

XIII. Science & Evolution (Parasitology, BLY 459, 2009)

A. Characteristics of a good *scientific* theory

1. TESTABLE
 - a. Must make predictions; must be *falsifiable*
 - b. Karl Popper: One cannot prove something is true, but one can prove something is false
 - c. Methodology
 - (1) Null hypothesis
 - (a) What is tested/rejected
 - (b) “Penicillin has no effect upon bacterial infections”
 - (2) Control
 - (a) Standard of comparison
 - (b) Experimental treatment omitted
 - (c) Placebo: Inactive substance
 - (d) Placebo Effect: Response to act of being treated
 - (3) Variables
 - (a) Independent
 - 1) Affects something
 - 2) X-axis
 - (b) Dependent
 - 1) What is affected by the independent variable
 - 2) Y-axis

Slide: Growth of pleurocercoids in body tissues of mice and their effect on the body mass of their hosts.

2. Repeatable
3. Stable
4. Simple
5. Non-authoritarian
6. No retrofitting
7. Supported by convergence of independent evidence

B. Basic concepts of evolution

1. Individuals within populations have different traits = *variation*
 - a. Mutation creates new genes
 - b. Genes of eukaryote offspring vary because of 2 events in meiosis
 - (1) Crossing over

Slide: Freeman 2nd ed. Fig. 12-6

- (2) Independent assortment

Slide Freeman 2nd ed. Fig. 12.8b

2. Genes enabling bearers to have more offspring become common in gene pool
 - a. Less than 1% of all organisms that are born ever reproduce

Slide: Biology in *The Far Side* Praying mantis lecturing students

- b. Maladaptive genes REMOVED from gene pool of population
3. Reproductively isolated groups eventually split/evolve into new species
4. Mechanisms

- a. NATURAL SELECTION
 - (1) Genes *removed* from population
 - (2) Death before reproduction
- b. SEXUAL SELECTION
 - (1) Females often choose the males
 - (2) May lead to exaggerated traits (= bright plumage, heavy large antlers) that increase predation risks for those being chosen
- c. SYMBIOSIS
 - (1) The ENDOSYMBIOSIS THEORY explains the origin of the eukaryotic cell
 - (2) Eukaryotic organelles replicate independently of mitosis and possess DNA and membranes
 - (3) Origin of the mitochondrion
 - (a) Characteristics of the predatory host cell
 - i Only capable of anaerobic fermentation
 - ii Engulfs aerobic bacterium
 - (b) Mutualistic relationship occurred
 - i Prey bacterium not digested
 - ii Prey provides host with abundant ATPs
 - iii Host provides bacterium with carbon compounds and protection

Slide: Figure from college introductory biology text showing origin of the mitochondrion as explained by the Endosymbiosis Theory

- (4) Origin of the chloroplast
 - i. Ancestral eukaryotic cell engulfed a photosynthetic cyanobacterium
 - ii. Prey provided host with sugars
 - iii. Host provided cyanobacterium with carbon dioxide and protection
 - iv. Explains presence of 3-4 membranes in eukaryotic chloroplasts

Slide: Figure from college introductory biology text showing origin of the chloroplast (with 4 membranes) as explained by the Endosymbiosis Theory

- (5) Over evolutionary time, many organelle genes were transposed onto the host's nuclear DNA

Slide: Diagram illustrating competing ideas about the evolutionary history of the eukaryotic cell with statement claiming most eukaryotic nuclear DNA apparently originally came from endosymbionts Zimmer, 2009, *Science*, On the Origin of Eukaryotes, 325: 668

C. O'Brien's "pet peeves" with evolution misconceptions

- 1. "Survival of the fittest"
 - a. Inexact & trite
 - b. Producing viable offspring much more important than simply surviving
- 2. Modern day species are more "advanced" or "better adapted" than extinct species

Slide: Biology in *The Far Side* Dinosaur lecturing

- a. Many large scale extinctions were caused by extraordinary events to which organisms had no chance to adapt.
 - (1) Asteroid impacts.
 - (2) Sudden changes in climate
- b. Dinosaurs were well-adapted to their environment
3. Over evolutionary time, species tend to increase in complexity
 - a. Jettisoning a trait may increase energy available for reproduction
 - b. Comparisons between parasites and their free-living relatives indicate that many parasites have lost structures (= Tapeworms are without a gut)
 - c. Traits are continually being gained AND lost over evolutionary time
4. Parasites are degenerate organisms that are significantly less complex than their free-living relatives
 - a. Parasites do NOT have FEWER traits than their free-living relatives
 - b. Parasites have DIFFERENT traits that enable them to complete their life-cycles.
 - (1) Infect new hosts
 - (2) Avoid host's immune system
 - c. At the cellular & molecular levels, parasites are probably more complex than their free-living relatives
 - (1) A typical trematode lifecycle can involve living in a vertebrate, a mollusk, and an arthropod
 - (2) Tapeworm integument is covered with microvilli that absorb nutrients

