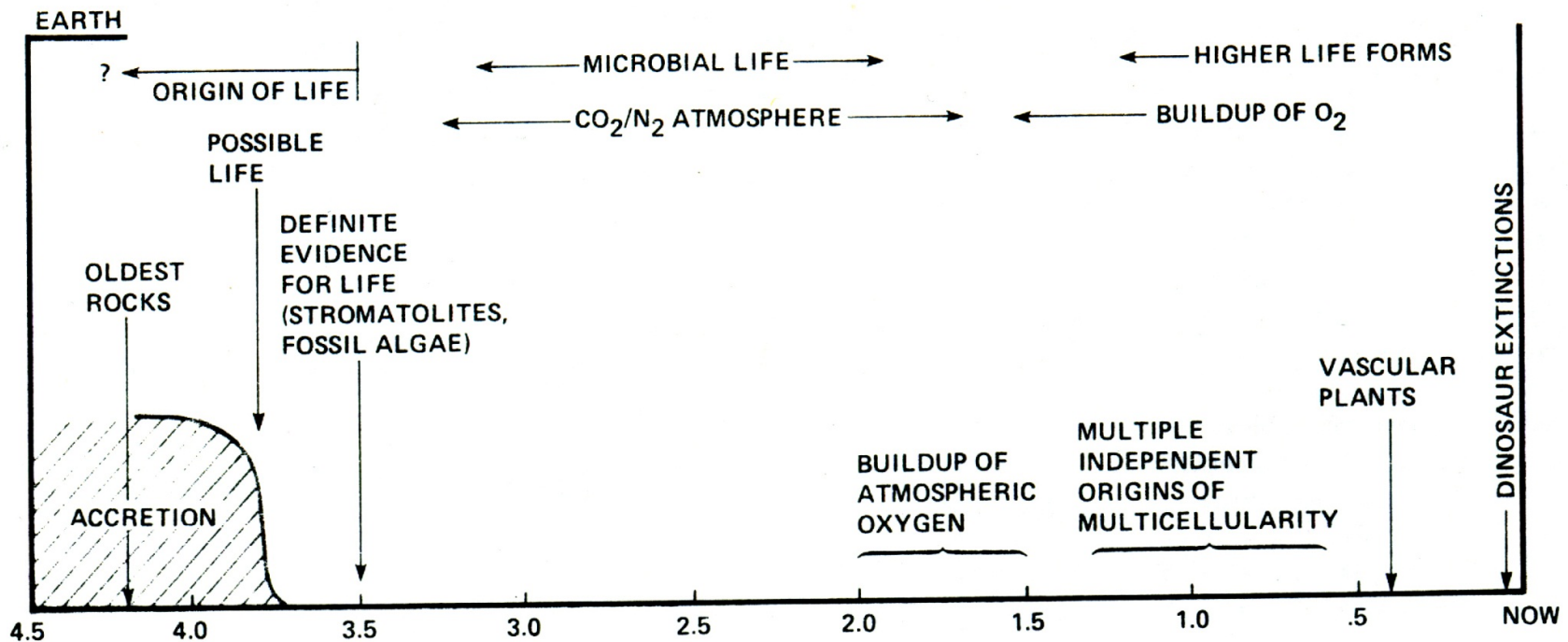


About 3 billion YA, the Earth's atmosphere began to accumulate oxygen. Oxygen gas O_2 was a very small % of Earth's atmosphere before photosynthetic bacteria arose. As photosynthetic organisms became more common, more O_2 was released into the atmosphere. The Earth's atmosphere is currently 20.8% oxygen by volume. Since the beginning of the Cambrian period, about 540 million years ago, atmospheric O_2 levels have fluctuated between 15% and 30% by volume. Eventually, (about 3-4 billion years from now) the Earth will lose most of its water and become desert-like. In about 5 billion years the Sun will become a red giant and the remaining water will be boiled away. As oxygen built up in the atmosphere, ozone (O_3) % also rose helping to filter out harmful ultraviolet light from the Sun.



