

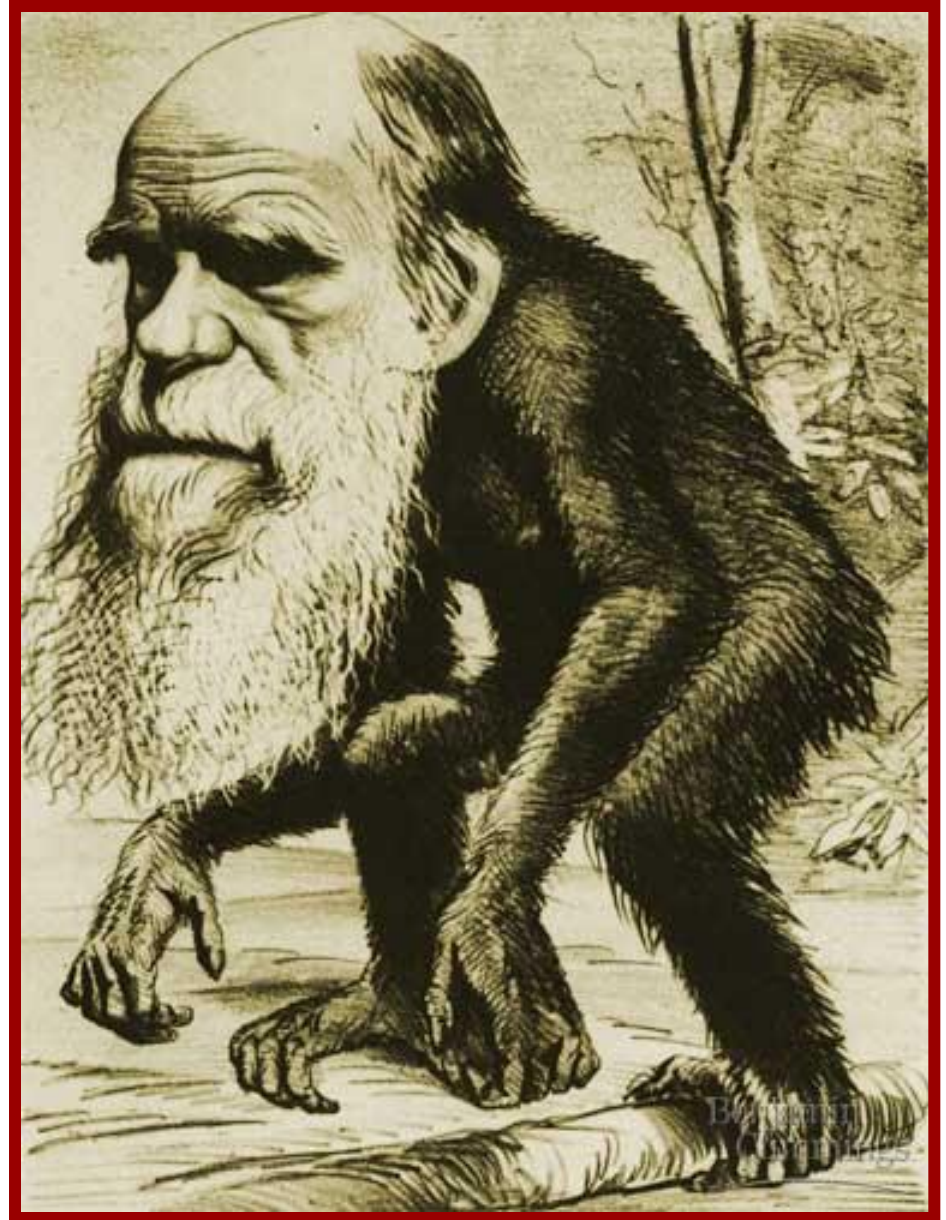
Human Evolution

