

PowerLecture:

Chapter 20

Life's Origin and Early Evolution

Section 20.0: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online

Impacts, Issues: **Looking for Life in All the Odd Places**

- Bioprospecting – finding species that might provide valuable products
- Extreme thermophiles – species that thrive in extreme temperatures
- *Thermus aquaticus* live in hot springs and pools in Yellowstone park and can withstand temperatures up to 80°C (176°F)

Impacts, Issues: **Looking for Life in All the Odd Places**

- Nanobes found growing 3.8 kilometers (3 miles) below Earth's surface in very hot rocks - 170°C (338°F)
- Too small to be alive, but do contain DNA and appear to grow
- Nanobes may be like proto-cells which preceded the origin of the first living cells

Impacts, Issues Video

Section 20.1: Weblinks and InfoTrac

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The Big Bang

- 12-15 billion years ago all matter was compressed into a space the size of our sun
- Sudden instantaneous distribution of matter and energy throughout the known universe

Archeon Eon and Earlier

- 4,600 mya: Origin of Earth
- 4,600 - 3,800 mya
 - Formation of Earth's crust, atmosphere
 - Chemical and molecular evolution
 - First cells (anaerobic bacteria)

Earth Forms

- About 4.6 and 4.5 billion years ago
- Minerals and ice orbiting the sun started clumping together
- Heavy metals moved to Earth's interior, lighter ones floated to surface
- Produced outer crust and inner mantle

Earth Is "Just Right" for Life

- Smaller in diameter, gravity would not be great enough to hold onto atmosphere

- Closer to sun, water would have evaporated
- Farther from sun, water would have been locked up as ice

First Atmosphere

- Hydrogen gas
- Nitrogen
- Carbon monoxide
- Carbon dioxide
- No gaseous oxygen

First Atmosphere

First Atmosphere

Miller's reaction chamber experiment

Section 20.2: Weblinks and InfoTrac

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Origin of Organic Compounds

- Amino acids, other organic compounds can form spontaneously under conditions like those on early Earth
- Clay may have served as template for complex compounds
- Compounds may have formed near hydrothermal vents

Chemical Evolution

- Spontaneous formation of porphyrin rings from formaldehyde
- Components of chlorophylls and cytochromes

RNA World

- DNA is genetic material now
- DNA-to-RNA-to-protein system is complicated
- RNA may have been first genetic material
- RNA can assemble spontaneously
- How switch from RNA to DNA might have occurred is not known

Proto-Cells

- Microscopic spheres of proteins or lipids can self assemble
- Tiny sacs like cell membranes can form under laboratory conditions that simulate conditions in evaporating tidepools
- Nanobes may resemble proto-cells

Stepped Art

Proterozoic Eon

- Origin of photosynthetic Eubacteria
 - Noncyclic pathway first
 - Cyclic pathway next
- Oxygen accumulates in atmosphere
- Origin of aerobic respiration

Section 20.3: Weblinks and InfoTrac

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The First Cells

- Originated in Archeon Eon
- Were prokaryotic heterotrophs
- Secured energy through anaerobic pathways
 - No oxygen present
 - Relied on glycolysis and fermentation

Prokaryotes

- Prokaryotic beginnings

- Stromatolites

Eukaryotes

- The rise of Eukaryotes

Section 20.4: Weblinks and InfoTrac

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Advantages of Organelles

- Nuclear envelope may have helped to protect genes from competition with foreign DNA
- ER channels may have protected vital proteins

Advantages of Organelles

Origin of organelles

Theory of Endosymbiosis

- Lynn Margulis
- Mitochondria and chloroplasts are the descendents of free-living prokaryotic organisms
- Prokaryotes were engulfed by early eukaryotes and became permanent internal symbionts

Theory of Endosymbiosis

Section 20.5: Weblinks and InfoTrac

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History of Life

Milestones in the history of life