Welcome to Class 10: Origin and Evolution of Life on Earth

Remember: sit only in the first 10 rows of the room

What are we going to discuss today?

When and where did life start on Earth?

When was the atmosphere safe for us to exist?

PRS: Which of these below gives the earliest evidence of life?

1. Radiometric dating
2. Ancient stromatolites
3. microfossils
4. Altered isotopic ratios

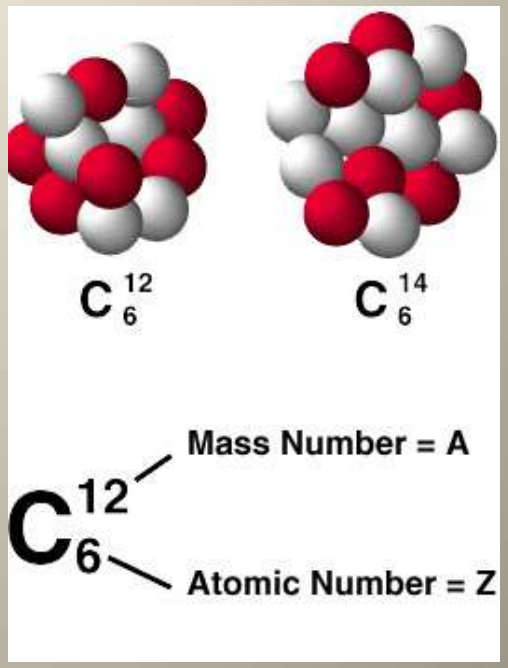
Remember to set your channel to 80!

The earliest evidence of life

Altered Isotopic ratios

Seen in unique spots within rocks dating back 3.85 billion years ago.

Most isotopic ratios were set in the rock during Earth's formation, 4.5 b. y. ago

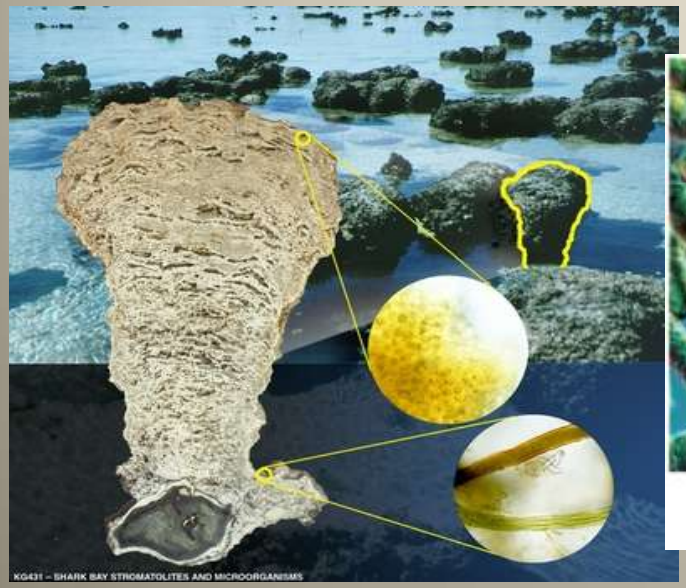


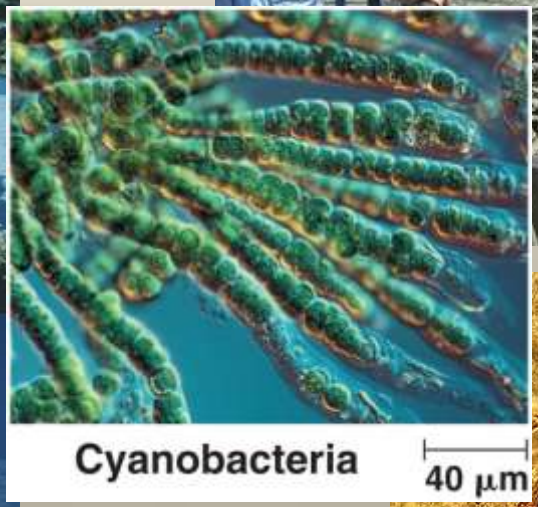
Why would altered ratios be consistent with life?

