



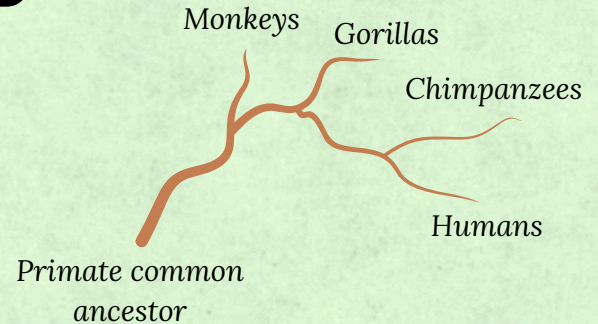
HUMAN EVOLUTION



BACKGROUND

Current humans share ancestry with other primates, such as monkeys and apes. This means that humans and primates share a **common ancestor** many million years ago! Over time, biological evolution caused the common ancestor's **traits to change** and eventually these changes led to the **evolution** of distinct primate species (including us)!

To see the shared common ancestry between humans and other primates, researchers look at the shape and structure of bones. The shape and structure of bones is also known as **morphology**. In this lesson, you will use photos and 3D scans to investigate the morphology of primate bones. The differences in morphology between primates is due to biological evolution. You will also explore the varying environments each primate called home. These environments were **selective pressures** for the evolution of important morphological traits.



Much like a **family tree**, humans and other living primates share ancestry

KEY VOCAB



Selective pressure: an evolutionary force that causes a particular trait (such as a morphological characteristic) to be more favorable in certain environments

COMPARE

The morphology (shape and structure) of a human and chimpanzee skull



Human



Chimpanzee

LEARNING GOALS

- 1) Identify morphological characteristics of five primate species.
- 2) Recognize the changes in morphological characteristics amongst these primates are due to evolutionary processes.
- 3) Become familiar with the climatic environments of each primate.

NGS STANDARDS

MS-LS4-1 Biological Evolution: Unity and Diversity



MS-LS4-2: Biological Evolution: Anatomical Evidence of Evolutionary Relationships



HUMAN EVOLUTION



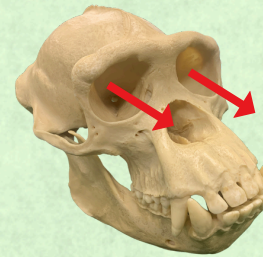
Chimpanzee (*Pan troglodytes*)

Evolved 7 million years ago, currently living



A comparison to a human hand

Identify: Large, forward-facing orbital sockets (eyes)



FACT

Forward-facing eyes are shared by all primates!

This trait evolved at around the same time as improved visual depth perception and **colored** vision



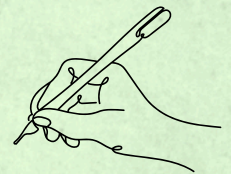
Identify: Long, prehensile (grasping) fingers

FACT

Grasping fingers are also shared by all primates! This trait evolved around the same time as opposable thumbs and fleshy finger pads!



ASSESS



What is a colored object in a forest that chimpanzees might be looking for?

UNDERSTAND

Tree environments can be **hard** to navigate. Both forward-facing eyes and grasping hands are morphological characteristics that helped chimpanzees **move through trees**.

Climatic Environment: fully arboreal (tree) environment in Africa





HUMAN EVOLUTION



Australopithecus africanus

Evolved 3.3 million years ago, extinct



Identify: Small brain

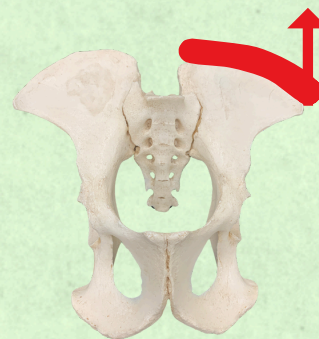
Scan for a 3D view of *Australopithecus africanus* skull



