Table 6: Evidence for a Universe Designed to Support Life

1. **gravitational coupling constant**
   - if larger: no stars less than 1.4 solar masses, hence short stellar life spans
   - if smaller: no stars more than 0.8 solar masses, hence no heavy element production

2. **strong nuclear force coupling constant**
   - if larger: no hydrogen; nuclei essential for life are unstable
   - if smaller: no elements other than hydrogen

3. **weak nuclear force coupling constant**
   - if larger: all hydrogen is converted to helium in the big bang, hence too much heavy elements
   - if smaller: no helium produced from big bang, hence not enough heavy elements

4. **electromagnetic coupling constant**
   - if larger: no chemical bonding
   - if smaller: no chemical bonding

5. **ratio of electron to proton mass**
   - if larger: no chemical bonding
   - if smaller: no chemical bonding

6. **expansion rate of the universe**
   - if larger: no galaxy formation
   - if smaller: universe collapses prior to star formation

7. **entropy level of the universe**
   - if larger: no star condensation within the proto-galaxies
   - if smaller: no proto-galaxy formation

8. **mass of the universe**
   - if larger: too much deuterium from big bang, hence stars burn too rapidly
   - if smaller: no helium from big bang, hence not enough heavy elements

9. **average distance between stars**
   - if larger: heavy element density too thin for rocky planet production
   - if smaller: planetary orbits become destabilized

10. **solar luminosity**
    - if increases too soon: runaway greenhouse effect
    - if increases too late: frozen oceans

11. **fine structure constant** (a function of three other fundamental constants, Planck’s constant, the velocity of light, and the electron charge)
    - if larger: no stars more than 0.7 solar masses
    - if smaller: no stars less than 1.8 solar masses

12. **$^{12}$C to $^{16}$O energy level ratio**
    - if larger: insufficient oxygen
if smaller: insufficient carbon