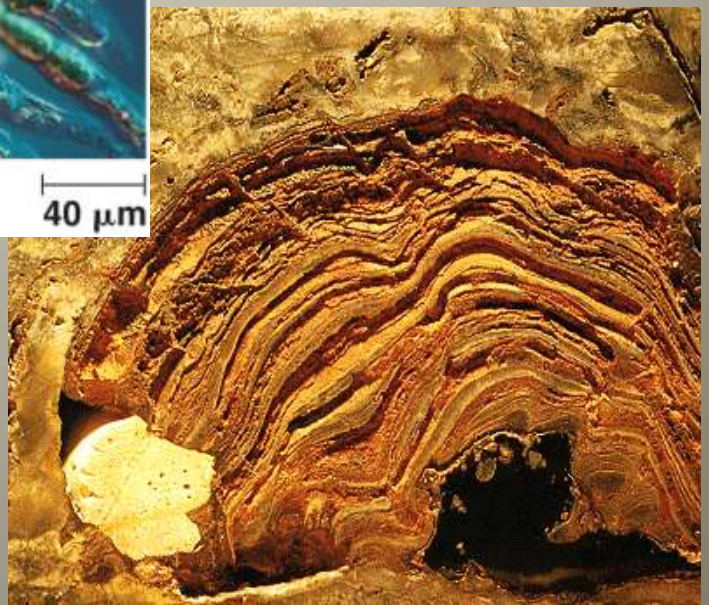
What kind of altered ratios would you expect to find if life had been present in the rock? Is this proof of life this far back?

Stromatolites

Accretionary structures formed from the layering and waste of biofilms of microorganisms.





