

Chapter Outline

32.1 Evolution of Primates

A. Primate Characteristics

1. Primates differ from other mammals by being adapted for arboreal life (life in trees).
2. Mobile Forelimbs and Hindlimbs
 - a. In primates, the limbs are mobile and the hands and feet have five digits each.
 - b. In most primates, flat nails replace claws and sensitive pads develop on the underside of fingers and toes.
 - c. Many primate hands have to some extent an opposable thumb; some also have an opposable big toe.
 - d. These features allow the free grasping of tree limbs and easy harvesting of fruit.
3. Binocular Vision
 - a. Primates have a reduced snout and the face is relatively flat.
 - b. The sense of smell is generally reduced.
 - c. The eyes are moved to the front of the face for overlapping views that provide stereoscopic vision.
 - d. Cone cells provide greater visual acuity and color vision but require bright light.
4. Large Complex Brain
 - a. Better senses requires both sense organs and a more complex brain to process the input.
 - b. More of the brain becomes devoted to processing information received from the hands and thumb, less to smell.
5. Reduced Reproductive Rate
 - a. Primates have more single births, which reduces the need for care for several offspring.
 - b. The period of parental care is extended with an emphasis on learned behavior and complex social interactions.

B. Phylogenetic Tree

1. All primates at one time shared one common ancestor; prosimians were an early group to diverge and African apes were the last group to diverge from our lineage.
2. Prosimians diverged first and are most closely related to the original primate.
3. Anthropoids
 - a. Surviving **anthropoids** are classified into three superfamilies: New World monkeys, Old World monkeys and hominoids.
 - b. New World monkeys reside in South America and Old World monkeys evolved in Africa.
 - c. New World monkeys (e.g., spider monkey and capuchin) have long prehensile tails and flat noses.
 - d. Old World Monkeys (e.g., baboon and rhesus monkey) lack prehensile tails and have protruding noses.
 - e. It is hypothesized that a common ancestor must have arisen earlier than the Oligocene when a narrower Atlantic would have made dispersal possible.
4. Ape Evolution
 - a. During the Miocene epoch, dozens of hominoid species arose.
 - b. *Proconsul* was one of several ape species prevalent in Africa during the Miocene and is believed ancestral to apes and humans.
 - c. At the end of the Miocene epoch, Africa joined with Asia, and the hominoids migrated into Europe.
 - d. At the end of the Miocene, the Africarabia region joined Asia and apes migrated into Europe and Asia.

- e. The two ancestral groups included dryomorphs and the ramamorphs that were ancestral to orangutans.
- f. *Dryopithecus* was a tree-dweller that moved similar to orangutans but did not walk along tree limbs as did *Proconsul*.

32.2 Evolution of Hominids

A. Human and Ape Lineage

1. Humans are most closely related to African apes.
2. Fossil and anatomical data indicate ancestors of African apes and the human lineage diverged about 7 million years ago during the early Pliocene epoch.
3. When such changes accumulate at a constant rate, it constitutes a molecular clock to indicate relatedness; these data indicate we diverged about 6 million years ago.

B. Hominids

1. Humans and their closest extinct relatives are hominids.
2. Hominids differ from modern apes such as the gorilla.
 - a. The longer curved spine places the center of gravity over the feet.
 - b. The broader pelvis and hip joints prevent swaying when we walk.
 - c. A longer neck on the femur in humans causes the femur to angle inward at the knees.
 - d. The human knee joint is modified to support the body's weight.
 - e. The human toe is not opposable but the foot has an arch for long distance walking.
3. Until recently, science thought that the climate changed forests into savannas; there is little evidence of a shift in vegetation at 6 MYA.
4. While still living in trees, the first hominids may have walked upright to collect overhead fruit.
5. Additional advantages of bipedalism include reduction of heat stroke and carrying food back to females.

C. Early Hominids

1. *Australopithecus ramidus kadabba* is an Ethiopian discovery dated at 5.8–5.2 MYA.
2. It is similar to *Australopithecus ramidus ramidus* based on bone fragments dated at 4.4 MYA.
3. Both are chimp-sized creatures that could stand erect.
4. However, they have a number of characteristics that are more apelike than humanlike.

D. Australopithecines

1. **Australopithecines** belong to the genus *Australopithecus* and diversified in Africa 4 MYA.
2. Expanding fossil record shows it is not an orderly sequence between forms.
3. Australopithecines evolved and diversified in Africa with gracile and robust forms with varied diets.

E. Southern Africa

1. *Australopithecus africanus* described by Raymond Dart in the 1920s is a gracile type from southern Africa.
2. Abundant fossils of *A. africanus* date about 2.8 MYA.
3. *Australopithecus robustus* was a robust type, it had a brain size of 500 cc similar to *A. africanus* and dated from 2 to 1.5 MYA.
4. Both had forelimbs longer than hindlimbs but probably walked upright.
5. *A. africanus* had a larger brain and is the best candidate as ancestor to early *Homo*.