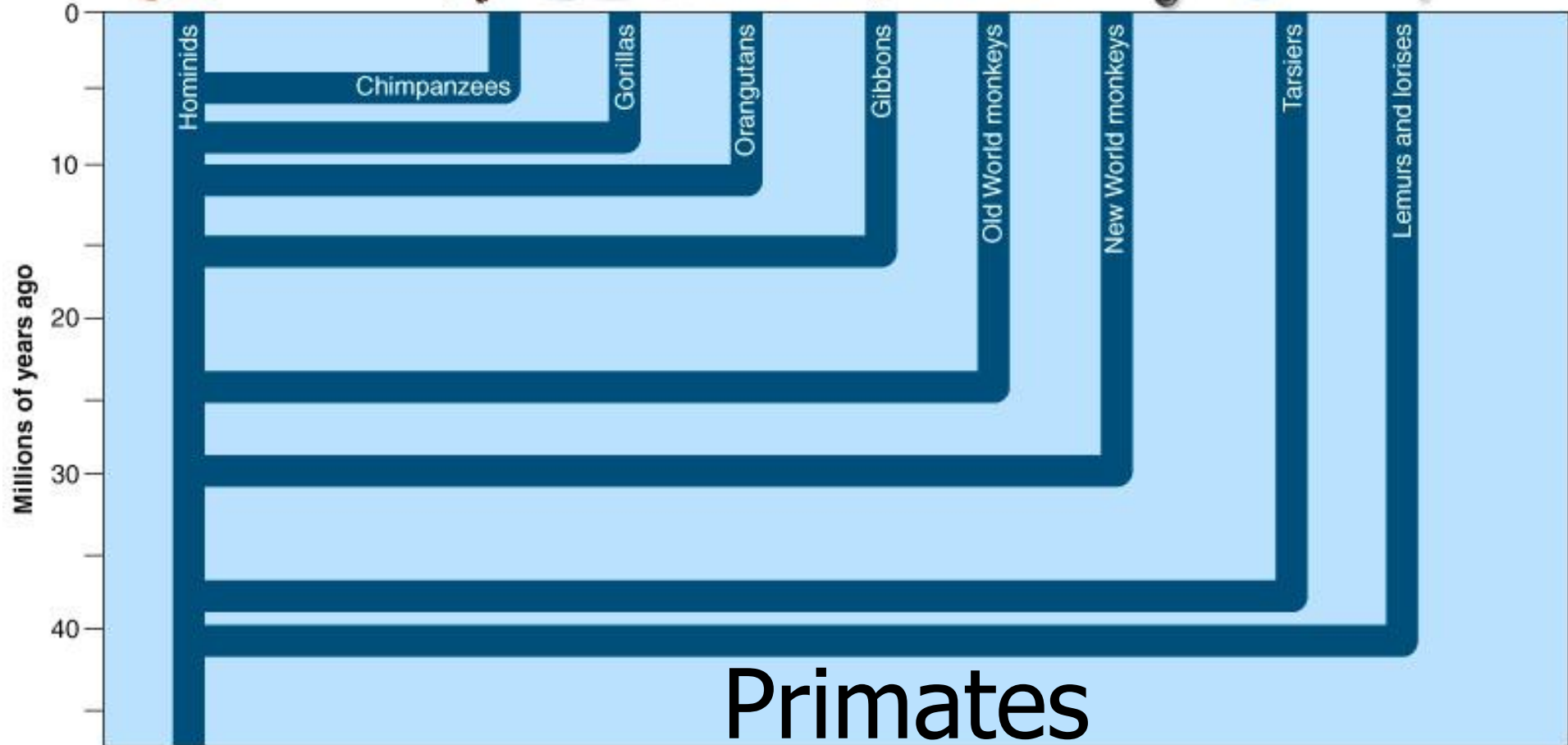
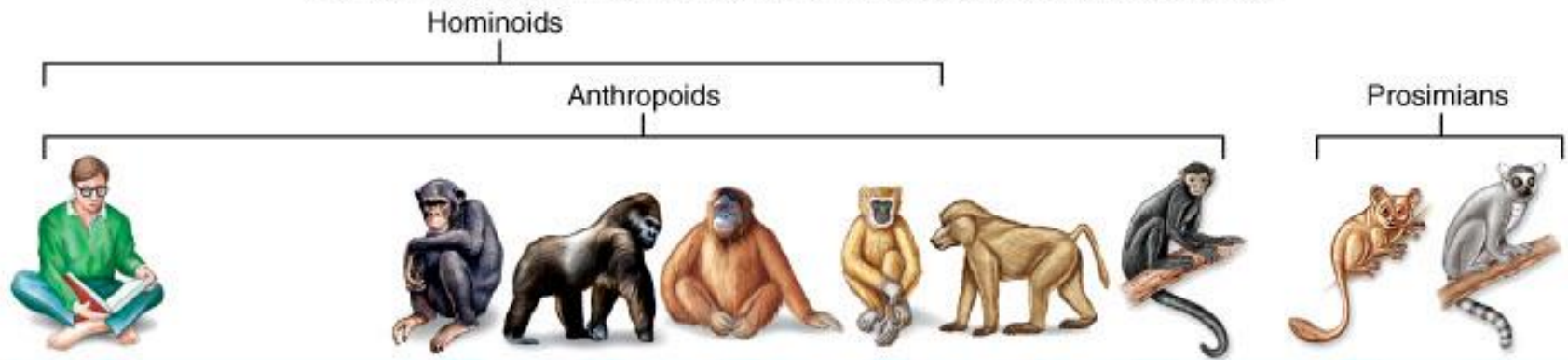
Chapter 3