D. Non-scientific hypotheses

1. TELEOLOGY
 - a. Attributing purpose to descriptions of natural events = "Everything happens for a reason"
 - b. Not scientific because it is not testable
 - c. Examples that have been used to explain cataclysmic events
 - (1) Hurricane Katrina was sent to the Gulf Coast because of "gambling, sin, and wickedness" Hank Erwin, Alabama State Senator after a tour of the damaged area
 - (2) The appearance of AIDS on the world scene is divine punishment for men who engage in homosexual activities
 - (3) The 9/11 Attack on the World Trade Center

Falwell: "What we saw on Tuesday...could be miniscule if...God continues to lift the curtain and allow the enemies of America to give us probably what we deserve...The ACLU has got to take a lot of blame for this. And I know I'll hear from them for this, but throwing God...out of the public square, out of the schools, the abortionists have got to bear some burden for this because God will not be mocked and when we destroy 40 million little innocent babies, we make God mad...I really believe that the pagans and the abortionists and the feminists and the gays and the lesbians who are actively trying to make that an alternative lifestyle, the ACLU, People for the American Way, all of them who try to secularize America...I point the thing in their face and say you helped this happen."

Robertson: "I totally concur..."

Transcript: Interview of Rev. Jerry Falwell by Pat Robertson on the 700 Club, Sept. 13, 2001

<http://www.truthorfiction.com/rumors/f/falwell-robertson-wtc.htm>

Slide: Apology Statement of Falwell issued on 9/14/01

<http://www.truthorfiction.com/rumors/f/falwell-robertson-wtc.htm>

d. Examples used to explain biological phenomena

- (1) Giraffes have long necks in order to eat leaves at the tops of trees. (not testable)
 - (a) Giraffes with long necks consume more leaves (= food than giraffes with short necks (testable)
 - (b) Female giraffes are more likely to mate with long-necked male giraffes than short-necked males
 - (c) Giraffes w/ long necks produce more offspring than short-necked (testable)
- (2) Female sea turtles...
 - (a) ...lay eggs on exposed sandy beach so that they will be incubated by the sun. (not testable)
 - (b) ...that lay eggs in sun-exposed locations have a greater hatching success than those whose eggs were deposited in shade. (testable)

2. ANTHROPOMORPHISM

- a. Defined: Attributing human emotions to animal activities & behaviors
- b. Examples
 - (1) Mother lion *loves* her offspring so much that she will risk her life to defend them
 - (2) Porpoises *like* humans

Slide: Atlantic Bottlenosed Dolphin with a large eye and “smile”

3. INTELLIGENT DESIGN (= ID)

- a. Creationist argument for ID
 - (1) Metabolic pathways, organisms, life-cycles are complex.

Slide: Life-cycle of a Butterfly

- (2) This complexity is “proof” that living organisms have been designed/created by a powerful being or beings.

Slide: M. Behe, a biochemist at Lehigh University, argues that the eukaryotic cell is too complex to have evolved. He proposes that life on earth began as primitive cells that were designed and left here by life forms from other star systems.

Slide...I find the idea of common descent (that all organisms share a common ancestor) fairly convincing, and have no particular reason to doubt it...Although Darwin’s mechanism—natural selection working on variation—might explain many things, however, I do not believe it explains molecular life. Behe, M.J., 1996, *Darwin’s Black Box*, p. 5

- b. Biological arguments against ID
 - (1) BAD SCIENCE: Impossible to test
 - (2) BAD SCIENCE: There are too many biological structures that are not intelligently designed = TOO MANY EXCEPTIONS
 - (a) Connection between respiratory & digestive tracts of vertebrates results in deaths by choking

Slides showing anatomy of esophagus, trachea & epiglottis, Heimlich maneuvers in humans & reptiles

- (b) Neurons of vertebrate eye lie obstruct incoming light before it reaches sensory receptors

Slides: Cell arrangement in vertebrate retina; comparison of anatomy of vertebrate and cephalopod eyes

- (c) Human head does not pass easily through birth canal.