Life Time line

Life on Earth



Key points of this slide are:

- Earth is about 4.5 billion years old
- Life arose about 3.5 billion YA
- About 2.5 billion YA O₂ started to accumulate in the atmosphere and built up to about 10% by about 1.7 billion YA
- Multicellular organisms arose numerous times...as late as 600 million YA to as long ago as 2.1 billion YA (recent "fossils" in Gabon...not confirmed)

Taxonomy

In the early 1700's Carl von Linne, AKA [Carolus Linnaeus](#) (Latin names are always more impressive), created the first well-organized system of organizing organisms into groups with names. It is the basis of the system used today to organize organisms based on a variety of similar properties. Each type of organism is given a species name

("specific epithet"). Closely related species are grouped into a genus. Closely related genera (plural of genus) are grouped into families; families are grouped into orders, orders into a classes, classes into a phyla, and phyla into a kingdoms. The species is the smallest group and on up to the largest group...the kingdom. As all things seem to go in the science of life, the more we learn the more complicated it gets. Linnaeus had two kingdoms: plants and animals. By the late 20th century we had 5 kingdoms. Recently we have been reordering the names of kingdoms and putting some the kingdoms in a even larger group called a [Domain](#). We currently have 3 domains. It will most certainly change as we learn more. Science is a work in progress.

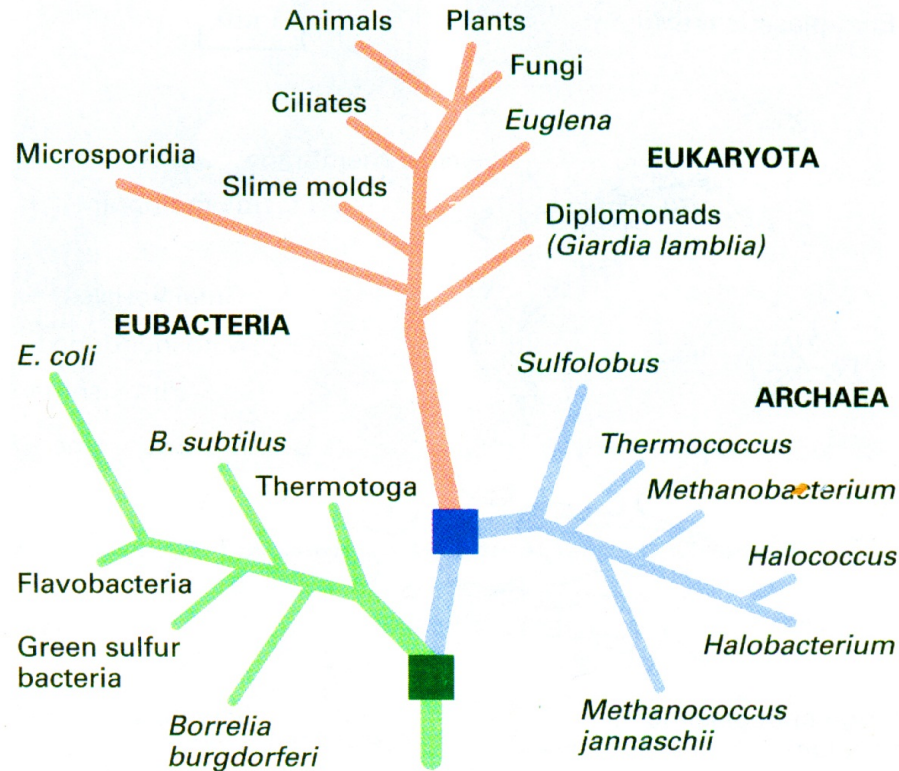
Species

For over 2,000 years we have been trying to keep track of the wide variety of life on Earth. The most basic name of very similar organisms is the species. At first, a species was a type of organism that had a description...someone would see an organisms and give it a name... typically based on how it appeared. Later, scientists agreed organisms belonged to different species if they could not interbreed. This created confusion since some species that were quite different could interbreed, but their offspring were not able to breed because they were sterile. A common example is crossing a female horse with a male donkey (typically) produces a mule. [Mules](#) are sterile (not fertile...produce no viable sperm or eggs). The latest version of a species is:

A group of organisms that in its typical habitat breeds only within that group.

