

## Hominin Evolution Overview

### Genotype and Phenotype:

- Each individual has a genotype (which genes they have) and a phenotype (the way in which those genes are expressed)
- Some phenotypic traits will be beneficial for survival, some will be neutral, and others will be maladaptive. Individuals with maladaptive phenotypic traits will tend to die off sooner, and individuals with beneficial traits will stick around to successfully reproduce.
- Individuals who exhibit higher fitness (able to reach reproductive age and reproduce) will be more successful in passing their genes onto the next generation through natural selection
- Over time, the prevalence of various genes in the population will change → EVOLUTION!

### Set the Scene:

- Around 6.5 million years ago, there was a human-chimp last common ancestor (LCA) from whom all hominins evolved
- This LCA would have a brain and body about the size of the ape. It would have had long arms and curved fingers, which would have allowed it to move around the trees to forage for food. It would have had larger canines than those seen in modern humans and the males would have likely been larger than the females (and also had larger canines). Although this LCA would have been comfortable moving throughout the trees, its main mode of locomotion would have been terrestrial quadrupedalism (walking on the ground on all fours). Its diet would have consisted primarily of fruits and leaves.

### Australopithecus (East and South Africa):

- Around 4 million years ago we find the earliest hominins—members of the genus *Australopithecus*. These were terrestrial bipeds (walked on two legs on the ground) but sometimes took to the trees to forage or for protection.
- Raymond Dart discovered the first specimens of *Australopithecus* in 1924 (Dart, 1925). Since then, hundreds of fossils from several species have been discovered. We now know that *Australopithecus* was a highly successful genus that persisted for nearly three million years.
- They were clearly fully bipedal, meaning that they were adapted for walking around upright on the ground. Traits that facilitated effective bipedal gait were being selected for (short bowl-shaped pelvis, cranium directly on top of the spine, big toe in line with other toes, etc.). Their brains were roughly the size of modern chimps and gorillas despite having a fairly small body size (approximately 65 lbs. adult females and 85 lbs. for adult males) (McHenry, 1992). Their canines were not as prominent as those of their last common ancestor.
- This mixed terrestrial (on the ground) & arboreal (in the trees) strategy would have served these species well in the mixed woodland and savannah environments they inhabited.

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### Paranthropus:

- Some australopithecids had highly specialized morphology as a result of their environment.
- Species in the genus *Paranthropus* had extremely large chewing muscles and big teeth in order to eat hard, low quality plant foods that required powerful chewing to process.
- Most *Australopithecus* species were extinct by 2 million years ago, but some robust forms persisted in East and South Africa until about 1.2 million years ago.

### *Australopithecus* vs. *Paranthropus*:

- Originally grouped together (more of a “lumper” approach), *aethiopicus* and *boisei* were thought to be more robust forms of *Australopithecus*. Eventually, scientists recognized that the 'robust' forms were different enough to be in their own species. Using more of a “splitter” mentality, the fossils were recognized as being different enough from the other australopithecines - and similar enough to each other - to be placed into a separate genus. This new genus was called *Paranthropus*.

### The Genus *Homo*:

- The earliest fossils of our own genus, *Homo*, date from about 2.3 million years ago (Kimbel et al. 1997). These early specimens are similar in brain and body size to *Australopithecus*, but show differences in their molar teeth, suggesting a change in diet.
- The oldest member of our species is *H. habilis* (2.3–1.4 mya). Anthropologists call *H. habilis* the “handyman” because there is evidence that they used stone tools. This would have added meat and bone to their previously exclusively-plant-based-diet.
- *H. rudolfensis* (1.9 mya) is very similar to *H. habilis* except it has a considerably larger cranial capacity (brain size relative to body size), a longer face, and larger teeth. Its long face and larger teeth make it similar to the Australopithecids but its larger cranial capacity grouped it into the genus *Homo*.
- *H. erectus* (1.9 mya–100 kya), the more widespread descendent of *H. habilis*, lived throughout Africa and Eurasia (Anton, 2003).
- *H. erectus* no longer has the arboreal upper limb adaptations as seen in Australopithecids. They have an increased cranial capacity and a reduction in the size of the teeth. This most likely reflects increasing reliance in social interaction and communication as well as a softer, richer diet.
- Around 700 kya, *H. erectus* in Africa gave rise to *H. heidelbergensis*, a species very similar to modern humans in terms of body proportions, dental adaptations, and cognitive ability (Rightmire, 2009). *H. heidelbergensis*, was an active big-game hunter, produced sophisticated stone tools, and had control of fire (Roebroeks and Villa, 2011).
- Neanderthals (*H. neanderthalensis*) are hominins with stocky physiques, complex behaviors, and brains similar in size to ours. They are thought to have evolved from *H. heidelbergensis* populations in Europe by at least 250 kya (Rightmire, 2008; Hublin, 2009). There is now sufficient evidence that we interbred with Neanderthals and many of us carry some of their genes in our own genetic makeups today (Green et al., 2010)!

