

Human Evolution



Overview

- Primates arose 85 Mya as tree-dwelling, large brained, social mammals
- The first bipedal hominins diverged from the apes in Africa some 5-7 Mya
- An increase in brain size *followed* the origin of bipedalism
- Earliest fossils of the genus *Homo* are 2.4 Mya old, and genus *Homo* eventually expanded throughout the Old World

THE HUMAN ANCESTRY

- Humans are **primates**, the mammalian group that also includes:
 - Lorises
 - Pottos
 - Lemurs
 - Tarsiers
 - Monkeys
 - Apes
- **Primates** evolved from insect-eating mammals during the late Cretaceous period.

Primates and Human Evolution

- Primates, meaning first
- Hominids, Family Hominidae, upright posture
- The Order Primates is one of the longest surviving (Eocene) and generalized group of mammals
- 2 suborders
 - Prosimii and Anthropoidea
- Superfamily Homonoidea (3 Families; includes chimps, gorillas, orangutans and humans)

Primates



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Three Groups of Primates

- The first group of primates includes:
 - Lorises
 - Pottos
 - Lemurs
- Tarsiers form the second group.
- The third group, **anthropoids**, includes:
 - Monkeys
 - **Hominoids**, the ape relatives of humans
 - And humans



Ring-tailed lemur



Tarsier



**Black spider monkey
(New World monkey)**



Gibbon (ape)



Orangutan (ape)



Patas monkey (Old World monkey)



Gorilla (ape)



Chimpanzee (ape)



Human

Laura Coronado and the Copestake

Figure 17.37

Primate Characteristics

- Primates are distinguished by characteristics that were shaped by the demands of living in trees. These characteristics include:
 - Limber shoulder joints
 - Eyes in front of the face
 - Excellent eye-hand coordination
 - Extensive parental care
- Taxonomists divide the primates into three main groups.

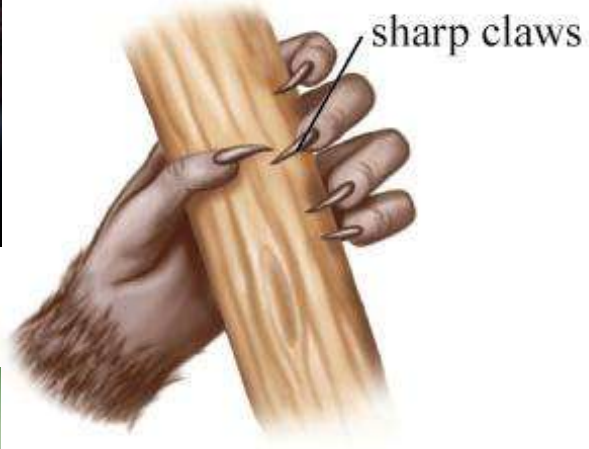
Primate Hands



orangutan



gorilla



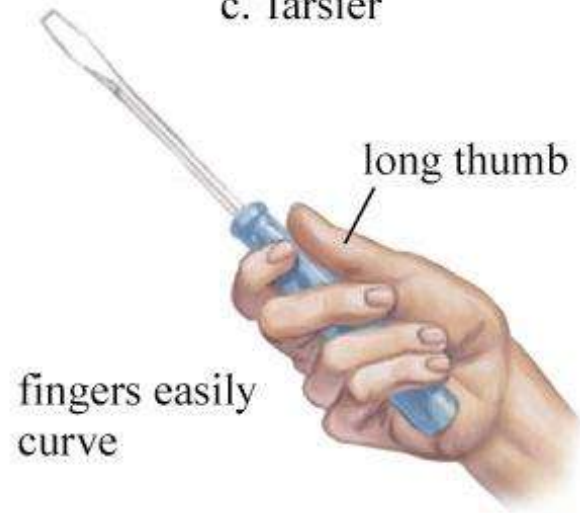
a. Tree shrew



b. Macaque



c. Tarsier



d. Human



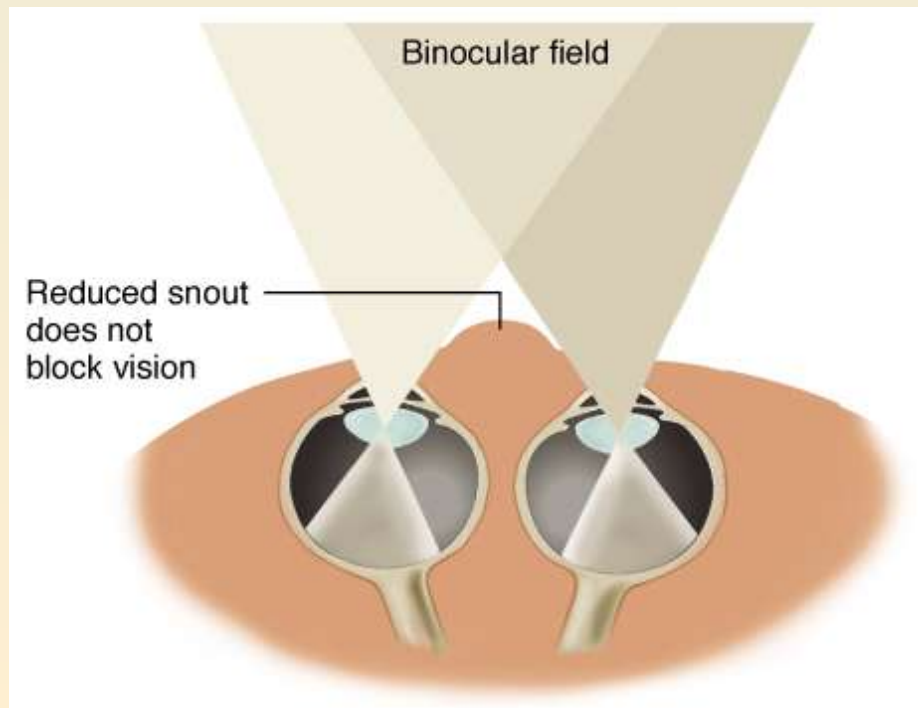
lemur



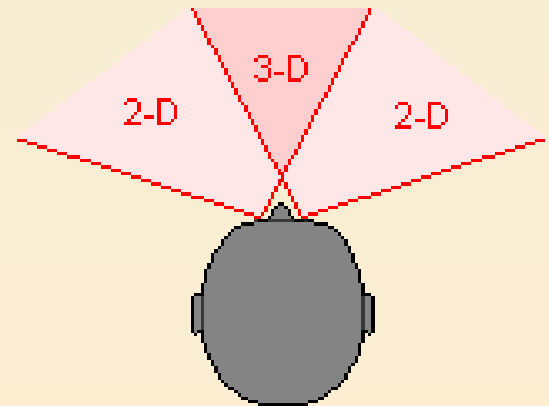
chimpanzee

Binocular Vision

- Stereoscopic vision and resultant depth perception allows primates to make accurate judgments about distance and position of adjoining tree limbs



- Retaining good peripheral vision is also of value



Primate Adaptive Radiations

- Three morphological grades: prosimians, monkey, and apes
- Prosimians were the first to diverge from the ancestral primate lineage (65 mya)
- Surviving derived anthropoids are classified into three superfamilies.
 - New World monkeys (? 35 mya ?)
 - Old World monkeys (35 mya)
 - Hominoids/apes (23 mya)

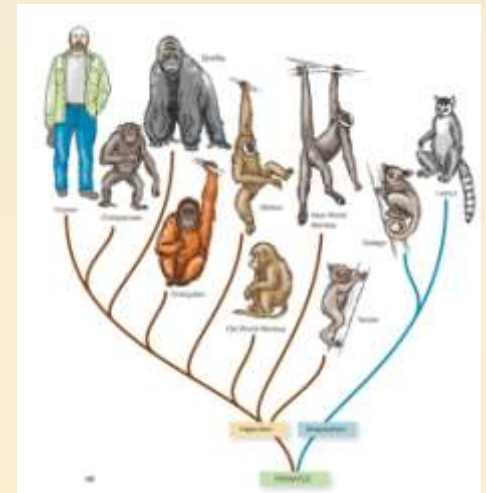


Figure 02A: Primates

Prosimians



← Tree shrew

(a) A prosimian



- Prosimians probably most resemble the early arboreal ancestral primates, as do the primates' cousin, the tree shrew
- Prosimians include the lemurs of Madagascar and the lorises, pottos, and tarsiers of tropical Africa and southern Asia

Today's prosimians (basal primates) include tarsiers and lemurs. They feed on plant parts, and have largely nocturnal lifestyles.

