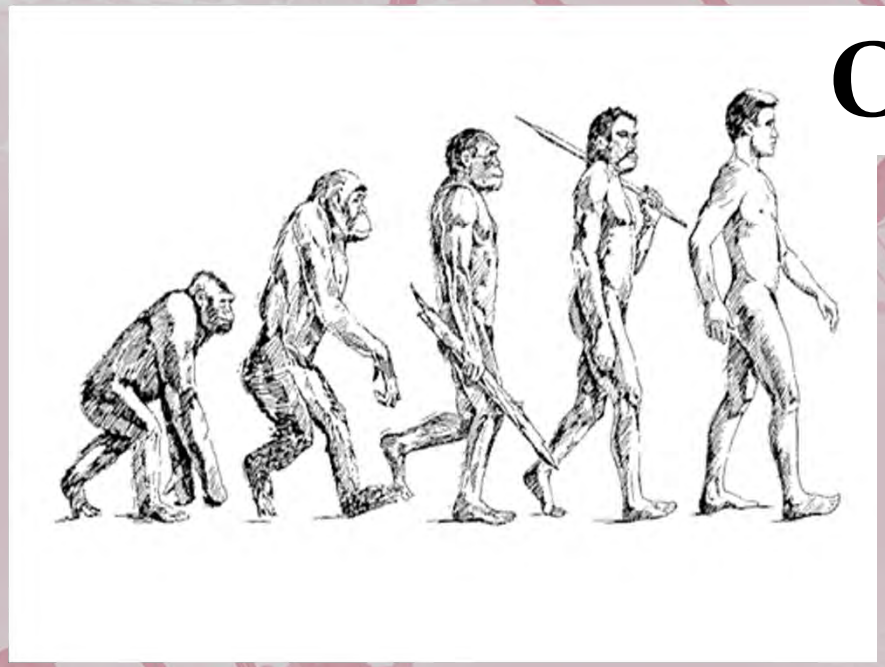
Genetics & Human Origins



OR

Melissa Antonio, Ph.D.
California Baptist University
ASA Conference 2012

The Debate of Human Origins

- ~30,000 years ago humans were anatomically and behaviorally similar throughout the world (1)
- How did this happen?
  1. Multiregional continuity:
     - *Homo erectus* left Africa 2 mya to become *Homo sapiens* in different parts of the world (1)
  2. Single origin of modern humans (out-of-Africa theory):
     - *Homo sapiens* arose in Africa and migrated to other parts of the world to **replace** other hominid species including *Homo erectus* (1)

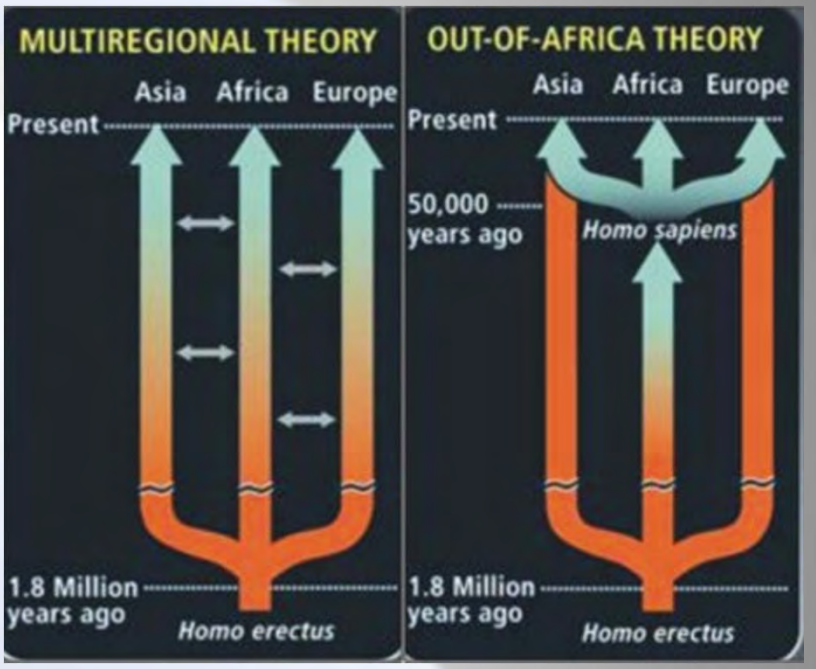
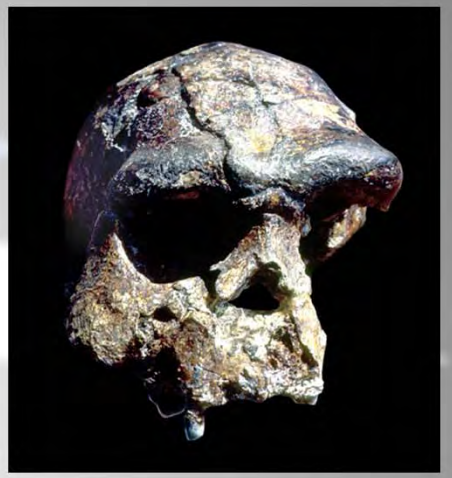