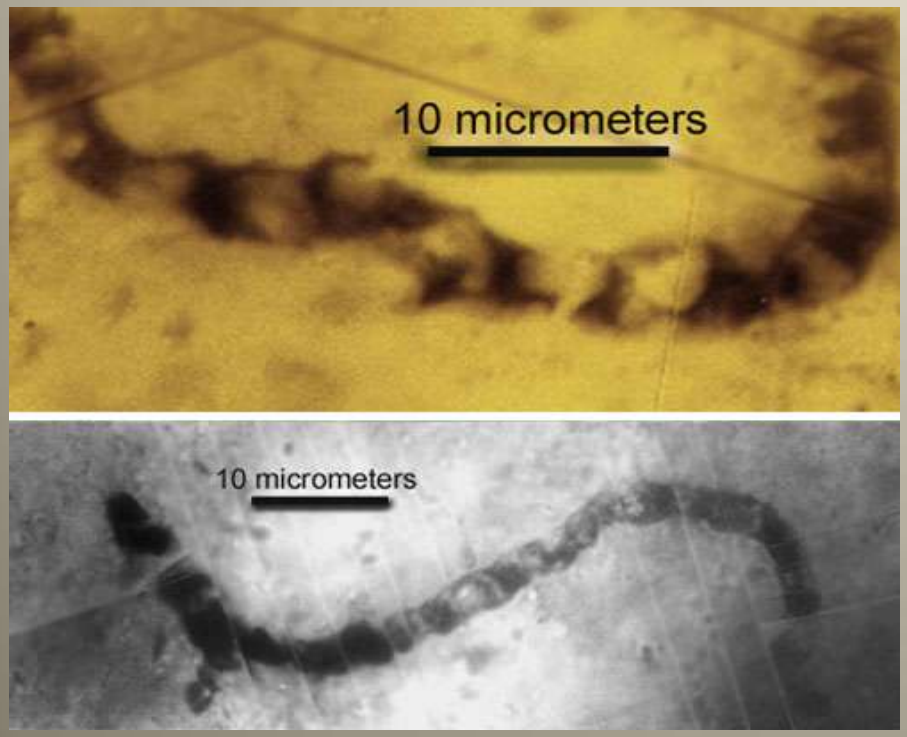


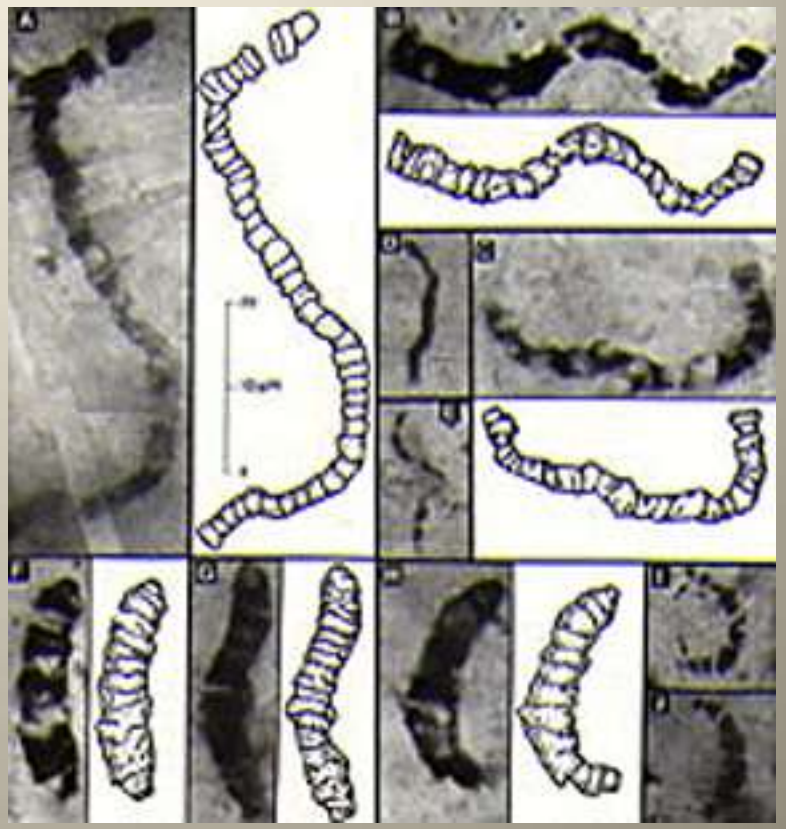
This life was photosynthetic. An algae called Cyanobacteria.

The earliest candidate fossils date > 3 b. y. ago.

Ancient microfossils

Cell walls and tissue are long gone, but they show the shape and organic content consistent with life.





Ages?? Still controversial.
2-3 billion years old

J. William Schopf, UCLA (claims up to 3.46 byo, but probably wrong)

PRS: How soon after the largest (sterilizing) impacts is there evidence for life?

