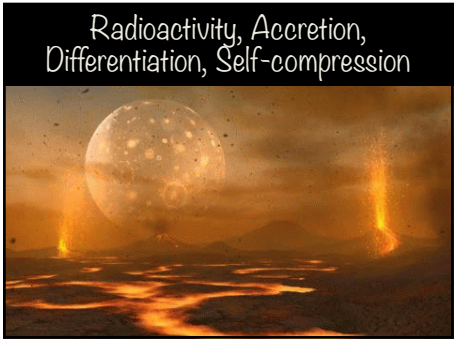
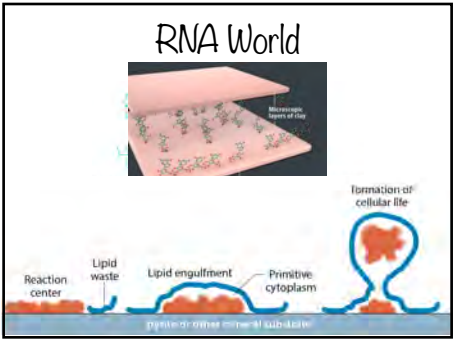




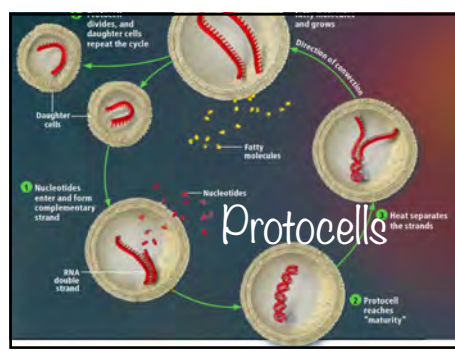
Radioactivity, Accretion,
Differentiation, Self-compression



Jack Hills Zircon, the oldest rock



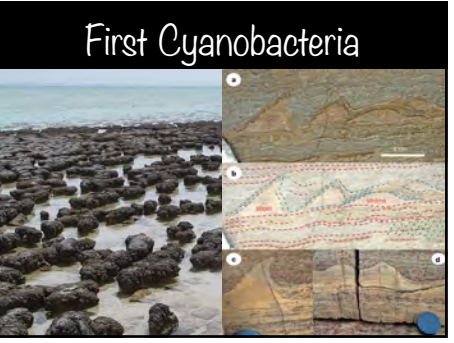
RNA World



Protocells



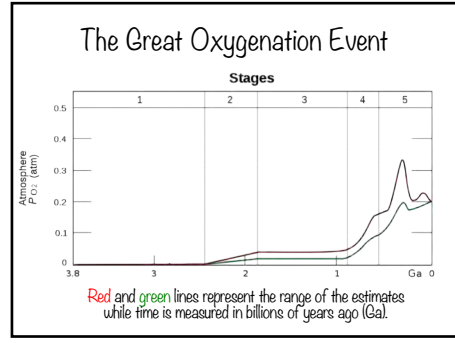
First Prokaryotes



First Cyanobacteria

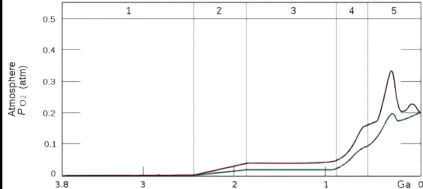


First Eukaryotes

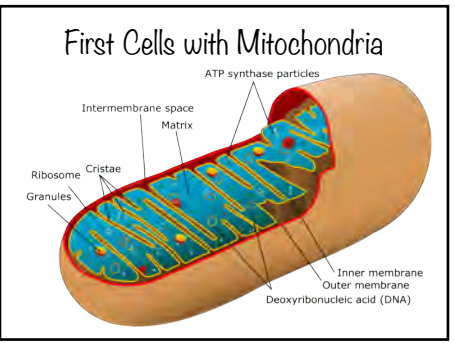


The Great Oxygenation Event

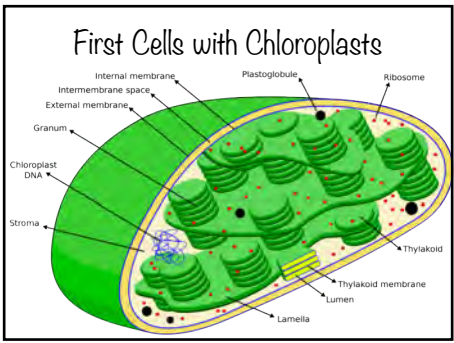
Stages



Red and green lines represent the range of the estimates while time is measured in billions of years ago (Ga).



