April 13, 2009

Agenda

• Announce
  – GW Lab, Thursday’s class
  – Scheduling of projects on Thursday
  – Observation, Tuesday 8pm April 21
  – Solar Altitude Lab Due Today
• Projects
• Review Astrobiology
• Course Evaluations

Projects

• World is complex
• Few issues come down to
  – Right or wrong
  – Black or white
  – Good or evil
• Media
  – For profit
  – Ridiculousness on both sides
  – Look for respectful arguing, not insinuation and emotional appeals
• Put together argument
  – Point by point
  – Supported with authoritative references

Evolution and The Big Bang Theories

• Both “just theories”…
  – supported by scientific evidence
  – Accepted by most scientists
  – Open to criticism but high hurdle by now
• Both avoid origins
  – Big Bang: doesn’t say where Universe came from, just that it was in a hot, dense state and expanded
  – Evolution: doesn’t say how life originated, just how it developed
• Both form “paradigms” within which fields develop

Evolution of the wing

• Criticism: If you find a watch on the ground, you don’t conclude it evolved. It was designed. Similarly, when you see a wing or an eye, it suggests a designer. Such complicated organs couldn’t develop through evolution since:
  – Intermediate steps don’t help natural selection
  – Probabilities of randomly mutating a wing essentially zero

Response

• Good argument, but doesn’t hold up
• There are possible benefits to half a wing (and simple eye):
  – Arboreal model—flight developed from gliders
  – Cursorial model—flight developed from runners
  – Wing-assisted incline running
  – video
**Evolution as Problem solver**

- Genetic algorithms
  - Formulate a problem in terms of numbers...say we're designing a robot with weight w and strength s
  - Goal: find "best" robot design
- Algorithm:
  - Define mathematical fitness function: \( f(w,s) = w^3s + s/w \)
  - Create initial population of possible designs
  - Evaluate fitness of each
  - Repeat:
    - Kill lowest 25% of designs
    - Stay alive top 25% of designs
    - Mutate and transfix "genes" of top 75%

**Life on Earth**

- Appeared "quickly" on Earth
  - 3.5 billion years ago evidence of first life (algae/bacteria)
  - 600 million years ago—explosion of life
  - 65 million years ago—dinosaurs wiped out
  - 6 million years ago—early hominids
  - 0.5 million years ago—us
- Common ancestry
  - Occurs in extreme areas—extremophiles (ocean vents, hot springs, arctic rocks)
  - Building blocks of life assemble naturally

**Origins of Life**

- Option 1: Chemical reactions...suggestive experiments
  - Can we produce life in the lab?
- Option 2: Panspermia...arrived from elsewhere
  - If we find life elsewhere, see if life related to us (DNA, carbon based, etc)

**Necessities for Life**

- Nutrients (chemicals needed to assemble)
- Energy (starlight, chemical reactions, heat source)
- Liquid as medium for life processes (liquid water, liquid methane, etc)

**Rare Earth Hypothesis**

- Life may be very rare because conditions here very special:
  - Requires heavy elements to make a terrestrial planet
  - Require safe from Xray and gamma ray radiation
  - Require large Jupiter-like planet to clear out bombarding asteroids
  - Require stable climate (provided by large moon)

**ET Life**

- How many habitable planets? Drake Equation
- Why no contact if life elsewhere? Fermi Paradox
- Searches: SETI, rovers (mars), telescopes (Kepler), probes (Voyager), METI (?)
Anthropic Arguments

- Seeks to explain features of nature/universe as necessary for us to exist (in some form) to observe them
- Why is the Universe flat? Anthropic response: because otherwise Universe would have collapsed or blown apart and we wouldn’t be here
- Why is age of universe about the age of stars? Dicke: Because life requires second generation of stars, so life not possible early (no metals) or late (burned out stars)