

Review

Exam 2 tomorrow

Presentation next week:
Frank Cartwright & Steve Pitula
Peter Kim & Adam Musto

Bacteria – Jonathan Coulton

Exam 2

- Will be similar to Exam 1 (class voted for 40 questions + 3 extra credit).
- Cover from last exam up to last Thursday's lecture.
- Again, one sheet of notes will be allowed.
 - We don't care how it's made or looks, and we won't collect it.

Key ideas

- Exoplanets
- Possible places for life in our solar system
- Life...
 - Basic structure of life
 - Protein and nucleic acids (DNA and RNA)
 - Progress of chemical evolution
 - History of life on Earth
 - Evolution to intelligence
- f_s, f_i, f_i – How do we estimate them?

Exoplanets

- What are exoplanets?
- What are the 4 ways to detect them?
- Why do we only detect the more massive planets?
- What is the newest mission to find Earth-like planets? What technique does it use?
- Why are the Solar System planets separated into rocky and gas planets?

Ne

- What is ne? What terms do we break it into?
- What is the habitable zone?
- What is the greenhouse effect?
- n_p
 - List some important factors to consider when estimating n_p .
- f_s
 - List some important factor to consider when estimating f_s

Basic Structure of Life

- Monomers and polymers
- What is a protein? What does it do?
 - What is the monomer for proteins?
 - What is an enzyme?
- What is a nucleic acid?
 - What is DNA? RNA?
 - What does DNA looks like? What does DNA do?
 - Three basic types of monomers for DNA/ RNA?
 - What is the function of the bases?

Basic Structure of Life – Continue

- What is the Codon code?
- What is a gene?
- What is a chromosome?
- Chirality
 - What is it?
 - What is the chirality we have?
- Murchison meteorite
 - What is it? Why is it important?

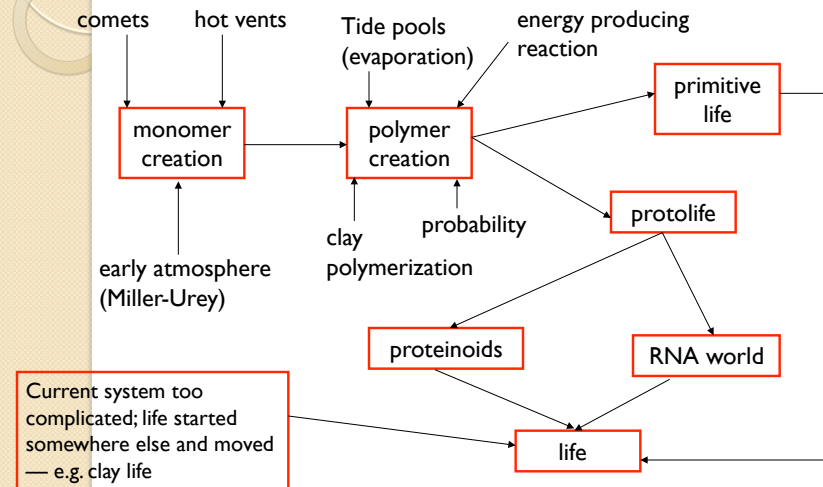
First Life

- What elements make up life? How abundant are they?
- Why does carbon play a main role?
- What role does water play?
- When did life first occur?
- What is the “chicken and egg” problem?
- Three steps for chemical evolution
 - Synthesis of monomers
 - Synthesis of polymers
 - Transition of life

Chemical Evolution

- Synthesis of monomers
 - What are the condition required?
 - Where might this happen?
 - What is the Miller and Urey Experiment?
 - What was its legacy for this class?
- Synthesis of polymers
 - What are the condition required?
 - Where might this happen?
- Transition of life
 - Two possibilities? Which one is more likely?
 - Protolife
 - Two concepts for protolife?
 - Which one is more popular?

Pathways to Life on Earth



Life – Elsewhere in the Solar System

- What are extremophiles?
- Where might we find life in the solar system?
 - Venus
 - Where? Why?
 - Mars
 - Where? Why?
 - Evidence for ice?
 - Jupiter? Jupiter's Moon?
 - Where? Why?
 - Saturn? Saturn's Moon?
 - Where? Why?

Life on Earth

- Classification of life
 - Three types of life?
 - Bacteria, archaea, eukarya
 - Prokaryotes
 - Two domains? What are the definitions?
 - Eukaryotes
 - What is the definition?
 - Which one came first?
 - Which one is more closely related to humans?
- What is the importance of sexual reproduction?
- fi
 - List some important factors to consider when estimating fi

Life on Earth – cont.

- What was the early atmosphere like?
- How was the Moon formed?
- Oxygenation of the atmosphere
 - When did it happen?
 - How did it happen?
 - Cyanobacteria
- For how long has life been on Earth?
- How long was life microscopic?
 - How do we determine the age of a fossil?
 - Radioactive dating (What is a half-life?)
 - C-14 (What does it work on? How does it work? How long can it trace back into history?)
 - K-40, U-235 (What does it work on? How long can it trace back into history?)

Life on Earth - intelligence

- What is the class definition of intelligence?
- What is the key aspect of the genetic code allows for eventual intelligence?
- Even though we have less info storage in our DNA than some animals, humans are more intelligent. Why?
- Describe hominid evolution.
- Examples of intelligence of animals other than human
 - Koko the Gorilla (What can she do?)
 - Alex the parrot (What could he do?)
- fi
 - What are the important factors to consider when estimating fi?

f; Considerations



- Intelligent life is a very recent development on Earth with the emergence of the primates, hominids, and H. sapiens.
- Everyone agrees that this particular evolution will not occur on other planets.
- The main point of our discussion has been the diversity of life and environment or pressures leads to unique life forms or species.
- That diversity, which is manifest in the genes, can lead to intelligence.
- It happened on this planet.
- It is likely to happen on other planets given the right conditions.
- But, we don't know what those conditions are.

f; Considerations



- Intelligence on this planet is best described as a continuum.
- How unique is our intelligence?
- Teaching sign language to chimps and gorillas have shown they are more intelligent than we thought.
- Don't forget Alex the parrot!



Alex (1976 - September 6, 2007)



Dr. Patterson persuades Koko not to smoke. "Kitten hates it, Koko!"

f_i Considerations



- Whales and dolphins are speculated to be of high intelligence, but communicating is difficult.
- With all of this in hand, we are ready to make the next estimate in the Drake equation.
- This term is only intelligent life that can communicate abstract thought to each other, not technological able to communicate.



What is f_i



- What is the fraction of life that forms human or better intelligence in less than about 4.5 billion years?
- If you think that it always does, then $f_i = 100\%$
- If you think that it is a statistical fluke or required supernatural invention then you could use 1/billion or $10^{-7}\%$.
- Anywhere in between is fair game.