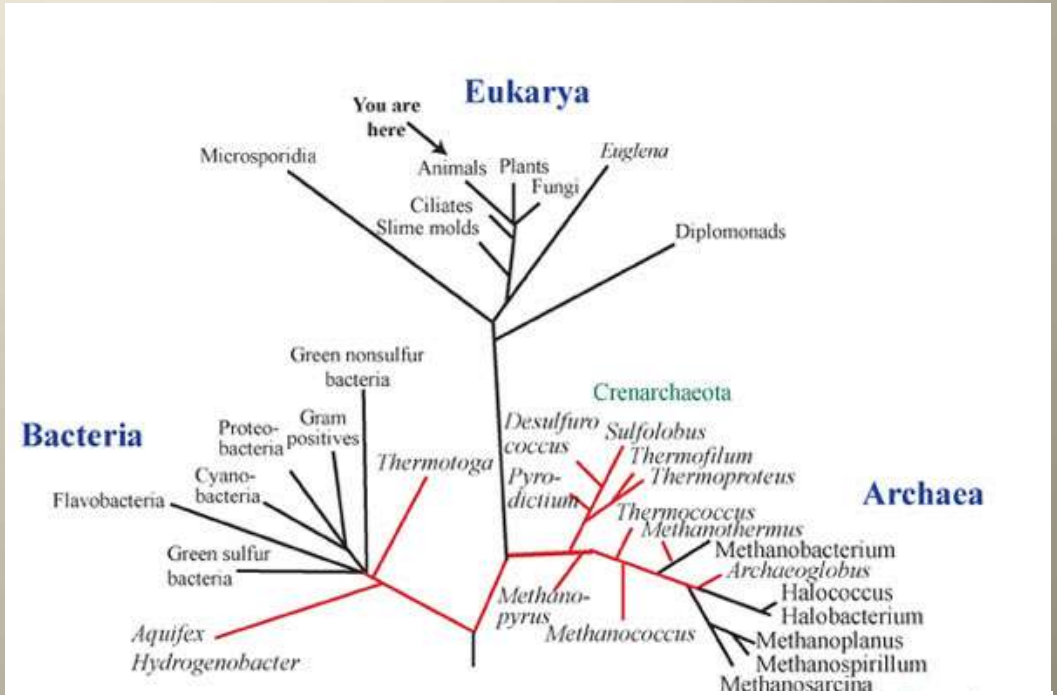
1. 1 billion years
2. 100s million years
3. 1 million years
4. Less than 1 million years.

PRS: Where would the earliest life be the most safe during the early bombardment phase on Earth?

1. Air
2. Shallow seas
3. Deep ocean
4. Caves

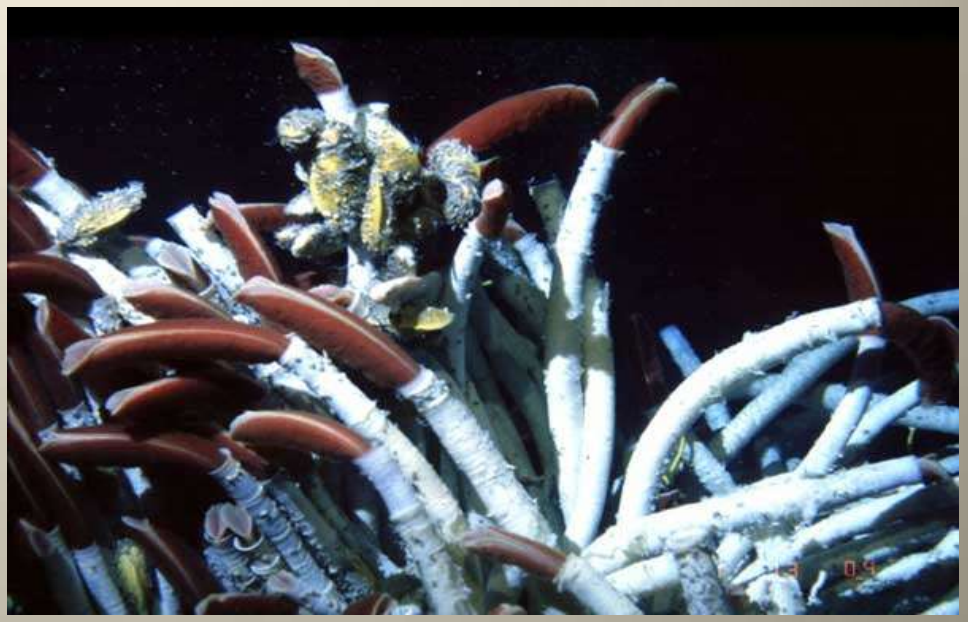
PRS: Which extremophile is genetically closest (base of life tree) to the 'universal ancestor' of all life?