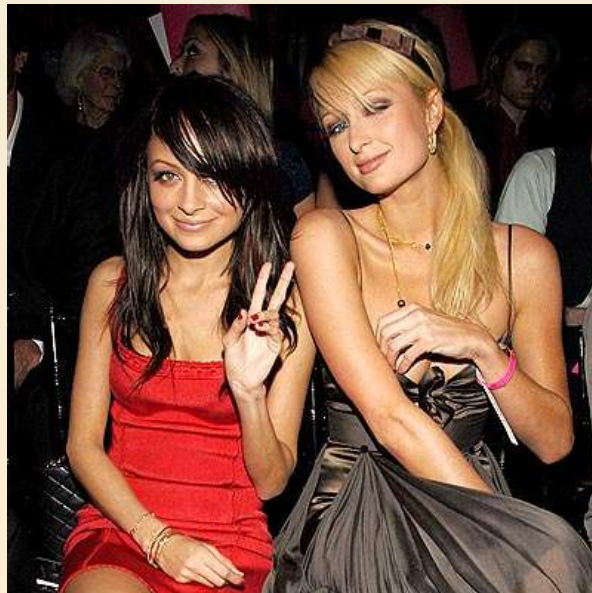
Tarsier



Lemur



The anthropoids, or derived primates, include the monkeys, apes, and humans.



One group of anthropoids are the platyrrhines. They evolved into the **New World monkeys**.



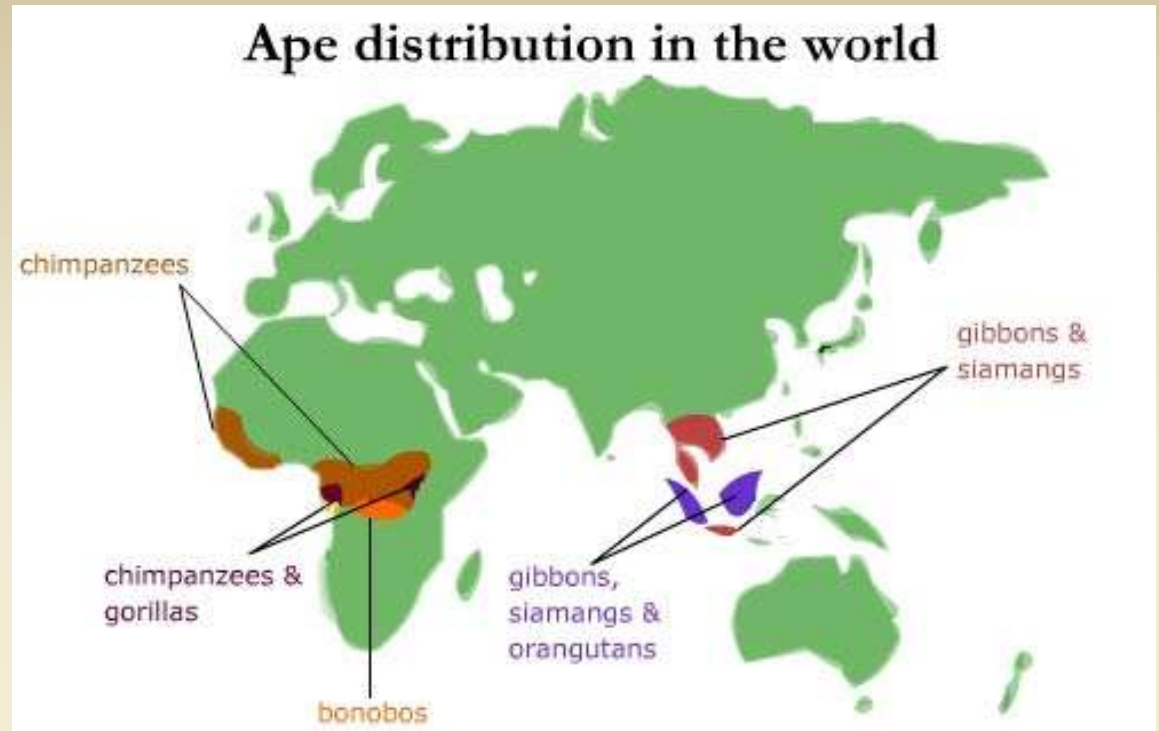
They are characterized by flat, spread nostrils and (usually) a prehensile tail.

Another group of anthropoids, the catarrhines, gave rise in Africa to the **Old World monkeys**.



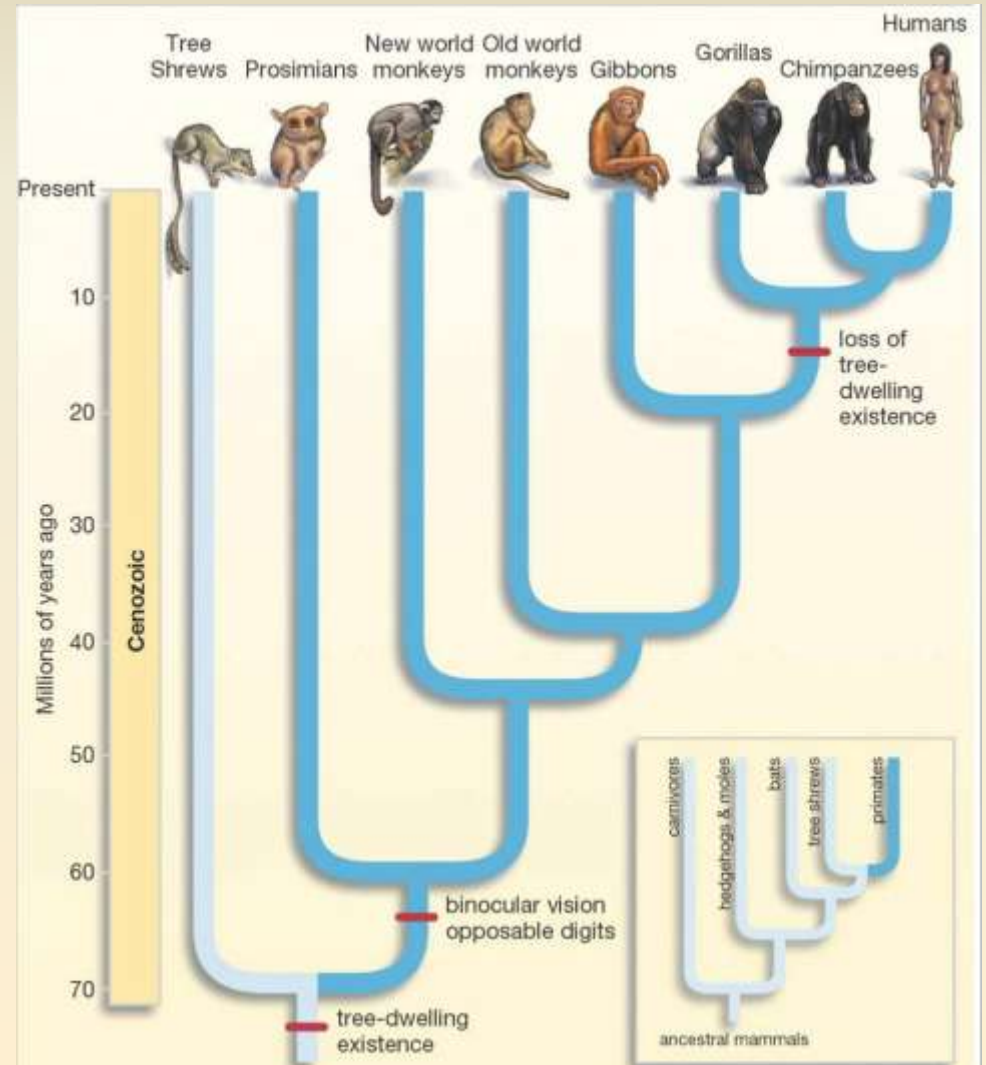
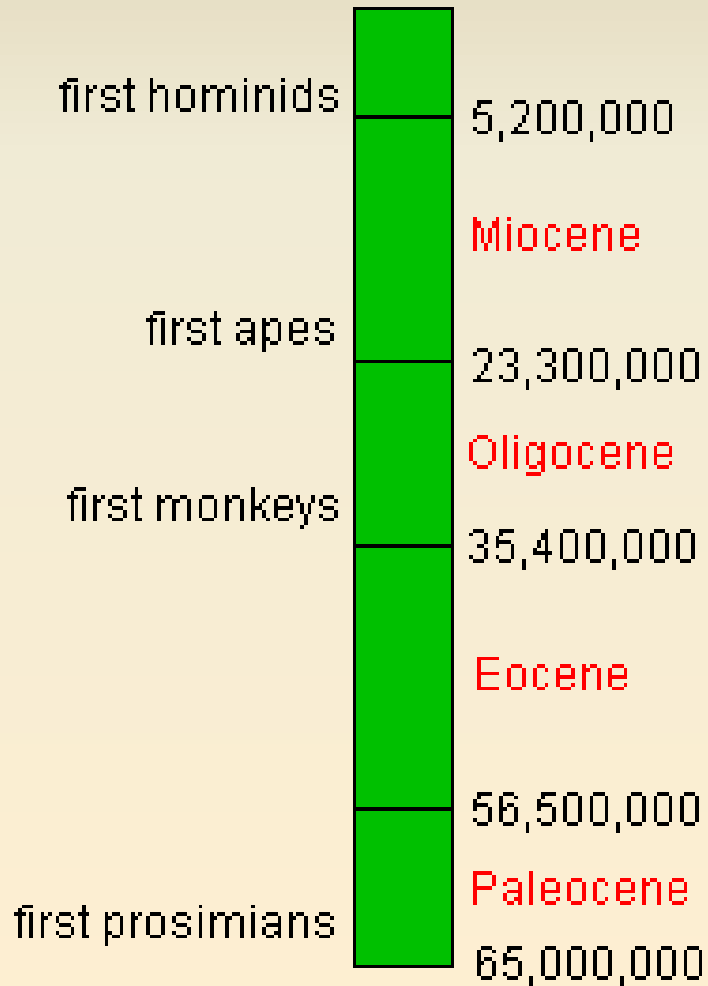
In them, the nostrils are closer together and the tail, if present, is not prehensile.

