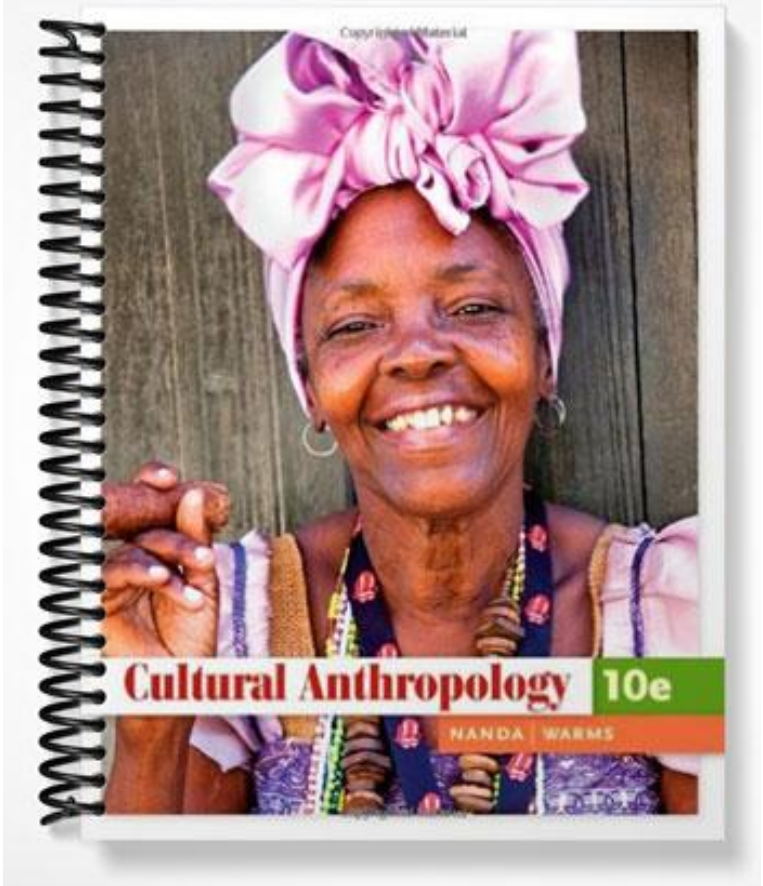
SOLUTIONS MANUAL



Chapter 2
Human Evolution

Chapter Outline

I. **Evolution** is directional change and is the primary way that we understand the biological history of humankind.
   A. The processes of evolution shaped humans' brains and bodies.
   B. It has also shaped our capacity for culture.

II. Charles Darwin's theory of natural selection proved the most convincing scientific explanation of the variety and history of life on earth.
   A. **Natural selection**—the mechanism of evolutionary change; changes in traits of living organisms that occur over time as a result of differences in reproductive success among individuals.
   B. Darwin's evidence and assumptions:
      1. Observed that no two living things, even those of the same species, are quite alike. Sources of variation:
         a) **Mutation**—a random change in genetic material; the ultimate source of biological variation.
         b) **Gene flow**—sexual reproduction and the movement of individuals and groups from place to place result in the mixing of genetic material.
         c) **Genetic drift**—changes in the frequencies of specific traits caused by random factors.
      2. Observed that most creatures, human and nonhuman, did not survive long enough to have offspring.
         a) Organisms fell victim to predators, contracted diseases, or perished through some defect in their biological makeup.
         b) Before the development of sanitation in the 19th century and antibiotics in the 20th, the vast number of human children also died young.
         c) In the world's poor nations, large numbers of children die before they reach the age of five.
   C. Darwin was profoundly affected by the philosophical works of Adam Smith and Thomas Malthus who both emphasized the role of competition in human social life.
      1. In the 1770s, Smith argued that competition among firms increased their productivity and led to social betterment.
      2. A quarter of a century later, Malthus wrote that, because human population levels rose much faster than agricultural production, struggles over resources were inevitable.
      3. Darwin, synthesizing these two positions, argued that creatures with traits that suited them well to their environment tended to win the struggle for nutrition and reproduction.
   D. Darwin further argued that those who won this struggle for survival were able, in some way, to pass some of the traits that led to their success to their offspring.
      1. Darwin reasoned that, over the course of millions of years, this process could give rise to new species and all of the tremendous variation of the natural world.

