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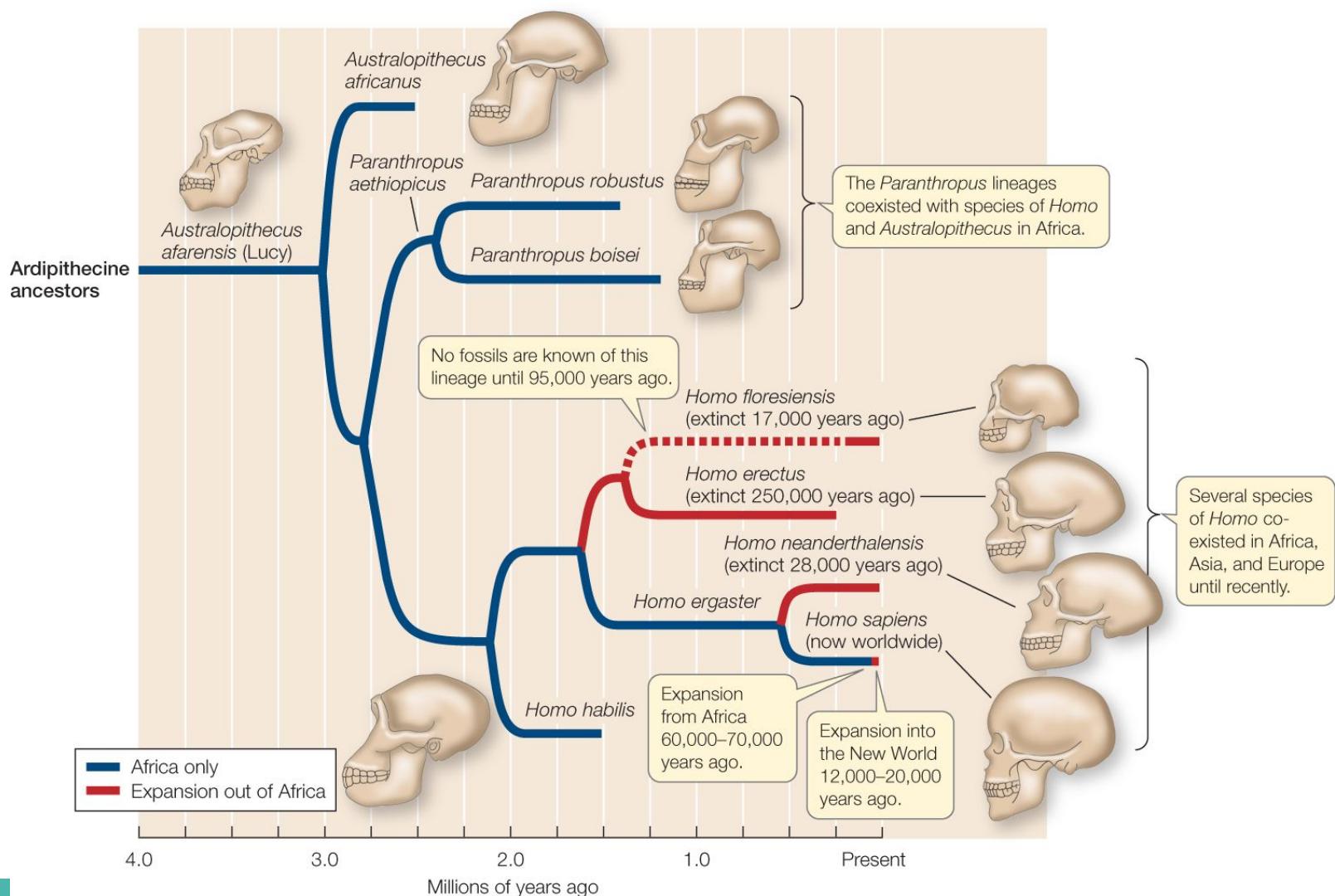
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# Human origins and evolution

