EVOLUTION: WHAT’S CHANGING?

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WHAT WILL WE BE COVERING?

• A History of Evolutionary Thought
• Modern Evolutionary Thought
• Understanding Scientific Arguments
• Arguments Against Evolution
• Inspiring Science
A HISTORY OF EVOLUTIONARY THOUGHT

• Jean Baptiste Lamarck
  • Transmutation of species – simple forms of life were created continuously by spontaneous generation
  • Innate life force – a nervous fluid that drove species to become more complex; change based on the use or disuse of organs
    • Advancing up the Great Chain of Being

• George Combe
  • *The Constitution of Man* (1828)
  • Laws control nature and society
A HISTORY OF EVOLUTIONARY THOUGHT

• Charles Darwin
  • HMS Beagle – a five year journey around the world
  • Five-week stop at the Galapagos where Darwin studied finches, tortoises and mockingbirds
    • Animals more suited to their environment
  • Publishes On the Origin of Species in 1859
    • Natural selection – mechanism
    • “Survival of the fittest”
    • Variation is heritable
MODERN EVOLUTIONARY THOUGHT

- Evolution is change in the heritable characteristics of biological populations over successive generations
- Natural selection
  - The more fit an organism the more likely they are to pass on their traits
  - Traits are heritable
- Combines genetics, biology, chemistry, biochemistry, ecology, etc.
- Microevolution vs. macroevolution
  - Microevolution – slight, short-term evolutionary changes within species
    - Ex. Hair color, eye color, beak shape etc.
EVOLUTIONARY TIMELINE

• 3.8 bya – the beginning of life on Earth
  • Primordial soup
  • Self-catalyzing RNA
  • Two groups split – bacteria and archaea
  • Two groups split – bacteria and archaea bya – Viruses present

• 2.4 bya – The great oxidation event
  • Cyanobacteria makes oxygen that builds up to make atmosphere (photosynthesis uncertain)
EVOLUTIONARY TIMELINE

- 2 bya – Eukaryotic cells (cells containing organelles) via endosymbiosis
  - Mitochondria and Chloroplasts
- 1.5 bya – Eukaryotes divide into three groups: plants, fungi, mammals
- 900 mya – First multicellular life develops (uncertain – possibly like choanoflagellates)
- 800 mya – Multicellular animals split into sponges and everyone else
- 533 mya – Cambrian explosion – many new body layouts
- 530 mya – First true vertebrate
EVOLUTIONARY TIMELINE

- 465 mya – Plants colonizing the land (oxygen on land)
- 460 mya – Fish split: bony fish and cartilaginous fish (sharks, skates, and rays)
- 440 mya – Bony fish split: lobe-finned fish and ray-finned fish (most regular fish)
- 397 mya – First four-legged animals, tetrapods, evolve and eventually go on to land
- 180 mya – Mammal population split: monotremes and others
- 40 mya – New World monkeys (higher primates) diverge
- 7 mya – Gorillas branch off
- 6 mya – Humans diverge
UNDERSTANDING SCIENTIFIC ARGUMENTS

• First and foremost, how do we argue?
  • Critical thinking!
  • Science isn’t made or posted on Facebook!
  • Research!
  • Ask questions!

• Ex. Second Law of Thermodynamics
  • Entropy increases
  • Molecular disorder and heat transfer
  • Ex. Ice melting in a drink
ARGUMENTS AGAINST EVOLUTION

• Faulty Fossil Record
  • Darwin’s hypothesis – gradualism
  • Huge lack of transitional forms

• What do evolutionists say?
  • “The fossil record is imperfect”

• "Fossils would be expected to show a continuous progression of slightly different forms linking all species and all major groups with one another in a nearly unbroken spectrum. In fact, most well-preserved fossils are as readily classified in a relatively small number of major groups”
  – Paleontologist Robert Carroll

Figure 1. This represents the "tree of life" under Darwin's gradual theory of evolution where one species turns into another species through slow, smooth, gradual changes over long periods of geological time.
ARGUMENTS AGAINST EVOLUTION

• A Fine-tuned Universe
  • Several universal constants are so fine-tuned that the slightest changes would cause breakdown
    • Strong Nuclear Force – the force that acts between protons and neutrons
      • An increase means no hydrogen and decrease means only hydrogen
    • Weak Nuclear Force – attraction of subatomic particles; nuclear decay
      • Changes mean either not enough helium > generation of heavy elements in stars
      • Stars would burn out too quickly > no spread of heavy elements
    • Gravitational constant \( (6.674 \times 10^{-11} \text{ m}^3\text{.kg}^{-1}\text{.s}^{-2}) \)
      • Slight changes here could cause stars not to form at all
ARGUMENTS AGAINST EVOLUTION