2. Darwin's theory is sometimes referred to as "survival of the fittest," but this phrase was coined by the social theorist Herbert Spencer, not by Darwin himself.
3. Strength and intelligence do not necessarily guarantee reproductive success, and are not important for all creatures and environments (such as the South American tree sloth).

III. Virtually all of the debate about evolution is religious and political rather than scientific.
   A. Evolution challenges a literal reading of religious stories. However:
      1. Many theologians agree that evolution is consistent with the teachings of their traditions.
      2. In 1950, the Catholic Church declared that evolution was compatible with Christian teachings.
   B. Today, there is no meaningful scientific challenge to evolution. Still:
      1. Scholars argue about the speed of evolution and the precise conditions under which it occurs.
      2. There is much discussion about the historic relationships of plants and animals and how they should be classified.
      3. Scientists may debate the appropriate evolutionary place of specific fossil human ancestors.

IV. Modern-day humans, gorillas, and chimpanzees evolved from a common primate ancestor.
   A. All animals are all equally evolved.
   B. Biological anthropologists use the fossil record, DNA studies, and immunology to try and determine the common ancestry of humans and other primate species.
      1. Creatures that became humans and apes split from those that gave rise to the monkeys of Europe, Asia, and Africa about 20-25 million years ago.
      2. Humans and the great apes (orangutans, gorillas, and chimpanzees) share a common ancestor that existed around 13 million years ago.
      3. Human ancestors diverged from the ancestors of chimpanzees around seven million years ago.
   C. Primates shared an **arboreal**—tree-dwelling—ancestry. Commonalities include:
      1. Grasping hands and feet for climbing.
      2. Hands and feet with fully opposable thumbs.
      3. Acute eyesight, color vision, and accurate depth perception.
      4. Reliance on hand-eye coordination that developed along with the expansion of the areas of the brain involved in vision, motor skills, and the integration of the two.
      5. A reduced sense of smell compared to most other mammals.
   D. Primates, particularly apes and humans, have larger brains relative to their body weight than do other animals, thus impacting their behavior.
      1. Almost all primates live in social groups.
         a) Gorillas live in groups consisting of a single adult male and numerous adult females and their offspring.

b) Chimpanzees live in groups that include several adult males and several adult females and their offspring.
c) Gibbons as well as several species of monkey live in monogamous pairs.
d) Several species of monkeys from Central and South America live in groupings with one female and two males.

2. The core of primate societies is the bond between mothers and their infant offspring.
   a) Another adult female (usually a relative) often will adopt an infant if the mother dies.
   b) Young primates learn initially by imitating the mother's actions when finding food and water and learning which animals are dangerous and which can be approached safely.
3. As primates grow older, play becomes central to their interaction with their age-mates. Through play, primates:
   a) Refine their physical skills, explore their world, and practice solving problems.
   b) Are motivated to learn because much learning, like play, is highly pleasurable for them.
4. In most primate societies, both males and females develop dominance hierarchies: that is, they are ranked as superior or inferior to one another.
   a) Overall, hierarchies serve to limit the amount of aggression within societies; once the hierarchy is established, lower-ranking individuals are less likely to challenge those with more status than might otherwise be the case.
   b) The critical benefit of high rank is greater access to food, sex, and other resources.
   c) There is evidence that high-ranking individuals reproduce more frequently than those of low rank, however this is controversial.
   d) Rankings are not absolutely fixed and are context-specific.
5. In addition to displays of aggression, primates have many means of reconciliation.
   a) Grooming is common among members of the same sex as well as members of different sexes.
   b) Among chimpanzees, baboons, and others, friends may hug, pat each other, or hold hands.
   c) Lip smacking and male-male mounting behaviors are used to establish, reestablish, or to maintain friendly relations between individuals and cohesion within the group.