Figure: http://www.thedailystar.net/photo/2010/08/24/2010-08-24__science01.jpg
http://www.msnbc.msn.com/id/19832535/ns/technology_and_science-science/t/study-stirs-debate-over-human-origins/

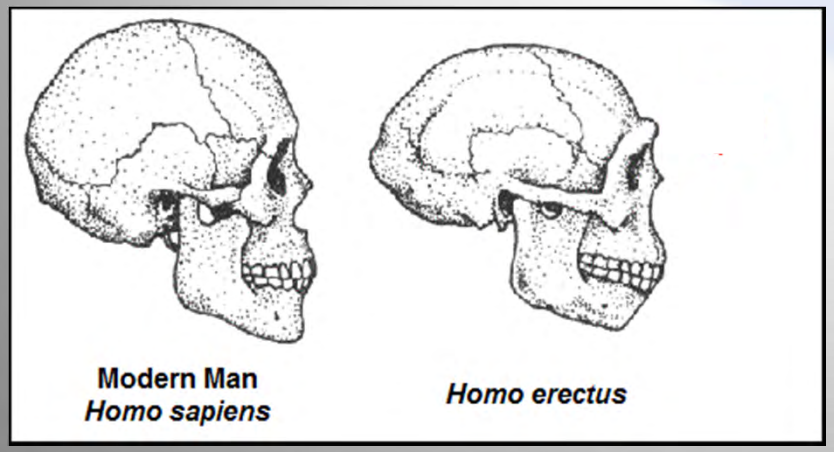
The Debate of Human Origins

- How are *Homo erectus* and *Homo sapiens* different from each other?
  - ”Postcranial remains of *Homo erectus* are generally thicker and more massively-built than those of *H. sapiens”* (2)
  - *Homo sapiens* have a larger cranial capacity than *Homo erectus* (3)
  - All other physical features are very similar between the two species (2)
    - Stature
    - Length of forelimbs and hindlimbs
    - Bipedal locomotion