1. Psychrophiles
2. Thermophiles
3. Endoliths
4. Xerophiles



Red lines indicate heat loving organisms

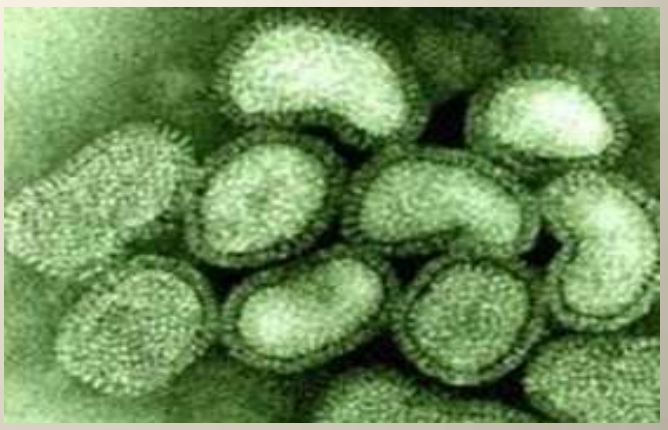
Thermopiles love the Deep Sea spreading centers.



Off of the microbial life, a plethora of large, complex life can live. These tubeworms and mussels are miles below the sea.

The black smoker vents are a source of abundant chemical energy and carbon for Chemoautotrophic life http://www.youtube.com/watch?v=XRHm9HPe1BQ&feature=related

Early, simple life probably made a lot of replication errors



What does this mean?

A lot of MUTATIONS.

This introduced new ways for life to function. Most were bad and killed the organisms. But some were beneficial. Lucky organisms survived and handed these traits to the next generation.

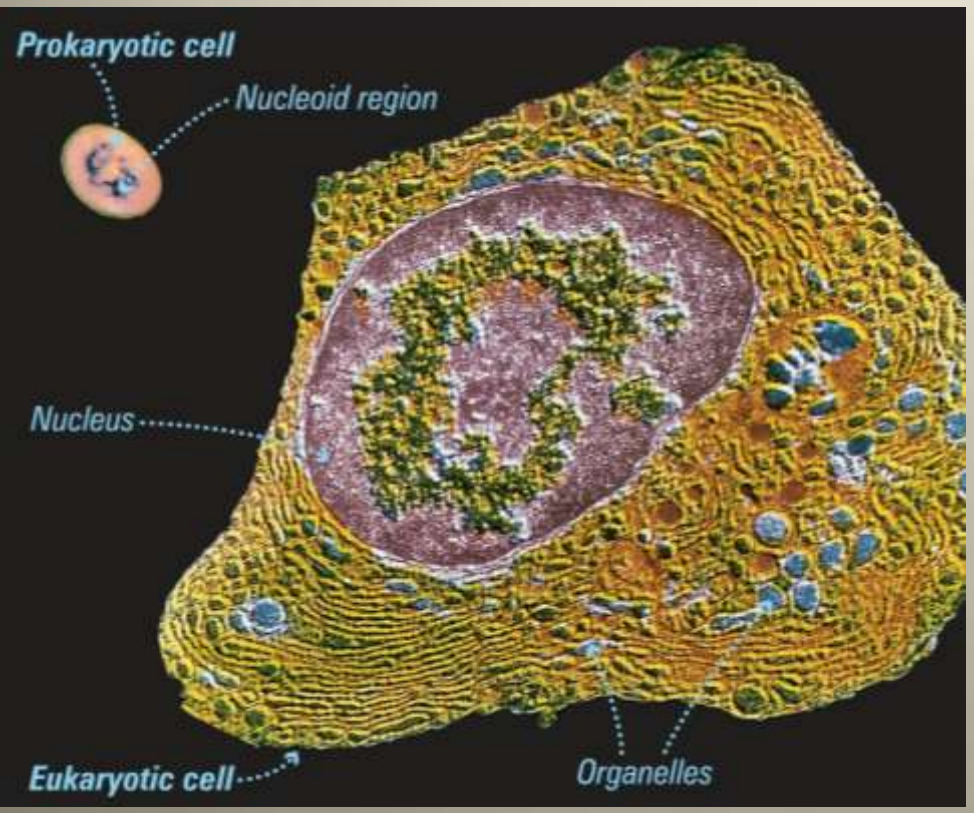
Through high rates of mutations and the process of natural selection, it is expected that there was very rapid evolution and DIVERSIFICATION among early life forms in the first few hundred million years of life on Earth. This is supported by fossil evidence: photosynthetic life appeared very quickly.

