

**LIFE ON EARTH
UNIT SIX
SUMMARY**

UNIT SIX MATERIAL

The videotapes to watch for this unit are:

Video Program 12 - A LIFE IN THE TREES

Video Program 13 - THE COMPULSIVE COMMUNICATORS

Read the CONCEPTS in the study guide:

CONCEPTS FOR EPISODE 12

CONCEPTS FOR EPISODE 13

Answer the QUESTIONS in the study guide:

QUESTIONS FOR EPISODE 12

QUESTIONS FOR EPISODE 13

OVERVIEW OF LEARNING OBJECTIVES

Video Episode 12

To become acquainted with:

1. adaptations to life in the trees
2. the various groups of primates and their characteristics
3. the forms of communication found in the primates
4. social behavior of the primates
5. lemurs, tarsiers, monkeys, orangutans, gibbons, gorillas & chimpanzees

Video Episode 13

To become acquainted with:

1. the evolutionary history of man
2. *Australopithecus*, *Homo erectus*, *Homo habilis* and *Homo sapiens*
3. role of bipedalism, tools, language in the evolution of man
4. study of primitive cultures today as a means to study the possible past
5. culture, agriculture, society in human culture

CONCEPTS FOR EPISODE 12: A LIFE IN THE TREES

PRIMATES

The primates are mammals that are adapted for tree-dwelling lifestyles. They typically have large brains, large eyes, binocular vision and grasping hands. Primates include lemurs, lorises and tarsiers, monkeys, great apes and humans.

The earliest primates first appeared about 55 million years ago. Two distinct characteristics evolved in the primates. First, the primates developed **grasping hands and/or feet with opposable thumbs**. Look at your hand. The thumb is at a different angle from the other fingers. You can touch the pad of your thumb to the pads of the other fingers, which allows you to hold and manipulate an object or tool. This is a distinct advantage for any mammal that lives in trees. Secondly, **binocular vision** evolved as the primate eyes were shifted to the front of the face. This allows the visual fields from both eyes to overlap, thus allowing three-dimensional vision and better depth perception. **[Note: Be aware that other mammals have binocular vision; other mammals have grasping hands. ONLY primates have binocular vision and grasping hands/feet with opposable thumbs.]**

The first primates are often called "**prosimians**" or "before monkeys". Only a few prosimians survive today -- lemurs, tarsiers and lorises. Most (but not all) of the prosimians are found on the island of Madagascar; all of the **lemur** species are found there. A grave area of concern is the rapid destruction of the tropical rain forest habitat in Madagascar; its destruction will mean extinction for the lemurs.

About 40 million years ago, primates switched from a nocturnal lifestyle (night life) to a diurnal lifestyle (active during the day). These new primates evolved from prosimian ancestors and became the **monkeys**. The switch to daylight living may have brought about improvements in the primate eye. Cones developed in the retina and color vision developed. The additional demands of color vision and perception require a larger brain. The **opposable thumb** became well developed in the monkeys. Monkeys in South America and Central America are called New World monkeys. All other monkeys are called Old World monkeys and include monkeys in Africa and Asia.

About 35 million years ago, a different type of primate evolved from prosimian ancestors -- the **great apes**. Apes have larger brains than monkeys and do not have tails. Apes are found in Africa and Asia; no apes or ape fossils have been found in North or South America.

There are four living types of great apes: **gibbons, orangutans, chimpanzees** and **gorillas**. Based on molecular studies, the evolutionary pathway to the gibbons split off from the basic ape line about 20 million years ago. The orangutan line split off about 14 million years ago. The split between the chimpanzee pathway, gorilla pathway and pathway to humans took place 7-9 million years ago. Humans and their direct ancestors (**hominids**) are discussed in video episode 13.

=====

THREATS TO DIVERSITY: One major threat to the great apes is habitat destruction. Another threat is the bushmeat trade, where the apes are hunted to supply game for urban populations. For more information, see this web site:

<http://bushmeat.net/>

=====

Unit References:

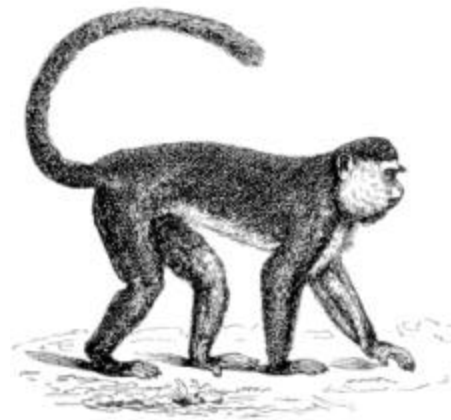
Raven and Johnson. 1996. *Biology*, 4th ed. Wm C. Brown.