In addition to the Old World monkeys, the catarrhines gave rise to the hominoids. The hominoids include the gibbons and the apes, including man.



Primates – Our
Order within
the Class
Mammalia

Primate Adaptive Radiations



Timing divergence from the molecular clock and fossils

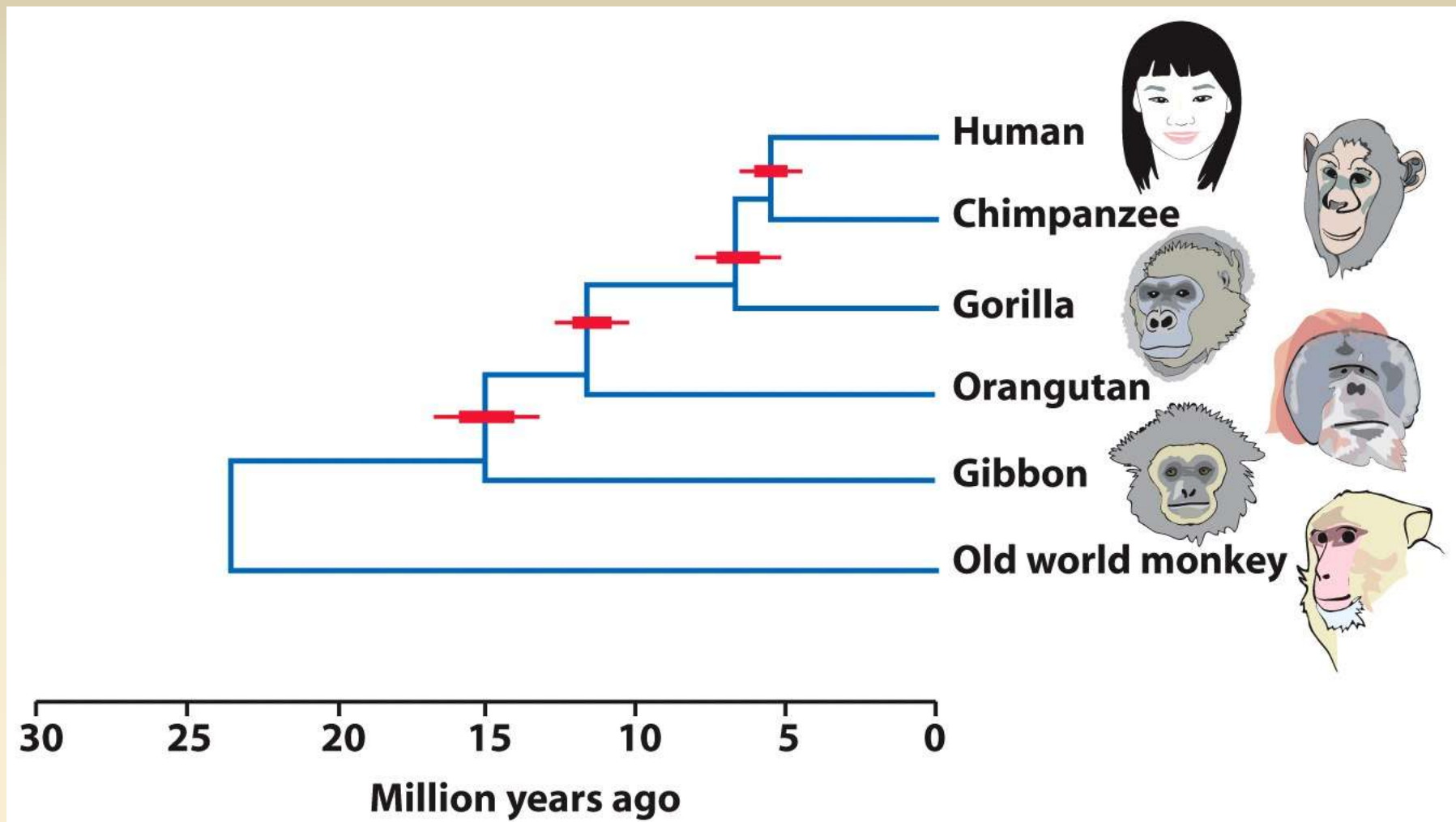
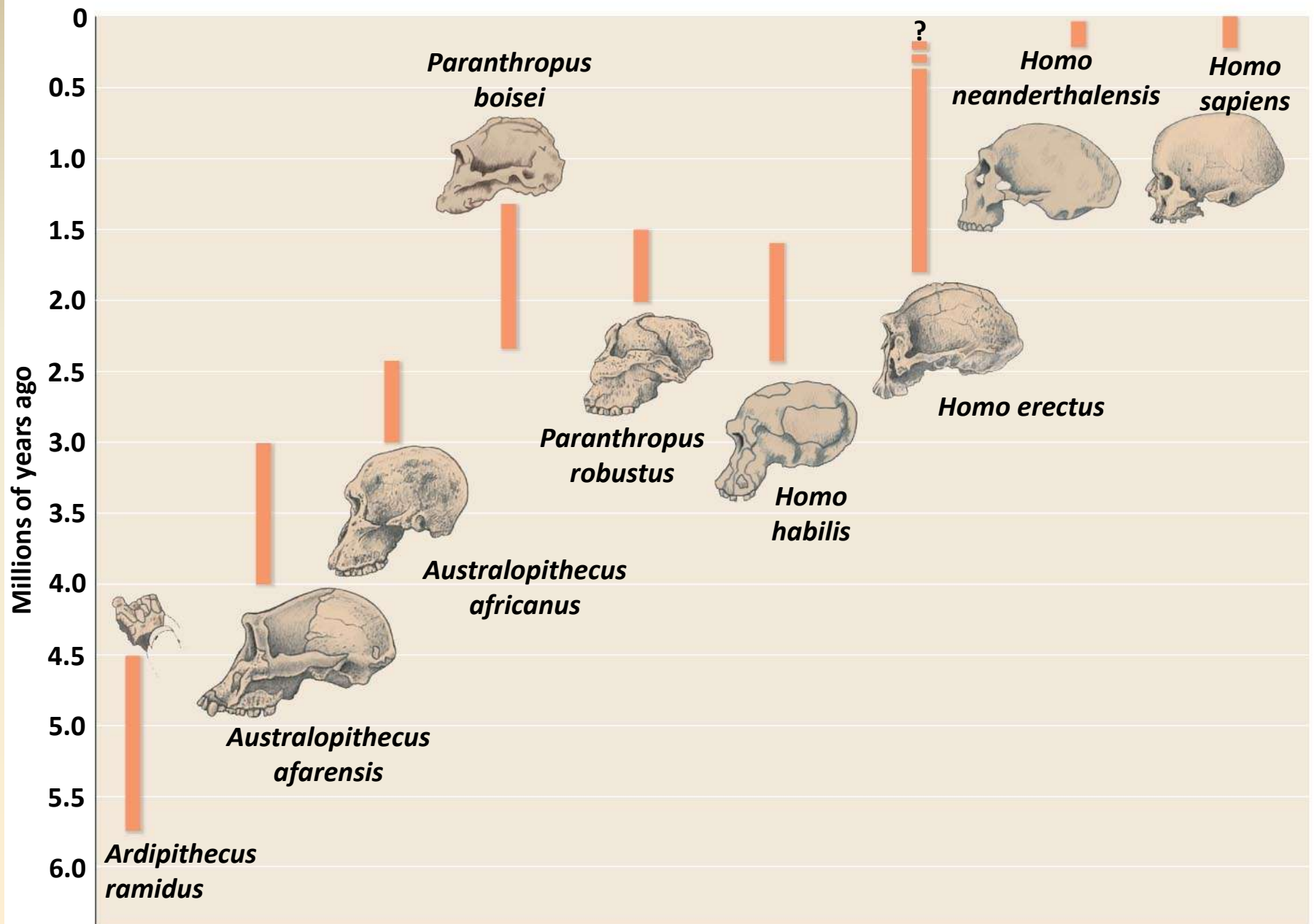
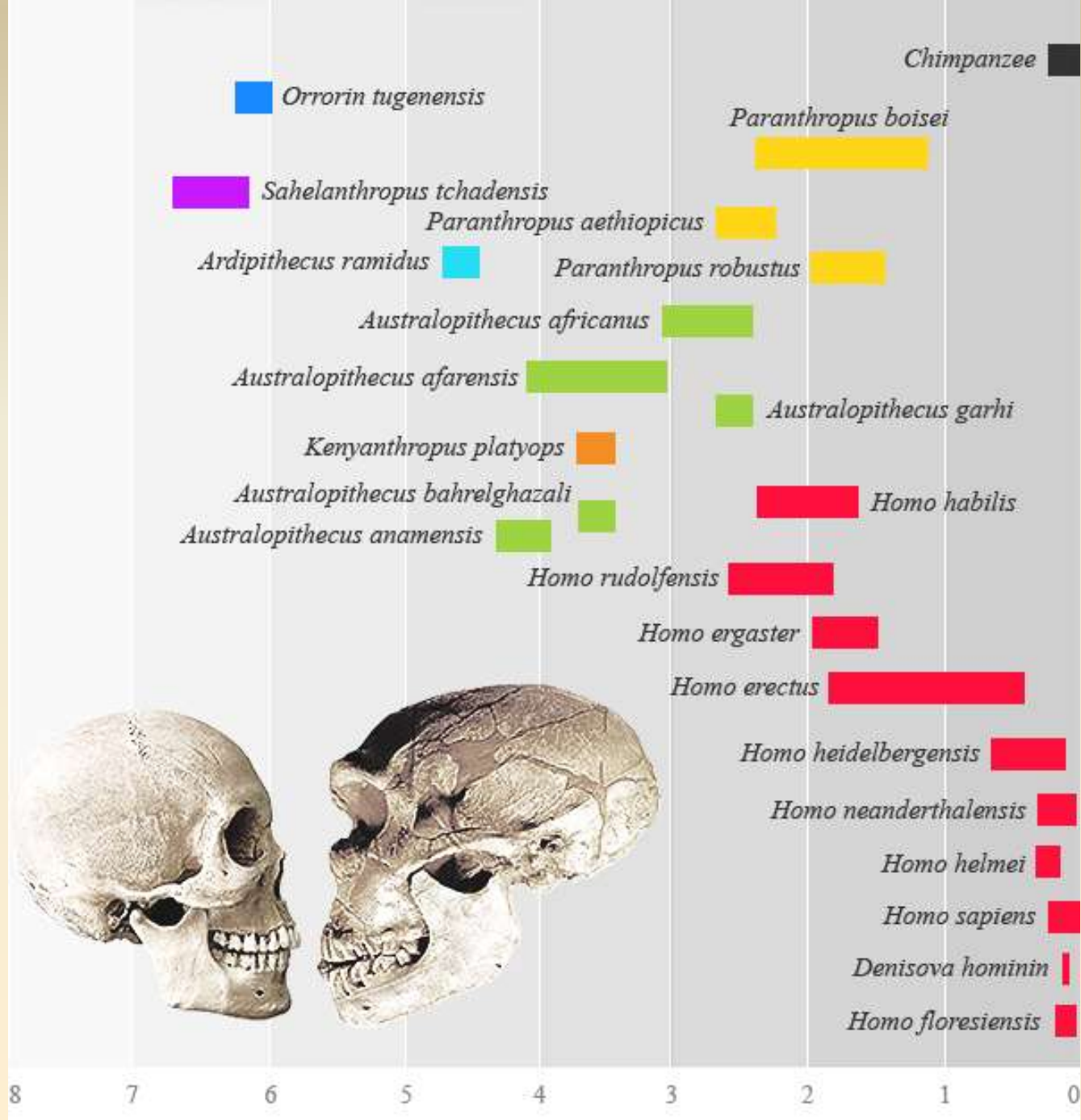