First Cells with Mitochondria



First Cells with Chloroplasts



First Animals

billions of years ago (Ga)	distance (m)	distance from prev (m)	Major events
4.54	0	0	earth forms
4.4	0.37	0.37	oldest rock Jack Hills zircon
4	1.43	1.06	RNA world
3.75	2.09	0.66	Protocells
3.5	2.75	0.66	1 st prokaryotes
2.7	4.86	2.11	1 st cyanobacteria
2.5	5.39	0.53	1 st eukaryotes
2.3	5.92	0.53	great oxygenation event begins
1.5	8.04	2.11	1 st cells with mitochondria
1	9.36	1.32	1 st cells with chloroplasts
0.6	10.41	1.06	1 st animals
0.475	10.74	0.33	1 st land plants
0.06	11.84	1.10	1 st primates
0.0002	12.00	0.16	1 st genus Homo (people)



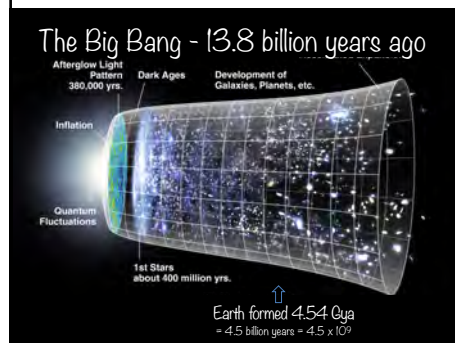
FIRST LAND PLANTS



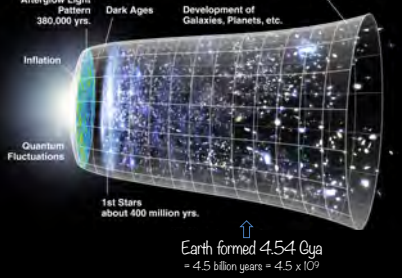
FIRST PRIMATES



First genus Homo



The Big Bang - 13.8 billion years ago



MICROBIO 480: Microbial Diversity

History of Life on Earth Activity, Prof. Kristen DeAngelis

Overview: The Earth is 4.5 billion years old, and had life early on that either began through abiogenesis or was seeded from impacting bodies (accretions) including the Moon. It was an RNA world until protocells evolved into what became our last universal common ancestor (LUCA). Evolution of life on earth resulted in the microbial diversity we see today.

Activity Learning Goals:

- Describe the events that culminated in the microbial diversity of today.
- Understand the order of major events in the history of life on earth.
- Explain the phylogeny of modern-day endosymbionts and viruses.

Print out the cards on the reverse of this sheet; alternatively, use the table below to set up a timeline. First, without looking at the table, try to place the cards in order. Try to use reasoning to think about why one event should come before another. Keep the last two cards (the table and the Big Bang card) attached to make a small folder so you can store your cards and use them to study later.

billions of years ago (Ga)	distance (m)	distance from prev (m)	Major events
4.54	0	0	earth forms
4.4	0.37	0.37	oldest rock Jack Hills zircon
4	1.43	1.06	RNA world
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0.0002	12.00	0.16	1 st genus Homo (people)

Questions:

1. Why do we call the last universal common ancestor (LUCA) a “prokaryote” but not modern day bacteria and archaea?
2. Explain what happened for the mitochondrial genomic DNA to place it in the class Alphaproteobacteria. What happened during this endosymbiotic event?
3. Which came first: cyanobacteria or cells with chloroplasts? How do you know?
4. Which came first: land plants or cells with chloroplasts? How do you know?
5. What do modern day RNA viruses tell us about the RNA world?