E. Non-human primates also use tools, but in ways that seem different both from the behavior of animals such as sea otters and humans.
1. There is a wide variety of complex actions requiring foresight and planning.
   a) The use of sticks and branches by monkeys to threaten others or defend themselves when they are threatened.

b) Food washing—the use of water to separate grains of wheat from sand, and playing with rocks—by some Japanese macaques.
c) **Termite fishing**—the learned use of twigs or blades of grass to extract termites from their mounds—by some groups of chimpanzees.
d) Making leaf sponges—by taking leaves, chewing them, and then using the resulting wad of material to soak up water from tree hollows—by chimpanzees.
e) Using hammer stones to break nuts.

2. Such practices are learned behaviors passed along as part of the knowledge of the social group, very much like human culture.
   a) Some groups of chimpanzees do some activities and others do not.
   b) Among all primates who use tools, it is the female who first develops tool-using skills and generally becomes more adept at tool use.

V. The Evolution of Humans:

A. Early ancestors were relatively few in number and geographically confined to Africa. They:
   1. Did not depend heavily on tools, and their cultures left few material remains.
   2. Spread from our African origins to inhabit most of the globe.
      a) This means humans have adapted to living in many different climates and ecosystems.
      b) Humans and their ancestors adapted to the different demands of their environments by finding new foods, making new tools, developing clothing, and controlling fire.

B. All human ancestors, as well as current-day humans, are members of the biological family *Hominidae*.
   1. Within this family, ancestors are known by the names of their:
      a) **Genus**—a group of similar species.
      b) **Species**—a group of organisms whose members are similar to one another and are able to reproduce with one another but not with members of other species.
   2. Human ancestors and modern-day people fall into two genera: *Australopithecus* and *Homo*.

C. Reconstructions of the evolutionary history of humans is based on fossil evidence:
   1. Fossilization of any kind is a rare event.
   2. Finding fossils requires luck, skill, and the use of scientific methodology.
   3. Excavation of a fossil is highly controlled and requires precision and mapping.
   4. Different dating techniques are used to analyze fossils:
      a) Potassium/argon dating (K/A).
      b) Carbon 14 dating (C14).
      c) Thermoluminescence.
      d) Paleomagnetic dating.

5. Date ranges of fossils always involve a margin of error.

D. There are unique human attributes:
   1. **Bipedalism**—walking on two feet, a distinctive characteristic of humans and their ancestors which played a critical role in human development.
      a) Only humans have a habitual stance on two feet.
      b) This form of locomotion involves substantial anatomical changes.
      c) Freed the hands, allowing human ancestors to carry things for long distances and make tools.
      d) Provided a wider view of their surroundings and can walk efficiently for long distances.
   2. In addition to bipedalism, particular aspects of tooth number, size, shape, and enamel are critical in tracing human ancestry.
   3. Sahelanthropus Tchadensis (Toumai) is:
      a) The earliest evidence currently available for a creature considered ancestral to humans.
      b) Dated between six and seven million years old.
      c) Found in Chad, 1,500 miles west of where almost all other extremely ancient human ancestor fossils have been found.
   4. The earliest substantial evidence for human ancestors is the *Ardipithecus ramidus* in northeastern Ethiopia.
      a) Tim White discovered the remains of more than 40 individuals who lived approximately 4.4 million years ago.
      b) These ancestors had large-shaped jaws, small brains, and teeth similar to those of modern-day chimpanzees.
      c) Evidence from their pelvic bones, skulls, and forelimbs indicates that they were bipedal.
      d) Reconstructions of the environment they lived in show a flat plain covered with open woodland and dense forests, reinforcing the notion that bipedalism first evolved in wooded areas rather than on grassy plains.