Darwin and Human Evolution

- Lamarck posed the hypothesis about our relation to apes before Darwin
- Darwin published "Descent of Man" in 1871
- caused criticism of his theory, but already the basic ideas of evolution had taken hold in the scientific community.





Primates

Monotremes

Marsupials

**Elephants
Manatees
Hyraxes
Aardvarks**

**Sloths
Anteaters
Armadillos**

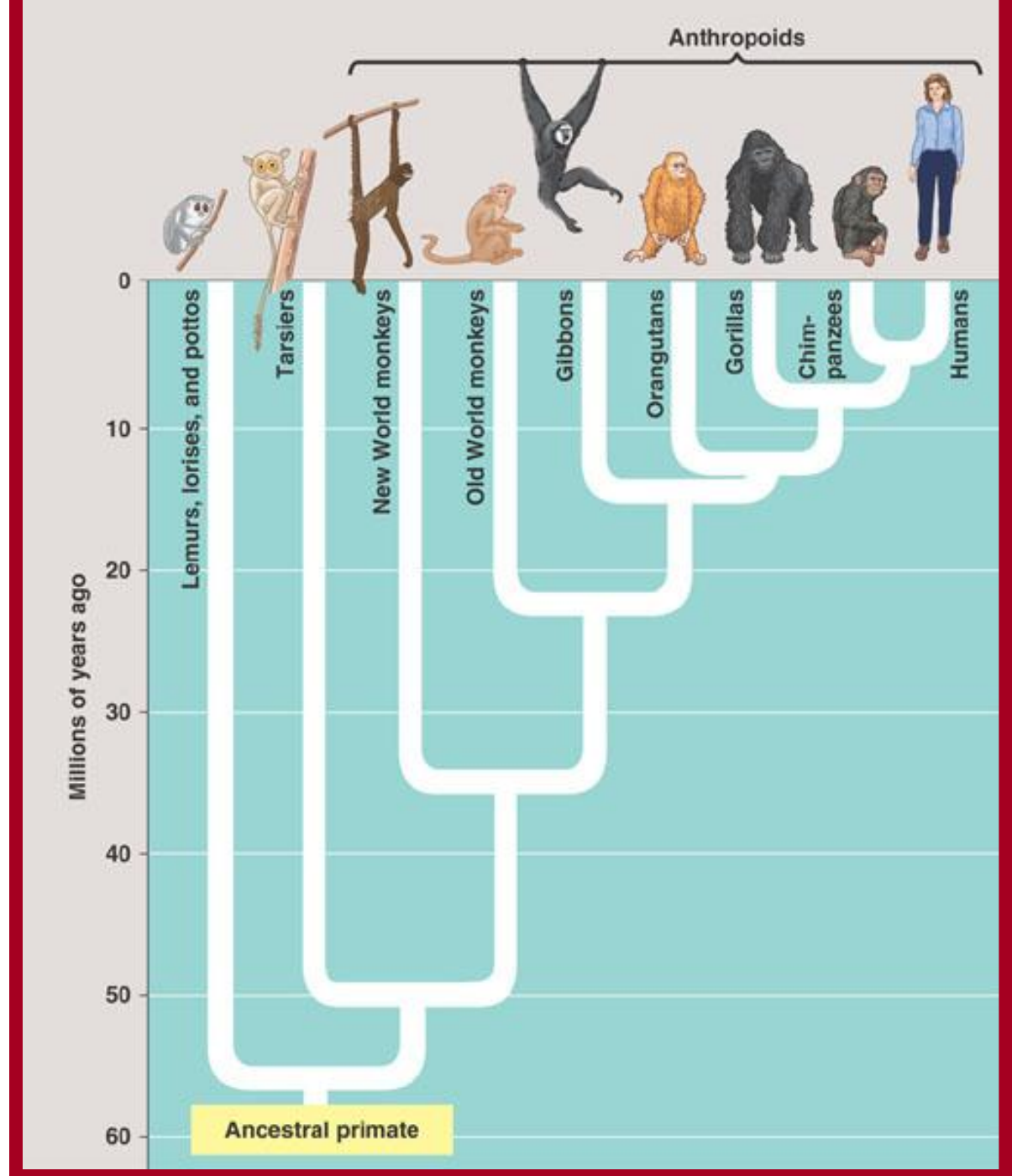
**Carnivores
Artiodactyls
Cetaceans
Perissodactyls
Bats
Core insectivores
(e.g., shrews)**