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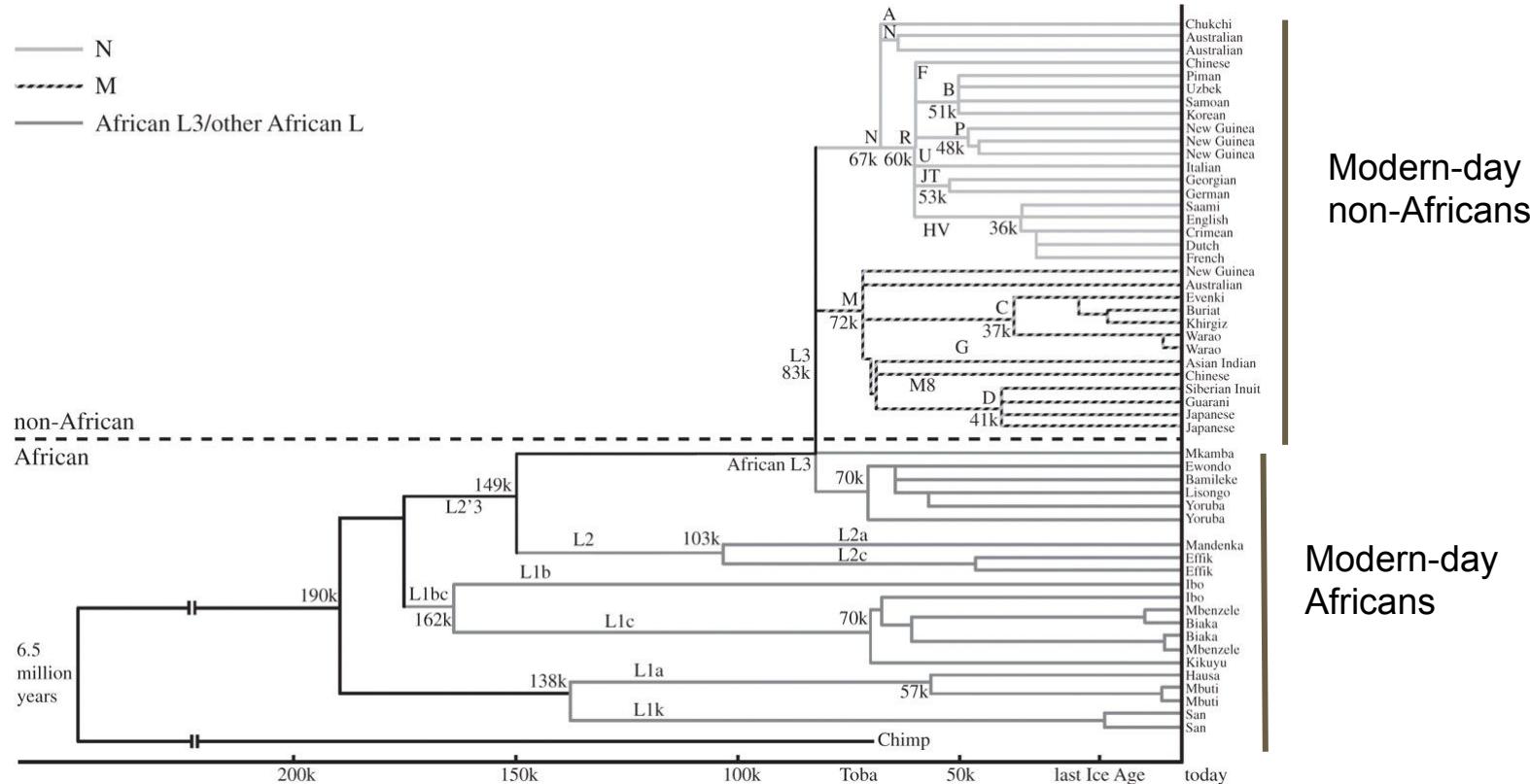
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Introduction to Evolution and Scientific Inquiry  
Dr. Stephanie J. Spielman; [spielman@rowan.edu](mailto:spielman@rowan.edu)

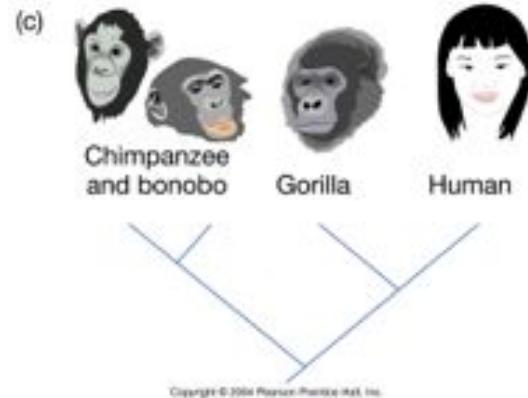
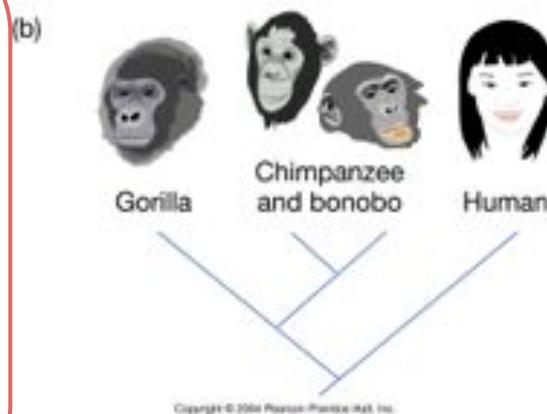
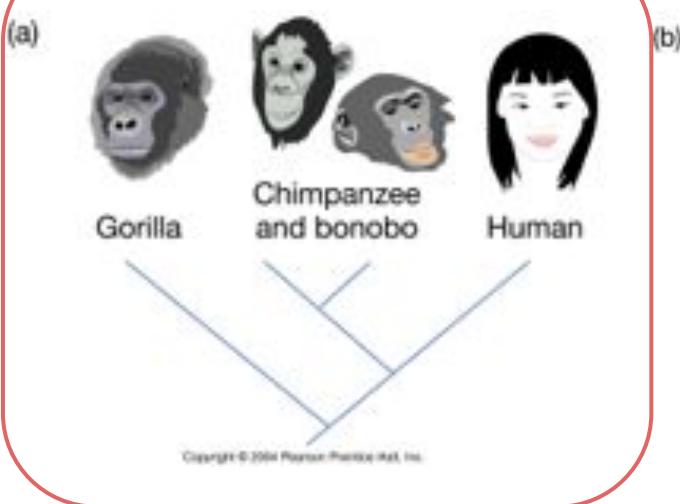


# Phylogenetics also shows humans are originally from Africa

— N  
- - - M  
— African L3/other African L



# Relationship with great apes is under debate, but first is generally preferred



# *Australopithecus afarensis* is among the earliest hominid fossils (3-4 ma)

- Earliest hominid fossils in sub-Saharan Africa
- Bipedal like modern humans
- Like other apes..
  - Protruding face
  - Small skull and brain, about size of modern chimp
- Transitional fossil!
  - "Intermediate" tibia and femur angles



"Lucy"  
(Ethiopia, 3.2 ma)



