Evolution: Human Evolution

Primates reflect a tree-dwelling heritage

Outline

1. **Key concepts**
2. **Characteristics of primates**
3. **Prosimians and anthropoids**
4. **The first hominids: *Ardipithecus***
5. **The first humans: *Homo habilis***
6. **Human evolution continues: *Homo erectus***
7. **Recent humans: *Homo sapiens***
8. **Conclusions**

Key Concepts:

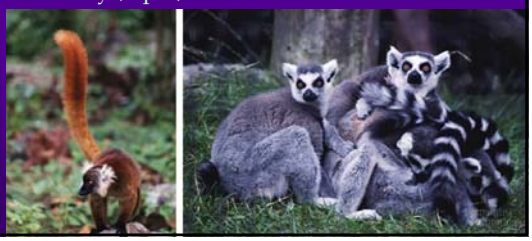
1. **Primates evolved more than 60 millions years ago**
2. Primates are mammals whose characteristics indicate arboreal ancestors
3. Two critical steps in the evolution of humans **– Upright walking and enlarged brains**
4. Use of fire and language enhances the survival of ***Homo***

Characteristics of primates

Primates: mammals whose characteristics indicate arboreal ancestors:

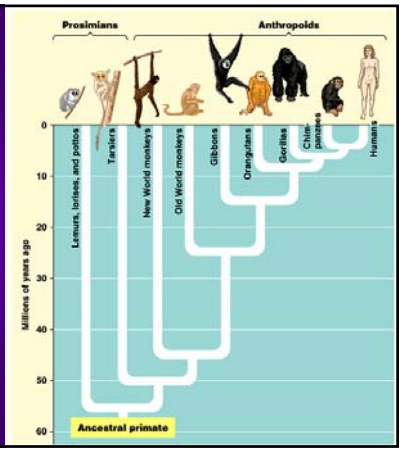
- Branched off from shrew-like mammals
- Flexible limbs and spine
- Hands and feet that grasp objects (opposable thumbs)
- Omnivorous diet
- Complex brain

- Primates are divided into two subgroups.
  - The Prosimii (**prosimians**), probably resemble early arboreal primates and include the lemurs of Madagascar and the lorises, pottos, and tarsiers of tropical Africa and southern Asia.
  - The Anthropoidea (**anthropoids**) include moneys, apes, and humans.



Loris

- The oldest known anthropoid fossils, from about 45 million years ago, support the hypothesis that tarsiers are the prosimians most closely related to anthropoids.



Prosimians and anthropoids

Two suborders of primates:

- **Prosimians (lemurs, lorises, etc.):**
  - **small, 1-14 lbs**
  - **generally nocturnal**
  - **highly developed sense of smell**
  - **ability to leap easily**
  - **descendants found in S.America, Africa, Madagascar**

Prosimians and anthropoids

Two suborders of primates:

- **Anthropoids (monkeys, apes, gorillas, chimpanzees, and humans):**
  - **different teeth structures**
  - **larger brain in proportion to body size**
  - **flat face; eyes closer together**
  - **long front and hind limbs**

Prosimians and anthropoids

Anthropoids exhibit behavioral differences relative to prosimians:

- **diurnal (active during day)**
- **have evolved color vision**
- **live in groups with complex social interaction**
- **care for their young for prolonged periods**

A capuchin, a New World monkey (left), and a vervet, an Old World monkey (right)

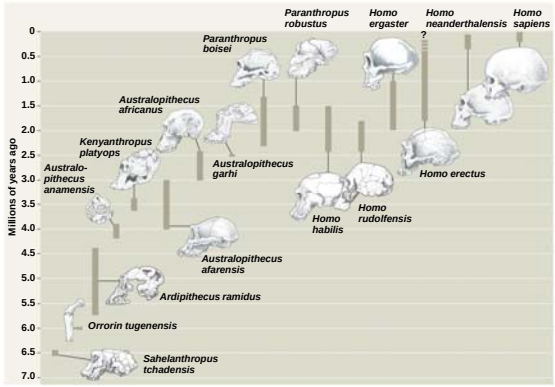
Apes: Gibbon (top left), orangutan (top right), gorilla (bottom left), chimpanzee (bottom right)

