“Nothing in biology makes sense except in light of evolution"

- Theodosius Dobzhansky
Characteristics of living things can be fully understood only in light of their history, that is, how they came to be.

Many do not, otherwise, make sense.
Things that do not make sense except in the light of evolution

“Biogenetic law”

Vestigial organs

Suboptimal design

Genome size and organization

examples to follow
The “Biogenetic Law” (Ernst Haeckel 1834-1919)

“Ontogeny recapitulates phylogeny”

meaning organisms pass through the developmental stages of their ancestors

– not entirely true

More accurately stated: the more closely two organisms are related, the greater the conservation (similarity, or duration of conservation) in their development
Vestigial Organs

legacies of inheritance that no longer serve any purpose
Female geometrid moth
The vermiform appendix
Suboptimal Design
The male reproductive tract

- Large intestine
- Seminal vesicle
- Ampulla
- Ejaculatory duct
- Prostate gland
- Bulbourethral gland
- Anus
- Epididymis
- Testis
- Scrotum
the left recurrent laryngeal nerve
Changes in the aortic arch pattern
Molluscan and vertebrate retinas
Genome size and organization
The human genome is ~3.2 billion nucleotides in length

There are four nucleotides in our DNA

Thus, the probability of these assembling strictly by chance in the particular order necessary to orchestrate the development of the exquisitely complex human species is

$$\frac{1}{(4)^{3.3 \times 10^9}}$$

- an impossibly small probability

*Biologists Agree!*
The large complex genomes of even the simplest living organisms are not randomly assembled from nucleotides.

New genes arise by duplication and neofunctionalization (i.e., they acquire new functions).

The evidence is that, like organisms themselves, genes are represented as gene families of common ancestry and related but distinct function.

Thus, a relatively small number of genes has gradually increased in number and functions in the long course of evolution.

(Incidentally, only ~2.5% of the human genome represents coding sequence, i.e., genes.)
Gene Duplication: e.g., Zebrafish MHC Class I Multigene Families
Does evolution pose a conflict with religion?

Not necessarily

On the one hand, science can only test those things that repeatably conform to the known laws of physics; it cannot test the supernatural

On the other hand, internal inconsistencies in Sacred Scriptures dictate that not all of it can be interpreted literally

Sacred Scriptures were written by people in the words and context of their primitive understanding of the universe thousands of years ago, and rewritten many times since
Does evolution pose a conflict with religion?

Conservatism of ‘design’ is consistent with both evolution by natural selection and religion

Conservatism in design of organisms can be explained by homology

**Homology** - the sharing of traits by virtue of their inheritance from a common ancestor, regardless of their form or function

Conservatism in design can also be explained by the “theist” position, i.e., God established the natural laws of physics and allowed the world to develop according to those laws

However, this does not comport with instantaneous Creation – by definition, the supernatural is not subject to the laws of physics and nature
Divine explanation for conservatism in design

"Scala Naturae" - a divine plan in the linear continuity from the simple to complex, i.e., from inorganic rocks to simple life forms to complex ones to human to angels to God

Advocates say God’s plan would surely be orderly

Others counter it is arrogant to presume to understand how God thinks

However, the real problem is that there is not a linear continuity of life, the ‘tree of life’ is multidimensional
What is Faith?

Faith is belief in something in the absence of evidence or in the face of conflicting evidence.

Faith is a noble human quality, but it is outside the realm of science – it is the antithesis of science.

Science can only address the observable and the testable that conform to reproducible laws of physics.

Therefore, science can neither substantiate nor repudiate the supernatural.
In the 17th century the Church controlled all research, both academically and legally in Western culture.

Answers to scientific questions were to be sought in Scriptures, not by observation, calculation, or experimentation.

In 1600 Giordano Bruno was burned alive at the stake for the heresy of advocating Copernican heliocentricity.

In 1633 Galileo Galilei was sentenced [only] to life imprisonment for the same offense – In 1992 the Vatican formally acknowledged that Galilei was correct and apologized.