# Australopithecus lived throughout east Africa until ~1.5 ma

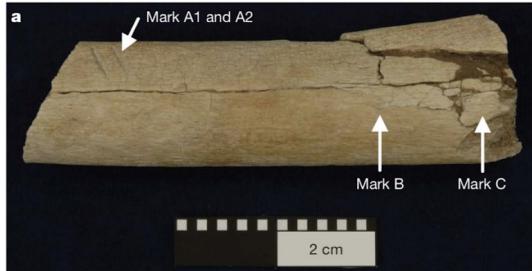


# Lucy used tools!!

## Evidence for stone-tool-assisted consumption of animal tissues before 3.39 million years ago at Dikika, Ethiopia

Shannon P. McPherron<sup>1</sup>, Zeresenay Alemseged<sup>2</sup>, Curtis W. Marean<sup>3</sup>, Jonathan G. Wynn<sup>4</sup>, Denné Reed<sup>5</sup>, Denis Geraads<sup>6</sup>, René Bobe<sup>7</sup> & Hamdallah A. Béarat<sup>8</sup>

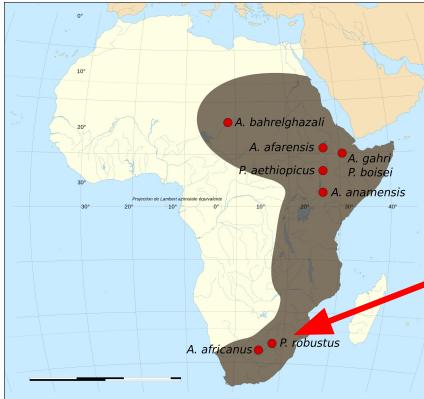
- Tools are a hallmark of human cultural evolution and signify intelligence
  - Previous research thought tools originated 1-2 ma



- Who else uses tools? For-fun reading:
  - <https://www.livescience.com/9761-10-animals-tools.html>

# *Paranthropus robustus* (1.5-2 ma) is a likely *Australopithecus* descendant

- A **robust** *Australopithecus* species discovered in South Africa
- Larger skull and thicker bone structure compared to *Australopithecus*



The *Homo* genus emerges ~2 ma with *Homo habilis*



*Homo erectus* lived ~1.6 ma - 400,000 years ago  
(recent!!)



*Australopithecus africanus*



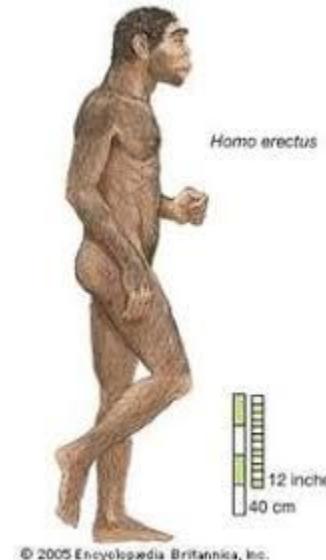
*Homo erectus*



*Homo neanderthalensis*

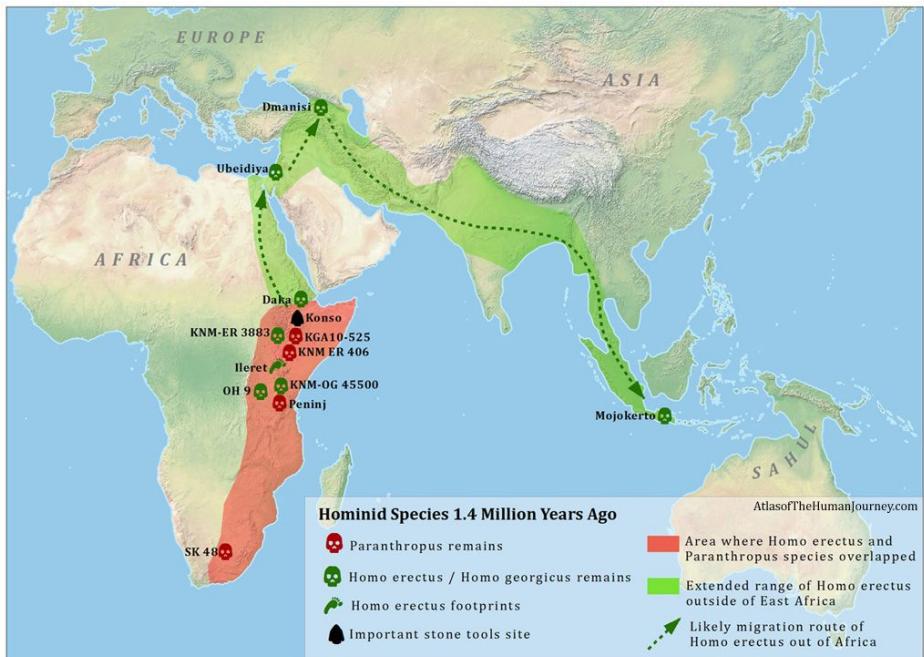
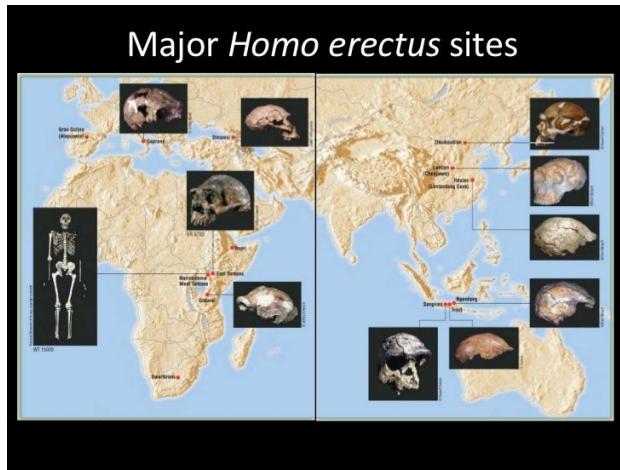
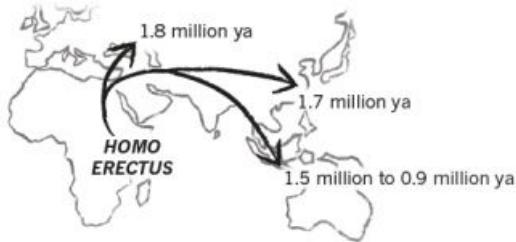