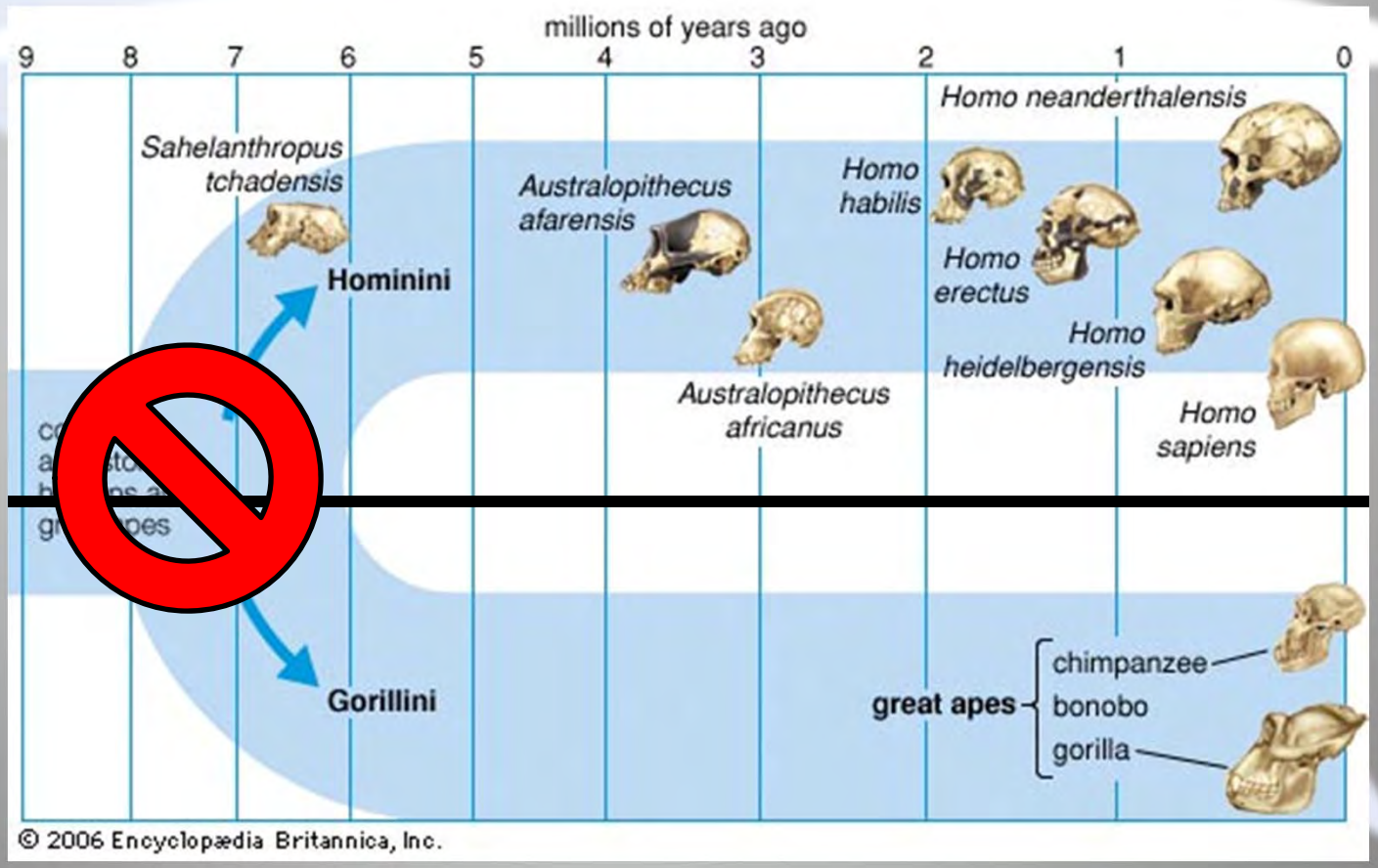
Peking man

Java man



The Debate of Human Origins

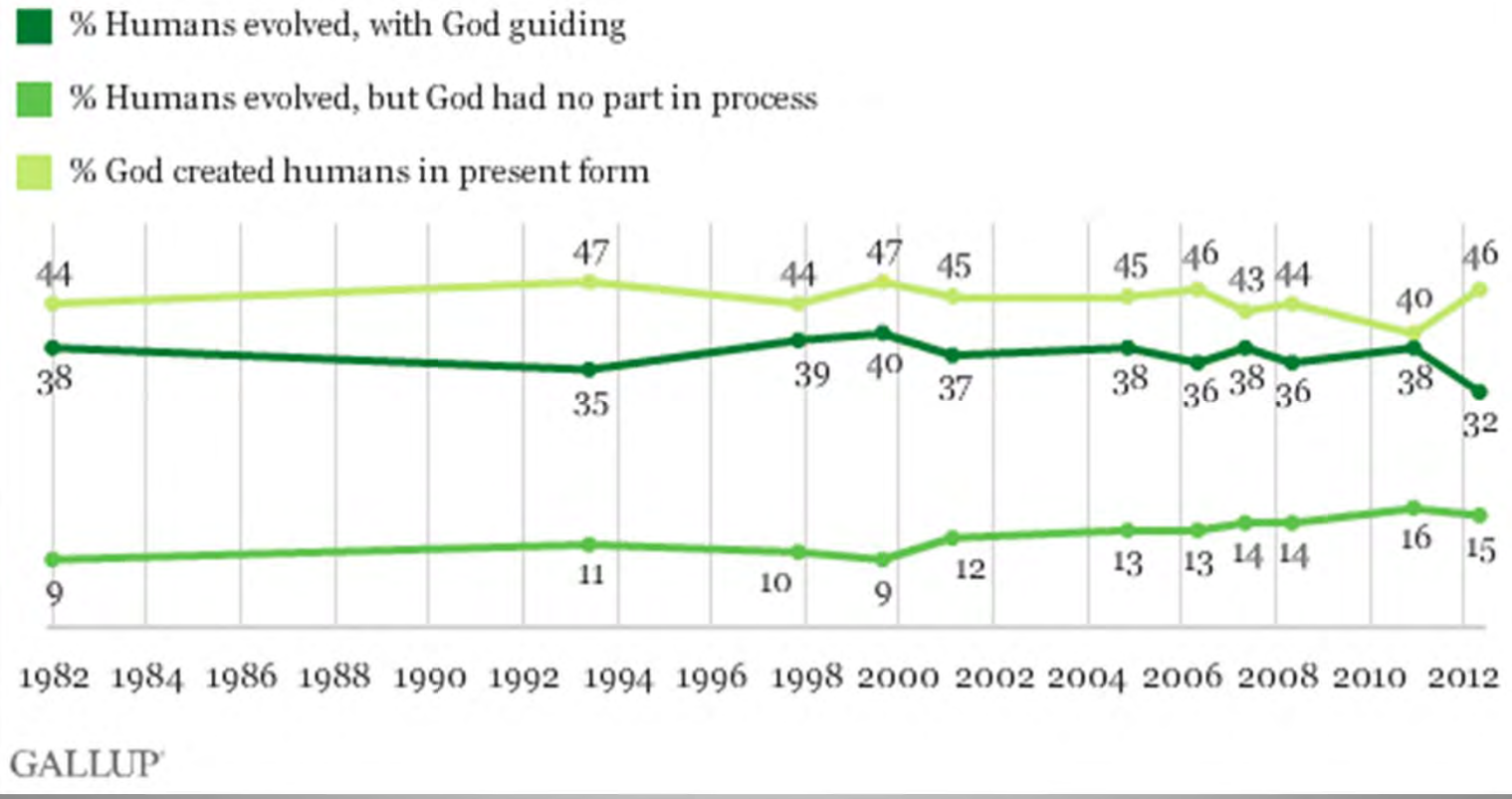
- Did we evolve from a common ancestor shared with the great apes? Or…
- were we uniquely created in the image of God?



http://www.britannica.com/EBchecked/media/141800/The-divergence-of-humans-and-great-apes-from-a-common