PRS: Which came first: Bacteria, Archaea, or Eukarya?

1. Bacteria & Achaea, then much much later, Eukarya.
2. Bacteria & Archaea, but very quickly after, Eukarya.
3. They all came at the same time.

Remember the Two kinds of `Cells' ?

Bacteria & Archaea are Prokaryotes. Eukarya are Eukaryotes



All three appear to be the same age through genome aging.

Yet..

The mitochondria and chloroplasts found in Eukarya cells have their own separate DNA, and this DNA groups these structures with bacteria..

Probably the Eukarya developed along side the Bacteria & Archaea, but may have started just slightly after.

PRS: When did the first multi-celled life appear?

1. 2 Billion years ago
2. 1.2 billion years ago
3. 550 million years ago
4. 500,000 years ago

PRS: When did the pre-Cambrian explosion occur?

1. 2 Billion year ago
2. 1.2 Billion years ago
3. 550 million years ago
4. 500,000 years ago

Pre-Cambrian Explosion was the start of the Phanerozoic (visible life) eon

Theories to explain this phenomenon:

Oxygen levels

Genetic complexity

Climate change

Absence of predators

The rest of the development

Plants moved to land about 475 million years ago (evolved from algae).

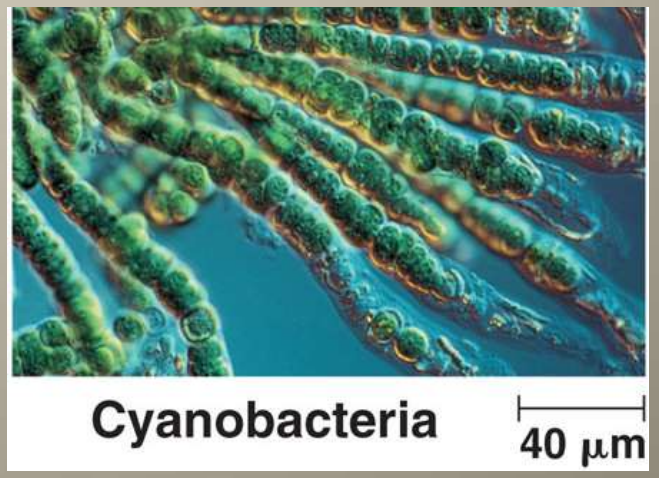
Vast forests and insects to eat them existed 360 million years ago. But there was no fire.. Why?

No large land animals (dinosaurs) until 250 m.y. ago (plenty of large animals in the oceans). Why the delay?

PRS: Where did our first atmospheric oxygen come from?