*Homo sapiens*



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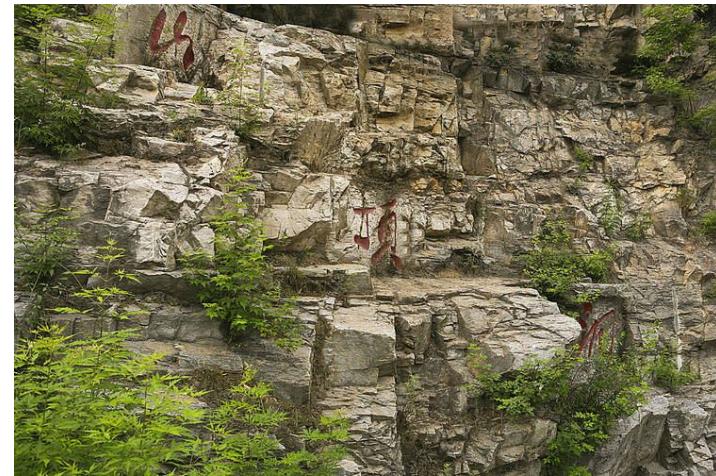
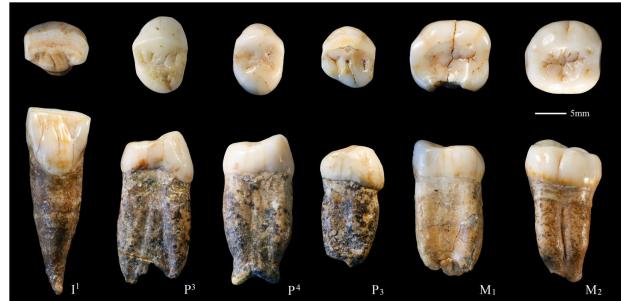
# *Homo erectus* ventured out of Africa





# "Peking Man" *Homo erectus* fossils

- Roughly 200 fossils found outside Beijing (Peking) in the 1920s
- ~200,000-700,000 years ago
- Ongoing excavation of site



# Origins of modern humans (*Homo sapiens*)



Earliest fossil, 315,000 years old..in Morocco?!



# Modern humans began to leave Africa as early as 180,000 years ago

- Recent research has uncovered the oldest out-of-Africa fossil in Israel
- Previously, we thought 100,000 years ago



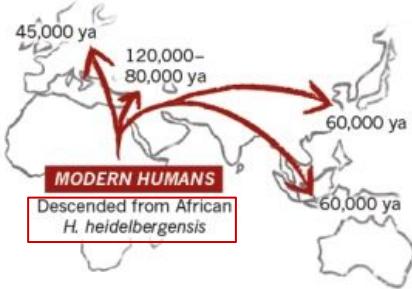
Human teeth in China from ~100,000 years ago



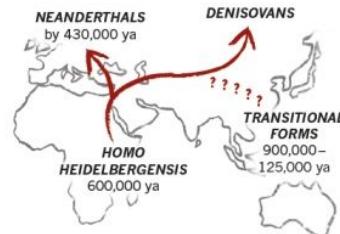
# Theories for human dispersal

## "Out of Africa" model

- **Several** different waves of leaving Africa



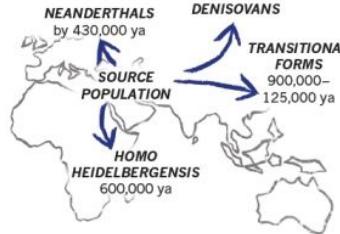
Modern humans emerged in Africa about 200,000 years ago and reached the Middle East by 120,000–80,000 years ago. Later waves of modern humans spread through Europe and Asia.



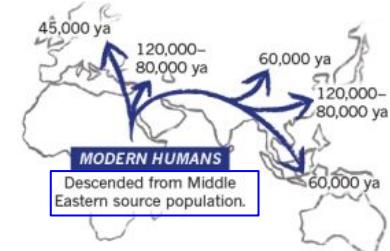
Homo heidelbergensis or other transitional forms evolved into Neanderthals and Denisovans. Hominins in China with mixtures of archaic and modern features may have derived from *H. heidelbergensis*.

## Alternative model

- Initial **single** migration to Middle East, and spread from there



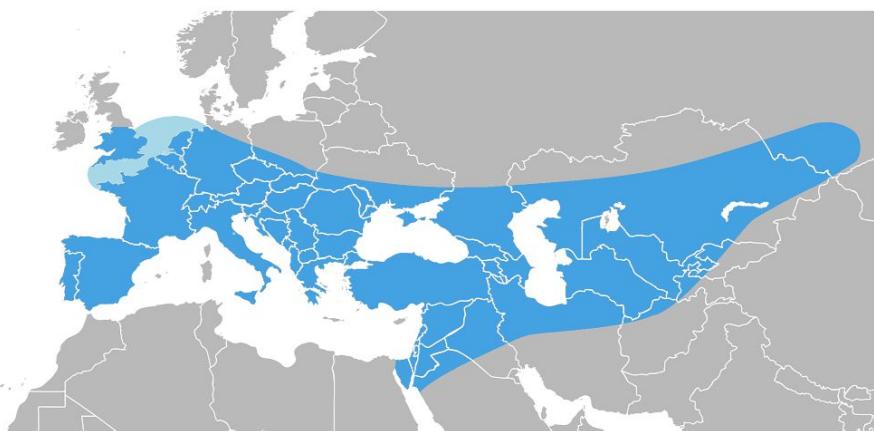
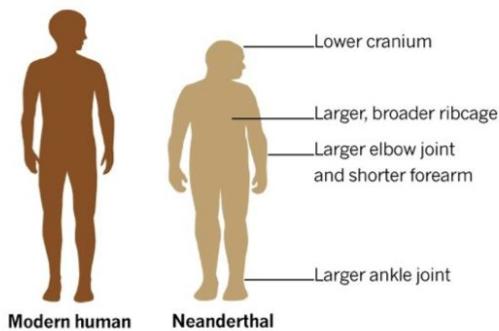
Homo erectus descendants in the Middle East give rise to various hominin groups in Europe and east Asia, as well as to *Homo heidelbergensis* in Africa.