E. **Australopithecines**—members of an early hominid genus found in Africa and characterized by bipedal locomotion and small brain size.
   1. Beginning with Raymond Dart's discovery of "Taung Child" in 1924, more than 10,000 individual australopithecine fossil bones have been found, comprising several hundred individuals.
      a) The earliest australopithecine fossils are from northern Kenya and are between 4.2 and 3.9 million years old.
      b) The most recent, from South Africa, are about one million years old.
      c) Though australopithecines are found only in Africa, they were a diverse and complex group of creatures that persisted for a very long stretch of time.
   2. In 1974, at Hadar in Ethiopia, a team led by Donald Johanson found an australopithecine skeleton. "Lucy":
      a) Is unusually complete; more than 40 percent of the bones are present.

b) Allowed anthropologists to answer definitively many questions about the way australopithecines looked, stood, and moved.

3. Mary Leakey, working at Laetoli in Tanzania, found a well-preserved bed of volcanic ash that was deposited about 3.5 million years ago.
   a) One trail was from two individuals who were probably walking together.
   b) Another trail was from three individuals.
4. Traits of the "gracile" australopithecines include:
   a) Heights between 3.5 and 5 feet tall and weighing between 65 and 100 pounds.
   b) Relatively small brains compared to modern humans;
   c) Protruding faces with relatively large and slightly overlapping canine teeth.
   d) Bipedalism with hips and lower limbs a bit different from modern people.
   e) The ability to live in a variety of arid and semiarid environments in eastern and southern Africa.
   f) That they were **omnivores**—animals that eat both plant and animal foods—as suggested by the size and shape of their teeth.
   g) A diet of fruits and vegetables, insects, and small animals, and they perhaps scavenged remains left by larger predators because of a lack of stone tools, relatively small size and lack of claws or very large canine teeth.
   h) That they were social animals living in small groups since the remains of numerous individuals were commonly found together.
5. About 2.5 million years ago, the "robust" australopithecines or *Paranthropus*, tended to be slightly larger than the "graciles," but the ranges for both height and weight clearly overlap.
   a) The presence of heavier skulls, reinforced with bony ridges, with substantially larger teeth and jaws, strongly suggests that these creatures were adapted for chewing heavy, coarse material, and were vegetarian.
   b) "Robust" australopithecines lived in Africa until about 1 million years ago and do not seem to be ancestral to modern humans.

F. ***Homo habilis***—a species of early human found in Africa present between 2.5 and 1.8 million years ago.
1. Emerged between 2.3 and 2.5 million years ago and was quite similar to *Homo rudolfensis*.
2. Several features distinguish *Homo habilis* from the australopithecines:
   a) Brains were quite large compared to the size of their bodies.
   b) Teeth were smaller than australopithecine teeth.
   c) Skulls were higher and their faces protruded less.

d) Legs tended to be longer whereas arms tended to be shorter.

3. In the course of evolution, human ancestors developed both the fine motor and the mental skills to make and use tools.
   a) *Habilis* were making fairly sophisticated sets of tools as early as 2.3 million years ago.
   b) By using tools, human ancestors could match the biting and chewing abilities of much larger, more powerful animals.
   c) With far fewer trees than were available to the earlier "gracile" australopithecines, human ancestors omnivorous diet allowed *habilis* to compete with members of other species for plant and animal foods.
   d) Oldowan tools are designed for cutting and bashing rather than hunting, strongly suggesting that *habilis* rarely killed large animals.
   e) Stone rings found at Olduvai indicate that *habilis* probably built shelters for protection from predators and cold weather.
4. The earliest remains of *habilis* are from east and southern Africa but it is possible they spread to other areas.

G. ***Homo erectus***—a species of early human found in Africa, Asia, and Europe. *Homo erectus* were present between 1.8 million and about 300,000 years ago, (however, *Homo floresiensis* may be a small version of *erectus* that existed 13,000 years ago).