**Rodents
Rabbits
Tree shrews
Primates**

Eutherians

Ancestral mammal

Primates



What's new in Primates

- **Origins estimated back to 65 MYA**
 - **Oldest fossil only goes back 45 MYA**
 - **Insect eating nocturnal mammal**
- **Derived traits for life in trees in the tropics**
 - **Grasping hands and feet**
 - **Separate big toe / thumb**
 - **Sensitive Skin ridges on hands and feet**
- **Large brains – eye hand coordination- brachiating**
- **Short jaws**
- **Forward looking eyes – close together, stereo vision**
- **Flat nails – not claws**
- **Long parental care with learned behaviors.**
- **Single births**
- **Fully opposable thumb**

Primate groups

- **Prosimians**
 - include Lemurs, Tarsiers
 - Probably more similar to origin arboreal ancestral primates
- **Anthropoids**
 - Include Monkeys, Apes and Humans
 - Split from the Prosimians about 45 MYA

Anthropoids

- **Include the Monkeys and the Hominoidea**
- **Monkeys** evolved in two areas, split about 35 MYA
 - **New World monkeys (older),**
 - all arboreal
 - have prehensile tail, nostrils open to the sides
 - Squirrel and capuchin monkeys
 - **Old World monkeys**
 - both arboreal and ground dwellers
 - Lack prehensile tail, nostrils open downwards
 - Rhesus monkey, baboons, macaques

Hominoids

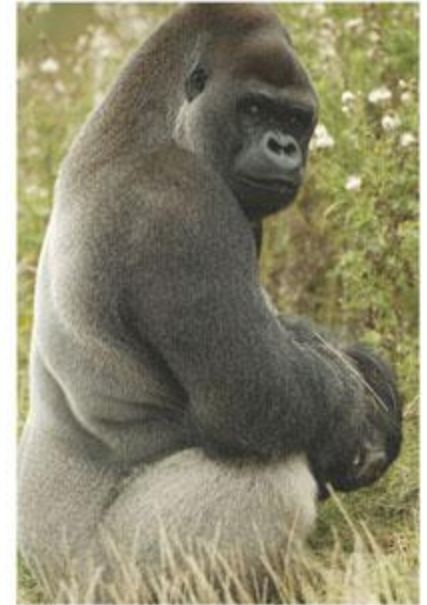
- **Include Great Apes and Humans**
 - **Apes: Gibbons, Orangutan, Gorillas, Chimpanzee/ Bonobo**
- **Split from monkeys about 20-25MYA**
- **Larger brain size to body size ratios than other primates**
- **More flexible behavior (less instinct, more learned behaviors)**
- **Mostly larger than monkeys (except gibbons)**
- **Have long arms, short legs and no tail.**
- **Gibbons and orangutans primarily arboreal**
- **Gorillas, Chimps and Humans**
 - **Social behavior**
 - **Primarily terrestrial**
 - **Chimps more closely related to humans than gorillas.**



(a) Gibbons, such as this Muller's gibbon, are found only in southeastern Asia. Their very long arms and fingers are adaptations for brachiation.



(b) Orangutans are shy, solitary apes that live in the rain forests of Sumatra and Borneo. They spend most of their time in trees; note the foot adapted for grasping and the opposable thumb.



(c) Gorillas are the largest apes: some males are almost 2 m tall and weigh about 200 kg. Found only in Africa, these herbivores usually live in groups of up to about 20 individuals.