The Debate of Human Origins

Which of the following statements comes closest to your views on the origin and development of human beings -- (human beings have developed over millions of years from less advanced forms of life, but God guided this process, human beings have developed over millions of years from less advanced forms of life, but God had no part in this process, (or) God created human beings pretty much in their present form at one time within the last 10,000 years or so)?



http://www.gallup.com/poll/21814/evolution-creationism-intelligent-design.aspx

The Evidence for Common Ancestry

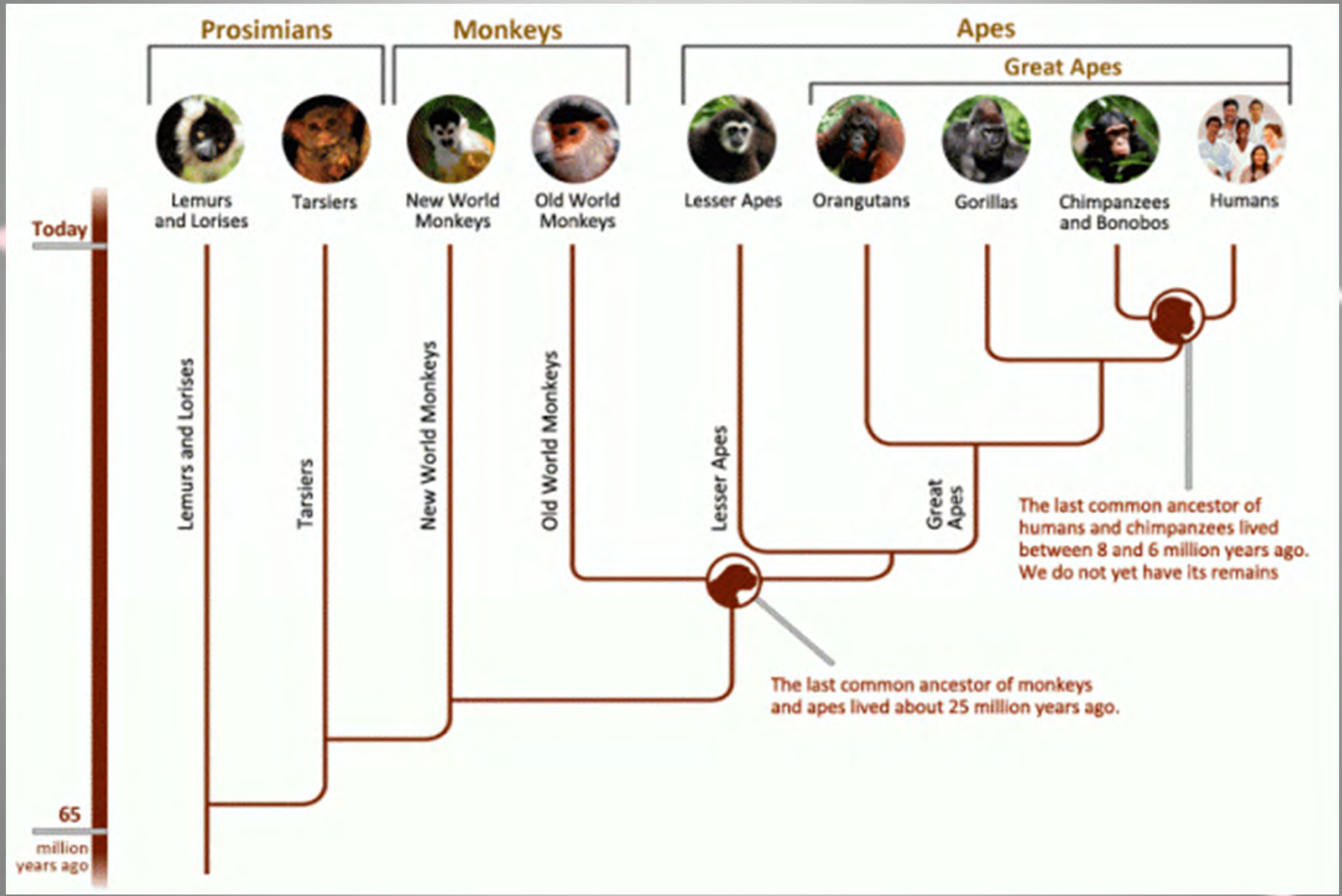
- Fossils
  - Speculation on human evolution is based on
    - Ape-like fossils : *Australopithecines*
    - Human-like fossils: archaic *Homo sapiens*; *Neanderthals*
    - Transitional species: *Australopithecus sediba*
- Genetics
  - Human genome ~ 98-99% similar to chimps
  - Random mutations

An *Australopithecus sediba* skull bears both human and ape traits. *Photograph courtesy Brett Eloff and Lee Berger*

"Mrs Ples", the most famous example of *Australopithecus africanus* from Sterkfontein cave in South Africa, probably grew up far from the cave where she died.*Darryl de Ruiter*

Homo habilis skull: Photo courtesy Wikimedia Commons and licensed under the GNU Free Documentation License and Creative Commons Attribution 2.5

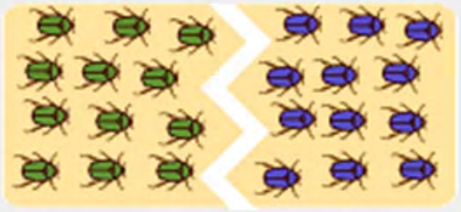
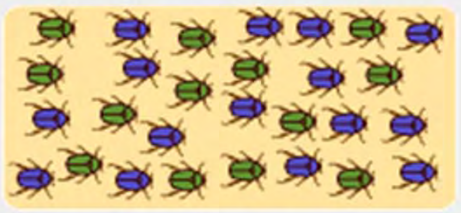
Divergence of Man and Chimp Lineages



http://humanorigins.si.edu/evidence/genetics

Divergence of Man and Chimp Lineages

- Possible causes of speciation?