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- Fossil and DNA evidence suggest our own species, *H. sapiens*, evolved in Africa 200 kya (Relethford, 2008; Rightmire, 2009), probably from *H. heidelbergensis*. Our species has large brains, exhibits complex behaviors such as cooperative hunting, tool use, and even abstract thought. *H. sapiens* eventually left Africa and populated the globe.

- New discoveries like *H. naledi* (900 kya) show us that we don't know everything yet about how we came to be! These small hominins demonstrate a "mosaic of traits" despite being fairly young! We don't really know what this means yet... Paleanthropologists still have a lot to learn!

### Why This Trend Towards Larger Brains?

- Big brains are thought to be beneficial for the development and use of tools, in social behavior, and as a means of adaptation to the environment.

- According to the social brain hypothesis, brain size (specifically the neocortex) is important when considering social behavior and group size. The neocortex is what gives us the ability to understand what others are thinking. Consider the following line of evidence: Individuals with larger brains are more successful socially, *thus* they have increased fitness (have more kids), *thus* they pass their genes off to their offspring. BUT, in order for this to be true there must be a strong selection pressure to move population towards larger brain size since big brains are calorically expensive!

### **This overview has been adapted from the following sources:**

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Wood, B., Collard, M., 1999. The changing face of genus *Homo*. Evolutionary Anthropology 8, 195-207.

Pontzer, H. (2012) Overview of Hominin Evolution. Nature Education Knowledge 3(10):8

### **Additional Sources:**

Anton, S. C. Natural history of *Homo erectus*. American Journal of Physical Anthropology S37, 126-70 (2003)

Blumenschine, R. J. et al. Late Pliocene *Homo* and hominid land use from Western Olduvai Gorge, Tanzania. Science 299, 1217-12121 (2003)

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- Young, N. M. et al. The phylogenetic position of *Morotopithecus*. *Journal of Human Evolution* 46, 163-184 (2004)
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## Hominin Evolution Overview