(d) Chimpanzees live in tropical Africa. They feed and sleep in trees but also spend a great deal of time on the ground. Chimpanzees are intelligent, communicative, and social.



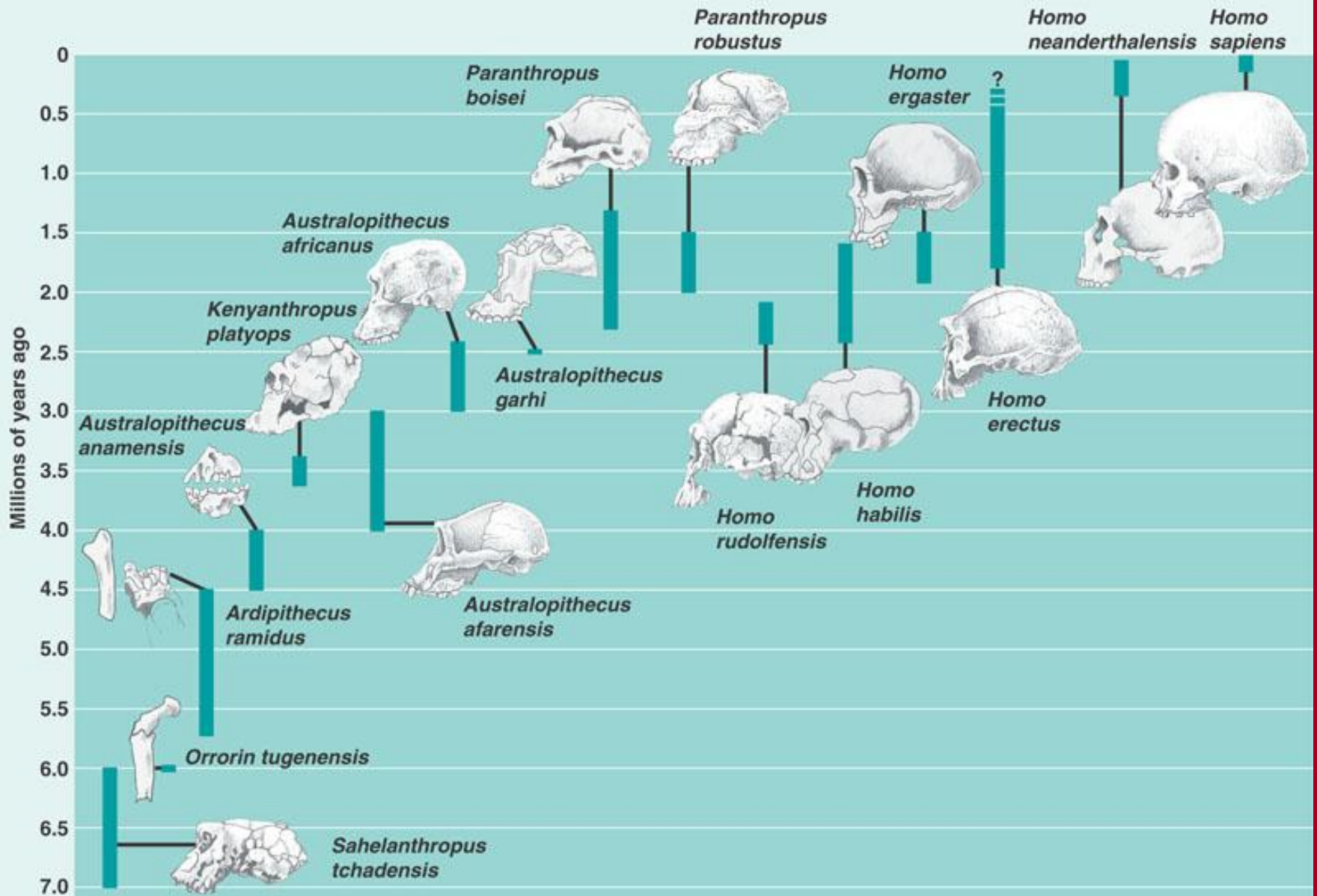
(e) Bonobos are closely related to chimpanzees but are smaller. They survive today only in the African nation of Congo.