1. Their features may have been roughly the same size as modern-day people.
   a) The 1.6-million-year-old skeleton of a 12-year-old erectus boy was found in the mid-1980s, at Lake Turkana in Kenya.
   b) *Homo erectus* brain size increased along with body size based on the first *erectus* fossils found by Eugene Dubois in the 1890s.
   c) The *erectus* skull is larger and heavier than *habilis* with a heavy ridge of bone above the eyes and a thick cranial bone.
   d) For modern humans, the maximum width of the skull is above the ears, but in *erectus* the skull's widest point is below them.
2. In order to thrive in the varying habitats of the Ice Age, *erectus* developed an increasingly sophisticated and complex culture.
   a) Zhoukoudian was inhabited between about 450,000 and 230,000 years ago. Its inhabitants made choppers, scrapers, points, and awls from stone.
   b) Most anthropologists agree that *erectus* was capable of controlling and using fire; however, it is not known if they were able to make it.
   c) *Homo erectus* almost certainly lived by hunting, scavenging, and gathering.

d) Although no animal skin clothing has survived, there is some evidence of needles among the bone tools found at Zhoukoudian.

e) The fact that they killed large animals suggests that social groups were relatively large and probably included complex mechanisms for distributing food, and perhaps other goods.

f) The brains of some Zhoukoudian individuals were removed after their death, but why this was done is unknown.

H. ***Homo sapiens***—a species of human found throughout the world. The earliest *Homo sapiens* appeared about 500,000 years ago.

1. On average, *Homo sapiens* have substantially larger brains than *erectus*. Modifications to the skeleton include:
   a) A lack of the heavy bony ridging above the eyes and the thick skull bone of the *erectus*.
   b) A high and vaulted skull with a large forehead.
   c) Lighter bones, which were favored as the human ability to learn increased and weaponry improved, and animals could be hunted from a greater distance.
2. ***Neanderthals***—members of a population of archaic *Homo sapiens* that lived between 130,000 and 35,000 years ago.
   a) Bones from locations throughout the Old World attest to ancestors who had lighter-boned, more rounded skulls than *erectus*, however these fossils still show the bony ridging above the eyes typical of *erectus*.
   b) Brain sizes, sometimes larger than those of modern people, appeared in Europe and in some parts of the Middle East.
   c) Appeared in Europe at about the same time as anatomically modern people *Homo sapiens sapiens.*
   d) The number and complexity of their tools pale in comparison to tools made by *Homo sapiens sapiens*.
3. By about 35,000 years ago, *Homo sapiens sapiens* had spread throughout the range of all other *Homo* and was the only form present. Various theories explain their origin:
   a) **Multiregional model**—a theory that seeks to explain the transition from *Homo erectus* to *Homo sapiens* by arguing that different populations of *Homo sapiens* are descended from different populations of *Homo erectus* (this model is consistent with the fossil record and seems to explain some of the anatomical differences among modern human populations).
   b) **Replacement model**—the theory that modern people evolved first in Africa and then spread out to inhabit virtually all the world, out competing or destroying other human populations in the process. Sometimes called the "Out of Africa" model and is based on molecular and genetic data (this model is based on mitochondrial and Neanderthal DNA evidence).

c) **Hybridization model**—a theory that seeks to explain the transition from archaic to modern *Homo sapiens* by proposing that modern and archaic forms interbred.

VI. *Homo sapiens* culture

A. Even archaic forms, such as the *Neanderthal,* were clearly cultural.

1. Several examples of burial of the dead by *Neanderthals* have been found:

a) The remains of nine individuals, four of which were intentionally buried, were found at Shanidar Cave in Iraq (these remains are between 45,000 and 60,000 years old).

b) High concentrations of pollen in the graves show that the bodies were buried with flowers, suggesting that *Neanderthals* had complex, symbolic rituals and a belief in the afterlife.

2. A severely injured Shanidar individual nevertheless survived this condition for many years, strongly suggesting that *Neanderthals* cared for and supported this individual.

3. New evidence from Moula-Guercy cave in France shows that some *Neanderthals* practiced cannibalism.

B. *Homo sapiens sapiens* made tools of much greater sophistication and efficiency than any prior species. These include:

1. **Atlatl**—a spear thrower; a device used to increase and extend the power of the human arm when throwing a spear.

2. Stone blades, scrapers, chisel-like tools called burins, as well as tools of bone, awls, needles, and tools for scraping and smoothing leather.

a) In addition to utility, many of these tools show clear aesthetic qualities.

b) Although many of the best-known early tools come from Europe, some of the earliest examples come from Africa between 180,000 and 75,000 years old.

c) Shortly after modern people appeared, more than 50 genera of large mammals became extinct and it is possible that hunting by humans was responsible for these extinctions.