Mode of speciation	New species formed from...	
Allopatric (allo = other, patric = place)	geographically isolated populations	
Peripatric (peri = near, patric = place)	a small population isolated at the edge of a larger population	
Parapatric (para = beside, patric = place)	a continuously distributed population	
Sympatric (sym = same, patric = place)	within the range of the ancestral population	

http://evolution.berkeley.edu/evosite/evo101/VC1aModesSpeciation.shtml

Divergence of Man and Chimp Lineages

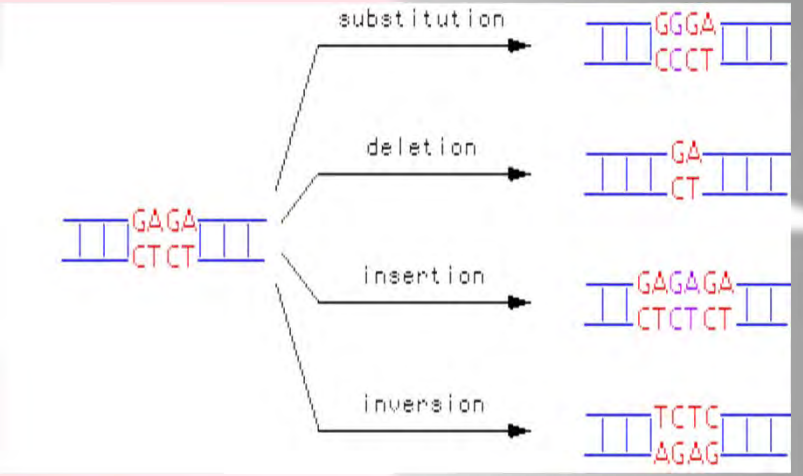
- Possible causes of speciation?
  - Ultimately, a major mutation may occur in any one of these mechanisms to prevent interbreeding within the original population resulting in two separate populations following its own divergent evolutionary path (4)
  - With sympatric speciation, the major mutation may prevent successful interbreeding between parts of the population that have the mutation and parts that do not (4)
  - So are mutations the driving force of evolution???

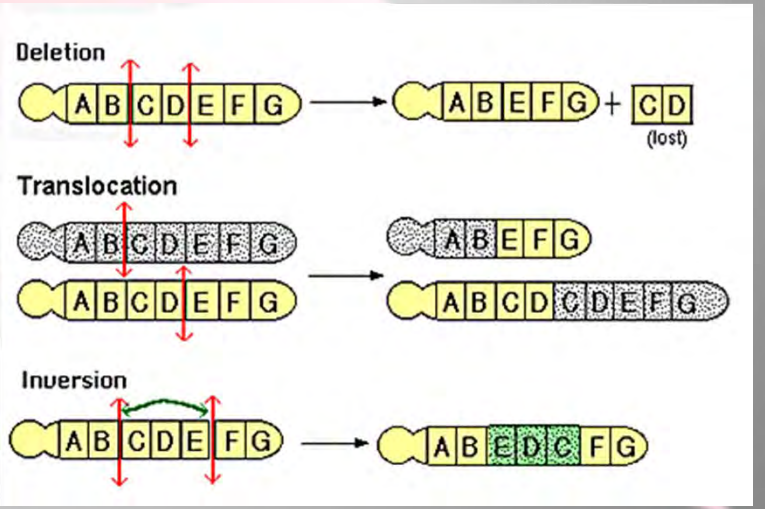
Common Ancestor + Mutations = Humans?

- In 2007, Masatoshi Nei's paper, *The New Mutation Theory of Phenotype Evolution*, states the following:
  - "Phenotypic evolution occurs primarily by mutation of genes that interact with one another in the developmental process."
  - "…phenotypic diversity among different phyla or classes of organisms is a product of accumulation of novel mutations…"
  - "…the driving force of phenotypic evolution is mutation, and natural selection is of secondary importance" (5).

Common Ancestor + Mutations = Humans?