Slides: Birthing sequence in humans

Slide: The moral dilemma of parasites as viewed by 19 century naturalists

... Why did God create parasites? To keep us from being too proud, by reminding us that we were merely dust. How did parasites get into us? They must have been put there by God, since there was no apparent way for them to get in by themselves. Perhaps they were passed down through generations within our bodies to the bodies of our children. Did that mean that Adam, who was created in purest innocence, came into being already loaded with parasites? Maybe the parasites were created inside him after his fall. But wouldn't this be a second creation, an eighth day added on to that first week---"and on the following Monday God created parasites"? Well, maybe Adam was created with parasites after all, but in Eden parasites were his helpmates. They ate the food he couldn't fully digest and licked his wounds clean from within. But why would Adam, created not only in innocence but in perfection, need any help at all? Here the catechism seems to have finally fallen apart. From Carl Zimmer 2000, *Parasite Rex*, p. 5

- (3) Bad Religion: ID is close to blasphemy
 - (a) Most animals are parasites
 - (b) Parasites are "well-designed" to infect and live inside hosts
 - (c) In humans, parasitic diseases are more commonly found among the poor than the rich
 - (d) Suffering of impoverished children caused by "intelligently designed" parasitic diseases presents a moral dilemma for Christian ID proponents who believe in a loving God

Slide: But, Jesus called them together and said, "Let the little children come to me, and do not hinder them, for of such is the kingdom of God." Luke 18:16

Slide: Impact of *Schistosoma* Roberts & Janovy, 2000, Fig. 16.17, p. 247

Slide: Quotation from *Creation Research Quarterly Journal*

... But the question remains of whether or not a loving God would plan invaders such as these [parasites]. Were these organisms designed from the start to perform functions they no longer perform? Answers to these questions may vary, but we can be sure that a loving God did not intend the rampant parasitism we observe today. From Armitage, M.H., 2000, *CRS Quarterly*, 184-194. The last sentence is a teleological statement and scientifically untestable

- i. One response is that diseases are the result of human sin

The only acceptable alternative to the evolution explanation is these complex life-cycles and "design-like" structures were planned by the Creator, at the point in history when He designed all of the other living organisms. Why and how some symbionts have today become pathogenic is open for speculation, but in a creation scenario, pathobiology must certainly be related somehow to the Fall of Adam and the subsequent Curse (Genesis 1:31; 3:18). From Armitage, M.H., 2000, *CRS Quarterly*, 184-194.

Slide: Genesis 1:31; 3:17; 3:18

Slide: The "Curse" of childbirth has become less of a problem in the developed world since World War II

- ii Would creationists want to argue that the infection of innocent children with “intelligently designed” parasites is akin to the military concept of “collateral damage”?

Collateral damage is a U.S. Military term for unintended or incidental damage during a military operation. The term, which originated as a euphemism during the Vietnam War, can refer to friendly fire, or the killing of non-combatants and the destruction of their property. http://en.wikipedia.org/wiki/Collateral_damage

Slides: Oklahoma Bombing and Timothy McVeigh’s concept of *collateral damage*.

“I recognized beforehand that someone might be ... bringing their kid to work ... However, if I had known there was an entire day care center, it might have given me pause to switch targets. That's a large amount of collateral damage.” http://www.courttv.com/archive/news/2001/0328/mcveigh_ap.htm

Slide: AL State Senator explaining his “collateral damage” hypothesis as to what caused Hurricane Katrina. "Warnings year after year by godly evangelists and preachers went unheeded. So why were we surprised when finally the hand of judgment fell?" he wrote. "Sadly, innocents suffered along with the guilty. *Sin always brings suffering to good people as well as the bad.*" (Italics added)

Fisher Humphreys, a professor of divinity at Samford University, didn't respond directly to Erwin, but he did say ... "A God that is irrational and vindictive, and filled with anger – that understanding of God is not the understanding we find in Christ. We don't believe in a God that is vindictive or cruel http://www.worldnetdaily.com/news/article.asp?ARTICLE_ID=46568 Posted Sept. 29, 2005

Slide: Why does O’Brien get so animated about creationism & ID?

Slide: Local Physician Expresses His Creationist Beliefs There is no process for biological evolution...All living things are made after their kind. *Mobile Register*, October 7, 2007, p. 2D

Slide: *Press-Register* article about antibiotic resistant staphylococcus at Spanish Fort High School. Health officials said the bug has evolved into a superbug because of the over-prescribing of antibiotics... October 24, 2007, pp: 1A & 4A