Figure 20-6 Evolutionary Analysis, 4/e
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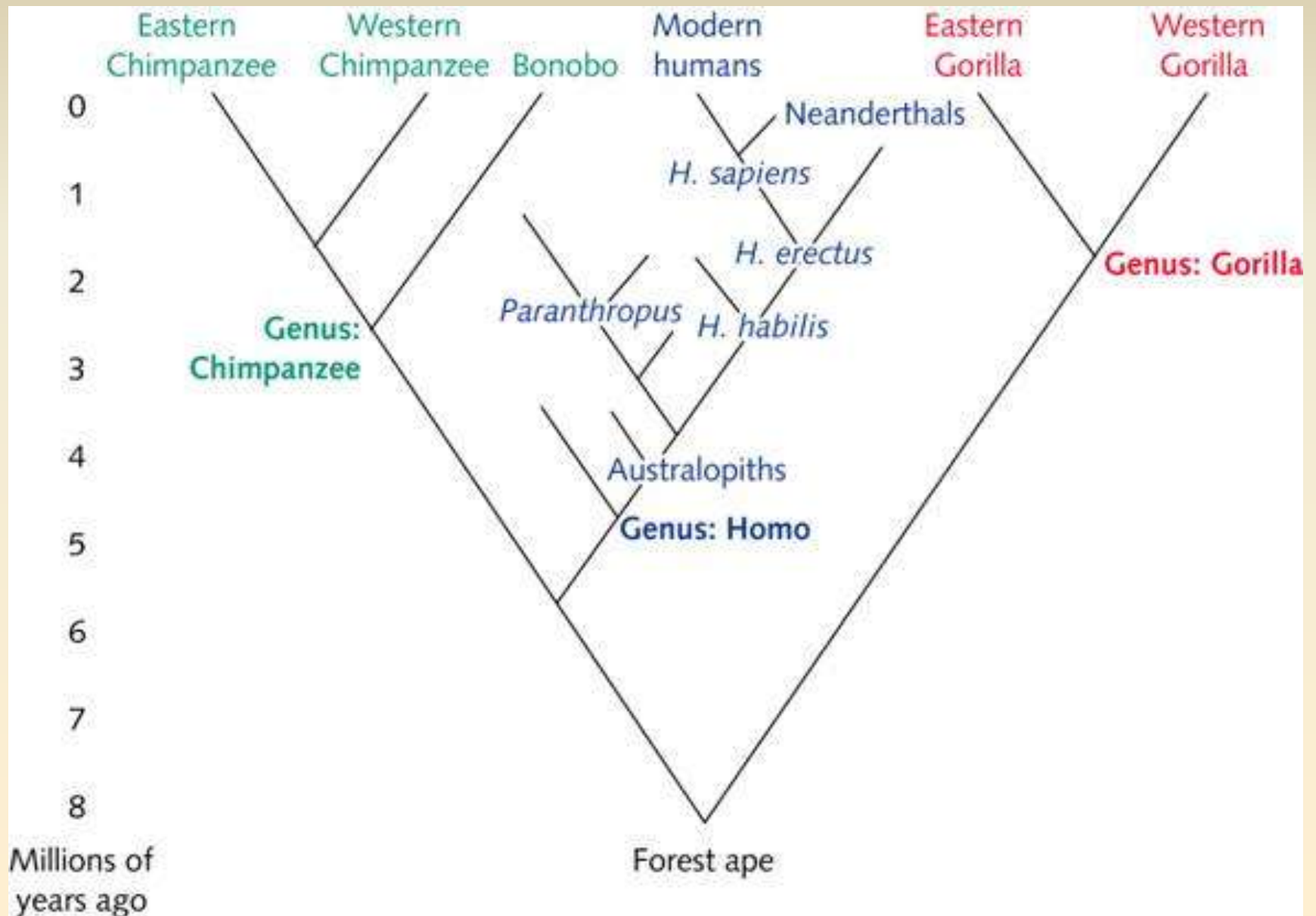
Some Common Misconceptions

- Chimpanzees and humans represent two divergent branches of the anthropoid tree that each evolved from a common, less specialized ancestor.
- Our ancestors were not chimpanzees or any other modern apes.
- Human evolution is not a ladder with a parade of fossil **hominids** (members of the human family) leading directly to modern humans.
- Instead, human evolution is more like a multibranched bush than a ladder.
- At times in hominid history, several different human species coexisted.
- Upright posture and an enlarged brain appeared at separate times during human evolution.
- Different human features evolved at different rates.