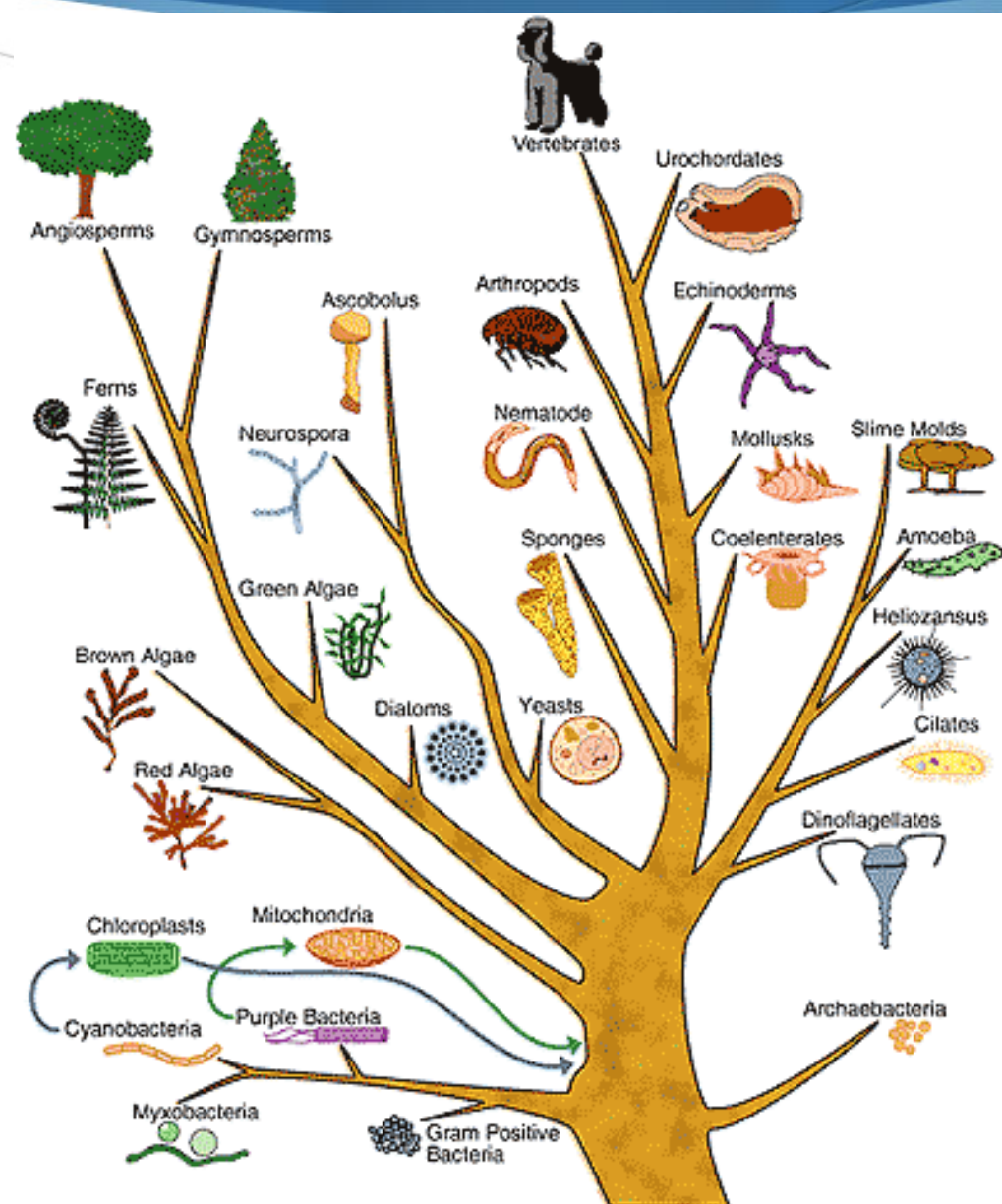
This definition has some fuzziness but most scientists seems to be able to live with it.

