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^3*s +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 milion 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)