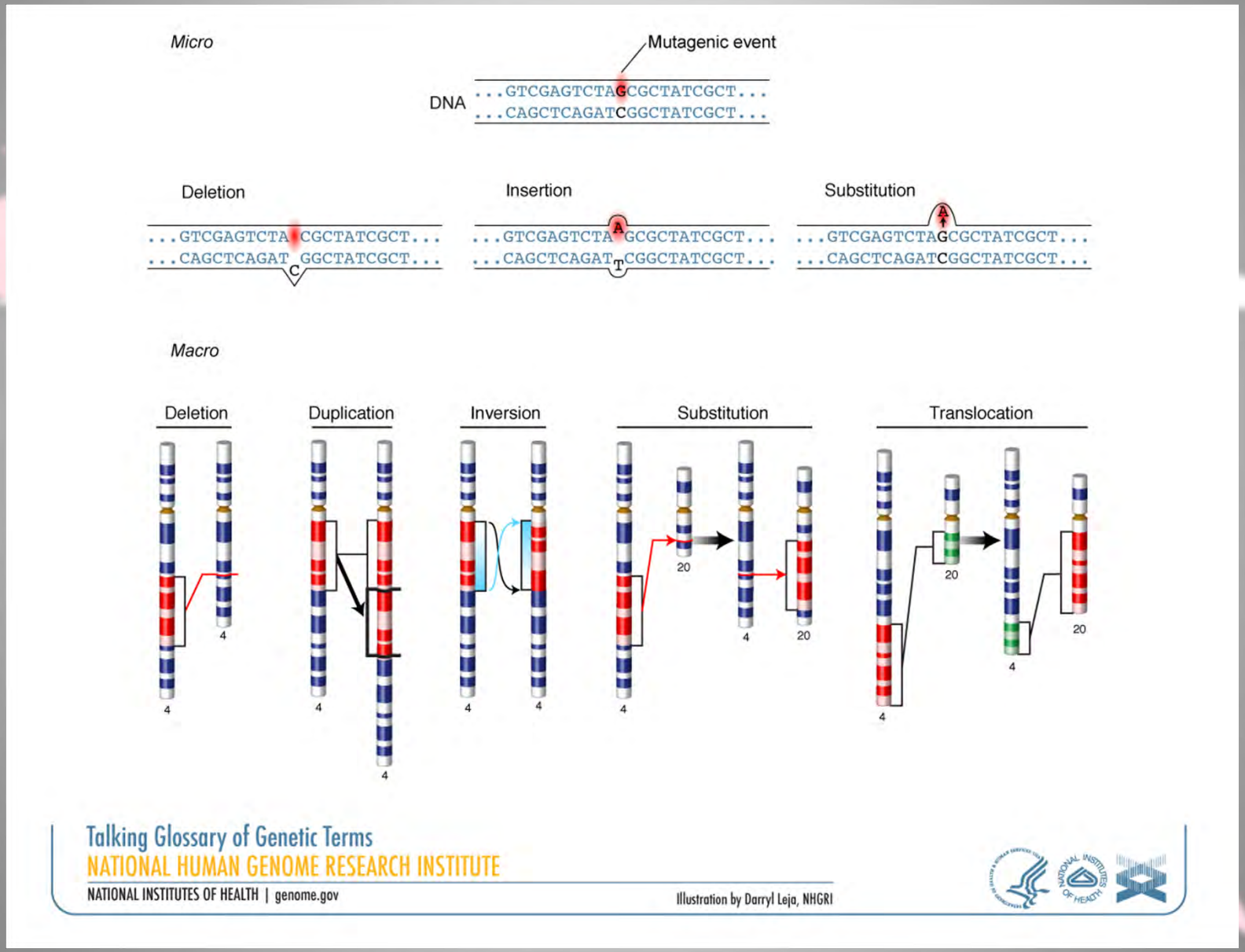
- Types of mutations
  - Point-mutations:
    - Deletion
    - Insertion
    - Substitution
  - Chromosomal rearrangements:
    - Deletion
    - Duplication
    - Inversion
    - Substitution
    - Translocation





Courtesy: National Human Genome Research Institute.

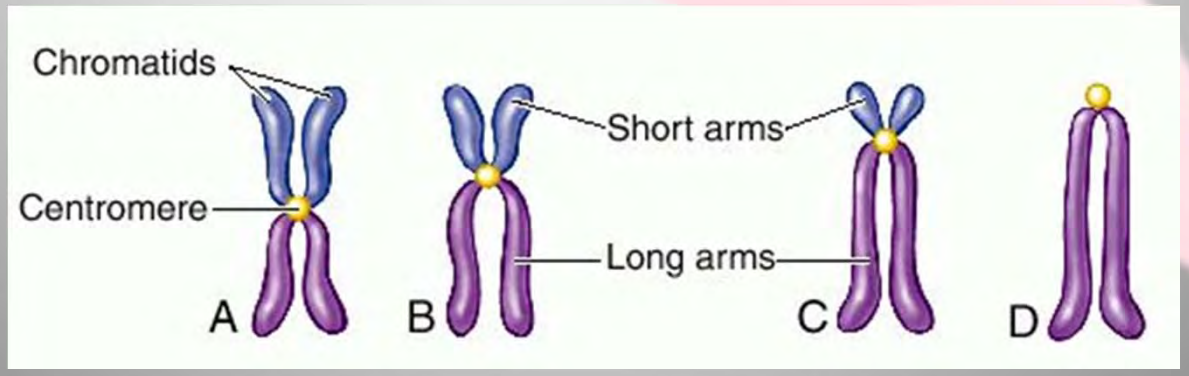
Common Ancestor + Mutations = Humans?