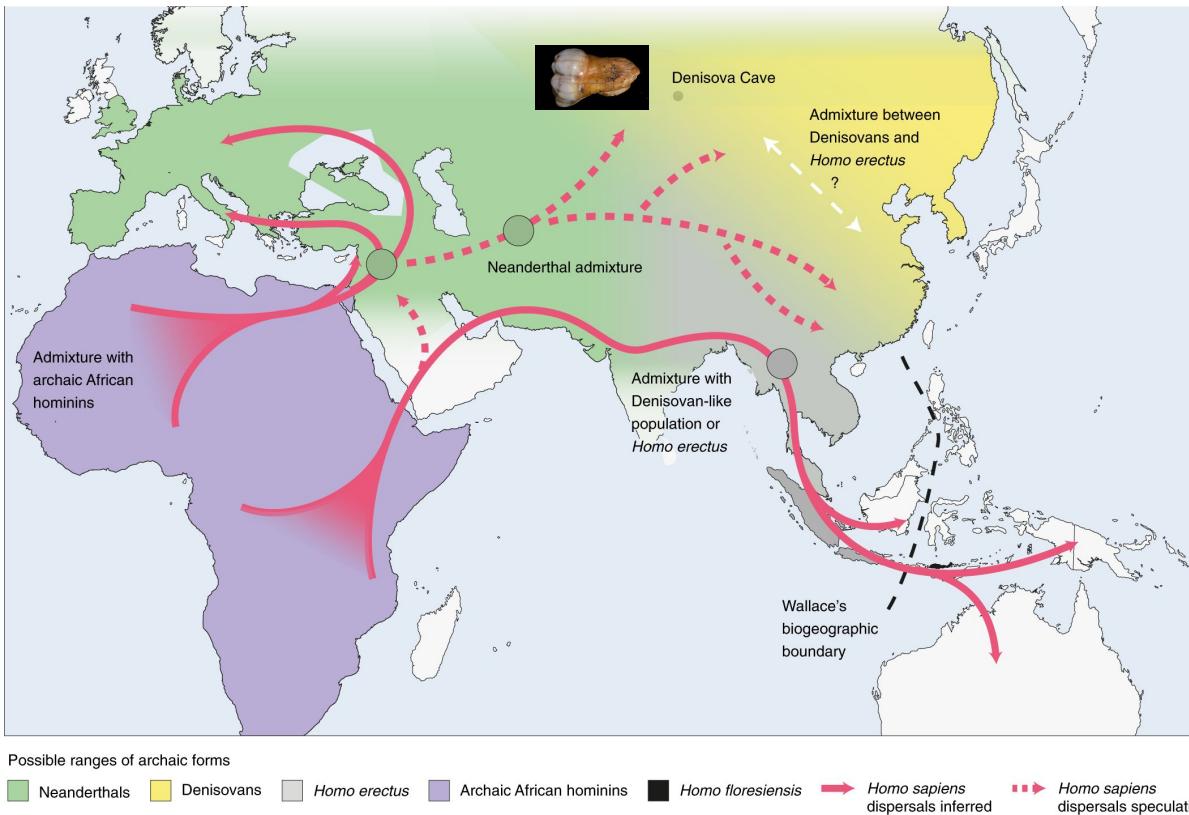
Modern humans evolve in Africa from *H. heidelbergensis* or another hominin derived from the Middle East, and they disperse to Eurasia in multiple waves.

©nature

# *Homo neanderthalensis* lived ~400,000-40,000 years ago



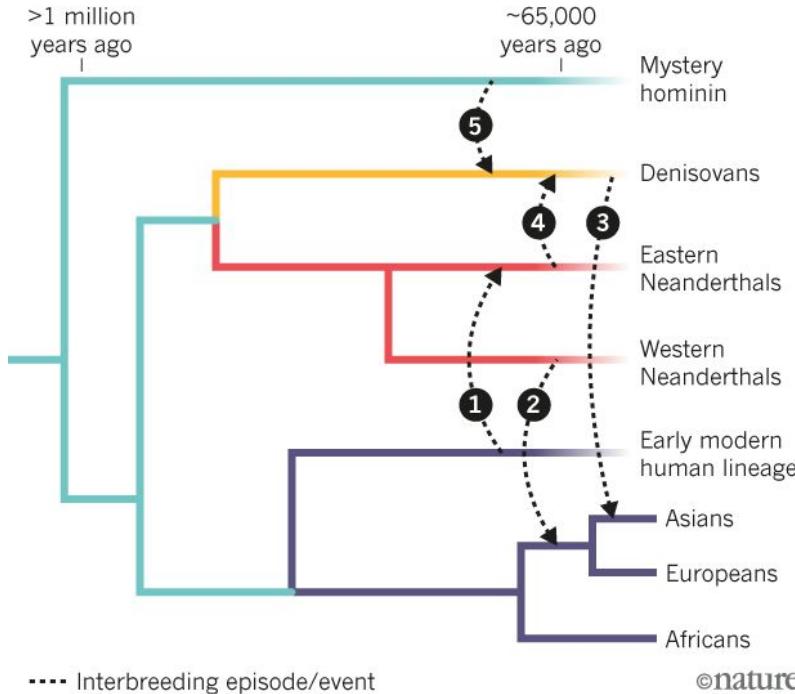
# *Homo denisova* lived during the same time



