Why We Believe
Week 9: The Scientific Method and Scientific Mythology

I. The Scientific Method
- A. The Scientific Method is a process that uses observation, hypothesis, testing, and re-hypothesis to establish facts in an attempt to understand the world.
- B. It is good for understanding repetitive physical phenomena.
- C. It is poor at evaluating non-repetitive, rare, and non-physical phenomena.

II. Grading of Scientific Evidence
- A. Multiple, randomized, prospective, blinded studies are the best.
- B. Followed by single, randomized, prospective, blinded studies.
- C. Followed by groups of studies which may be limited by lack of randomization, blinding, etc.
- D. Followed by single poor quality studies.
- E. Followed by observation.
- F. Followed by opinion.
- G. The best evidence is graded a law.
- H. The next best evidence is graded as theory.
- I. Unproven ideas are considered hypothesis.
- J. Observations are observations.
- K. Opinions are opinions.

III. What is Prospective?
- A. Prospective is looking ahead.
- B. It is important because we can miss important things looking backward.
- C. This is sometimes referred to as recall bias.

IV. Extrapolation
- A. Extrapolation is to project current trends into the past or the future.
- B. Scientifically this is to be avoided whenever possible.
- C. Generally you want to test standards on both sides of the information that you want.

V. Mythology
- A. Myth – A story designed to explain a set of current or past events or conditions.
- B. Myth differs from history in that it does not rely on eye-witness accounts or manuscript evidence.
- C. Scientific mythology is explaining events or conditions in terms of scientific phenomena without meeting the burdens of the scientific method.
- D. Evolution is Scientific Mythology
- E. There is no way to test evolutionary theory.
    1. Even if you could recreate evolution it a test tube it would only show that this was ONE way that it could have happened.
    2. It uses extreme examples of retrospective analysis and extrapolation.

VI. Cosmology
- A. The study of the beginning of the universe.
- B. Cosmology, like evolution is retrospective, speculative, abuses extrapolation, and relies heavily on assumption.

VII. Light Travel to Date the Universe

A. Light travels at 3.0 x 108 Meters/S or 186,000 Miles/second

B. The farthest stars that we can see are billions of light years away; therefore they must be at least billions of years old.

C. Sounds like a pretty good argument on the surface, but let's look further.

D. What assumptions does this dating system make?

1. Stars are made first, then light.
2. The speed of light is constant.

E. The Bible states that light was made first. – See Genesis 1

F. Speed is distance traveled/time. Distance may be constant in the universe, but time is not.

1. Time Dilation
    a. Time varies with speed and gravity.
    b. The faster you go the less time you experience.
    c. Time decreases (slows) with increasing gravity.

G. The Big Bang Theory supposes that we live in a boundless universe without a center.

H. If in we live in a bounded universe with a center and we are near the center then light coming from the furthest stars in the universe would travel billions of years in a couple thousand earth years.

VIII. The Big Bang

A. The Big Bang is not a theory.

B. The Big Bang solves nothing.

IX. The Second Law of Thermodynamics

A. All things move toward increasing disorder (entropy).

B. Entropy is a state function.

1. State functions describe things like temperature. If it is 73^{o} outside it does not matter how it got there.
2. There is a minimum amount of energy to get to any state. You may take a longer path but not a shorter one.
3. Order like temperature is a state function. A clean room has a certain amount of order. You may get to that amount of order by many paths, but there is a minimum amount of order that must be overcome.
4. Any intermediate states must be added to the amount of order to be overcome.

X. Entropy-Enthalpy Compensation

A. A certain amount of order can be overcome by energy. (i.e. hitting an old TV to improve the picture).

B. The amount of order that can be overcome this way can be described mathematically.

C. In chemistry if a reaction is less likely than $1/10^{18}$ it is considered not possible for a common mechanism. If it is less likely than $1/10^{50}$ then it could not happen in all of space and all of time.

D. The odds of making the simplest single cell organism (calculated from the odds of making its DNA) far exceed $1/4^{56000}$ or $1/10^{34000}$.

E. The odds of making a human would be $1/4^{3,000,000,000}$ or $1/10^{1,800,000,000}$.

F. If $1/10^{1,800,000,000}$ were written out in 10 point type an the 1 placed in San Francisco, CA the last 0 would be in St. Louis, MO.

XI. Exceeding the Activation Energy

A. Activation energy is the amount of energy that it takes to make something come apart.

B. Another limitation to Entropy-Enthalpy compensation is that the energy applied cannot exceed the activation energy of the substance worked on.

C. The Enthalpy required can be calculated with the equation $S=k\ln w$

D. Evolution clearly exceeds that activation energy of the affected organisms.