Human
Evolution
History matters:
- personal basis
- group basis
HISTORY

GEOGRAPHY/CONTEXT

humanity
The recognition of the power of context and history motivates creationists

Their concern: If we accept a history of animal behaviors and an identity as an animal, we will act that way.

Response:
- Should we deny "bad' history or truth? (crusades, holocaust)
- Should we deny that humans are animals? (drug testing, disease models)

Context/history is not all:
- With knowledge we can learn/change
- Without knowledge we repeat errors
Evolutionary history also matters

“By the toll of a billion deaths, man had earned his immunity, his right to survive among this planet's infinite organisms. And that right is ours against all challengers for neither do men live nor die in vain”

- War of the Worlds

Caucasian:  
Cystic fibrosis

Ashkenazi Jewish:  
Tay-Sachs disease

African:  
Sickle cell disease

Mediterranean:  
Beta-thalassemia

Non-European:  
Lactose intolerance
Many cultures see a continuum of animal to mankind in nature

10 incarnations of Vishnu

Fish
turtle
boar
half-lion
dwarf
humans ...
Great Sage, Equal of Heaven, prepares his troops for battle.
Monkey approaches the five pillars at the farthest reaches of Heaven.
Exposure to primates in the East may have led to cultures more embracing of a continuum between mankind and animalkind.

Few primates in Europe ...

*alcohol vs marijuana*

Even when creationists deny the evolution of humans, it is very easy for them to pick the set of species that seem the closest and deny their relatedness, which doesn't really make sense.
The "great apes"

- *Pongo pygmaeus* (Borneo)
- *Pongo abelii* (Sumatra)
- *Pan troglodytes* (Africa)
- *Pan paniscus* (Africa)
- *Homosapiens* (everywhere, but originally Africa)
- *Gorilla gorilla* (Western Africa)
- *Gorilla beringei* (Eastern Africa)
orangutan: from Malay *orang* man + *hutan* forest
Chimpanzee, *Pan troglodytes*
bonobos: "pygmy" chimps

Pan paniscus

www.paniscus.net
The similarities between apes and humans are more than just external morphological, there are internal similarities as well.

*Homo, Pan, Gorilla, Orangutan*
The similarities between apes and humans are more than just morphological, there are genetic similarities as well.

The similarities between apes and humans are more than just morphological, there are genetic similarities as well.

(a) 4,700 BP of the mitochondria (maternal inheritance)

(b) The testes-specific protein Y (y-linked)

(c) Noncoding regions of b-globin gene cluster (autosomal) - scale is estimated branching times (~5 MYA)
The Great Apes: Evolution and phylogeny overview

Primate ancestors

Family: Cercopithecidae

20+ genera of Old World Monkeys

Family: Hylobatidae

4 genera of Gibbons

Hominids (Family Hominidae)

The Great Apes

Genus: Pongo
2 species of Orangutan

Genus: Gorilla
2 species of Gorilla

Genus: Pan
2 species of Chimpanzee

Genus: Homo
1 species of Human

This tree of life shows humans’ closest evolutionary relatives and their recent common ancestry.

(cc) davehuth.com/blog
What is the history of those lineages?

Human fossil studies

Problems:  
**Taphonomy**: study of fossil formation  
- Environment - forests and grasses vs aqueous  
- Population size - low over time  
- Suitable fossilizable parts - teeth  
Logistics, African location of most fossils

Advantages:  
Lots of effort and motivation  
Economic applications  
Unique and distinctive features
Human fossil record, begins approximately 6-7 MYA

There is debate about whether *Orrorin* and *Sahelanthropus* are ancestors or relatives.
Primate traits:
- Large brains
- Overlapping (binocular) vision
- Senses, sight > smell
- Heterodont dentition
- Clavicle, nails, thumbs

Human traits:
- Bipedalism;
- Larger brains;
- Development of different areas of the brain (speech)
- Thinner, lighter skeletons
Tool use is not uniquely human

FIGURE 26.13 Tool use in wild common chimpanzees (*Pan troglodytes*). A female chimpanzee in the Tai National Park, Ivory Coast, pounds a nut with a wooden club, as her one-year-old son watches. (Photograph courtesy of C. Boesch.)
Human fossil record, begins approximately 6 MYA humans are already bipedal

*Sahelanthropus*, 6-7 MYA

*Orrorin*, 5.6-6.2 MYA

*Ardipithecus ramidus*, 4.4 MYA

*Australopithecus anamensis*, 3.9-4.2 MYA
Gracile australopithecines

Australopithecus afarensis
3-3.9 MYA

Lucy, canines reduced

Australopithecus africanus
2.4-2.8 MYA

teeth bigger, canines even more reduced
Robust australopithecines

*australopithecus boisei*
1.4-2.3 MYA

*australopithecus robustus*
1-2 MYA
Another group, early humans

*Homo rudolphensis*: 1.8-2.4 MYA

*Homo habilis*: 1.6-1.9 MYA
Homo erectus
0.3-1.8 MYA

body skeleton very modern
stone tools
fire

Homo ergaster

African species of erectus
Homo heidelbergensis
0.2-0.6 MYA
robust
Europe

Homo neanderthalensis
0.03-0.3 MYA
big brains
robust
medicine?
religion?

Homo sapiens
0.1 MYA - present
FIGURE 26.7 Frontal and lateral reconstructions of the skulls of a chimpanzee and some fossil hominids. (A) Chimpanzee. Note large canine teeth, projecting incisors, low forehead, prominent face and brow ridge. (B) *Australopithecus afarensis*. Some of the same features as in the chimpanzee are evident. (C) *Australopithecus africanus*. Note small canines, higher forehead. (D) *Australopithecus boisei*. The large molars, heavy cheekbones, and slight crest on the skull are elements of a complex of characters adapted for chewing tough foods such as roots. (E) *Homo habilis*. The face projects less, and the skull is more rounded, than in *A. africanus*. (F) *Homo erectus*. Note the still more vertical face and rounded forehead. (G) *Homo sapiens*, Neanderthal type. Rear of skull is more rounded than in *H. erectus*. (A, B after Jones et al. 1992; C–G after Howell 1978.)
Relationships between all these early "human" species are unclear.

Figure from Sean B. Carroll (2003) *Nature* 422:849
Sahelensis, Orrorin, Ardipithecus: little detailed data

Australopithecines: spread through Africa

*Homo erectus*: Spreads through Africa and also the rest of the world

*Homo sapiens*: Spreads through Africa and also the rest of the world

Either eliminates or interbreeds with *erectus* and *neanderthalensis*

Current best model is recent single migration out of Africa

Alternative is parallel evolution of *erectus* lineages
Prior to DNA data the multiregional hypothesis was favored by many.
   - For example, the morphological characters, zygomatic arches, etc., of *H. erectus* differ in certain regions in the same way as present *H. sapiens* populations do.

Molecular evidence gives a different story.

**Multiregional**: parallel evolution of *H. erectus* to *H. sapiens* in different parts of the world with limited gene flow.

**Out of Africa**: 100,000 years ago a group of *H. sapiens* migrated to the rest of the world, replacing all other *Homo* species present.

~2 MYA

~100,000 YA
Molecular evidence gives a different story.

Data from Kidd et al paper
FIGURE 26.11 The possible major routes of expansion of modern human populations in the last 100,000 years or so, based largely on genetic data. These dates are very approximate, and may be revised in light of future research. (After Cavalli-Sforza et al. 1994.)
Genetic relationships show a migration pattern not obvious from skin color patterns - due to the plasticity of such simple morphological traits (lots of homoplasy).

Futuyma, 1998: pp 739