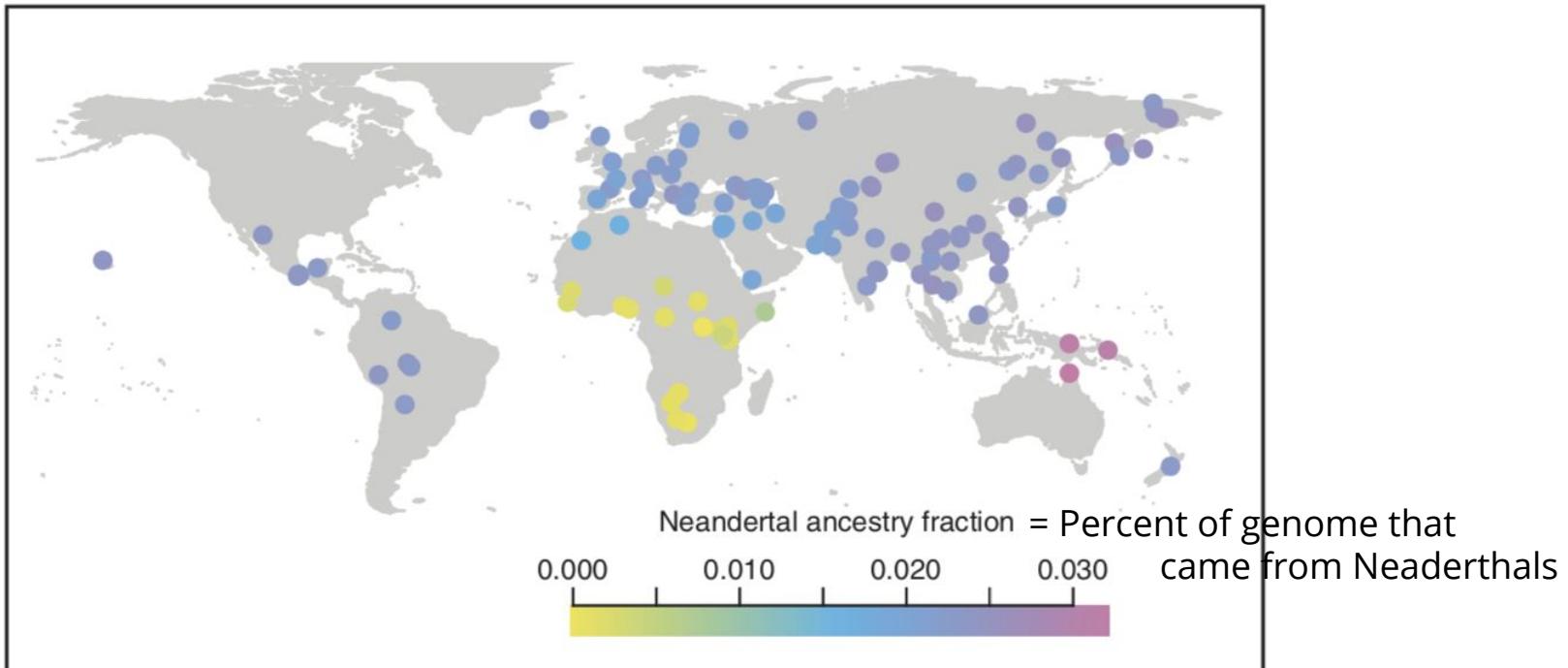
# There was extensive interbreeding among *Homo* "species"

## A HISTORY OF INTERBREEDING

Early modern humans, Denisovans, and Neanderthals all interbred with each other on multiple occasions in the past 100,000 years.

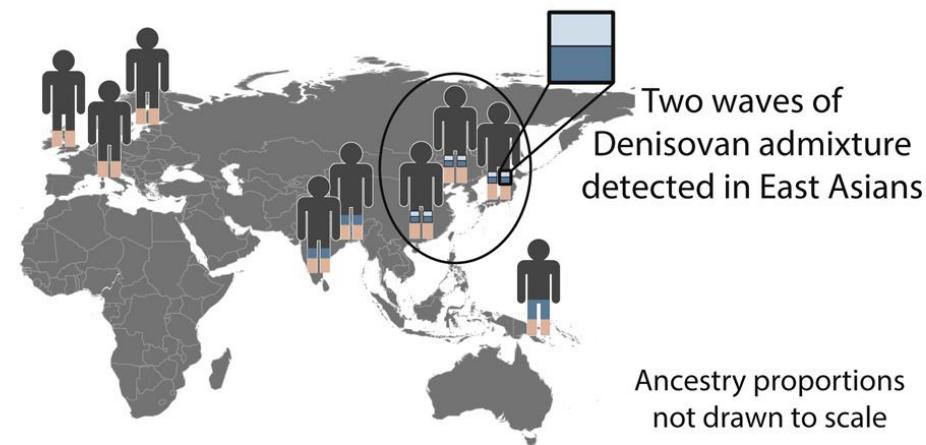
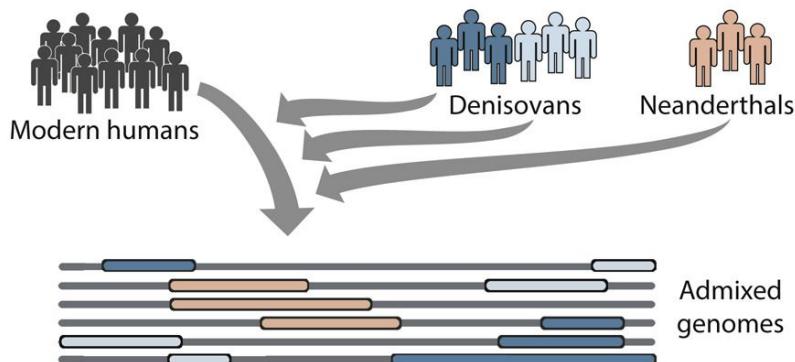