Campbell, Reece and Mitchell. 1999. *Biology*, 5th ed. Benjamin Cummings.

Websites: <http://pin.primate.wisc.edu/>

http://www.emory.edu/LIVING_LINKS/Taxonomy.html

<http://animaldiversity.ummz.umich.edu/chordata/mammalia/primates.html>



QUESTIONS FOR EPISODE 12: A LIFE IN THE TREES

1. What adaptations are necessary to enable an animal to live in the trees?

2. What animals are considered to be primates?

LEMURS AND OTHER PRIMITIVE PRIMATES

3. What characteristics are found in the lemurs?

4. Describe the ring-tailed lemur and its natural history. How does it use scent?
How does it use its grasping hands?

e. aye-aye

7. When are bush-babies, pottos and lorises active? Where are they found?

8. a. Describe the loris.

b. Describe the tarsier. How does it differ from other primitive primates?

MONKEYS

9. Describe the marmosets and their natural history.

14. Describe the baboon and its natural history. How do members of a baboon troop communicate?

15. Describe the macaques.

Locator: Tropical Rain Forest of the Far East

17. What is unusual about the young of the silver leaf monkey?

GREAT APES

18. What changes have occurred in the body of the great apes?

19. Describe the orangutan of Borneo. What behavioral change has occurred as a result of its great size?

20. What changes have occurred to the gibbons? How do these changes correlate to its activity in the trees?

21. Describe the natural history of the gorilla. What is the social structure of a gorilla family? What change has occurred to the hand and foot of the gorilla?

22. Describe the natural history of the chimpanzees. What is unusual about their diet?

CONCEPTS FOR EPISODE 13: THE COMPULSIVE COMMUNICATORS

Human evolution is an area of interest and controversy. Contrary to popular beliefs, the human line is not a simple straight-line progression of one species evolving from another. Instead, like in most evolutionary trees, there are branches from the human tree that lead to evolutionary dead ends. We just happen to be at the end of one of many branches that has managed to survive. Furthermore, new fossils are found every year that change the picture of human evolution. You can find information and articles about human evolution and new discoveries in many places: on the news and TV specials, as well as in magazines and books.

At the time the videos were made, the fossil history was interpreted as a progression from one form to another, with anatomical modern humans at the apex. Thus, the relationships appeared like this:

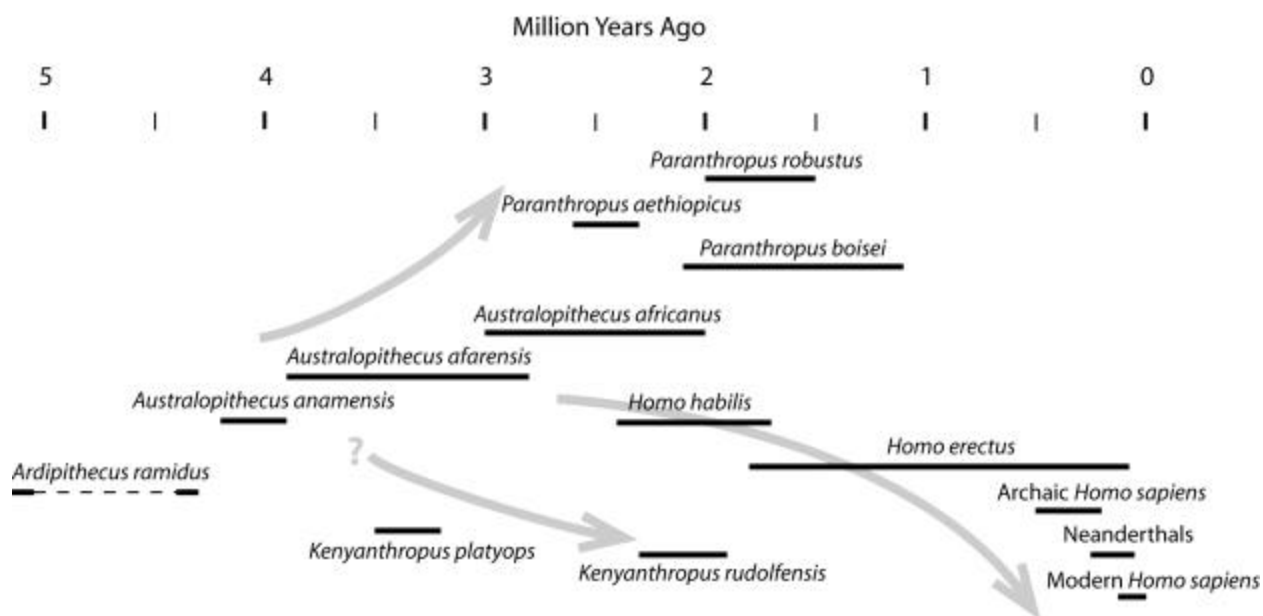


This was interpreted as *Australopithecus* was the ancestor of *Homo habilis*, which was the ancestor of *Homo erectus*, which was the ancestor of *Homo sapiens*, which had two different sub-species: *Homo sapiens sapiens* and *Homo sapiens neanderthalensis*.

