Outline

· Origin of Life
· Biological Evolution
· Common Descent
· Natural Selection
· Primates
  - Human Evolution
  - Evolution of Modern Humans
Origin of Life

• The Primitive Earth.
  - Theorized early primitive atmosphere consisted mostly of water vapor, nitrogen, and carbon dioxide, with small amounts of hydrogen and carbon monoxide.
    ✷ Little, if any, free oxygen.

Origin of Life

• Small Organic Molecules.
  - Primitive gases may have reacted with one another and produced small organic compounds such as nucleotides and amino acids.

• Macromolecules.
  - RNA-first hypothesis.
  - Protein-first hypothesis.
Origin of Life

- **Protocell.**
  - A protocell, which could carry on metabolism but not reproduce, may have formed when lipids and microspheres formed a lipid-protein membrane.

- **A True Cell.**
  - A true cell can reproduce.
    - Modern cells replicate before cell division occurs.

Chemical evolution

a. The primitive atmosphere contained gases, including H₂, CO₂, and N₂, that escaped from volcanoes. As the water vapor cooled, some gases were washed into the oceans by rain.

b. The availability of energy from volcanic eruption and lightning allowed gases to form small organic molecules, such as nucleotides and amino acids.

c. Small organic molecules could have joined to form proteins and nucleic acids, which became incorporated into membrane-bound spheres. The spheres became the first cells, called protocells. Later protocells became true cells that could reproduce.
Biological Evolution

- First true cells were prokaryotic.
  - Eukaryotic cells evolved later, followed by multicellularity and other kingdoms.
    - Biological evolution is a change in life forms that has taken place in the past and will take place in the future.
    - Adaptation is a characteristic that makes an organism able to survive and reproduce in an environment.

Common Descent

- Charles Darwin first formulated the theory of evolution and gathered evidence that life forms change over time and distance.
  - Lines of evidence.
    - Fossil evidence.
    - Biogeographical evidence.
    - Anatomical evidence.
      - Homology vs. Analogy.
    - Biochemical evidence.
Fossil records have built the case for primate evolution

**Natural Selection**

- **Natural selection** is a process by which a species becomes adapted to its environment.
  - Contrasted to Lamarck's teleological explanation.
    - Critical elements of natural selection.
      - Variation.
      - Struggle for existence.
      - Survival of the fittest.
      - Adaptation.
Humans Are Primates

- Biologists classify organisms according to their hypothesized evolutionary relatedness.
  - Binomial name lists genus and species.
- Characteristics of primates.
  - Opposable thumb.
  - Well-developed brain.
  - Nails.
  - Single birth.
  - Extended parental care.
  - Emphasis on learned behavior.
Primate diversity

Asian Apes
- White-handed gibbon, Hylobates lar
- Orangutan, Pongo pygmaeus

African Apes
- Western lowland gorilla, Gorilla gorilla
- Chimpanzee, Pan troglodytes

Humans. Homo sapiens
Humans Are Primates

- Molecular data have been used to determine the date of the split between hominids and apes.
  - When two lines of descent first split, the genes and proteins of the two lineages are nearly identical.
  - As time goes by each lineage accumulates genetic changes.

Humans Are Primates

- Many genetic changes can be used as a molecular clock to indicate relatedness of two groups.
  - Evolution of bipedalism is believed to be the distinctive feature that separates hominids from apes.
Evolution of Australopithecines

- Hominid line of descent begins in earnest with the australopithecines.
  - Evolved and diversified in Africa.
  - It is unknown which australopithecine is ancestral to early Homo.
Evolution of Humans

- *Homo habilis* dates between 2.0 and 1.9 mya and may be ancestral to modern humans.
  - Teeth evidence indicates omnivory.
  - Animal bone evidence indicates use of tools to strip meat.
  - Skulls of early *Homo* suggest portions of the brain associated with speech areas were enlarged.
Homo erectus

- Homo erectus and like fossils are found in Africa, Asia, and Europe, and date between 1.9 and 0.3 mya.
  - Compared to H. habilis, H. erectus had a larger brain and a flatter face.
  - H. erectus was first hominid to use fire, and fashioned more advanced tools than early Homos.

Homo erectus: 10 years old, 1.6 million years
Evolution of Modern Humans

- Multiregional continuity hypothesis states that *Homo sapiens* evolved in several different locations.
  - Opponents suggest out-of-Africa hypothesis.
Neanderthals

- First Neanderthals were discovered in Germany’s Neander Valley, and date back 200,000 years ago.
  - Evidence of cultural advancement.
    - According to out-of-Africa hypothesis, Neanderthals were eventually supplanted by modern humans.

Cro-Magnons

- Cro-Magnons are the oldest fossils to be designated *Homo sapiens*.
  - Named after fossil location in France.
    - Hunted cooperatively, and may have been first to have language.
      - Advanced culture included art.
We Are One Species

- Human beings are all classified as *Homo sapiens.*
  - DNA variation between races is the same level as DNA variation within the same race.
    - Differences in body shape represent adaptations to temperature and environmental conditions.
Multiethnic - adaptations to environment

United States  Eskimo  Massai

Review

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