Tree of life

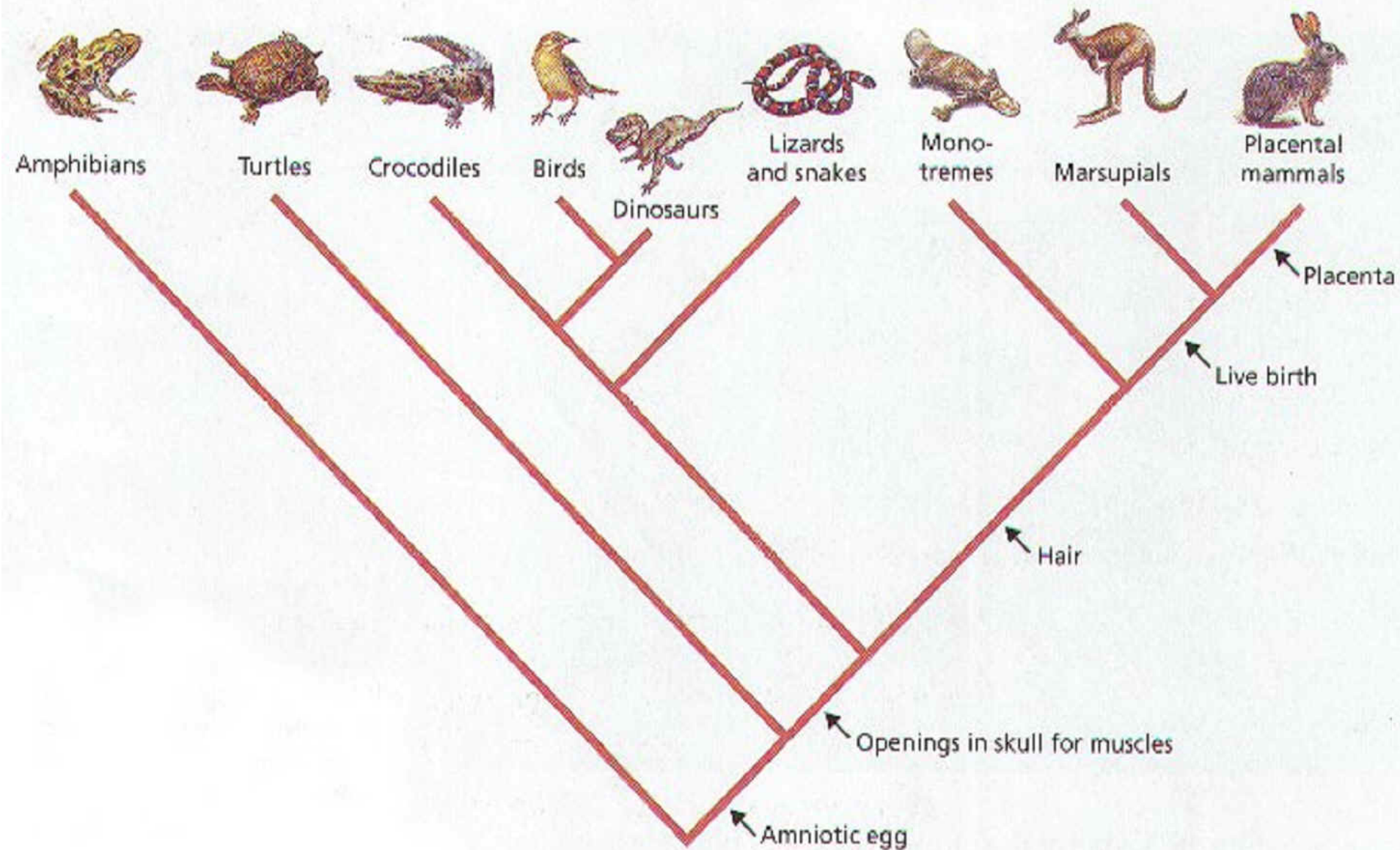


There are a number of depictions of the tree of life. Most modern “Trees of Life” have 3 Domains: 1) Eubacteria (sometimes called just Bacteria). This first domain is where most of the common bacteria belong...all its members are single celled organisms with no nuclei. The most famous bacteria *E. Coli* belongs to this Domain. The Domain called Archaea has single celled bacteria also but they seem to have evolved along a different path as the domain “Bacteria”. Initially, most of the Archaea were bacteria that are considered “extremophiles” because they live in extreme habitats, but we later found these single celled organisms in other habitats. The Domain with the most familiar organisms is the Eukaryota. This Domain has organisms with nucleated cells. They range from single celled organisms such as *Euglena* and *Paramecia* to multi-cellular fungi, plants and animals.

