# Life on Earth, Lessons Learned

11-30-2005

# Opening Discussion

- Have you seen anything interesting in the news?
- How much does the carbon cycle matter to the global warming debate? The key is the timescale. It's great if we don't screw things up too badly in the 400,000 years it will take for nature to respond.
- Biology in the carbon cycle. Bottom line is that locking carbon in plants and animals isn't very effective because they die and decompose so quickly.
- Melting polar caps and comparisons to Venus.
- Will Mars or Venus ever be habitable again?

# More Minute Essays

I'm not allergic to wool, but I don't wear it much. My feet are size 13.5. My favorite color (if I have to pick one) is black.

I lived in Winn 2nd, South 3rd, South 1st, and Murchison 1st.

# Life on Earth

- We learned last class about how life has impacted the Earth.  In particular, life has made significant alterations to the atmosphere of the Earth.  Without life, we wouldn't have any oxygen in our atmosphere.
- Today we want to look more at the history of life on our planet and how we know the things that we do about life.  This is essential for understanding not only th history of our planet, but also for understanding the possibilities of life on other planets.

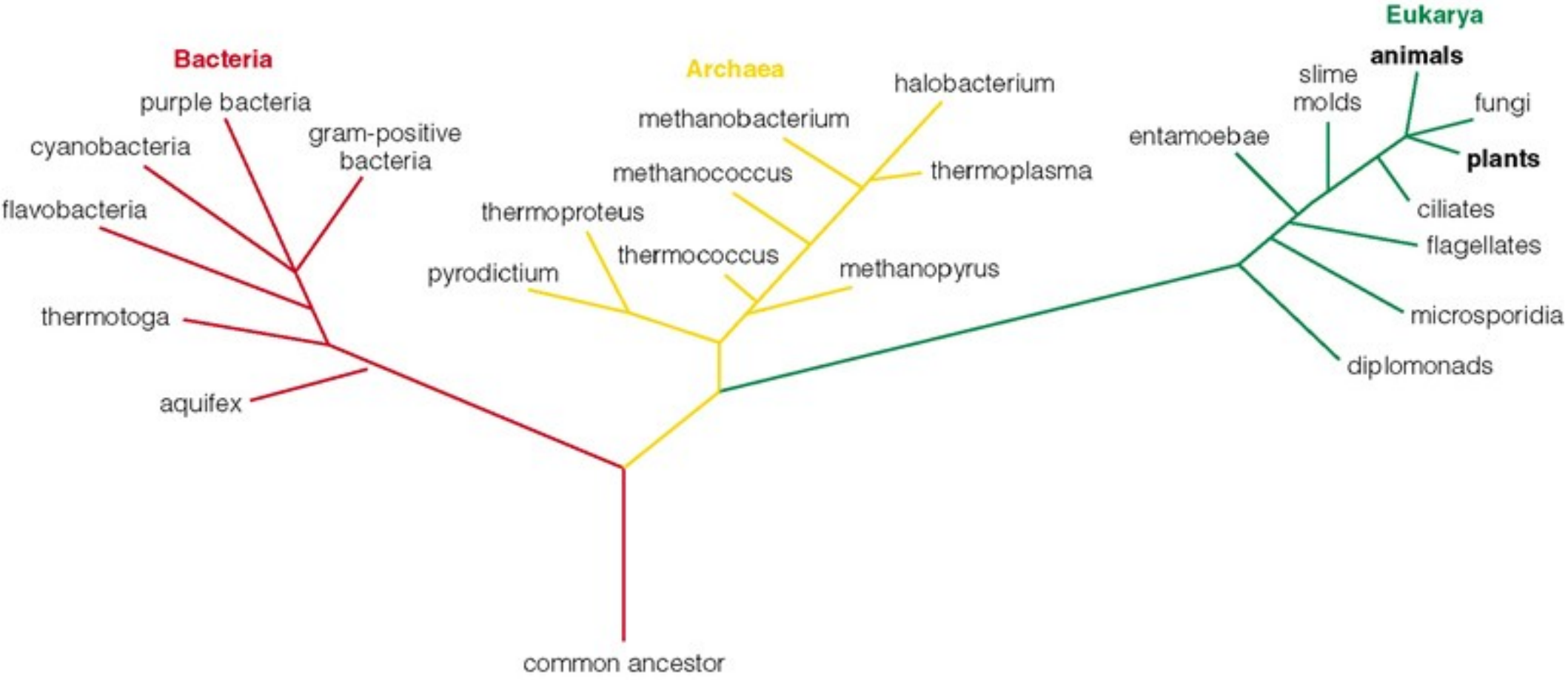
# Fossils

- The majority of our knowledge of past life comes from the fossil record.
- When animals die in certain situations, their remains can be preserved and fossilized. This mainly happens when the body is under water and sediment is piled on top of it. The sediment turns to stone and the fossil in encased.
- We know the relative ages of fossils based on their depths in the sediment. Deeper layers correspond to older times. Radiometric dating can give us more accurate exact dates for the layers of rock as well.