C. Eastern Africa

1. *Australopithecus afarensis* is based on many skeletal fragments (Lucy) dated at 3.18 MYA.
 - a. Its brain was small at 400 cc.
 - b. This may have been ancestral to the robust types, *A. aethiopicus* and *A. boisei* that later died out.
 - c. They may be the species that left the Laetoli footprints in volcanic ash about 3.7 MYA.
 - d. This species is thought to have stood upright and walked bipedally.
 - e. Because the australopithecines were apelike above the waist (small brain) and humanlike below the waist (walked upright), this uneven evolution of traits is referred to as **mosaic evolution**.
2. It is possible that *Australopithecus afarensis* is ancestral to early *Homo*.

D. Evolution of Early *Homo*

1. Fossils are assigned to the genus *Homo* based on the following traits:
 - a. brain size 600 cc or greater;
 - b. jaw and teeth are human-like; and
 - c. tool use seems evident.

2. *Homo habilis*
 - a. The oldest fossils to be classified in the genus *Homo* are known as ***Homo habilis*** dated between 2.0 and 1.9 MYA.
 - b. *H. habilis* warrants classification as a *Homo* because of a brain size as large as 775 cc and smaller cheek teeth.
 - c. Cut marks on bones suggest the use of tools to prepare meat and possible scavenging.
 - d. Tools associated with *H. habilis* include flakes used to scrape away hide or remove meat.
 - e. The skulls indicate that this hominid may have had speech to help in cooperation and sharing.
 - f. Culture is dependent on the ability to speak and transmit knowledge.
3. *Homo erectus*
 - a. Eugene DuBois, a Dutch anatomist, unearthed the first *H. erectus* bones in Java in 1891.
 - b. Fossils found in Africa, Asia, and Europe date between 1.9 and 0.3 million years ago.
 - c. The African and Asian types may be different species.
 - d. *H. erectus* had a brain capacity of 1000 cc, was taller than *H. habilis*, and had a striding gait.
 - e. *H. erectus* fossils found in Java and the Republic of Georgia at 1.9 MYA and 1.6 MYA indicates an early migration from Africa, followed by *H. erectus* evolving in Asia and spreading to other areas.
 - f. These are the first hominids to use fire, to be systematic game hunters, and possibly to use home bases.

32.3 Evolution of Humans

A. Evolution of Modern Humans

1. Two contradicting hypotheses are suggested about the origin of modern humans.
2. The **multiregional continuity hypothesis** proposes that modern humans originated separately in Asia, Europe, and Africa.
 - a. If valid, then a distinctive continuity in anatomy and genetic variation is expected in each location.
 - b. Evolution of modern humans would be essentially similar in several different places.
3. The **out-of-Africa hypothesis** states that modern humans originated only in Africa and after migrating into Europe and Asia, they replaced the archaic *Homo* species found there.
 - a. All extant humans are descended from a few individuals from about 100,000 years ago.
 - b. Mitochondrial DNA analyses indicate a close genetic relationship among all Europeans; although the first analysis was flawed, the data tend to support the out-of-Africa hypothesis.

B. Neanderthals

1. Neanderthals were named for Neander Valley where skeletons were dated as early as 200,000 years ago.
2. Neanderthals are classified as *Homo neanderthalensis*.
3. Classic Neanderthal anatomy includes massive brow ridges; a nose, jaws, and teeth that protruded forward; a low sloping forehead; a lower jaw sloping back without a chin; a longer pubic bone; a slightly larger brain than that of modern humans; shorter and thicker limb bones; and heavier muscles in shoulder and neck.
4. It is speculated that a larger brain than that of modern humans was required to control the extra musculature.
5. The sturdy build of Neanderthals was likely adaptation to cold climate; they lived in Eurasia during last Ice Age.
6. The Neanderthals give evidence of being culturally advanced.
 - a. Most lived in caves, but those who lived in the open may have built houses.
 - b. They manufactured a variety of stone tools, including spear points, scrapers, and knives.
 - c. They used and could control fire, which probably helped in cooking frozen meat and in keeping warm.
 - d. They buried their dead with flowers and tools and may have had a religion.

C. Cro-Magnons

1. **Cro-Magnons** are modern humans (*H. sapiens sapiens*) found in Eurasia 100,000 years ago.
2. Cro-Magnons are named for a fossil location in France and had a thoroughly modern appearance.
3. They had advanced stone tools and may have been the first to throw spears.
4. Cro-Magnons hunted cooperatively, and perhaps were the first to have had a language.
5. Cro-Magnons may have been responsible for extinction of large mammals during the late Pleistocene.
6. Cro-Magnon culture included figurines carved out of bone and antler, and cave paintings.

D. Human Variation

1. Some human variation evolved as adaptation to local environmental conditions: darker skin to protect from UV light, lighter skin for vitamin D production, etc.
2. A bulkier body also benefits in colder regions while hot climates favor a slight build and longer limbs.
3. Hair texture, eyelid fold, and other traits are not explained as adaptations.
4. Variation among modern populations is considerably less than among archaic human populations of 250,000 years ago.
5. Comparative studies of mtDNA indicate that human populations had a common ancestor no more than a million years ago.
6. The great majority of genetic variation, about 85%, occurs within ethnic groups, not among them.