Essentially, all hominids were divided into two genera: small-brained but bipedal *Australopithecus* and big-brained, tool-using *Homo*.

The current view is substantially different, including as many as five different genera: *Ardipithecus*, *Australopithecus*, *Paranthropus*, *Kenyanthropus* and *Homo*. There are multiple species within each genus. The relationships among these organisms are not clear-cut; instead they appear very “bushy”, with lots of side branches. See the diagram on the next page for a simplified version with side branches.

Geologic Range of Hominid Fossils



Paleoanthropologists disagree about how to arrange these different hominid fossils into a branched set of relationships. We have not drawn the links between the different taxa because of these disagreements. This does not indicate that the general pattern discussed in the text is inaccurate, just incomplete, and in some cases there is uncertainty in the details. Overall, there is a general increase in brain size and development of bipedality over time as discussed in the text. Details like the degree of bipedality, the overall size, the size and shape of the skull, and the relative size of the teeth and associated muscles are different in different organisms. (Names and ranges accurate as of Spring 2002)

WHAT IS "HUMAN"?

One of the problems with looking at human ancestry is "what exactly is a human"? Different anthropologists use different characteristics to decide which fossils are "human" and which are not. Some people argue that *Homo habilis* is not a human, even though it used tools, because its brain capacity might not have been large enough for abstract thought. Other people consider any member of the genus *Homo* as humans; a fossil organism is called *Homo* if it used tools.

AUTHORS' NOTE: These interpretations are a great way to show how scientific interpretation is colored by personal values or training. There are traditions and schools within the field, plus cultural biases, that creep into people's thought patterns. These underlying assumptions, which are often subconscious, affect perceptions. (In other words, they're stuck within the box and they don't even know they are in a box!) So *Homo sapiens neanderthalensis* is embraced as a member of our species (i.e., could breed with us) by some; others vehemently insist that *Homo sapiens neanderthalensis* is a totally different species (i.e., could not breed with us).

You are probably aware that many people are uncomfortable with the topic of interracial marriage. Just imagine their reaction to the suggestion of Neanderthals mating with modern humans.

HOMINID EVOLUTION

While there are several different theories about the fine details of hominid evolution, two key characteristics apply to the hominids. First, they walked upright on two legs (**bipedalism**). Their bodies reflect the structural changes necessary to shift from walking on four legs to walking on two legs.

Secondly, their **brains** are far larger than the brains of a comparable ape. The braincases of these early hominids are much larger than you would predict from looking at the braincase of another primate, such as a gorilla.

Only some of the hominids are shown on the video. One of the earliest hominid ancestors is *Australopithecus*. There are at least five species of *Australopithecus* known from fossils. The oldest is over 4 million years old; several fossils date to almost 2 million years old. The fossils show that these hominids walked upright, their teeth are more humanlike than apelike, and their brain capacity is about one-third the size of modern humans.

The first human evolved from some *Australopithecus* ancestor about 2 million years ago. These first humans were named *Homo habilis* or "handy man" since tools were found with the fossils. The oldest fossils are about 2 million years old but there are fossil tools that date to 2.5 million years ago. The fossils have a brain capacity of about half the size of modern humans. *Homo habilis* lived in Africa about 500,000 years before becoming extinct.

The next species on the human line to evolve was *Homo erectus* or "erect man" or "man who walked upright". (Note: this was **not** the first hominid to walk upright. It was named "erect man" because these fossils were the first non-*Homo sapiens* fossils that were found. Once named, the names are not changed.) *Homo erectus* walked upright, was about 5-6 feet in height, and had a larger brain (about two-thirds the size of modern humans), a skull with prominent brow ridges and a rounded jaw. *Homo erectus* fossils have been dated at 1.8 million years old; they apparently evolved in Africa and spread quickly throughout Asia and Europe. They lived in small social groups, used flint and bone tools, took shelter in caves or crude wooden huts, and hunted animals. *Homo erectus* is the first human (in the fossil record) to demonstrate the use of fire. In Africa, *Homo erectus* disappeared about 500,000 years ago; in Asia, *Homo erectus* disappeared about 80,000 years ago.