• Huge Gaps in Origin of Life
  • Generation of Primordial Soup
    • Water-based sea of simple organic molecules
    • No viable mechanism
    • Miller-Urey experiment
  • Polymers require dehydration synthesis
    • A water based environment is not favorable for this
    • Thermodynamically favorable for the opposite to happen - hydrolysis
ARGUMENTS AGAINST EVOLUTION

• Huge Gaps in the Origin of Life
  • RNA > DNA and Proteins
  • DVD analogy
    • A DVD contains huge amounts of information
    • Can only be read through a DVD player
    • Imagine that you only have a DVD but it contains the instructions to build the first DVD player
  • Violates the Central Dogma of Biology
ARGUMENTS AGAINST EVOLUTION

• Irreducibly complex structures
  • Biological systems cannot evolve by successive small modifications to pre-existing functional systems through natural selection
  • Systems in all living organisms are made of several steps and processes
  • Removal of a part of this system causes collapse
    • Ex. A car engine
Aerobic Cellular Respiration

**Glycolysis in the Cytoplasm**
- Glucose $\rightarrow$ $2$ pyruvate
- $2$ ATP

**Citric Acid Cycle in the Mitochondria**
- Pyruvate $\rightarrow$ $3$ CO$_2$, $4$ ATP
- $2$ NAD$^+$, $2$ FAD$^+$
- $2$ oxaloacetate

**Krebs Cycle**
- Oxaloacetate $\rightarrow$ $6$ CO$_2$, $12$ NAD$^+$, $10$ FAD$^+$, $8$ ATP
- $2$ oxaloacetate

**Electron Transport Chain**
- $2$ NADH $\rightarrow$ $12$ ATP
- $2$ FADH$_2$ $\rightarrow$ $10$ ATP

**Photosynthesis**
\[6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}\]

**Photosynthesis:***
- **1. Photolysis:** Light energy breaks bonds in water, producing ATP, NADPH, and O$_2$.
- **2. Calvin Cycle:** Occurs in the stroma of the chloroplast.
- **3. Light-Independent Reactions (Dark Reactions):** Occur in the stroma, using NADPH and ATP to reduce CO$_2$ to glucose.

**Chloroplast**
- **Primary photosynthesis** produces ATP and NADPH.
- **Light-dependent reactions** (photolysis) convert light energy into chemical energy (ATP and NADPH).
- **Light-independent reactions** (Calvin cycle) use ATP and NADPH to convert CO$_2$ to glucose.

**Important Components**
- Chlorophyll
- Light-dependent reactions: Water splitting, ATP synthesis, NADPH synthesis.
- Light-independent reactions: CO$_2$ fixation, ATP utilization, NADPH utilization, glucose synthesis.
ARGUMENTS AGAINST EVOLUTION

• God said that it didn’t happen
  • The book of Genesis shows us how God created the universe
    • “And God said…”
    • The order of creation is logical and planned
    • Light > water > sky/atmosphere > land/seas and plants > sun and moon > birds and sea creatures > land creatures > man
COMPLEXITIES OF THE HUMAN BODY
COMPLEXITIES OF THE HUMAN BODY
“For his invisible attributes, namely, his eternal power and divine nature, have been clearly perceived, ever since the creation of the world, in the things that have been made. So they are without excuse” – Romans 1:20
PRAISING GOD’S HANDIWORK

“For you formed my inward parts; you knitted me together in my mother's womb. I praise you, for I am fearfully and wonderfully made. Wonderful are your works; my soul knows it very well. My frame was not hidden from you, when I was being made in secret, intricately woven in the depths of the earth. Your eyes saw my unformed substance; in your book were written, every one of them, the days that were formed for me, when as yet there was none of them”

Psalms 139: 13-16
“All things were made through him, and without him was not any thing made that was made.” – John 1:3
PRAISING GOD’S HANDIWORK

Praise the LORD!
Praise the LORD from the heavens; praise him in the heights! Praise him, all his angels; praise him, all his hosts!
Praise him, sun and moon, praise him, all you shining stars!
Praise him, you highest heavens, and you waters above the heavens!
Let them praise the name of the LORD! For he commanded and they were created. And he established them forever and ever; he gave a decree, and it shall not pass away.

Psalm 148:1-6
Lift up your eyes on high and see:
   who created these?
He who brings out their host by number,
   calling them all by name;
by the greatness of his might
   and because he is strong in power,
not one is missing.

- Isaiah 40:26