We see Neanderthal genes in certain human genomes, more so Asian than European. ~None in Africans



# *Homo sapiens* interbreeding with Denisovans

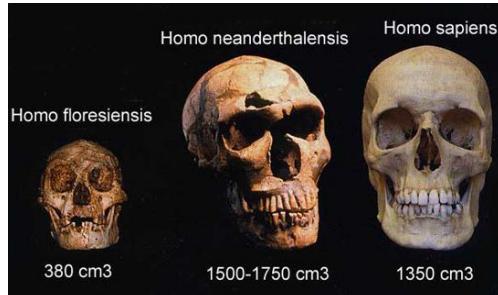
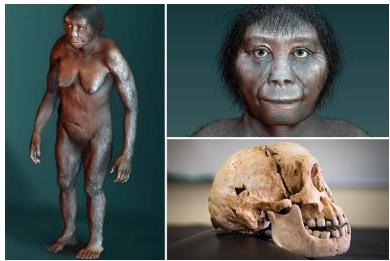
Admixture = fancy word for interbreeding



# Neanderthal-Denisovan hybrid discovered last year



# Other *Homo* species only observed outside of Africa



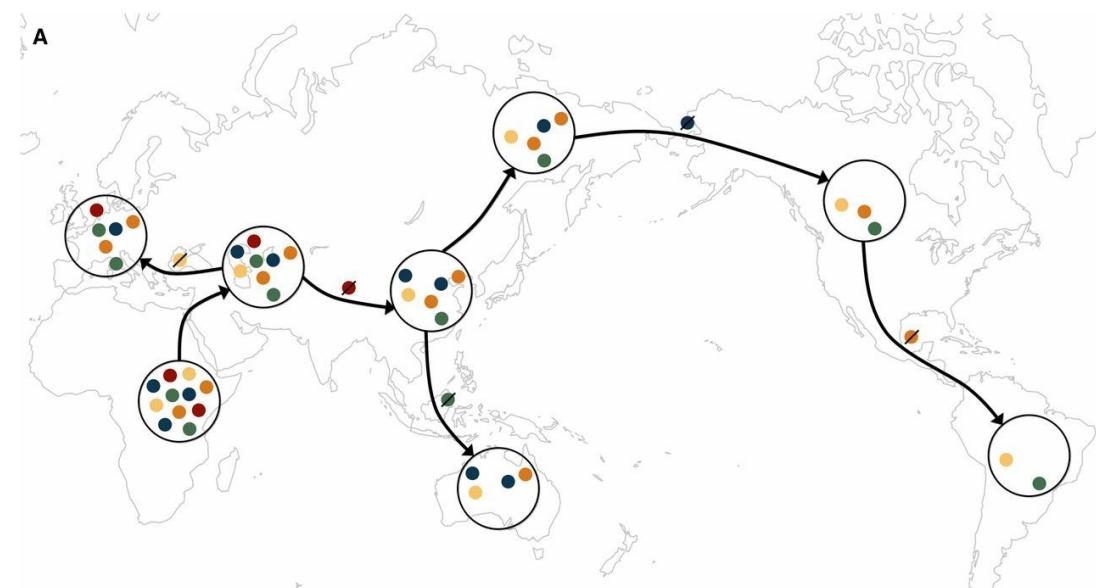
<https://www.youtube.com/watch?v=MGN2DvDYWgc>

# **Evolution and diversity of modern humans**

# Human genetic diversity is higher in sub-Saharan Africa

Two main reasons:

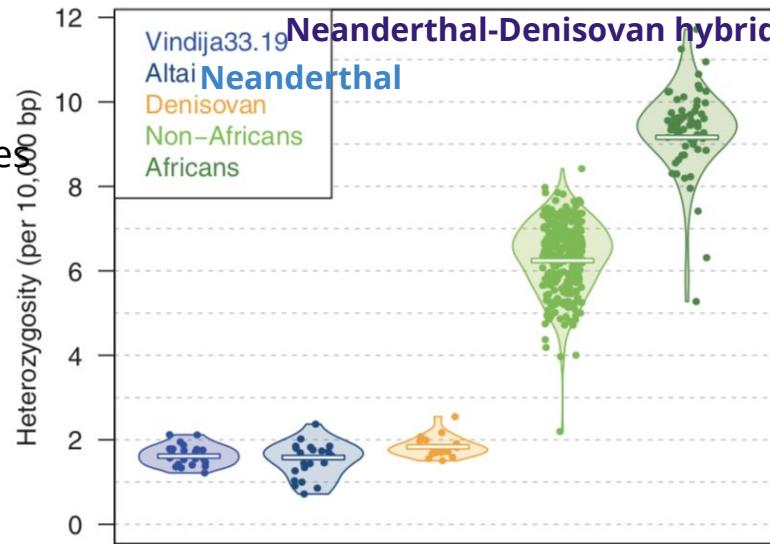
1. Successive bottlenecks (drift!)
2. Local adaptation to new environments (strong directional selection)



Circles = alleles

# Humans have much more diversity than do ancient (now extinct) species. Implications?

Y-axis: How many genes in an individual are heterozygous, per 10,000 nucleotides?