### Supplemental Material: Human Evolution Family Tree

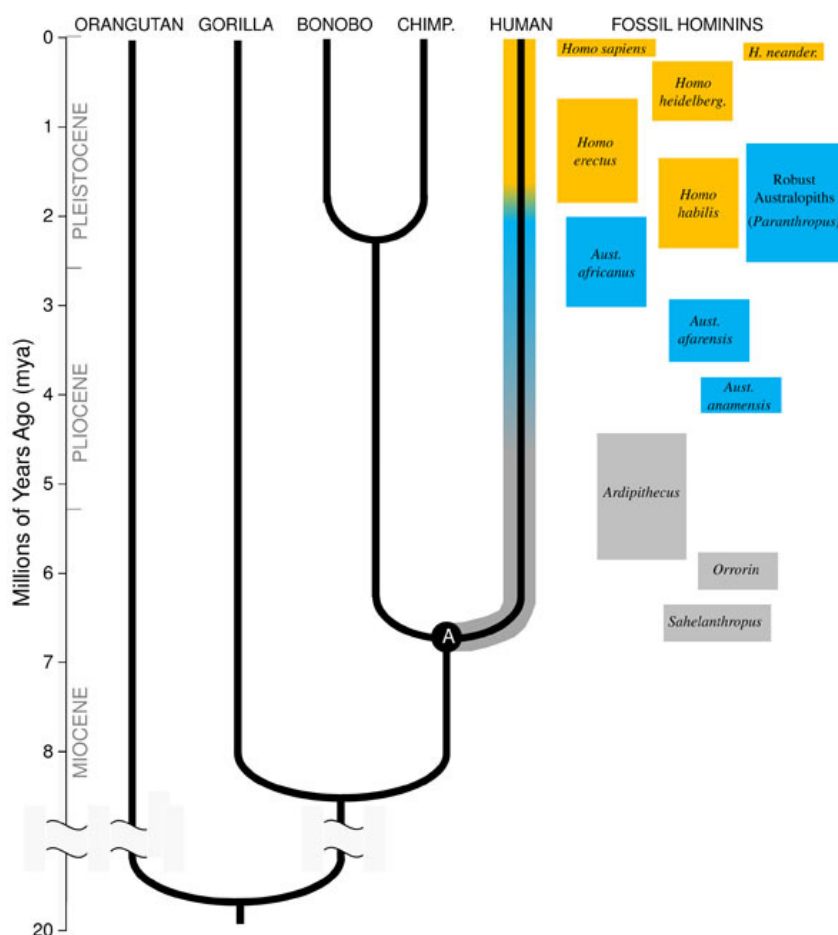


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<https://www.nature.com/scitable/knowledge/library/overview-of-hominin-evolution-89010983>

#### The human evolutionary family tree.

Relationships and estimated divergence times of the living apes are shown. Hominins are all species, including side-branches and extinct species, on the human line (highlighted) after our Last Common Ancestor with chimpanzees & bonobos (marked “A”). Some fossil hominin species are shown in the right-hand column, with their approximate age ranges indicated; early hominins: gray, Australopithecus: blue, Homo: orange.

## Hominin Evolution Overview

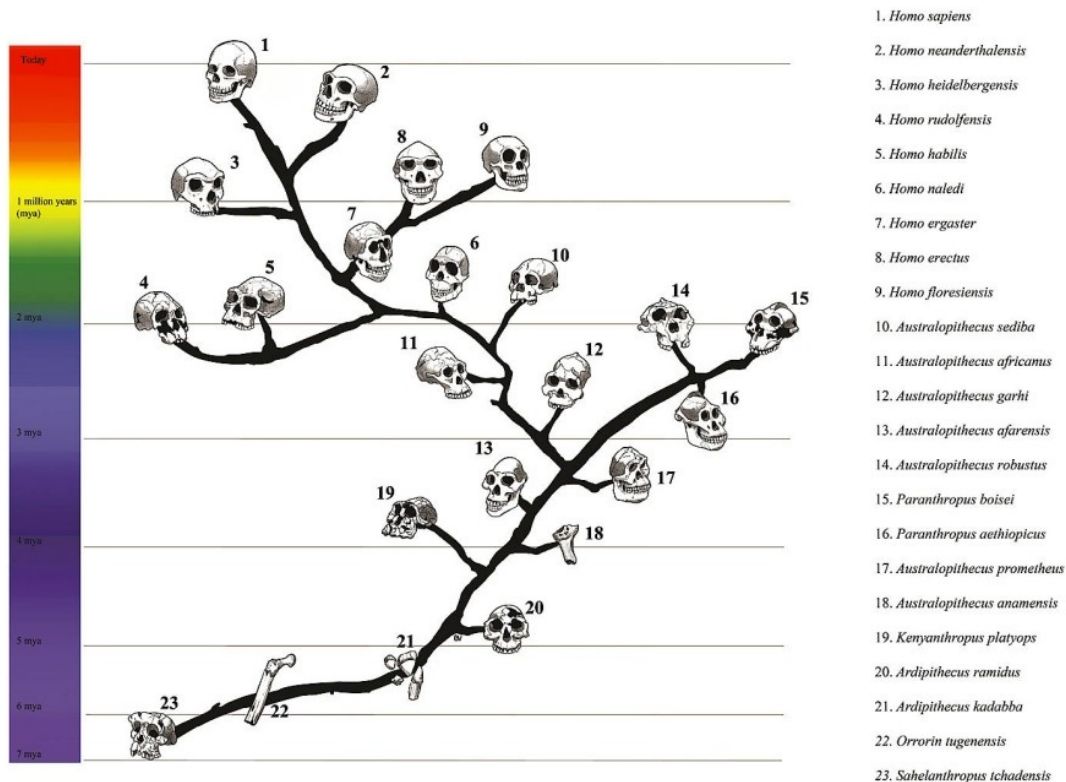


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## Hominin Evolution Overview