Hominoid Phylogeny



Features of early hominid evolution

1. Exact path of descent unknown

- more hominid species continue to be discovered.

2. Evolution was continuous and gradual

- no sudden “jumps” in size or cranial capacity observed.
- cranial capacity increased from 600-800 cm³ to 1200-1400 cm³ over past 2 MY.

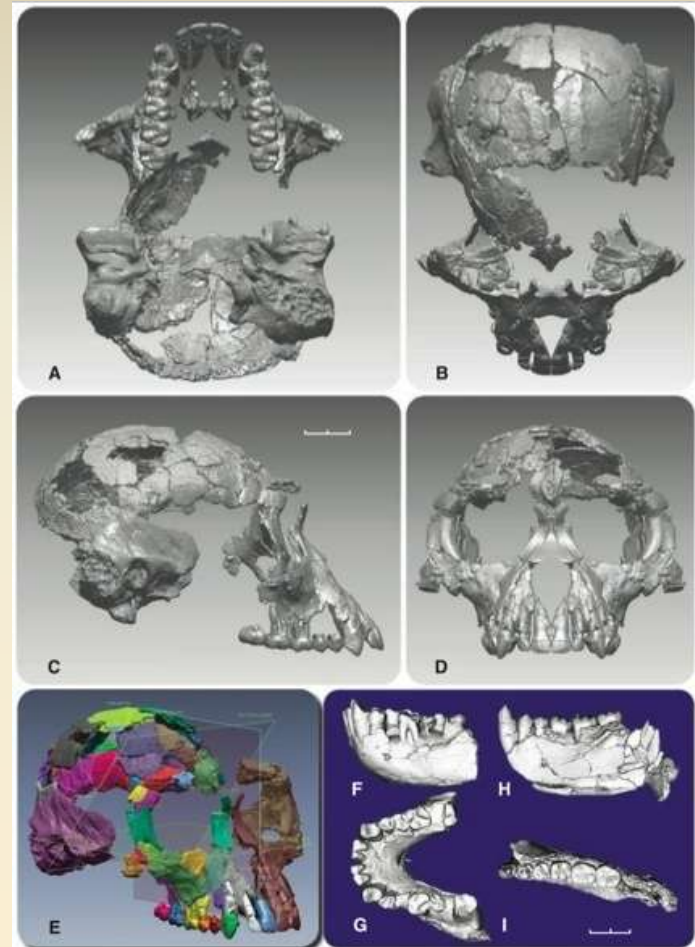
Approximate Timeline for Human Prehistory

1. Ardipithecines: 5.8 to 4.5 mybp
2. Australopithecines: 4.5 to 1.2 mybp
3. *Homo erectus*: 2.0 to 0.5 mybp
4. Archaic *Homo s. sapiens* and *Homo sapiens neanderthalensis*: 500,000 - 200,000 years
5. Modern *Homo s. sapiens*: the last 200,000 years

Ardipithecus ramidus

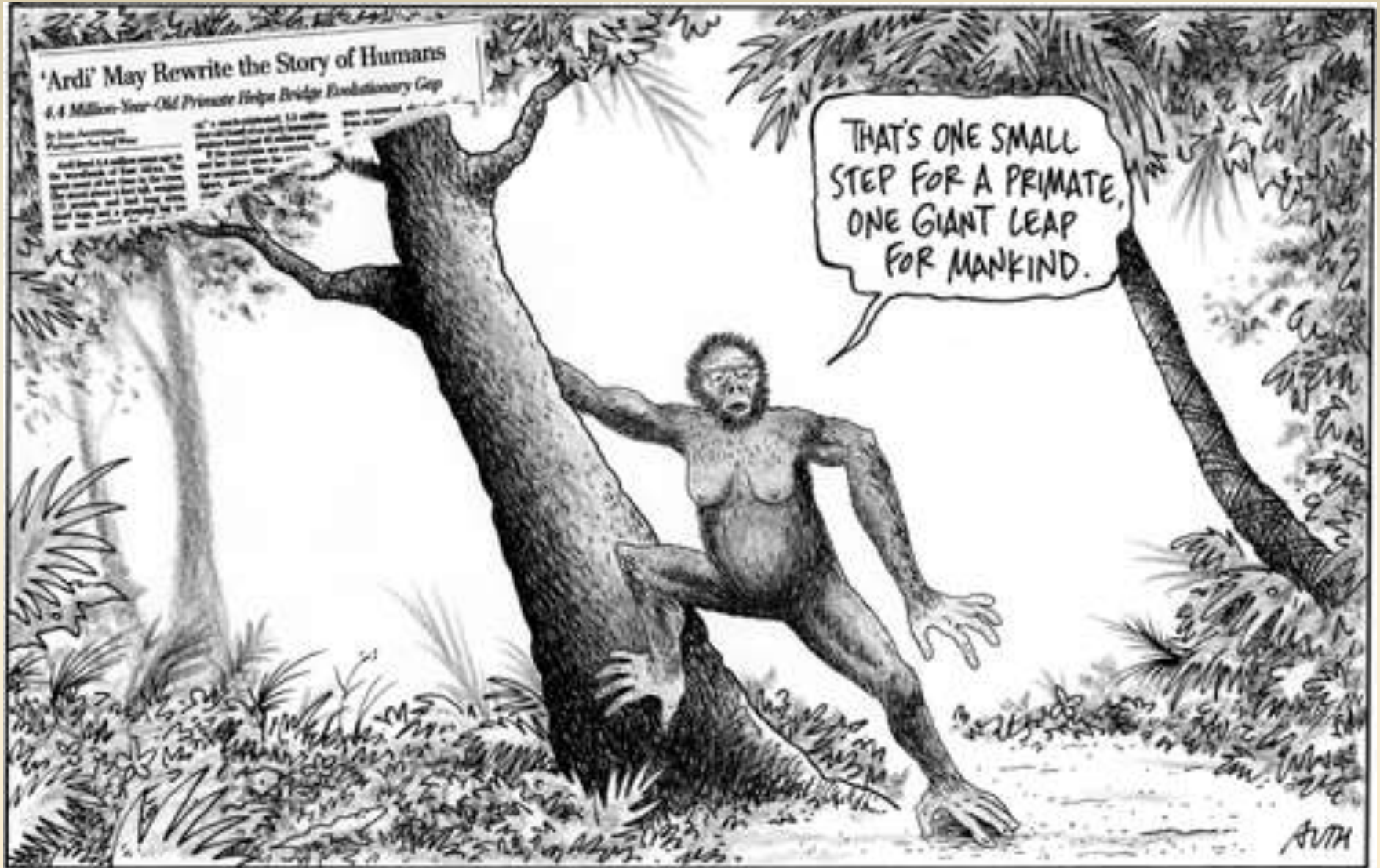


2009!



The skeleton was crushed into hundreds of small fragments, making for a 3D jigsaw puzzle for the scientists doing the reconstruction

Ardipithecus 5.8 to 4.5 mybp



10-4-09 THE PALM BEACH POST-OPINION: UNIVERSAL VOICES



Ardipithecus ramidus is called "the root of terrestrial apes"

The first fossil was dated 4.4 mya

Fossil records show that Ardi lived in a tropical clearing in Ethiopia

Ardi means "soil" and Ramid "root"

Pithecus is derived from the Greek word "monkey"

Ardi was named in September 1994.

Ardi was smaller (1.2 m) and less anatomically specialized than modern chimps or gorillas

Anatomical traits suggest a combination of arboreal and bipedal locomotion

Ardipithecines

- Two described species:
 - *A. kadabba*, dated to approximately 5.6 million years ago (late Miocene)
 - *A. ramidus*, which lived about 4.4 million years ago during the early Pliocene
- *Ardipithecus ramidus* had a **small brain**, measuring between 300 and 350 cm³
- This is about the same size as a modern bonobo or female common chimpanzee brain, but much smaller than the brain of australopithecines like Lucy (~400 to 550 cm³) and roughly 20% the size of the modern *Homo sapiens* brain
- Like common chimpanzees, *A. ramidus* was much more prognathic than modern humans



The first bipeds: Australopithecines



Australopithicines

- ***Australopithecus africanus*** was discovered in 1924 by Raymond Dart in South Africa. Since then, many specimens have been discovered in East Africa, particularly in **Olduvai Gorge** by **Mary and Louis Leakey**.
- East African fossil sites have yielded hundreds of hominid bones, documenting human evolution over the past 4 million years.
- Interbedded volcanic ash allows radiometric dating of the hominid fossils.