Identify: Slightly curved pelvis compared to flat chimpanzee pelvis



Australopithecus africanus

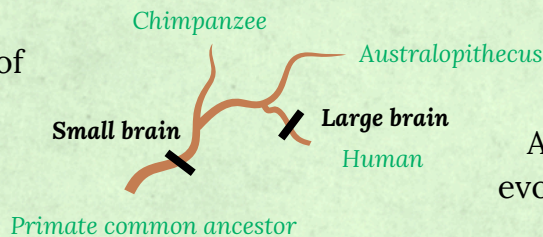


Chimpanzee

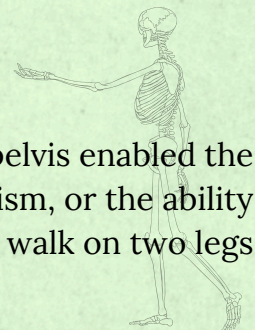
FACT

FACT

A small brain is a retention of an older morphological characteristic the primate common ancestor had



A slightly curved pelvis enabled the evolution of bipedalism, or the ability to walk on two legs



Climatic Environment: both arboreal (tree) and grasslands environment in Africa



ASSESS

Can you think of **selective pressures** for walking on two legs?

ASSESS

If *Australopithecus africanus* lived in both tree and grassland environments, how do you think they **moved**?

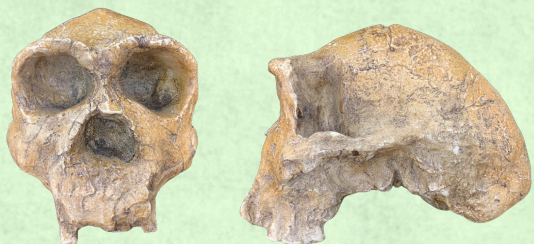


HUMAN EVOLUTION



Homo erectus

Evolved 2 million years ago, extinct



Identify: Modern human-like body proportions and limbs



Identify: Medium-sized brain

FACT

“Medium-sized” means the *Homo erectus* brain size was between chimpanzee and human brain size

Scan for a 3D view of *Homo erectus* skull



Turkana Boy, lived in Turkana, Kenya around 1.6 million years ago

TOOL MAKER



Homo erectus was a very good **stone tool maker**. They would use their stone tools to hunt animals.

FACT

Modern human-like body proportions and limbs meant *Homo erectus* was **fully bipedal** and could even run long distances!

Climatic Environment: varying climates in Africa, Western Asia, and Eastern Asia



ASSESS

Homo erectus was the first hominin (human ancestor) to leave Africa. What traits helped them to do so?



HUMAN EVOLUTION



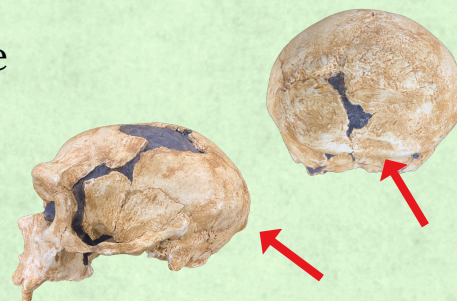
Neanderthals (*Homo neanderthalensis*)

Evolved 500,000 years ago, extinct



Identify: Thick brow ridge

Identify: Bump at the back of the skull (occipital bun)



Scan for a 3D view of Neanderthal skull

FACT

Older Neanderthals had a more robust and stockier skeletal build than modern humans, which can be observed in these two morphological traits

MORE ALIKE THAN YOU THINK

Neanderthals were more like humans than one might think! Neanderthals created artwork, ritually buried family members, and even mated with ancient humans!



Neanderthal game animal



Neanderthal cave art, created 65,000 years ago!

WHY?

Cold European winters and a heavy meat-eating diet

Climatic Environment:

Europe, which can endure harsh winters

ASSESS

If humans and Neanderthals were so similar, why do you think humans are the only species that lives today?





HUMAN EVOLUTION



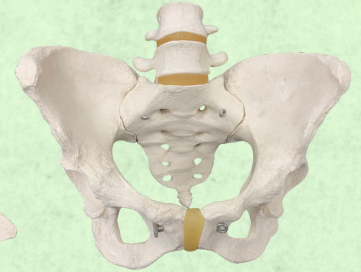
Humans (*Homo sapiens*)

Evolved 300,000 years ago, living



Identify:
Large brain

Identify: Curved and
broad pelvis



Comparison of
human (above) and
chimpanzee (left)
pelvis

Scan for a 3D
view of early
Homo sapiens
skull



FACT

Due to humans' large brain, they are smart enough to create advanced societal structures, cultural symbols and environmental adaptations



LANGUAGE

Humans are the only known hominin to have language!