The oldest fossils of *Homo sapiens* ("wise man") are about 500,000 years old. These archaic *Homo sapiens* are similar to modern humans but they have anatomical differences, such as larger teeth and prominent brow ridges. (At the same time, their brain size is significantly larger than *Homo erectus*, approaching the average of modern humans.)

In Europe and Asia, archaic humans evolved into Neanderthals (*Homo sapiens neanderthalensis*). The oldest Neanderthal fossils are 130,000 years old. The Neanderthals had short powerful bodies. Their skulls were massive with heavy brow ridges above the eyes. Interestingly enough, their brains were larger than modern humans. The Neanderthals made many tools, including axes and spearheads. They apparently cared for their injured and elderly. They buried their dead, even placing flowers in the graves, (although there is some controversy about this interpretation). By 100,000 years ago, they were common throughout Europe, Asia and the near East.

The body changes seen in Neanderthals appear to have evolved in response to the cold climate of the Ice Ages.

Human fossils that are very similar to modern humans appear in Africa more than 120,000 years ago. They made beautiful stone tools. By 30,000 years ago, they had spread out of Africa everywhere except the Americas. The fossil evidence is backed up by molecular evidence based on mitochondrial DNA.

About 35,000 years ago, these modern humans appeared in Europe. The Neanderthals were gone by 30,000 years ago. These modern European humans are often called Cro-Magnons, named after the French valley in which the first fossils were found. Cro-Magnons (*Homo sapiens sapiens*) used sophisticated stone tools, as well as tools made from bone and horns. They had a complex hunter-gatherer society. These are the humans responsible for the glorious cave paintings found throughout Europe, evidence that Cro-Magnons used symbolic language. Visit some of the oldest, most amazing art in the world at these websites from the French government:

<http://www.culture.gouv.fr/culture/arcnat/chauvet/en/>
<http://www.culture.gouv.fr/culture/arcnat/lascaux/en/>

One question still persists: What happened to the Neanderthals? The answer to this question is often hotly debated. One version is that Cro-Magnons interbred with the Neanderthals. Another hypothesis is that Neanderthals succumbed to diseases brought by Cro-Magnons (a fate that also happened to native Americans when Europeans came to the Americas). However, this hypothesis is challenged by evidence that Neanderthals and Cro-Magnons coexisted for several thousand years in some places. One hypothesis is that Cro-Magnons were better competitors and replaced Neanderthals. Another recent hypothesis is based on differences in migration between Neanderthals and Cro-Magnons. Another version is that Cro-Magnons actively killed the Neanderthals, a vision which has horrifying implications about our species, if true. Yet another version is that Neanderthals were absorbed into modern humans by interbreeding. So, which is the "true" explanation of the fate of the Neanderthals? We don't know but this is a hot topic of debate. (Check out this website: <http://www.pbs.org/wgbh/nova/neanderthals/> for the Nova episode *Neanderthals on Trial*. The episode discusses the controversy over whether Neanderthals belong in the same species as modern humans or are a separate species. This also has insights into the nature of science, particularly how scientists' perspectives and values can influence their work.)

WHAT ARE HOMINIDS?

Why do we keep using the term "early hominids" or "first humans"? Well, it's just the easiest way to stay out of trouble.

Traditionally, scientists used the term "**hominid**" to describe the species in the human lineage (species that evolved after the split between modern humans and the great apes of Africa). The main trait for defining a species as "hominid" was bipedalism (walking on two legs). This had evolved by about 4 million years ago. In a sense, if a primate walked on two legs, it was a hominid. However, more recent genetic evidence has suggested a different classification. Recall that geneticists' experiments have shown that humans are probably more closely related to the chimpanzees than to the other apes (for example, the gorilla). So a traditional classification that puts gorillas and chimps together in one group, and

humans and other hominids in a different group, doesn't accurately reflect the evolutionary relationships between these species.

So a new classification is being adopted by a growing number of researchers. In this new system, the family Hominidae, or "hominids," is now considered to include all of the great apes (chimps, humans, gorillas, the Asian orangutan, as well as all the extinct species in the fossil record related to these species). A subfamily Homininae (the "hominines") is used to refer specifically to the African apes; chimps gorillas and humans, which separated evolutionarily from the Asian apes around 13 million years ago. Orangutans, and their extinct relatives are placed in the subfamily Ponginae (the "pongines"). To characterize the human line after its split from the other African ape lineages between 5 and 8 million years ago, a tribe classification Hominini ("hominins") is adopted.