C. In addition to tools, early people left many symbolic and artistic remains and domesticated plants and animals.

1. **“Venus” figurines**—small stylized statues of females made in a variety of materials by early modern humans between 30,000 and 20,000 years ago.

a) About 40 intact figures have been discovered along with fragments of at least 80 more.

b) Many depict women with exaggerated breasts and buttocks.

c) They have been variously interpreted as art for art’s sake, fertility magic, representations of female deities, erotic images made for male pleasure, and ordinary women’s views of their own bodies.

2. Cave paintings are perhaps the most spectacular of the cultural remains left by early *Homo sapiens sapiens.*
3. About 10,000 years ago, some people turned increasingly to the domestication of both plants and animals.
    a) Dogs were domesticated between 14,000 and 10,000 years ago.
    b) People in the Middle East were beginning to use rye by about 13,000 years ago but did not become dependent on farming until about 10,000 years ago.
    c) The move from hunting herd animals to domesticating plants and animals involved substantial increases in the amount of work humans had to do.
    d) It led to an increase in disease, physiological stress, a reduction in well-being, and a decline in nutrition.
    e) With this subsistence shift, larger populations could be supported.

VII. Human variation

A. Many human traits show **clinal distributions**—the frequency change of a particular trait as you move geographically from one point to another.
1. The frequency of blood type varies geographically.
    a) In far northeastern Europe and northern Russia, between 25 and 30 percent of the population have type B blood.
    b) In Spain, in the far southwest, only between 10 and 15 percent of the population have type B blood.
2. The sickle-cell gene is common in areas that have a high incidence of malaria, particularly certain regions of West Africa, India, and the Middle East.
    a) Inheriting the gene from a single parent confers a degree of immunity to malaria; inheriting it from both produces sickle- cell anemia.
    b) In some areas where malaria is particularly prevalent, as much as 20 percent of the population may have the trait.
3. Skin color in humans, and in many other mammals, follows a clinal distribution.
    a) The darkest colors are found in bright, tropical regions, and the lightest colors in far northern or southern areas where there is much less sunlight.
    b) As one travels, for example, from equatorial Africa to northern Europe, skin color becomes progressively lighter.
    c) The primary factor in all colors of skin is **melanin**—a pigment found in the skin, hair, and eyes of human beings, as well as many other species, and responsible for variations in color.
4. The relationship between melanin, ultraviolet light, and skin cancer:
    a) Melanin in skin absorbs ultraviolet rays and hence protects people from skin cancer.
    b) Skin cancer rates are highest in Australia, a largely tropical nation colonized by northern light-skinned Europeans.

B. Human ancestors evolved in bright, tropical East Africa and probably had very dark skin.
   1. In northern latitudes, light skin color must confer some reproductive advantage.
      a) Children with insufficient exposure to sunlight do not produce enough vitamin D. This insufficiency results in **rickets**—a childhood disease characterized by softening and bending of leg and pelvis bones.
      b) Melanin in skin protects from skin cancer by absorbing ultraviolet light, however, in doing that it also reduces the amount of ultraviolet light available to interact with the cells that are critical in the manufacture of vitamin D.
      c) Dark skin color may also be more prone to frostbite however the biological mechanisms in this relationship are unknown.
   2. Skin color has no biological connection with any particular cultural traits.

Learning Objectives

The chapter covers the evolution of human beings from about four million years ago to present. It explains how an evolutionary perspective provides insights into how we came to be culturally-dependent animals. After reading Chapter 2, students should be able to:

1. Understand Darwin's theory **of evolution by natural selection**.

2. State the **characteristics** humans have in common with our nearest nonhuman relations.

3. Enumerate how **modern-day humans** differ from earlier ancestors.

4. **Distinguish** *Australopithecines*, *Homo habilis*, and *Homo erectus*.