Australopithecines: The First Hominins

A. africanus, the skull discovered by Raymond Dart in 1924 in S. Africa.

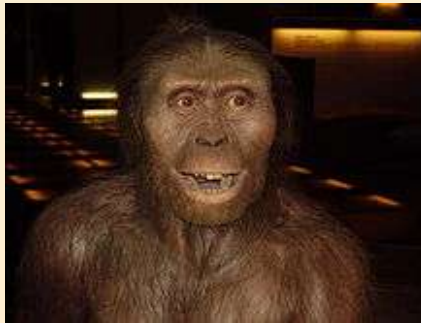


Australopithecus = “southern ape”

Australopithecus afarensis



- “Lucy” was an adult female of about 25 years
- About 40% of her skeleton was found, and her pelvis, femur (the upper leg bone) and tibia **show her to have been bipedal**
- She was about 107 cm (3'6") tall (small for her species) and about 28 kg (62 lbs) in weight



Australopithecus afarensis:

Hominin Footprints

- The footprints demonstrated that hominids were bipedal walkers at least 3.5 million years ago
- Most scientists think the footprints were made by *A. afarensis*, whose fossils are found nearby



Footprints at Laetoli - dated at around 3.6 million years



Excavated by Mary Leakey and her team in 1978 and 1979, the trackway consists of some 70 footprints in two parallel trails about 30 meters long, preserved in hardened volcanic ash. It is significant that the earliest stone tools known are about 2.6 million years old, made nearly a million years *after* the footprints at Laetoli. The Laetoli hominids were therefore fully bipedal well before the advent of toolmaking—an event considered to define the beginning of culture—and the traces they left behind provide evidence that the feet led the way in the evolution of the modern human brain.

Rise of the genus *Homo*



- Earliest fossils from same African sites as *Australopithecines*
- Most date between 2.4 and 1.8 mya
- *Homo habilis* means "handy man"
- Growing consensus that there may have been 2 or more species of *Homo* living at the same time by about 2 mya

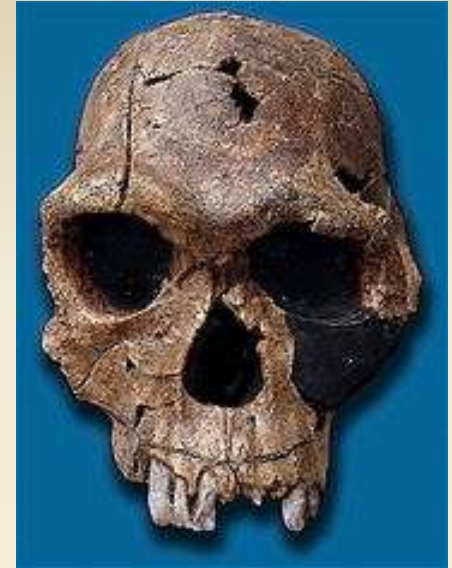
Homo habilis



Artist
rendition of
H. habilis.



- ✧ 612 cc brain
- ✧ 2.3 - 1.6 mya
- ✧ first toolmaker
- ✧ prognathic face, brow ridge
- ✧ probable meat-eater
- ✧ possibly arboreal
- ✧ discovered in 1960 by Leakeys



ER-1813 – *Homo habilis*

Homo Habilis and the Evolution of Inventive Minds

– ***Homo habilis***, “handy-man”:

- Had a larger brain, intermediate in size between *Australopithecus* and modern humans
- Walked upright
- Made stone tools that enhanced hunting, gathering, and scavenging on the African savanna

– ***Homo erectus*** was the first species to extend humanity’s range from Africa to other continents.

- The global dispersal began about 1.8 million years ago.
- Was taller than *H. habilis*
- Had a larger brain
- Gave rise to Neanderthals

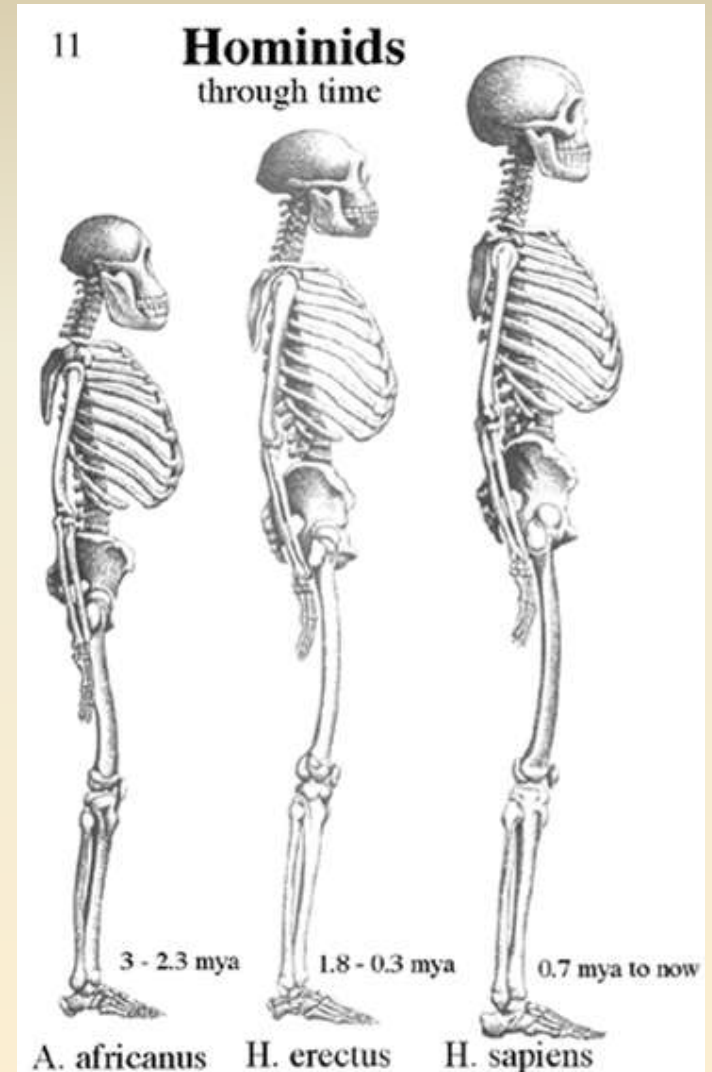
Cranial capacity for Genus *Homo*

Cranial Capacity

<u>TAXON</u>	<u>Mean Cran Cap</u>
<i>Homo habilis</i>	675 cc
early Erectine	834 cc
late Erectine	1065 cc
Erectine (all)	987 cc (650-1325 cc)
Modern <i>H. sapiens</i>	1350 cc

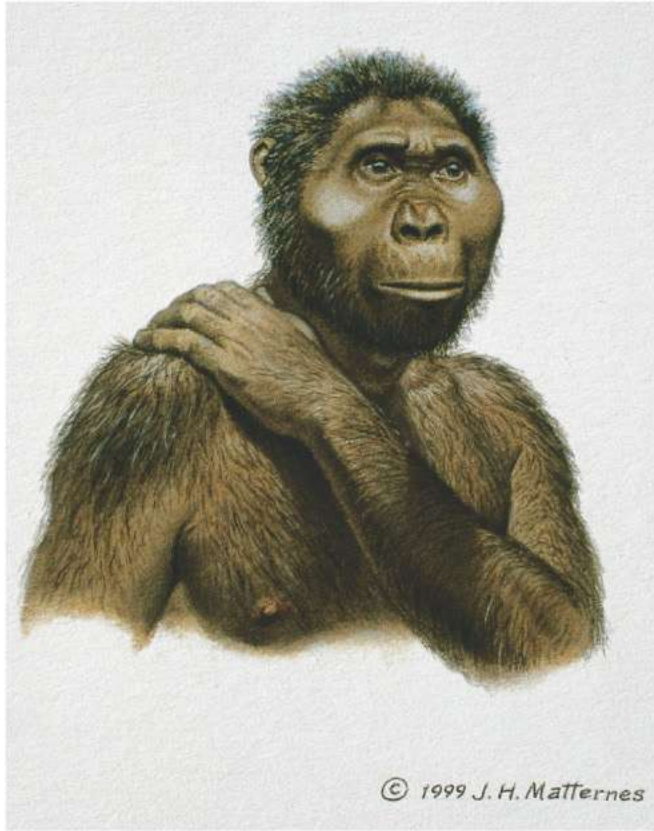
Hominin Evolution

- Major *Homo* advances:
 - Brain size
 - Better bipedalism
 - Hunting
 - Fire (*H. erectus*)
 - Tools
 - Oldowon (*H. habilis*)
 - Acheulean (*H. erectus*)
 - Mousterian (*H. heidelbergensis*)
 - Solutrean (*H. sapiens*)
 - Built shelters (*H. heidelbergensis*)
 - Clothing (*H. neandertalensis*)
 - Language (Neandertals?)