As late as the 1860’s, all private American universities were still sectarian.
These are foundational creation truths which cannot be separated!! On this site, you will find the facts in over 100 different links. The Levitating Globe, shown on the left, has an electromagnet and computerized sensor hidden in its display stand which causes the Earth to levitate motionless in the air. Could God have engineered something like that for the real Earth? The Bible and all real evidence confirm that this is precisely what he did, and indeed:

**The Earth is not rotating...nor is it going around the sun.**

Today's cosmology fulfills an anti-Bible *religious* plan disguised as “science”. The whole scheme from Copernicanism to Big Bangism is a factless lie. Those lies have planted the Truth-killing virus of *evolutionism* in every aspect of man’s “knowledge” about the Universe, the Earth, and Himself. Take your time. Check it all out. Decide for yourself.
Blind faith can lead people to make poor decisions about:

- Medicine
- Environment
- Determinism
If you gave away everything you owned, who do you see about this guarantee?

Judgment Day
May 21 2011

Cry mightily unto God Jonah 3:8

Mon - Fri 6:30 - 8 PM
91.7 FM FamilyRadio.com
The Scientific Method

Make observations

Suggest a hypothesis to explain those observations

Test the hypothesis

the scientific method can never prove hypotheses to be correct (i.e., factual), because it can only test them under a given set of experimental circumstances
Fact – something known to be true by direct repeatably measurable and independently verifiable observation

Hypothesis – a statement of something that might be true

Theory – a statement of what are known to be general laws, principles, or causes of something known or observed; theory is not conjecture
Facts (measurable observations)
Human and chimp DNA is 98-99.5% identical.
Many fossils fill the gap between humans and chimps.
Humans and chimps uniquely share two critical language centers in the left cerebral hemisphere
Nariokotome Homo erectus cerebral asymmetry
Evolutionary Hypotheses
Evolutionary hypotheses are testable
A little background on fish classification

Chondrichthyes – cartilagenous fishes, e.g., sharks
Osteichthyes – bony fishes
   Actinopterygii – ray finned fishes, typical fishes
   Dipnoi – 3 Southern Hemisphere lung fishes
   Sarcopterygii – fleshy finned fishes, mostly extinct
Labyrinthodont amphibians – presumed earliest tetrapods
Rhipidistii (Sarcopterygii: Crossopterygii) – presumed ancestors of labyrinthodonts
Cross-section of a *Eusthenopteron* labyrinthodont tooth
Labyrinthodont limbs
fin-foot intermediate
Fossil Crossopterygians – thought long extinct
Latimeria “the coelocanth” – a “living fossil” (Sarcopterygii: Crossopterygii) first known to Western science in 1938

Null Hypothesis (H₀) – Labyrinthodonts evolved from Crossopterygians, so amphibian DNA should be more like coelocanth DNA than like other fish DNA.
Lungfish (Sarcopterygii: Dipnoi)

Alternate Hypothesis ($H_A$) – Labyrinthodonts evolved from Dipnoi, so amphibian DNA should be more like lungfish DNA than like coelocanths DNA.
Why had evolution remained unrecognized for so long?

It is a slow process in most organisms.

Human generations – and memory, are comparatively short.
Well-meaning “environmentalists” of Nebraska protested to “save” forests in the Platte riverbed …

… not remembering that the forest grew there as the result of reduced river flow due to the construction of dams between 1909 – 1940

Bare riverbed historically produced by scouring of annual floods is critical nesting habitat for Sandhill Cranes
Many tens of thousands of petroglyphs document a vastly different climate in Saharan Africa 8-10,000 years ago

- a long time measured in human generations
- the blink of an eye in geological time
Tadrart Acacus
central Sahara desert
Libya

10,000 years ago

today
Ten thousand years ago in what would become Las Cruces people coexisted with elephants, giant ground sloths, camels, tapirs, and saber-toothed cats.
Some historic individuals who challenged dogma and doctrine on the age of the earth