5. Understand **clinal distribution** and the existence of **human variation** among modern-day populations.

Key Terms

These are the anthropological terms introduced in Chapter 2. Students can write definitions of these terms during class or while studying to see how well they understood the reading.

arboreal 27
atlatl 40
australopithecines 32
bipedalism 31
clinal distribution 41
evolution 23
gene flow 24

genetic drift 24
genus 30
Homo sapiens 37
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Homo erectus 36
hybridization model 38
melanin 41
multiregional model 38
mutation 24
natural selection 24
Neanderthal 38
Oldowan tools 33
omnivore 33
parallax 27
primates 27
replacement model 38
rickets 43
sexual selection 44
species 30
termite fishing 29
"Venus" figurines 40

Lecture Suggestions

- As a way of introducing natural selection and the discussion of biological evolution, ask students to do a short research assignment on how different religious institutions and traditions address human evolution scientifically and theologically.
- Ask students to make a chart of human evolution, stating major discoveries, geographical location, and cultural and physical characteristics for each of the hominid species. Identify the "trends and tendencies" manifested across the various human species.
- Trace the development of one of the more recent human diseases, such as H1N1 or AIDS, from animals to humans and discuss the role of mutation in evolution of all species.
- Using film clips, photos, or even first-hand observations at zoos or preserves, work with students to identify common characteristics that are shared between primates, human and non-human.

Film Suggestions

The Story of Hominid Evolution. 1997. Two parts, 47 minutes each. A two-part series distributed by Films for the Humanities and Sciences. Part One: The History of the Anthropoid: The Search for the beginning. Friedemann Schrenk and Meave Leakey examine fossil specimens recovered at Lake Turkana, Lothagam, and Kanapoi. They examine the relationships between *Australopithecus afarensis*, *A. boisei*, and *Homo habilus*. Part Two: Origins of *Homo Sapiens*: East African Roots. Shrenk travels to Makapansgat caves and many other locations to explore hominid remains.

Kennewick Man: An Epic Drama of the West. 2002. 86 minutes. A film by Kyle Carver and Ryan Purcell. Discusses the discovery in 1996 of the Kennewick Man in Kennewick, Washington, dated at more than 9,000 years. The original discovery was by two college students who stumbled upon the remains. The ensuing controversy is one of science and religion. The film follows the history and controversy behind this skeleton, highlighting issues of science and religion, archaeology, human evolution, repatriation, cultural heritage, and Native Americans in the United States today.

The Trail of the Mummy. 2007. 52 minutes. Produced by AVRO in co-production with ZDF/Arte and RNTV. The Egyptian mummy Anchhor, more than 2,500 years old, is one of the few fully intact mummies ever discovered. In this film, using excavated objects, location filming, interviews, and 3-D animation techniques, the life and mummification of Anchhor are traced step-by-step allowing viewers to see this intriguing process of preservation.

InfoTrac College Edition Exercises

Students will need to access the *Info Trac College Edition* to answer the following questions.

1. Go to the search field and type in "Chimps to People: Apes Show Contrasts in Genetic Makeup." Read the selection and answer the following:
   a. Describe the evolutionary relationships between chimpanzees and humans.
   b. Explain how a chimpanzee's genes differ from a human's.

2. Return to the search field and type in "A New Human Ancestor." Read the selection and answer the following:
   a. Describe the evolutionary relationship between *Australopithecus garhi* and humans.
   b. Describe the similarities among australopithecine species and the great apes.

Internet Sites/Exercises

1. The National Center for Science Education (NCSE) was founded in 1981 to preserve the integrity of science education and remains the only organization that specialized in keeping evolution in the science classroom and scientific creationism out of the classroom. Access its site at **http://www.natcenscied.org.**
   a. Use the search function on the homepage to read about "Project Steve." What is it? Why is it called "Project Steve?"
   b. Discuss the Creation/Evolution controversy from 1859 to the present.

2. The American Museum of Natural History offers online tours through the evolution of vertebrates. Access its site at **http://www.amnh.org/exhibitions/permanent/fossilhalls/virtualtours** and answer the following questions:
   a. How are "primitive" mammals similar to "advanced" mammals?
   b. Describe the similarities among various dinosaur species and mammalian species.