Artist's Conception of the Two Hominin Species

(a) *Homo habilis*



Homo habilis stayed close to home (Africa)

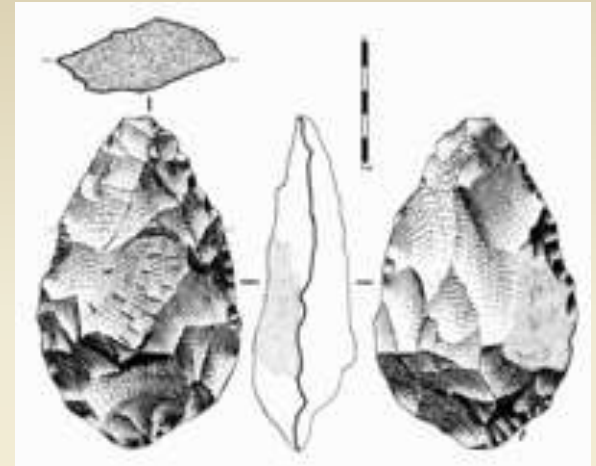
(c) *Homo erectus*



Homo erectus migrated widely from Africa into Asia.

Acheulean Tools

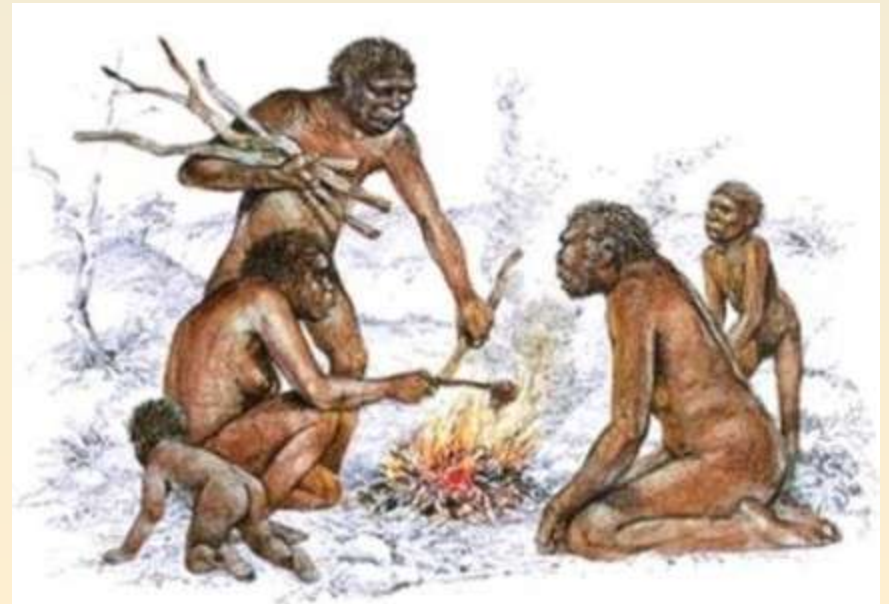
- Acheulean tools are typically found with *Homo erectus* remains.
- It was the dominant technology for the vast majority of human history and more than one million years ago it was Acheulean tool users who left Africa to first successfully colonize Eurasia.





Homo erectus camp sites show evidence of many animal bones and many tools.

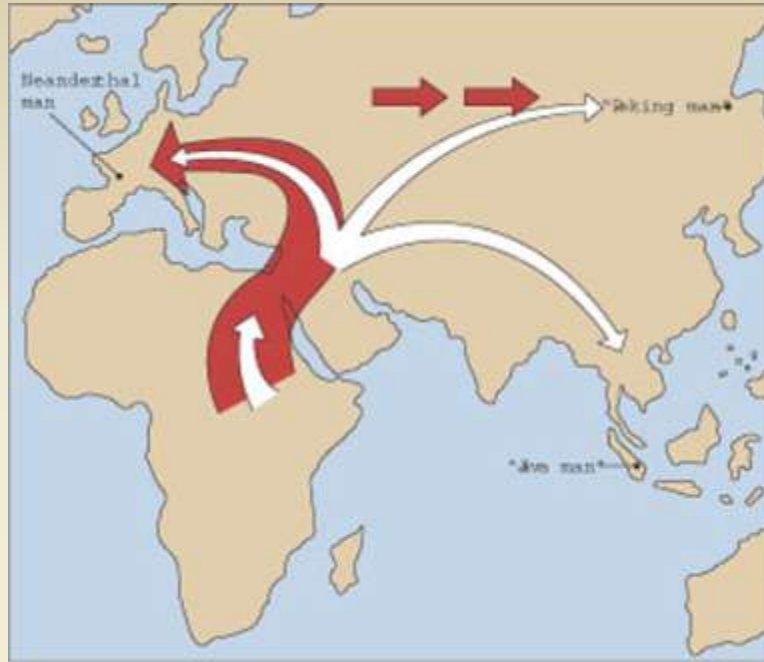
There is also some evidence of fire, although their use of it is uncertain.



The species that followed, *Homo erectus*, was the first to be found outside of Africa.



Out of Africa



- Homo erectus (white arrows) originated in Africa but spread to parts of Eastern Asia, and perhaps into Europe. H. neanderthalensis apparently followed much the same migrations out of Africa as did H. sapiens after them.

Out of Africa (Single Region)

- About 130,000 years ago, the first anatomically modern *Homo sapiens* evolved in East Africa (probably from *H. erectus*)
- then migrated out of Africa to Europe, Asia, and the rest of the world.
- At this point, *H. sapiens* may have interbred with *or* out-competed other existing species, such as *H. erectus* and *H. neanderthalensis*.

Multiregional Hypothesis

- 1.8 mya, *Homo erectus* evolved in East Africa and then began to migrate to Europe and Asia (due to lack of water and shelter)
- A very successful species, *H. erectus* survived until 33,000 years ago! So...the Multiregional hypothesis argues that modern *H. sapiens* evolved from the *different H. erectus* stocks in *different* regions (continents) at the same time.
- After *H. sapiens* evolved in these different regions, may have been interbreeding, thus sharing of genes.

Original Neanderthal Skullcap



Homo neanderthalensis

- discovered in the Neander Valley (Tal) near Dusseldorf, 1856
- massive brain--about 1,400cc on average
- large torso, short limbs, broad nasal passages
- later remains show decrease in robustness of the front teeth and face, suggesting use of tools replaced teeth
- retained occipital torus, some mid-facial prognathism



Range of *Homo neanderthalensis*

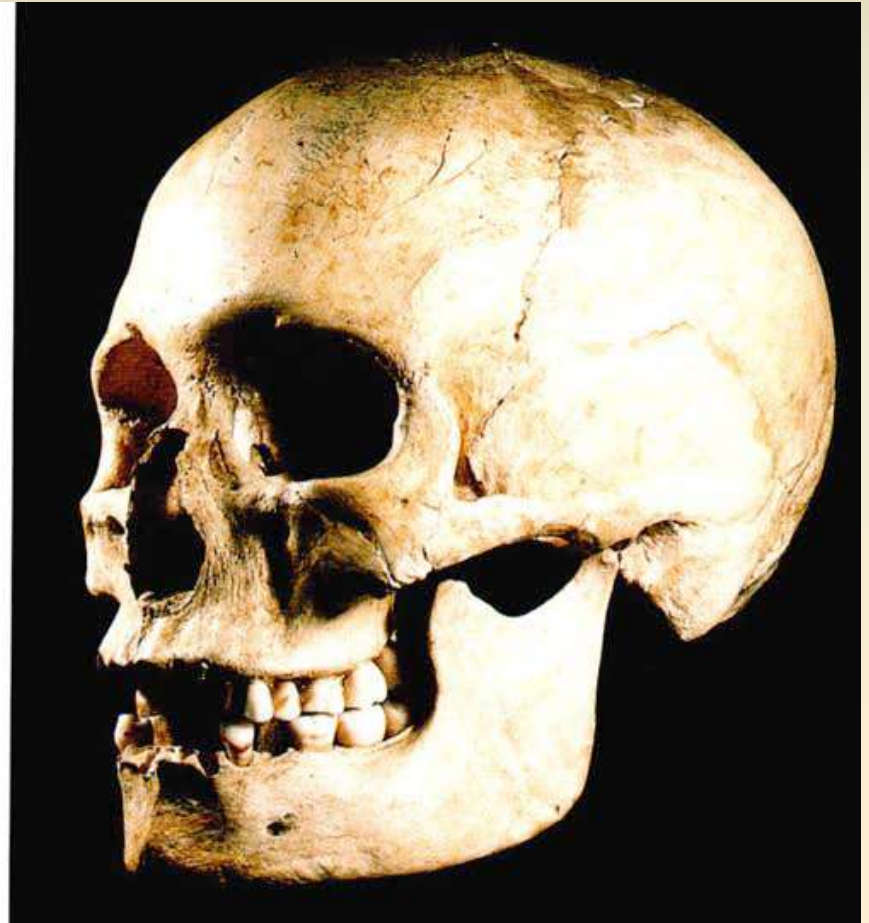
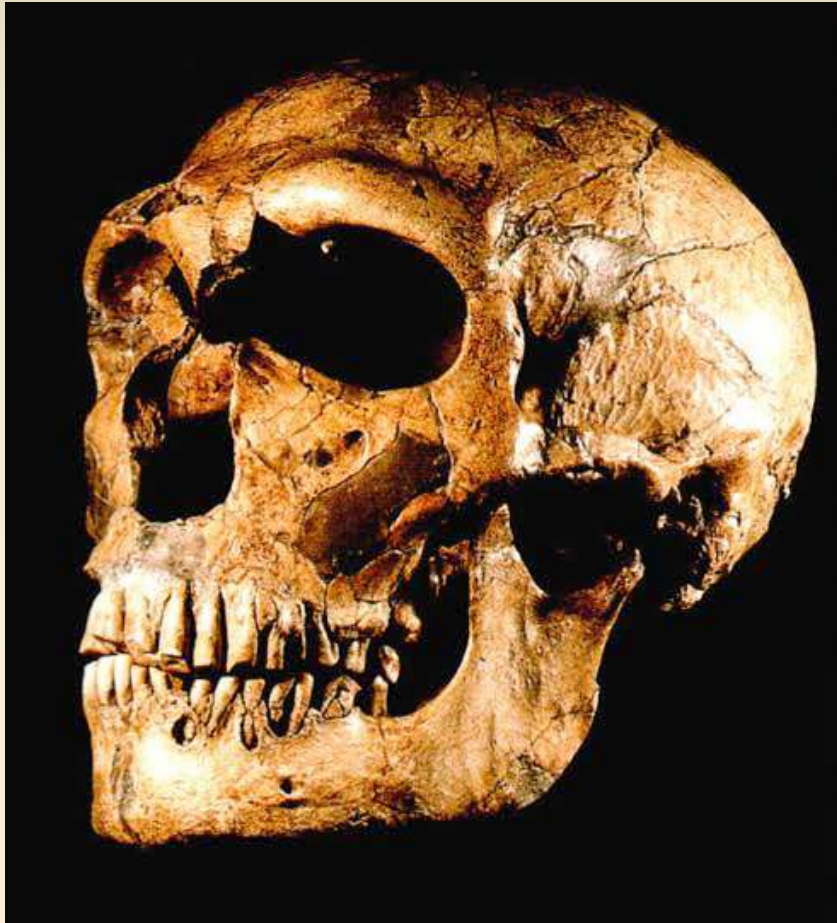