But it isn't that simple! Some researchers strongly disagree, preferring the traditional classification, and they reserve the term hominid strictly for the human lineage. Still others argue that the creation of a tribe classification is not warranted. Other researchers place the orangutans in a separate family Pongidae, instead of separating them at the subfamily level . . .

Confused yet?

It is a complicated and intricate debate, and it certainly isn't resolved yet. So to avoid problems, we have used terms like "early humans", "early hominids", etc. to describe those species leading to modern humans, but after the split from the African apes. More information is available at the Smithsonian web exhibit of human origins:

<http://www.mnh.si.edu/anthro/humanorigins>

References: Raven and Johnson. 1996. *Biology*, 4th ed. Wm C. Brown.

Websites:

<http://sapphire.indstate.edu/~ramanank/index.html> (info about Neanderthals)

<http://www.talkorigins.org/faqs/homs/index.html> (Fossil hominids & human evolution)

<http://www.becominghuman.org/> (Human evolution—an online documentary)

<http://www.mnh.si.edu/anthro/humanorigins> (hominid introduction)

<http://www.newscientist.com/news/news.jsp?id=ns99991528> (out of Africa article)

<http://www.accessexcellence.org/bioforum/bf02/klein/index.html>

(Online lecture about human origins)

Timeline for Unit 6

| | |
|--------------------------|--|
| 6,000-15,000 years ago | agriculture developed |
| 30,000-10,000 years ago | cave paintings in Europe |
| 40,000-35,000 years ago | European Cro-Magnons |
| 120,000+ years ago | oldest fully modern <i>Homo sapiens sapiens</i> fossils in Africa and Israel |
| 230,000-30,000 years ago | <i>Homo sapiens neanderthalensis</i> |
| 500,000 years ago | possible earliest <i>Homo sapiens</i> fossil |
| 1.8 mya-80,000 | <i>Homo erectus</i> |
| 2.5 mya-1.7 mya | <i>Homo habilis</i> ; first chipped rocks used as tools |
| 3.2 mya | “Lucy” fossil (<i>Australopithecus afarensis</i>); habitat was woods or grasslands dotted with trees |
| 4.2-3.9 mya | <i>Australopithecus anamensis</i> ; bipedal; lakeside forests |
| 4.4 mya | <i>Ardipithecus ramidus</i> ; dense forests |
| 7 mya | split between chimpanzees and humans |
| 9 mya | split between gorillas and chimpanzees/humans |
| 14 mya | orangutan split off from other great apes |
| 20 mya | gibbons split off from other great apes |
| 25 mya | spread of grasslands |
| 33 mya | earliest known fossil of ape (<i>Aegyptopithecus</i>) |
| 40 mya | prosimians, monkeys |

mya = millions of years ago

Authors’ Note: Please be aware that the timelines for ancient humans and their ancestors change as new fossil evidence is found and as scientists debate the meaning of the fossil evidence. In other words, before we revise this lab manual again, these dates may well be altered.

- b. Why did the early ape men begin to stand erect? What advantage did standing erect (bipedalism) provide?
-
- 4. When do chipped stones appear in the fossil record? What is the purpose of the chipped stones?

***Homo erectus* (Upright man)**

- 5. What changes occurred in the body of the next human, *Homo erectus*? “Upright man” appear in the fossil record about 1.8 million years ago.
-
- 6. What types of tools were used by *Homo erectus*?

15. What are the purposes of the aboriginal paintings? What is significant about symbols?

16. What relationship exists between climate and skin pigmentation?

17. What major changes occurred in human society about 10,000 years ago?

Locator: Uruk in Syria

18. What does examination of the ruined city, Uruk, reveal about the early cities? What significant item was discovered in Uruk?

19. What is significant about the development of the written language?

20. a. Living organisms encode information in what molecule? _____

(Ignore Attenborough's description of a gene. He's wrong when he says genes consist of many molecules of DNA. Technically, a gene is just one portion of one DNA molecule.)

b. What information do genes provide?

21. One popular technique is to reduce the time span of all living things to one year. When this technique is used, the beginning of life forms is considered to be January 1. (Note: In the film, Attenborough states this to be 3.5 billion years ago. This date is now estimated as 4.5-4.6 billion years ago.)

If we use the same year as Attenborough, what occurs during:

a. the middle of August

b. the beginning of November

c. the end of November

d. the beginning of December

e. mid December

- f. December 25

 - g. early morning of December 31

 - h. 11:58 pm on December 31
22. What is unusual about the society and culture of modern man? How do our communication skills differ from other animals? What changes in our technology have increased our ability to retrieve and store information?
23. According to scientific evidence, is man the “ultimate triumph of evolution”?