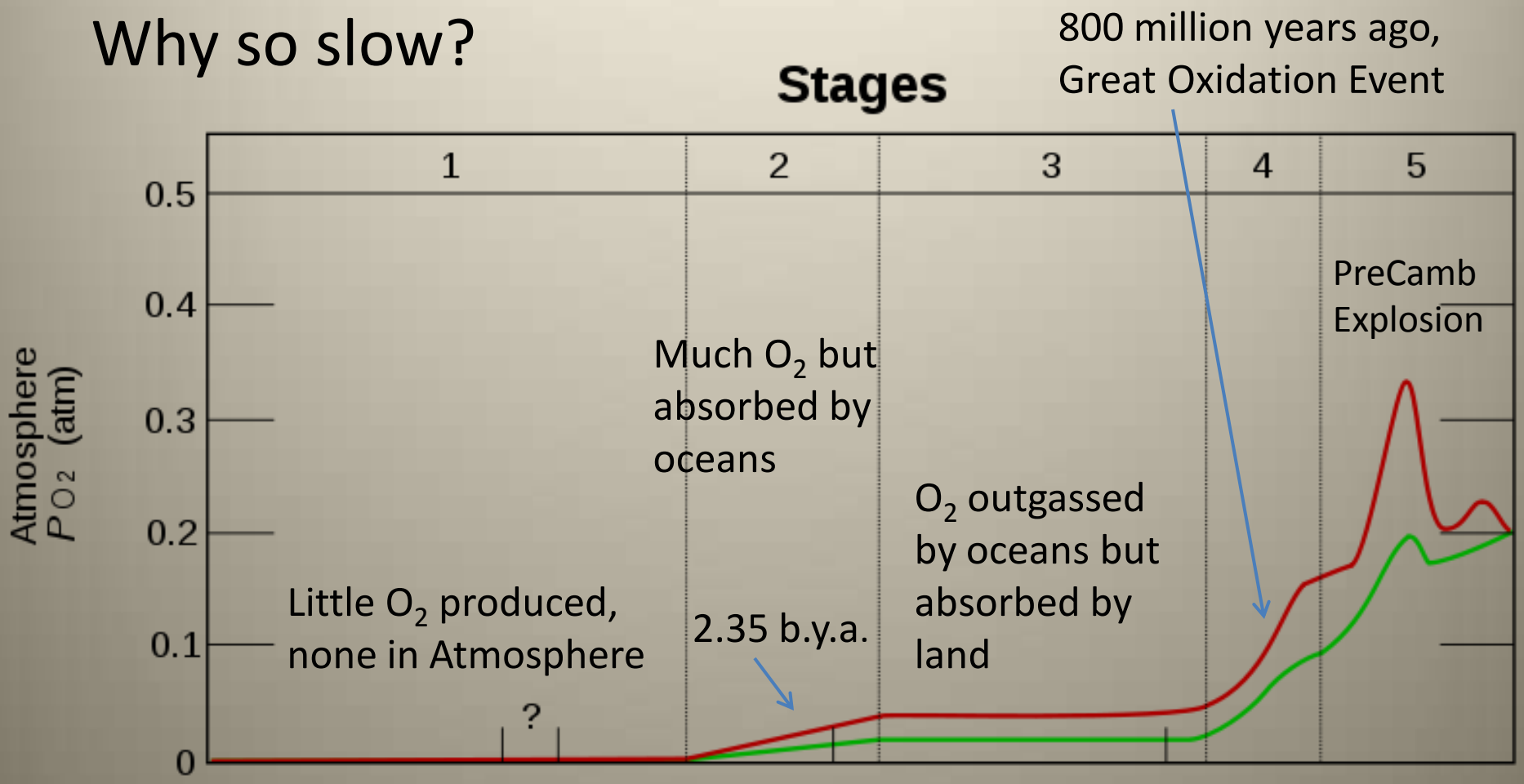
1. Early forests
2. Plants in the water
3. Bacteria

More specifically:



Stromatolites date back 3.5 b.y.
Oxygen began to show up 2.35 b.y. ago.

Why so slow?



Benefits of O_2 – rich atmosphere

Oxidation reactions lead to very efficient cellular energy production, to support MACRO organisms