# Origins of Life

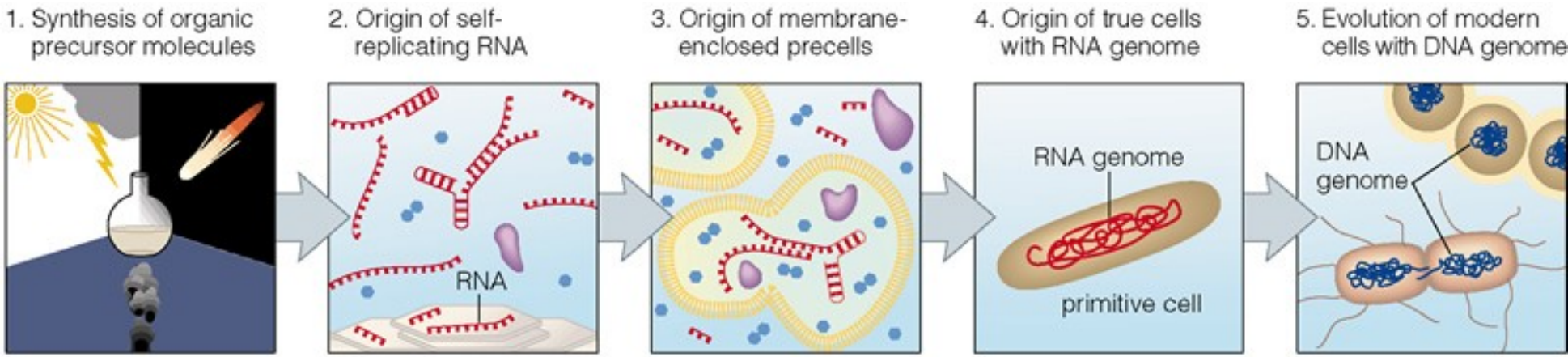
- We do not know exactly where life originated, but there is strong evidence that all life on Earth came from a single origin.
- All life on Earth has certain chemical similarities. It all uses the same 20 (of more than 70) amino acids. All organisms use ATP to store energy and use DNA to transmit genetic information.
- All life shares nearly the same genetic code to translate DNA into amino acids with groups of 3 base pairs indicating an amino acid.
- The genes found in all life are remarkably similar.

# Tree of Life



# First Life

- Based on DNA evidence, the lifeforms that are most closely related to all other things on Earth are simple lifeforms that live near deep sea vents (black smokers). They get their energy from heat and chemicals in the jets of water coming from the vents.
- The organic molecules of life are common and easy to form.



# When Did Life Begin?

- There is fossil evidence of life of Earth dating back to 3.5 billion years ago.
- Carbon ratios in rocks as old as 3.85 billion years indicate the presence of life.
- That is about as old as life could possibly be. Prior to that time the heavy bombardment was happening and the Earth was regularly being hit by large impactors. Some were large enough to vaporize the oceans and sterilize the planet.
- It is even possible that life formed on Earth several times as was wiped out. Life might also have formed on Mars or Venus and been transported.

# Early Evolution

- The reproduction of life involves copying DNA. This process isn't perfect and imperfections are called mutations. Many mutations don't matter. Many others cause alterations that aren't compatible with life. A few will produce changes that are beneficial.
- When the change is beneficial, the new organism is more capable of surviving and it reproduces and passes on its genetics. This process is known as natural selection and is the real key to the theory of evolution.
- This process diversified life over billions of years and led to the development of photosynthesis, but everything was single celled for at least a billion years after life arose.

# Oxygen!

- Roughly 2 billion years ago the levels of oxygen in our atmosphere rose significantly. Life had finally started to win the battle with natural chemical reactions. The levels were probably lower than those today until about 200 million years ago.
- With oxygen came animals and the ozone layer. Prior to the ozone layer the land had been sterile. With the protective ozone layer plants moved onto land (475 million years ago). They were quickly followed by animals who could utilize that new food source.

# Cambrian Explosion and Diversity

- Up until 540 million years ago the majority of life was single celled. In the 40 million years following that animals diversified into all 33 phyla that we currently find. This diversification over a short period of time is called the Cambrian explosion.
- Dinosaurs dominated the Earth for over 100 million years, ending 65 million years ago. At that time mammals began to take over.
- The earliest humans appear in the fossil record just a few million years ago (after 99.9% of Earth history). We have only been technologically advanced for a few hundred years.

# Minute Essay

- If we do find life in samples returned from another body, how might we be able to tell that they aren't contaminants from Earth?
- Maurine's birthday was yesterday.  Hopefully some people will help her celebrate it in proper Trinity style.
- I will not be around for the study session today.
- The last assignment is due on Friday.