# Tales in local human adaptation



Marine diet



Lactose tolerance



Malaria resistance



Cholera resistance



Arsenic-rich environment



Cold climate



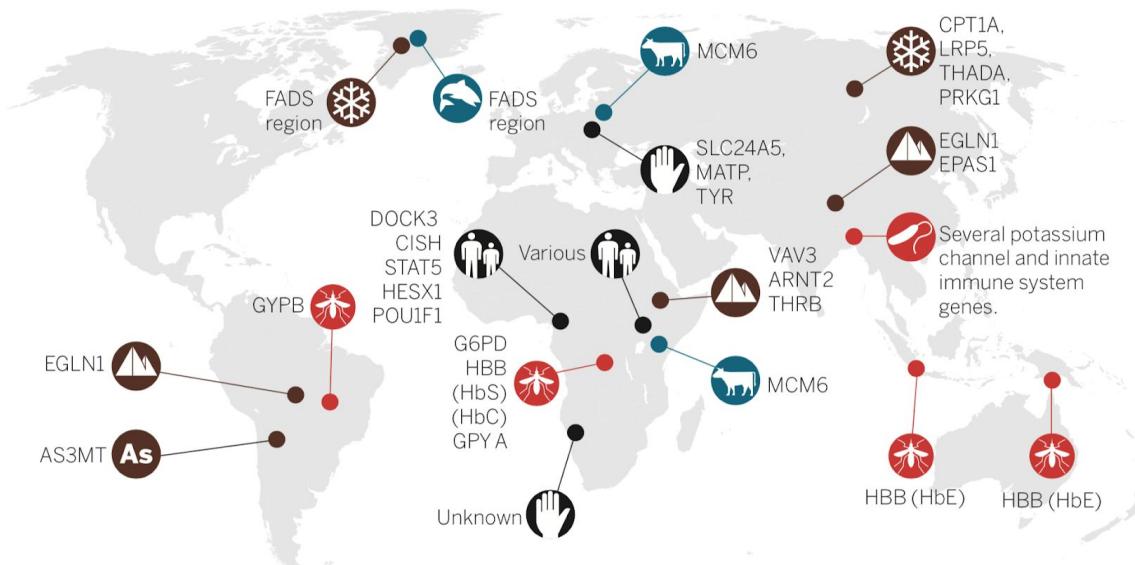
Altitude



Light skin pigmentation



Short stature

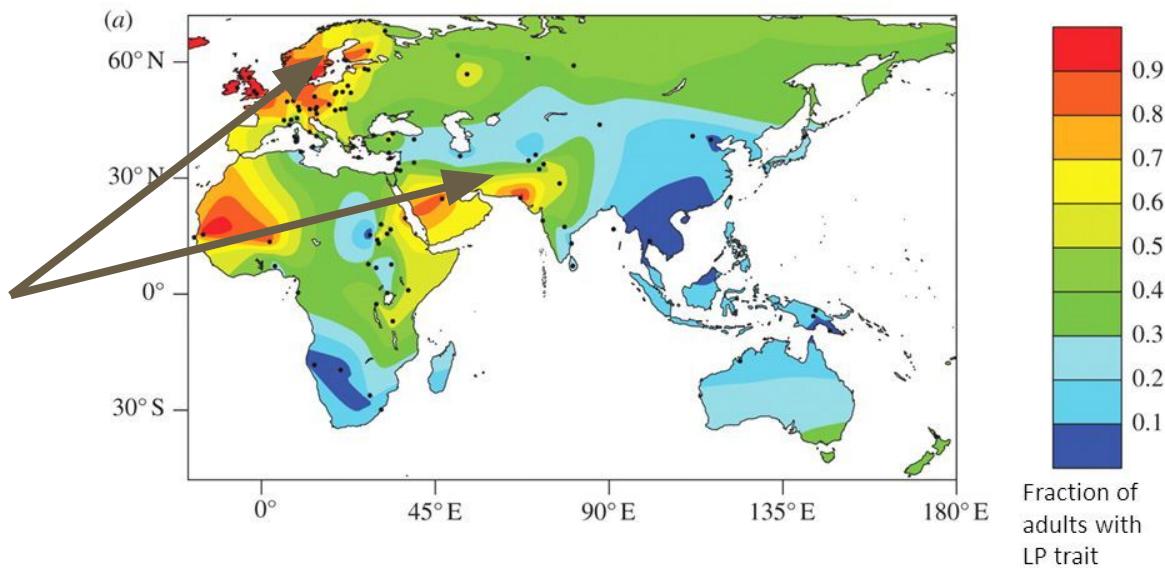


# The evolution of lactase persistence (LP)

- Lactose intolerance is an **ancestral trait!**
- As children we all digest milk by definition (we are mammals) with the **lactase enzyme**
- Lactose intolerant individuals stop making lactase between ages 2-5 years old.
- Individuals with lactase persistence keep making it, i.e. the lactase enzyme *persists* after childhood → lactose tolerance

# Who can drink milk?

Genomes show  
DIFFERENT mutations  
in the same gene  
allowing for LP!  
= **convergent**  
**evolution towards LP**  
in humans



# Light-colored skin is also convergently evolved

- **Allele frequencies** for the light-skin mutation of European populations.
  - Grey in pie chart = European mutation
  - Black in pie chart = Ancestral dark-skin gene



These human populations have light skin, but do NOT have the European mutation.

# High altitude populations have convergently adapted



Ethiopian Highlands