**Georges LeClerc** (“Comte de Buffon”) (1707-1788) – based on estimates of the rate of earth cooling

Jean Léopold Nicolas Frédéric (“Georges”) **Cuvier** (1769-1832) – based on faunal turnover in the fossil record

**James Hutton** (1726-1797) – based on measurement of sedimentation rates. Hutton introduced the concept of … **uniformitarianism** – the premise that the processes that operate today are the same as those that operated in the past, so the past can be understood by studying the present
Earth is 4.6 BILLION years old
Plate Tectonics

the unifying theory of structural geology

a non-biological example of theory in practice
Observations
Mountain ranges
Mountain ranges
Volcanism
Earthquakes and fault zones
Earthquakes and fault zones
Earthquakes
Fault zones
Fault zones
Fault zones
Complementary contours of trans-oceanic continents
Deep ocean trenches and mountain ranges

- Mt. Everest (8848 meters above sea level)
- Mariana Trench
- Challenger Deep (11,035 meters below sea level)
Coral reefs growing to the surface from depths below the reach of sunlight
Disjunct endemism: Lungfishes in South America, Africa, and Australia
Disjunct endemism: Fossil Mesosaurs in eastern South America and West Africa
Observations summarized:

- Mountain ranges
- Deep ocean trenches
- Volcanoes
- Earthquakes and fault zones
- Tsunamis
- Complementary contours of trans-oceanic continents
- Coral reefs growing to the ocean surface from depths greater than they can survive
- Disjunct endemism
The earth’s crust is broken into pieces, called ‘plates’
Preliminary Determination of Epicenters
358,214 Events, 1963 - 1998
Plate tectonic theory – the unifying mechanism
How Plate Tectonics is validated, measured and mapped

Ongoing movements measured by satellite GPS

Past movements mapped using magnetic reversals recorded in oceanic crust
Magnetic field oriented as it is today
Magnetic field reversed
Development of Thought
Scala Naturae – the concept of a chain of existence from the inanimate to simple life forms to man to angels to God

Carolus Linnaeus 1707-1778 great naturalist who endeavored to document the Scala Naturae in his encyclopedic work…

“Systema Naturae” (1735) - hierarchical classification of life (Kingdom, Phylum, Class, Order, Family Genus, Species)

concept of extinction unknown or unaccepted at the time
James Hutton (1726–1797) “uniformitarianism” or “actualism” - processes that we can observe today are essentially the same as those that have occurred in the past, i.e., the past can be understood through the present

- an important concept that could be extended from the inorganic to the organic world

- important, too, for its implications on

1) the age of the earth, and

2) that the earth is ever-changing

3) this change is purposeless
many ideas regarding the mutability of life emerged in the 1700-1800's, before Darwin - the important theme being that species were *not un*changing

Georges Louis LeClerc (AKA “Comte de Buffon”) 1707-1788 wrote “*Histoire Naturelle*” 1750's - suggested that congeneric species had common ancestors

Jean Baptiste Lamarck 1744-1829 wrote “*Philosophie Zoologique*” (1809) - origination of species by spontaneous generation at different times, *orthogenesis* along the Scala Naturae and adaptation - inheritance of acquired characteristics
Charles Darwin 1809-1882

best known for writing "On the Origin of Species" (1859) in which he presented his theory of Descent with Modification by Natural Selection

a medical school drop out, he matriculated at Christ's College of Cambridge University with the intent of joining the clergy

in 1831 (about age 22) he became the ship's naturalist on the 5-year voyage of the HMS Beagle around the world

observations he made primarily in So. America and on islands nearby influenced the development of his thought, these were supplemented by a lifetime of observation, experimentation, and consultation with authorities in the natural sciences
Charles Darwin 1809-1882

to his credit, he studied and experimented for decades before consolidating his thoughts into writing

poor health and the independent arrival at the theory of natural selection by Alfred Russel Wallace (1823-1913) prompted Darwin to write "On the Origin of Species" (1859) in which he presented and defended his theory of Descent with Modification by Natural Selection