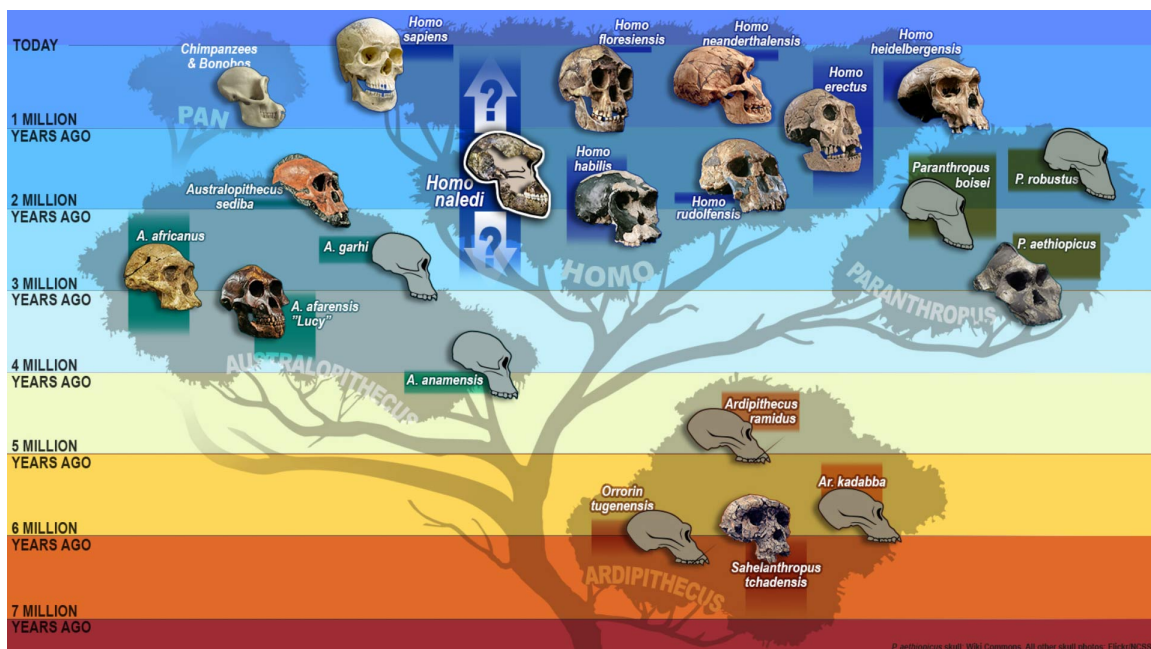


Image credit: S. V. Medaris / UW-Madison

<http://www.sci-news.com/othersciences/anthropology/science-homo-naledi-03224.html>

## Hominin Evolution Overview

### Supplemental Material: Reconstructions



*Australopithecus africanus*

Reconstruction based on AL444-2 by John Gurche

<http://humanorigins.si.edu/evidence/human-fossils/species/australopithecus-africanus>



## Hominin Evolution Overview



*Australopithecus sediba*

<http://ngm.nationalgeographic.com/2011/08/malapa-fossils/fischman-text>

## Hominin Evolution Overview



*Paranthropus boisei*

Reconstruction based on OH 5 and KNM-ER 406 by John Gurche  
<http://humanorigins.si.edu/evidence/human-fossils/species/paranthropus-boisei>

## Hominin Evolution Overview



*Paranthropus aethiopicus*

Reconstruction by Roman Yeveyev

<https://i.pinimg.com/originals/75/7b/7a/757b7a01c6d9661c0a9e436bf066c937.jpg>

## Hominin Evolution Overview



*Homo habilis*

Reconstruction by John Gurche - National Geographic Magazine Oct, 2015  
[http://evolution-involution.org/habilis\\_rudolfensis\\_erectus\\_gurche.jpg](http://evolution-involution.org/habilis_rudolfensis_erectus_gurche.jpg)



## Hominin Evolution Overview



*Homo rudolfensis*

Reconstruction by John Gurche - National Geographic Magazine Oct, 2015  
[http://evolution-involution.org/habilis\\_rudolfensis\\_erectus\\_gurche.jpg](http://evolution-involution.org/habilis_rudolfensis_erectus_gurche.jpg)

## Hominin Evolution Overview



*Homo erectus*

Reconstruction based on ER 3733 by John Gurche  
<http://humanorigins.si.edu/evidence/human-fossils/species/homo-erectus>