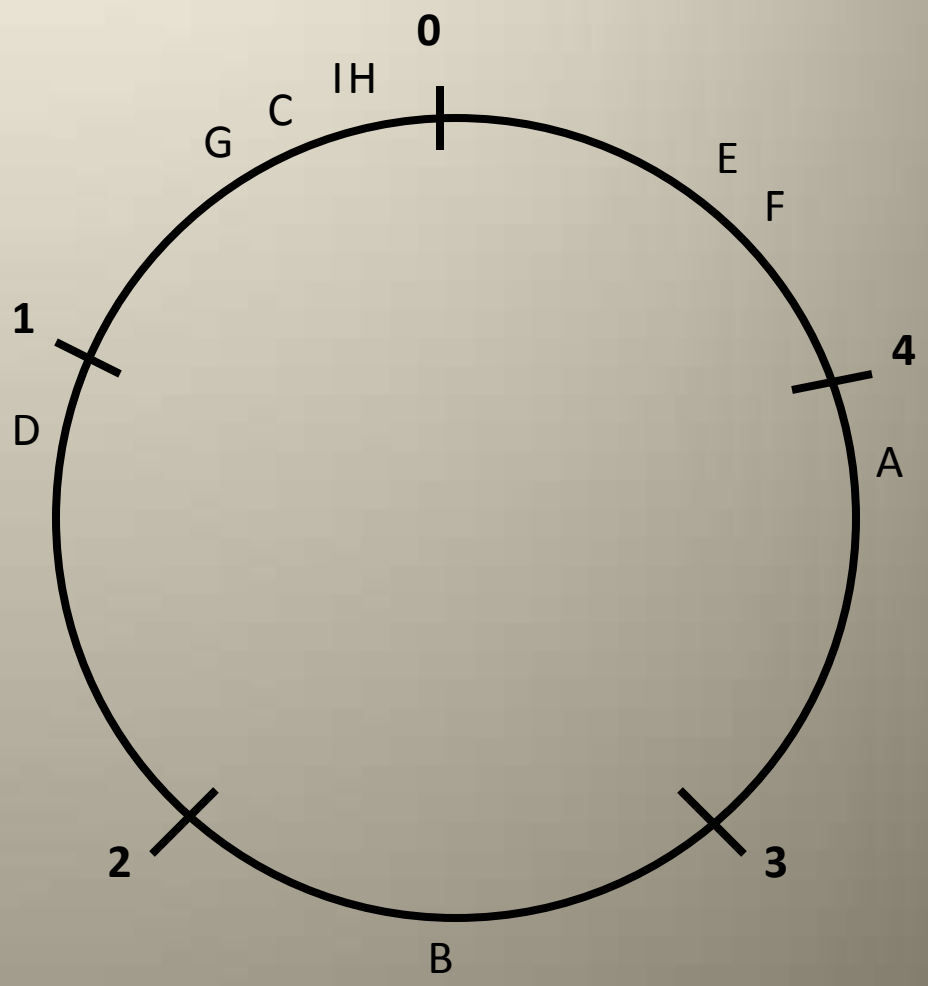
The free O_2 in the air, also lead to the formation of the OZONE LAYER (O_3). This protected life on land from harmful UV radiation.

Important events in the history of life

Draw a circle representing
5 billion years of time:

A. First evidence of life
B. First oxygen in Atmosphere
C. Oldest Oceanic Crust
D. First multi-cellular organisms
E. Formation of Earth
F. Oceans & atmosphere form
G. Pre-Cambrian Explosion
H. Rise of Mammals
I. Dinosaurs went extinction

Billions of years ago



Put all your materials on the floor and place your PRS clicker in front of you.

Please: use just one clicker for yourself.

Take care that others can not view your selection

1. The earliest evidence of life is from ____

    1. Ancient microfossils
    2. Fossilized stromatolites
    3. Isotopic ratios
    4. Sea floor fossils

2. The black smoker vents are a source of _____ for early life

1. water
2. protection
3. Iron
4. energy

3. A high rate of mutations is thought to create _____ life forms.

1. diverse
2. stable
3. early
4. macro

4. The pre-Cambrian explosion started where?

1. Deep sea Vents
2. On the land
3. In the oceans

5. What kept oxygen levels low for a billion years on earth?

1. Life respiration
2. Absorption by the oceans.
3. Volcanism
4. Plate tectonics

To do list for next class

- Refer to the class syllabus
- Read assigned pages in textbook and review study questions on objectives list
- Bring PRS transmitter to class