Why isn’t Wallace credited like Darwin?
• He was abroad, involved in entrepreneurial ventures with some bad luck
• He became increasingly spiritual, especially regarding evolution of the human soul, falling into disfavor with the scientific community
• He was of a lower class and never achieved a position of academic stature
• He never popularized his work in a book like Darwin
Factors that influenced Darwin:

1) principle of inheritance

2) belief in common ancestry of organisms, but no mention of humans and monkeys

3) difficulty in distinguishing between varieties and species (arguments between 'experts' on which was which, yet divine creation held as paramount the existence of one and not the other)

4) origin of domestic "varieties" by artificial selection

5) variation exists in all natural populations, even without human selection
Factors that influenced Darwin (continued):

6) geometric powers of increase, strongly influenced by Thomas Robert Malthus' (1766-1834) "Essay on the Principle of Population" (1798), which advocated that human population growth exceeded the rate of increase of food supply, therefore unchecked growth would lead to famine

7) nature of checks on increase - competition is universal and most severe between individuals of the same species

8) extinction - inferred to result from natural selection; extinct fossils never reappear later (therefore, no spontaneous generation)
Factors that influenced Darwin (continued):

9) hybridization results in sterile offspring in some cases, fertile offspring in others - it makes no sense that different species would follow different rules of hybrid fertility/sterility if they were created as is; could it be that speciation is complete in some and not in others?

10) traits that distinguish species are similar in kind to those that distinguish subspecies or varieties, there are only more of them; therefore speciation must occur by the accumulation of many small changes, and change must be gradual

11) the geological record must be very incomplete - a (correct) rationalization for why not all intermediates (ancestors) are known as fossils

12) fossil forms are more complex in younger sediments
Factors that influenced Darwin (continued):

13) importance of geographic proximity and physical barriers to dispersal to patterns of similarity (relatedness)

   a) fossil rodents of So. America are more like living rodents of So. America than either are like rodents from No. America or Europe
Caviomorph rodents are endemic to South America.
Factors that influenced Darwin (continued):

13) importance of geographic proximity and physical barriers to dispersal to patterns of similarity (relatedness)

   b) groups of mockingbirds on Galapagos Islands archipelago seemed to be more similar to one another, and more similar to the species of nearby So. America, than to the species of No. America
Species’ similarity often correlates with geographic distance.
Factors that influenced Darwin (continued):

13) importance of geographic proximity and physical barriers to dispersal to patterns of similarity (relatedness)

c) absence of terrestrial (nonflying) mammals (e.g., monkeys and elephants) in remote islands of Oceania that are otherwise well suited to them as tropical jungles – it makes no sense that if these were created with purpose that they would be left unused
Factors that influenced Darwin (continued):

14) Linnaeus' hierarchical classification described not a linear Scala Naturae but multidimensional relationships - groups subordinate to groups can be explained only by common ancestry and descent with modification

15) vestigial organs and biogenetic principle
from these observations, Darwin proposed the Theory of Natural Selection

"if variations useful to any organic being ever occur, assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation, or survival of the fittest, I have called natural selection."
With the amassing of fossils and new studies of comparative anatomy, descent with modification was accepted in the late 1800's.

but the theory of natural selection was not spontaneous changes by mutation were thought instead to be important, much because of a lack of understanding of genetics.
Hugo de Vries 1848-1935  Dutch botanist who first introduced the concept of the gene, and who argued that each new mutant of evening primrose was a new species

Gregor Mendel 1822- 1884 an Austrian monk who introduced the concept of Mendelian inheritance, and dominant and recessive traits, based on crossing experiments with peas (e.g., crosses between wrinkled/smooth green/yellow)

Genetics unknown to Darwin and others of his time

Rediscovery in the early 1900's of Gregor Mendel's (1865) genetic experiments on peas led to renewed interest in the theory of natural selection and "the Modern Synthesis"
The New Synthesis (AKA Synthetic Revolution, Modern Synthesis)  
1930-1940's

A union of population genetics and evolution by natural selection - most importantly, mutation and selection (or adaptation) are not alternatives, they are not mutually exclusive, but instead complementary.