"Lion-man" of Germany, dated 35-40 thousand years ago, a cultural symbol

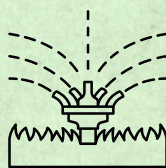
ASSESS

What is the advantage of language?

Climatic Environment: diverse environments, ranging from arctics to deserts

ASSESS

What other environmental adaptations do humans have?



Examples of environmental adaptations for diverse environments





HUMAN EVOLUTION



ASSESSMENT ANSWERS

Chimpanzee

Q: What is a colored object in a forest that chimpanzees might be looking for?

A: Fruit! Chimpanzees eat many colored fruits, including figs, mangos, bananas, watermelons, and apples. The evolution of colored vision in the primate common ancestor allowed chimpanzees to identify a yummy meal a lot quicker!

Australopithecus africanus

Q: Can you think of selective pressures for walking on two legs?

A: There are many selective pressures for walking on two legs, which is known as bipedalism. Walking on two legs allowed hominins (human ancestors) to carry many objects (e.g. weapons, tools, and food), travel long distances, and view their surroundings better.

Q: If *Australopithecus africanus* lived in both tree and grassland environments, how do you think they moved?

A: To live in tree environments, *Australopithecus africanus* climbed trees with their grasping hands just as chimpanzees do! To live in grassland environments, *Australopithecus africanus* walked on two legs, a trait which evolved in part due to their slightly curved pelvis.

Homo erectus

Q: *Homo erectus* was the first hominin (human ancestor) to leave Africa. What traits helped them to do so?

A: *Homo erectus* was fully bipedal, which means they could walk and run very long distances - even all the way out of Africa! *Homo erectus* was also very good at making stone tools, which they used to build shelters, hunt, and butcher animals with. These traits allowed them to survive in other environments outside of Africa.



HUMAN EVOLUTION



ASSESSMENT ANSWERS

Neanderthal (Homo neanderthalensis)

Q: If humans and Neanderthals were so similar, why do you think humans are the only species that lives today?

A: Researchers still aren't quite sure! One hypothesis includes that ancient humans were smarter and could make better tools, such as sewing needles for clothes in the cold winter climate. Another hypothesis is that the Neanderthals simply started dying off more than humans. More recently, researchers believe that human and Neanderthal mating allowed Neanderthals to be genetically "absorbed" into the human population, a process known as introgression.

Humans (Homo sapiens)

Q: What is the advantage of language?

A: Language allowed humans to communicate about abstract topics, important information, or potential dangers.

Q: What other environmental adaptations do humans have?

A: In nearly all environments, humans build shelters to protect themselves from the climatic elements. In cold environments, humans use fire and many layers of insulation (either clothing or blankets) to stay warm. In hot environments, humans rely on wells for water and air-conditioning to stay cool.



CITATIONS AND ACKNOWLEDGEMENTS



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Created by Gabriella Snyder

Photo Citations (in order of each photo's appearance):

Chimpanzee hands, Tambako The Jaguar, 2012, Flickr.

Mother and Baby Chimpanzee, wildlife shot, Gombe National Park, Tanzania, guenterguni, 2018, Getty Images.

Australopithecus. Maurice Wilson, National Museum of History.

KNM-WT 15000 (Turkana Boy), Chip Clark, Smithsonian Museum of Natural History.

Homo erectus, Acheulian man, The Natural History Museum, Alamy Stock Photo.

Cordate shaped hand axe (replica), José-Manuel Benito Álvarez, 2007, Wikimedia Commons.

Red scalariform sign, panel 78 in hall XI of La Pasiega gallery C., Hoffman et al., 2018, Science.

Family of Neanderthals, NASA-JPL-Caltech.

The lion man from the Stadel cave in the Hohlenstein, Lonetal (Bade-Wurtemberg), Dagmar Hollman, 2013, Wikimedia Commons.

Gas Field Workers in Baluchistan, Albert Moldvay, National Geographic.

Next generation reindeer herder on the tundra in northern Russia, Thomas Nilsen, Barents Observer.

All other graphics were sourced from CanvaPro.



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Educational Content:

The educational content in the lesson was sourced from the University of Iowa's ANTH:1301 Human Origins lectures by Dr. Robert Franciscus. His lectures are based off of the book *Introduction to Physical Anthropology* (15th Edition), Jurmain R., Kilgore L., Trevathan W., Ciochon R.L., Bartelink E., Wadsworth & Cengage Learning.

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