Courtesy: National Human Genome Research Institute.

Common Ancestor + Mutations = Humans?

- Which of the types of mutations is more likely to set up a barrier to gene flow between subgroups within what were originally the same species?
  - Chromosomal rearrangements
    - Comparing human and chimpanzee chromosomes, in humans chromosomes 1, 4, 5, 9, 12, 15, 16, 17, and 18 have inversions of genetic codes compared with homologous chromosomes in chimpanzees (6)
    - Human chromosome 2 has resulted from an end-to-end fusion of two acrocentric chromosomes that remain separate in all other great apes (7, 8)



Dorland's Medical Dictionary for Health Consumers. © 2007 by Saunders, an imprint of Elsevier, Inc.

Common Ancestor + Mutations = Humans?

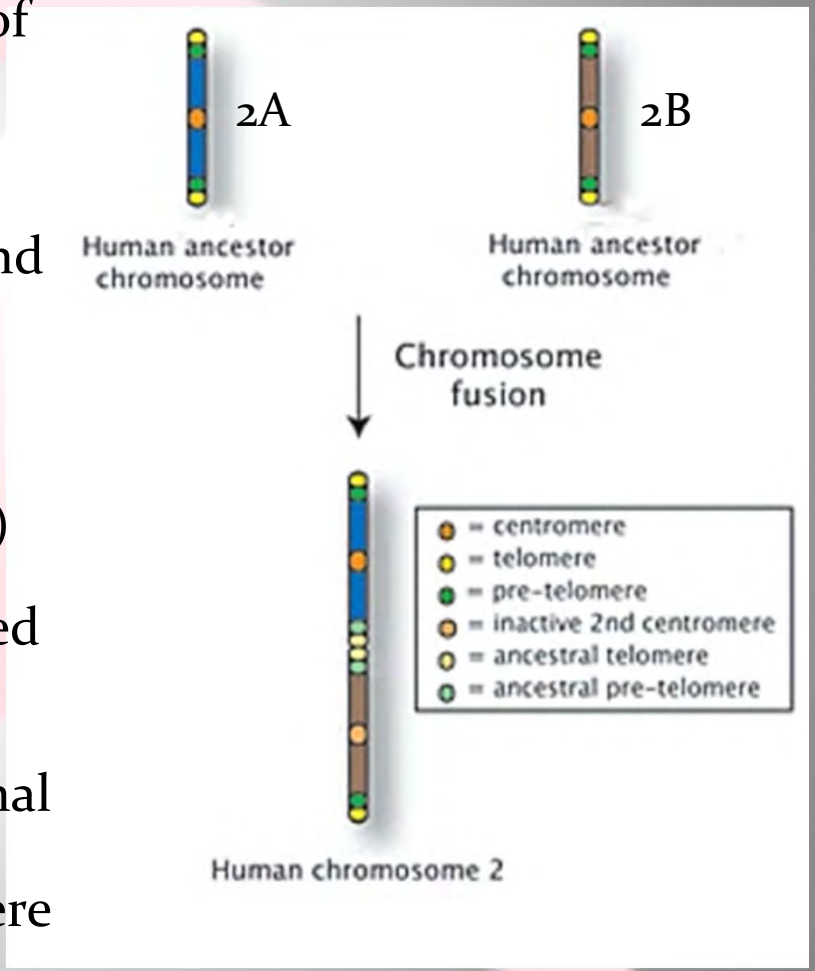
- How do such chromosomal rearrangements block gene flow?
  - Hypothesis: genetic recombination during meiosis is greatly reduced in individuals heterozygous for rearranged chromosome
  - If recombination occurs → will lead to major deletions and duplications of genetic material → unviable offspring
  - If no recombination occurs → no deletions or duplications → heterozygous individual is fertile → rearrangement will "fix" within population → barrier of gene flow in those chromosomes (4)

Common Ancestor + Mutations = Humans?

- Summary of proposed mechanism of speciation:
  1. Chromosomal rearrangements occur due to random mutation
  2. Recombination is suppressed in the rearranged chromosomes
  3. Mutation is fixed in the population
  4. Suppression of recombination isolates genetic material on that chromosome
  5. Over time chromosomes continue to mutate and become rearranged, lack of gene flow leads to more and more divergent evolution on these chromosomes
  6. Results in sexual incompatibility between populations that carry and do not carry the rearrangements
  7. Speciation is complete

Example: Fusion of Human Chromosome 2

- Is human chromosome 2 evidence for human evolution?
  - Evolutionists suggest that the fusion of human chromosome 2 is evidence of common ancestry
- What is the evidence? (9)
  1. The analogous chromosomes, 2A and 2B, in the great apes create an identical banding pattern to the human chromosome 2
  2. The sequence at the ends of the ancestral chromosomes (telomeres) is found in the middle of human chromosome 2, as would be expected
  3. The centromere of human chromosome 2 lines up with the chimp chromosome 2A chromosomal centromere, as would be expected
  4. Remnant of the chimp 2B centromere are found at the expected place on the human chromosome