## Hominin Evolution Overview



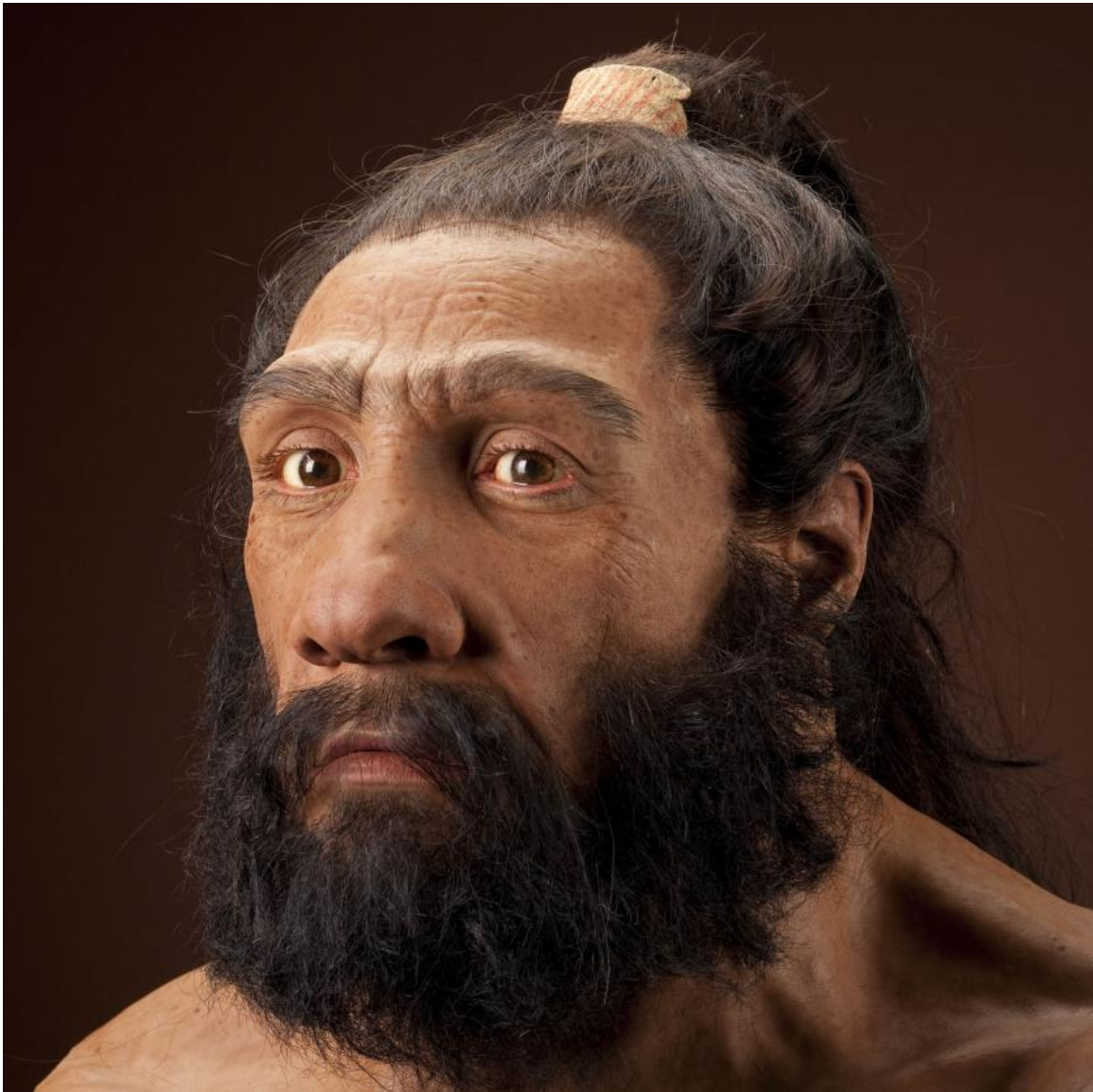
*Homo heidelbergensis*

Reconstruction based on Kabwe by John Gurche

<http://humanorigins.si.edu/evidence/human-fossils/species/homo-heidelbergensis>



## Hominin Evolution Overview



*Homo neanderthalensis*

Reconstruction based on Shanidar 1 by John Gurche

<http://humanorigins.si.edu/evidence/human-fossils/species/homo-neanderthalensis>



## Hominin Evolution Overview



Homo sapiens

<http://www.nhm.ac.uk/discover/how-we-became-human.html>

## Hominin Evolution Overview



*Homo naledi*

Reconstruction by John Gurche and Mark Thiessen

<http://www.sci-news.com/othersciences/anthropology/science-homo-naledi-03224.html>