Mutation is the raw material upon which selection acts.

Studies performed especially on *Drosophila* and plants by population geneticists vindicated Darwin's assertion that evolution is a gradual process and does not occur by saltation (contrary to de Vries).
Important figures in the development of the New Synthesis

**Ronald A. Fisher** – population geneticist, statistician, racist

**J. B. S. Haldane** – population geneticist, foundational work on genetic linkage and hybrid sterility

**Sewall Wright** – population geneticist, foundational work on genetic drift and fitness landscapes

**Theodosius Dobzansky** – *Drosophila* geneticist, genetic basis of race (but not a racist) and speciation

**Ernst Mayr** – author of the ‘Biological Species Concept’, role of reproductive isolation in speciation
“Tenets" of the New Synthesis

many of these were restatements or variations of Darwin's arguments, at times restated in the new vocabulary of genetics

1) phenotype results from interaction of genotype and environment; environmental effects are not heritable but may influence the expression of genes

2) the hereditary material consists of discrete genes that mutate to form different alleles of a gene

3) recombination in sexual reproduction adds to genetic variation

4) proportions of genotypes in populations change
“Tenets" of the New Synthesis

5) *genetic drift* (random change) and *selection* (non-random change) accelerate the rate of evolution beyond the mutation rate

6) geographically discrete populations tend to differ genetically

7) differences among populations or among species are *polygenic*, therefore accrue by many small steps

8) natural selection occurs presently as well as in the past resulting in differences between populations that tend to be adaptive
“Tenets" of the New Synthesis

9) species tend to be reproductively isolated (biological species concept) and may need to be geographically isolated in order for divergence to lead to speciation

10) small scale variation within populations (microevolution) accumulates and leads to large scale variation between sister taxa (macroevolution)
DNA was first discovered and isolated from cell nuclei in 1869 by Friedrich Miescher, a Swiss physician.

Its chemical composition was determined by (Ludwig Karl Martin Leonhard) Albrecht Kossel in 1878, a German biochemist.

Building on a experiment performed in 1927 by British bacteriologist Frederick Griffith that showed dead bacteria could ‘transform’ live bacteria into a new phenotype …

… Oswald Avery, a Canadian-American physician, demonstrated that DNA was the substance of inheritance in Griffith’s experiment.

In 1944 Avery and his colleagues showed that genes and chromosomes are comprised of DNA.
We now know several sources of variation in addition to point mutations and recombination in and of DNA.

Examples

- alternative splicing and exon shuffling (gene products > genes)
- copy number variation (CNV)
- transposable elements
- epistatic interactions among genes and their modifiers
- epigenesis - micro RNAs, methylation, histone modification,
  endosymbionts
- horizontal gene transfer (HGT) - introgressive hybridization,
  retroviruses, plasmids, phages, biofilms
Areas of Current Evolutionary Research

paleontology

evolutionary genetics/population genetics/conservation genetics

developmental biology

molecular evolution - genes phylogenies, gene families, genomics noncoding DNA, gene regulation, selection

epigenetics

evolutionary ecology

behavioral evolution (ecology)

physiological evolution

systematics
Areas of Current Evolutionary Research

medicine
  emergent disease - origin, spread, transmission, evolution
disease - inheritance, risk, etiology, prevention, treatment
organ regeneration

conservation and environmental management

agriculture - artificial selection, genetic engineering, pest control
evolution of sex, sexual traits, and sexual behavior

biogeography – macroevolution

speciation – sympatric, species longevity, species diversity
origin of life