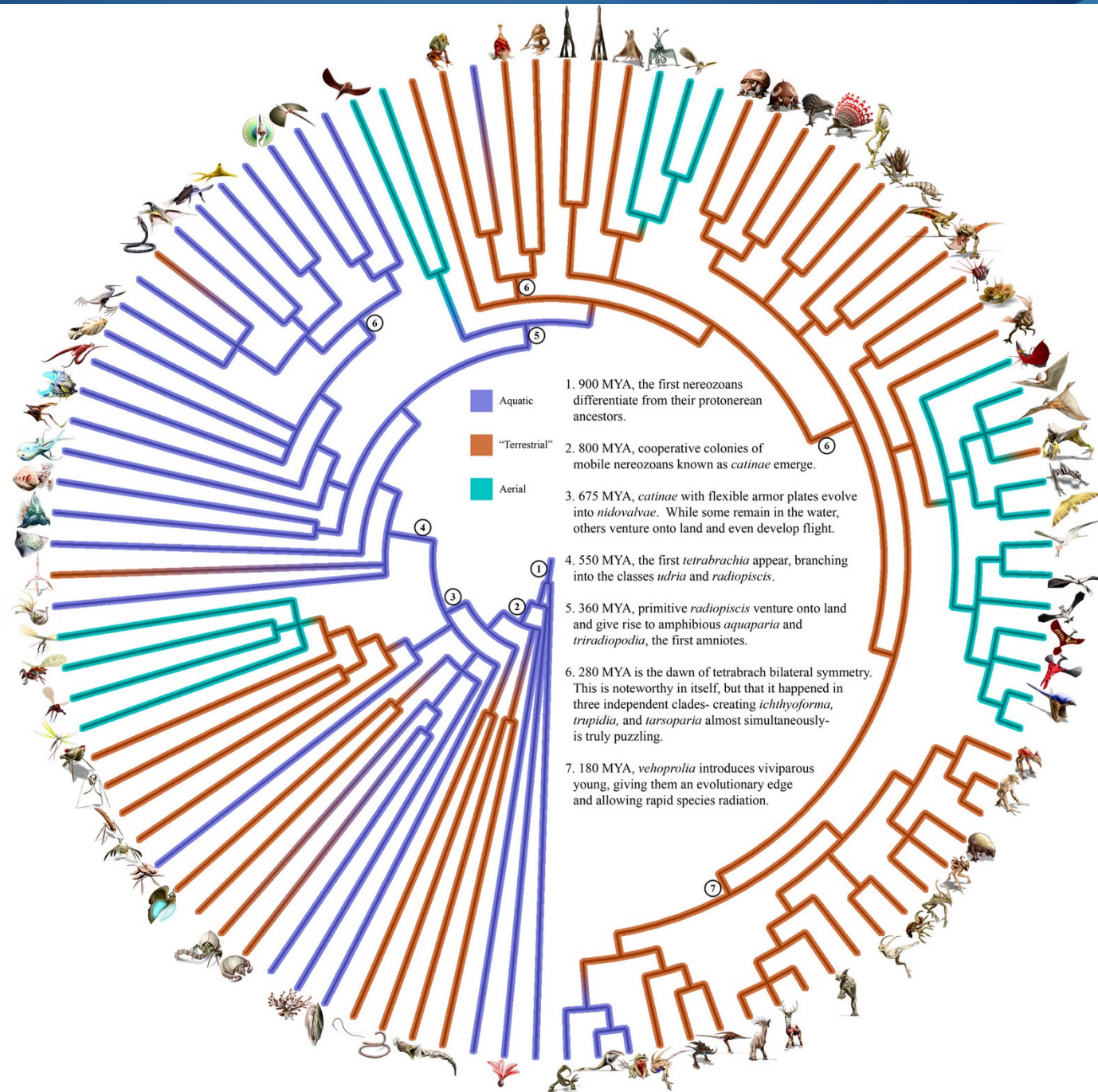
A tree with pictures. This one is interesting because it shows the endosymbiont theory in evolution where cyanobacteria evolved into chloroplasts and purple bacteria evolved into mitochondria. The evidence that supports this theory is: A bacterial cell is about the same size as a mitochondrion...An E. coli cell is about 2 microns long and about 0.5 microns in diameter, mitochondria have a single circular chromosome as do bacteria, the ribosomes of bacteria and mitochondria are the same size and a different size from those found in the cytoplasm of the eukaryotic cell...pretty cool eh!



A cladistic representation. A cladogram attempts to show how groups of organisms are related and which ones are more closely related. In this cladogram, placental mammals and marsupials are closely related and probably have a more recent common ancestor than monotremes and placental mammals.



Circular Cladogram



Plant and animal cells have organelles including a nucleus to house the chromosomes (Eukaryotes). Bacterial cells do not have membrane-bound nuclei (Prokaryotes).

Plant vs Animal vs Bacteria

Plant and animal cells have organelles including a nucleus to house the chromosomes (Eukaryotes). Bacterial cells do not have membrane-bound nuclei (Prokaryotes). *The bacterial cell in this image is NOT to scale. A bacterial cell is about the same size as a mitochondrion...An E. coli cell is about 2 microns long and about 0.5 microns in diameter.* Eukaryotic cells have a number of membrane-bound organelles. These include: mitochondria that carry out respiration to make energy (mostly ATP and release carbon dioxide as a byproduct...not waste), chloroplasts that carry out photosynthesis to make sugar (splitting water and releasing oxygen...not waste), vacuoles to hold fluids, lysosomes that digest biomolecules, plastids that store pigmented molecules, endoplasmic reticulum that carries out the translation of mRNA into protein. There is also non-membrane bound organelles such as the ribosome that functions in translation.

The bacterial cell in this image is NOT to scale. A bacterial cell is about the same size as a mitochondrion...An E. coli cell is about 2 microns long and about 0.5 microns in diameter.