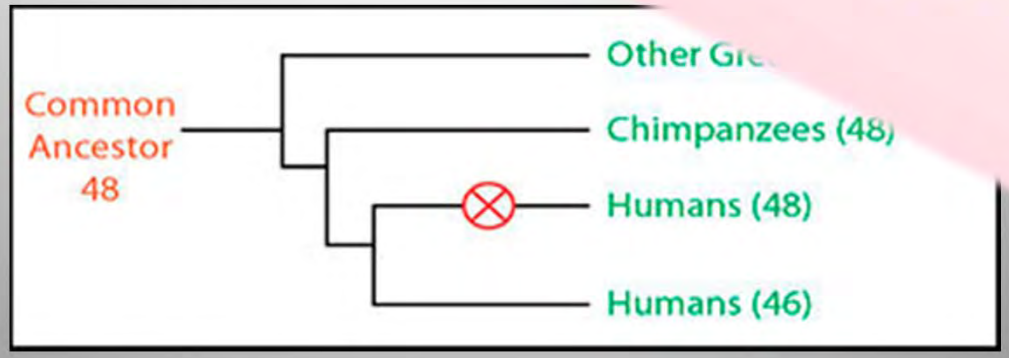
http://14-billion-years-later.tumblr.com/post/16537002470/chromosome-2-two-chromosomes-possibly-one-of-my

Example: Fusion of Human Chromosome 2

- Dr. Kenneth Miller and other evolutionists *conclude* that the fusion of human chromosome 2 is evidence that humans and the great apes have descended from a common ancestor (10)
- But how does the evidence prove a common ancestor??
  - According to creationists, "the evidence points to the fusion of human chromosomes, but gives no indication when this happened, except that it must have occurred to…the ancestor of all living humans." (10)

Example: Fusion of Human Chromosome 2

- Cell biologist, Dr. Will Brooks, from University of Alabama wrote an article: "Of Apes and Men: Chromosome 2 in Humans and the Chimpanzee" (10)
  - If fusion event demonstrates common ancestry, then there must be a link between the fusion event and the great apes—none exists
  - Thus, fusion event must have occurred after the split between chimps and humans
  - Chromosomal rearrangements of such magnitude are not easily passed to offspring
  - Assuming common ancestry, there should be two groups of humans: one group with 48 chromosomes; the other with 46 c'somes
  - Otherwise, very strong positive selection must have favored the diploid number 46 and those with 48 c'somes became extinct (11)



Example: Fusion of Human Chromosome 2

- So what's the explanation for the appearance of human chromosome 2 fusion?
- Brooks provides two possible explanations (10):
  1. Humans were created with 48 chromosomes but after some time underwent the fusion
     - Not likely…
  2. God created mankind with 46 chromosomes including a second chromosome having the characteristics we observe today
     - Likely…but why would God purposefully create a chromosome that LOOKS like a fusion??

"In the beginning God created…"

- Recall the scripture, God's words:
  - "For my thoughts are not your thoughts, neither are your ways my ways, declares the LORD. As the heavens are higher than the earth, so are my ways higher than your ways and my thoughts than your thoughts" (Isaiah 55:8-9).
  - "By the word of the LORD the heavens were made, and by the breath of his mouth all their host…For He spoke, and it was done; He commanded, and it stood fast" (Psalm 33:6,9).

Background: "God's creation" by Alex Andreou

Upcoming Topics

- "The Nature and Purpose of Randomness"
  by *Mark Shelhamer*, Johns Hopkins University
- "Implications of high mutation rates and other recent genomic advances upon the question of human origins"
  by Chris Osborne, California Baptist University
- "The Contribution of Bioinformatics to Evolutionary Thought"
  by *Deborah Osae-Oppong*,
- "What Is the Size and Topology of the Genomic Universe"
  by *Paul A. Nelson*, Biola University

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Common Ancestor + Mutations = Humans?

- According to geneticist, R.H. Byles, there are nine conditions for mutation fixation, **all** of which **must** be met (12):
  1. Neutral environment
     - "The environment must be selectively neutral" or the mutant gene will not be retained in the population.
  2. No structural change
     - "There must be no pleiotropic effect involved with the locus or loci, or, if such effect exists, all the phenotypic structures involved must be neutral."
  3. Net effect must be unidirectional
     - "…the mutational event must be recurrent and the rate of back mutation must be so small as to be irrelevant."
  4. High mutation rate
     - "The mutation rate at the relevant locus or loci must be very large."

Common Ancestor + Mutations = Humans?

- According to geneticist, R.H. Byles, there are <u>nine conditions for mutation fixation</u>, **all** of which **must** be met (12):
  5. Large population
     - "As population size decreases, the probability that a mutation will be eliminated increases."
  6. Selective neutrality of polygenes
     - "Polygenes are not relevant unless the entire anatomical complex is itself selectively neutral."
  7. Little hybridization
     - "There must be little or no hybridizing admixture."
  8. Necessity of high penetrance
     - "The genetic structures involved must have high penetrance."
  9. High heritability
     - "The phenotype must have high heritability"