The skull of the classic Neanderthal found in 1908 at La Chapelle-aux-Saints.



First reconstruction of Neanderthal man.

Homo Neanderthalensis vs. *Homo sapiens*



Neanderthal Reconstruction





The Origin and Dispersal of *Homo Sapiens*

- The oldest known fossils of our own species, *Homo sapiens*:
 - Were discovered in Ethiopia
 - Date from 160,000 to 195,000 years ago
 - DNA studies strongly suggest that all living humans can trace their ancestry back to a single African *Homo sapiens* woman who lived 160,000 to 200,000 years ago.
- Fossil evidence suggests that our species emerged from Africa in one or more waves.
- The oldest fossils of *H. sapiens* outside of Africa are 50,000 years old.
- The oldest fossils of humans in the New World are uncertain, but are at least 15,000 years old.

Upper Palaeolithic – Hotbed of Culture

- 40 – 10k yBP
- Shelters
 - 15,000 yBP Ukraine
 - Some made with mammoth bones
 - Wood, leather working; carpentry
- Tools
 - From cores to blades
 - Specialization
 - Composite tools
 - Bow and arrow
- Domestication of dogs
- Gathering rather than hunting became the mainstay of human economies.

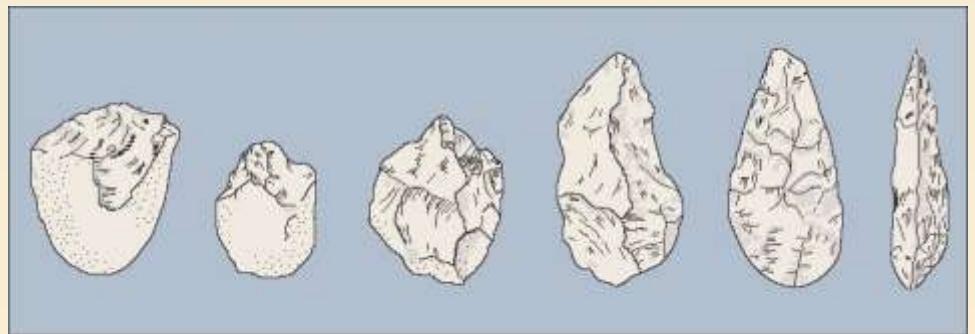


Top: Straw Hut



Left: Mammoth bone hut

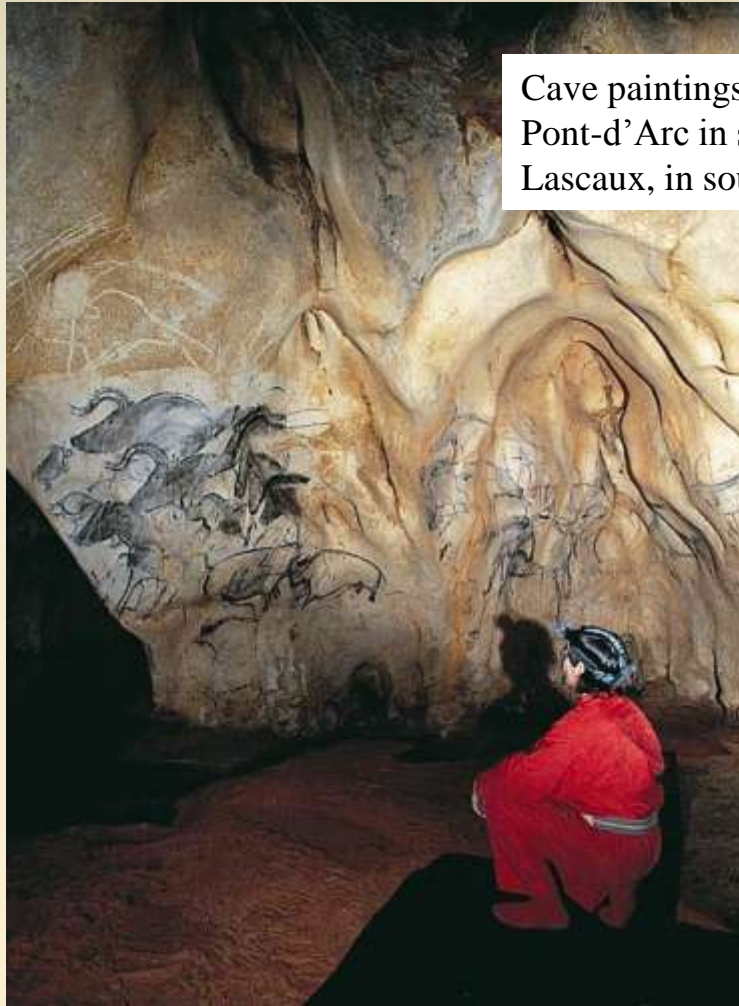
Bottom: Tool progression



Cultural Evolution

- **Culture** is the social transmission of accumulated knowledge, customs, beliefs, and art over generations.
- Culture is primarily transmitted by language.
- Cultural evolution has had three major stages.
 - First, nomads who were hunter-gatherers:
 - Made tools
 - Organized communal activities
 - Divided labor
 - Created art
 - The second main stage of cultural evolution was the development of agriculture in Africa, Eurasia, and the Americas, about 10,000 to 15,000 years ago.
 - The third stage was the Industrial Revolution, which began in the 1700s.

Archaic H. sapiens Culture



Cave paintings from 20,000 years ago at Vallon-Pont-d'Arc in southern France (left) and from Lascaux, in southwest France



- Cave paintings
 - Mostly animals on bare walls
 - Subjects were animals favored for their meat and skins
 - Human figures were rarely drawn due to taboos and fears that it would somehow harm others

Early H. sapiens Culture

- Art
 - Traces of art found in beads, carvings, and paintings
 - Cave paintings in Spain and southern France showed a marked degree of skill
- Female figurines
 - 27,000 to 22,000 years B.P. (Western Europe to Siberia)
 - Called “venuses,” these figurines depicted women with large breasts and broad hips
 - Perhaps it was an example of an ideal type, or perhaps an expression of a desire for fertility or abundance.



Venus of Willendorf.
Discovered in 1908 in Austria
and dated to approximately
23,000 years ago.

Cave Paintings – Lascaux, France – Cro-Magnon - 17,300 ye





26,000 year old Cro-Magnon
Mammoth Ivory self portrait

End