*The first **Hominins** (Hominids) :*
Sahelanthropus

Two critical steps in the evolution of humans:

- Bipedalism (walking upright on two legs): pre-adaptation developed in arboreal life
- Enlargement of brain relative to rest of body

Figure 34.45

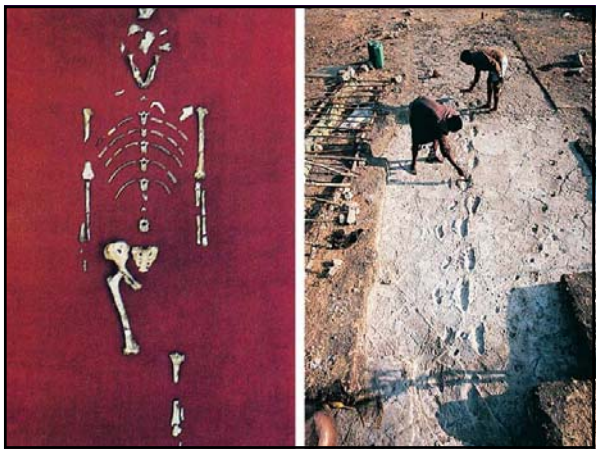


The Hominins

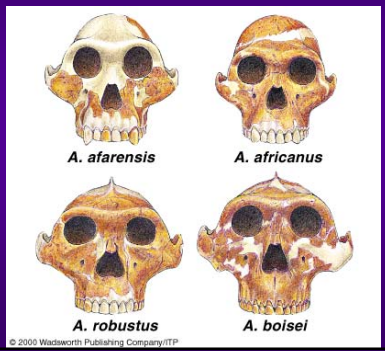
Hominins (formerly called hominids) are more closely related to humans than to chimpanzees

Scientists have discovered fossils of about 20 species of extinct hominins

- ***Australopithcans anamensis* and *A. afarensis* ("Lucy"), 3-4 mya in Africa; had apelike jaws, small brain but more human-like arm and leg bones; walked erect; lived on Savannah; ate plants**



The First Hominids
Skulls of Australopiths



- Misconception: Early hominins were chimpanzees
  - Correction: Hominins and chimpanzees shared a common ancestor
- Misconception: Human evolution is like a ladder leading directly to *Homo sapiens*
  - Correction: Hominin evolution included many branches or coexisting species, though only humans survive today

The first humans: Homo habilis

***Homo habilis* ("skillful human") existed 2.4-1.5 mya; fossils found in Olduvai Gorge**

- **Tree climber (from hand structure)**
- **Larger brains**
- **Walked erect, bipedal**
- **More diverse diet (teeth structure different from australopithecines)**
  - **Showed diets of**
    - **Nuts and seeds**
    - **Soft fruits and insects**
- **Used stone tools to prepare food, etc.**

Homo ergaster

- *Homo ergaster* was the first fully bipedal, large-brained hominid
- The species existed between 1.9 and 1.5 million years ago
- *Homo ergaster* shows a significant decrease in sexual dimorphism (a size difference between sexes) compared with its ancestors
- *Homo ergaster* fossils were previously assigned to *Homo erectus*

Human evolution continues: Homo erectus

Evidence of a human culture dependent on intelligence and communication:

- Walked fully upright; size of modern humans with bigger brains than *H. habilis*
- Hunter-gatherers
- Sophisticated tools and tool use; first evidence of fire use, 1.4 mya
- Use of language enhances survival
- It was the first hominin to leave Africa

Neanderthals

- Neanderthals, *Homo neanderthalensis*, lived in Europe and the Near East from 350,000 to 28,000 years ago
- They were thick-boned with a larger brain, they buried their dead, and they made hunting tools
- Recent genetic analysis indicates that gene flow occurred between Neanderthals and *Homo sapiens*

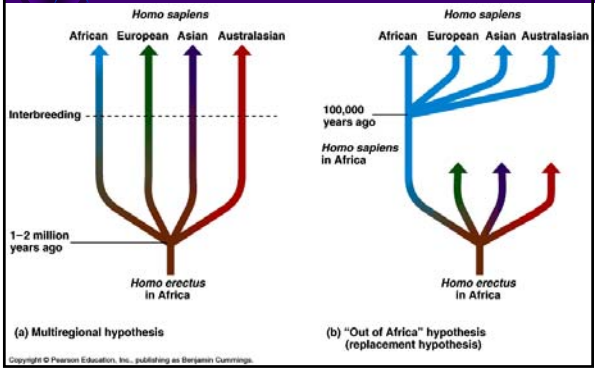
Recent humans: Homo sapiens

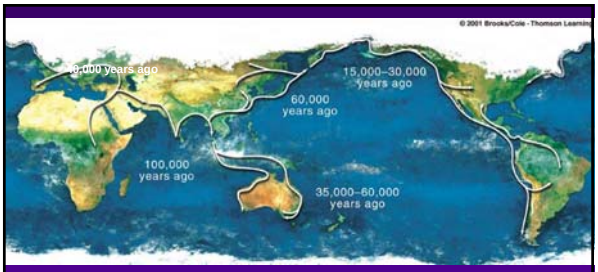
- *Homo sapiens* appeared in Africa by 195,000 years ago
- All living humans are descended from these African ancestors
- The oldest fossils of *Homo sapiens* outside Africa date back about 115,000 years and are from the Middle East
- Humans first arrived in the New World sometime before 15,000 years ago

Recent humans: Homo sapiens

- Probable evolution from *H. erectus*
- Cro-Magnon man (modern) exhibited culture, language, abstract thinking (art, ritual), social customs, farming/breeding animals, etc.
- Language (oral) 300,000 to 30,000years ago
- Agriculture ca 10,000 years ago
- Written language ca 7,000 years ago
- Cultural evolution thereafter

Two hypotheses for the origin of anatomically modern humans



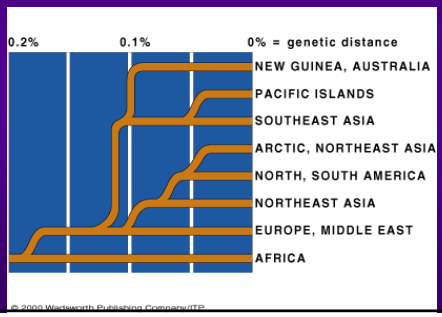


- So far, the genetic data have mostly supported the replacement hypothesis.
  - Using changes in mitochondrial DNA (mtDNA) among human populations as a molecular clock, research have reported a time of genetic divergence of about 100,000 years ago.
    - This is supported by nuclear genetic markers.
  - The mtDNA extracted from Neanderthal bones fall completely outside the range of mtDNA for modern Europeans.
    - These data suggest that Neanderthals contributed nothing to the ancestry of anatomically modern humans in Europe.

- To choose among these competing hypotheses, comparisons of Y chromosomes in 2001 provide perhaps the most important genetic data so far.
  - The Y chromosome is passed from male to male through the generations of a family with a minimum of crossing over with the X chromosome.
  - The diversity among Y chromosomes is limited to mutations.
  - By comparing the Y chromosomes of males from various geographic regions, researchers were able to infer divergence from a common African ancestor less than 100,000 years ago.

Family Tree for Population of Modern Humans

- Biochemical evidence



Hominin Species	Mean age (millions of years; x)	$x_i - \bar{x}$	Mean Brain Volume (cm^3; y)	$y_i - \bar{y}$	$(x_i - \bar{x})(y_i - \bar{y})$
Ardipithecus ramidus	−4.4		325		
Australopithecus afarensis	−3.4		375		
Homo habilis	−1.9		550		
Homo ergaster	−1.6		850		
Homo erectus	−1.2		1,000		
Homo heidelbergensis	−0.5		1,200		
Homo neanderthalensis	−0.1		1,400		
Homo sapiens	0.0		1,350		

In Conclusion

- *Primates include the prosimians, the tarsioids, and the anthropoids*
- *The first primates were small and rodentlike*
- *H. habilis, the earliest known species of the genus Homo, evolved by 2.5 million years ago*
- *Homo erectus* **and** *Homo sapiens* **displayed remarkable behavioral flexibility and creativity**
- *Modern humans are adapted to a wide range of environments*