Hominoids

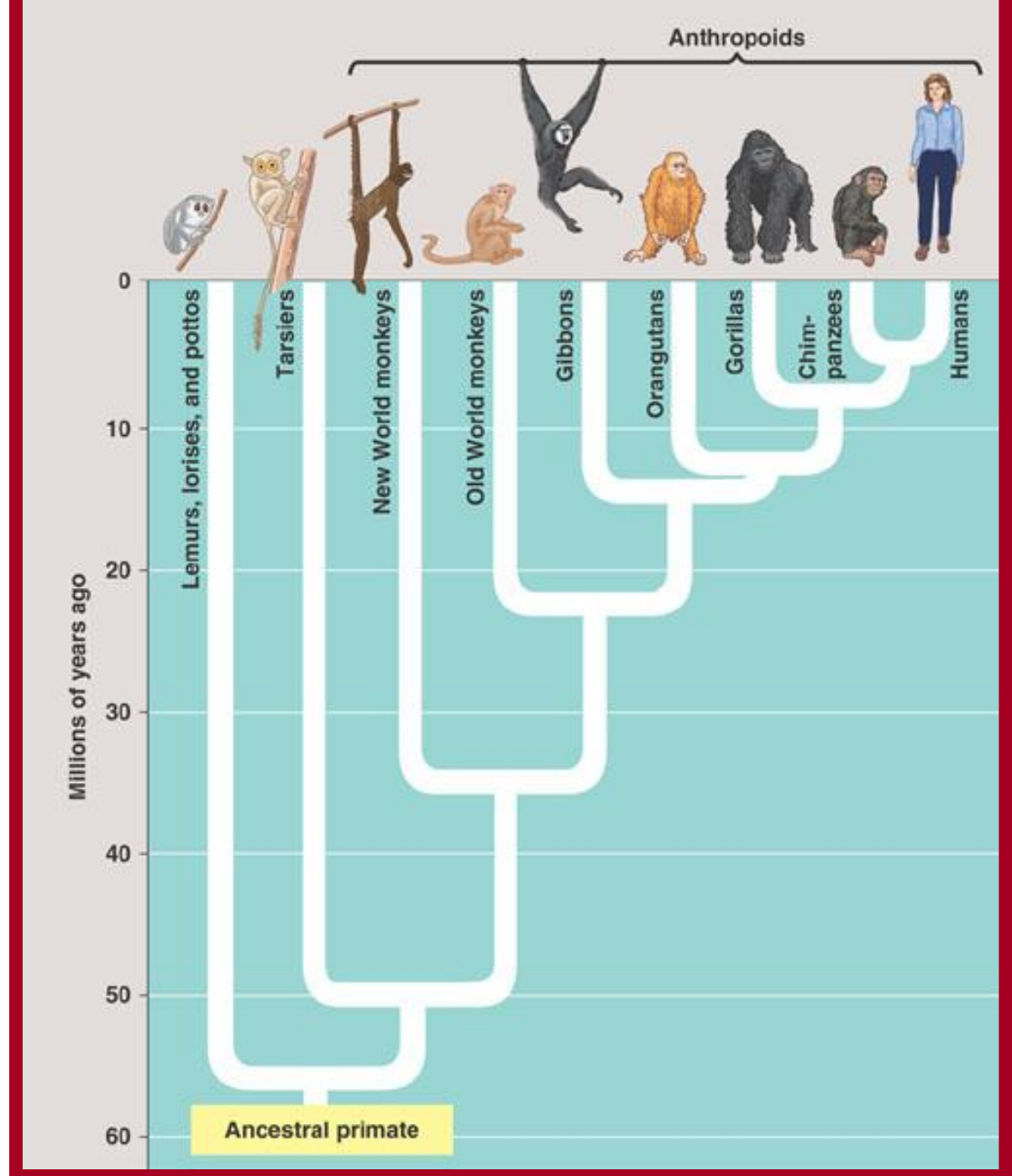


Hominins (Hominids)

- **All species believed to be more closely related to human than chimpanzees**
- **Humans and our direct ancestors, since the split from chimps.**
- **Major groups:**
 - **Australopithecines**
 - **Paranthropus**
 - ***Homo* genus**
- **Chimps are not ancestral species !! We shared a common ancestor.**
- **Not a direct line to us !! A radiating lineage. Several hominids species co-existed.**
- **Gorillas, chimps and hominids split about 6-8 MYA. At a generous 25 year generation time: 320,000 generations ago with strong natural selection**



Primates

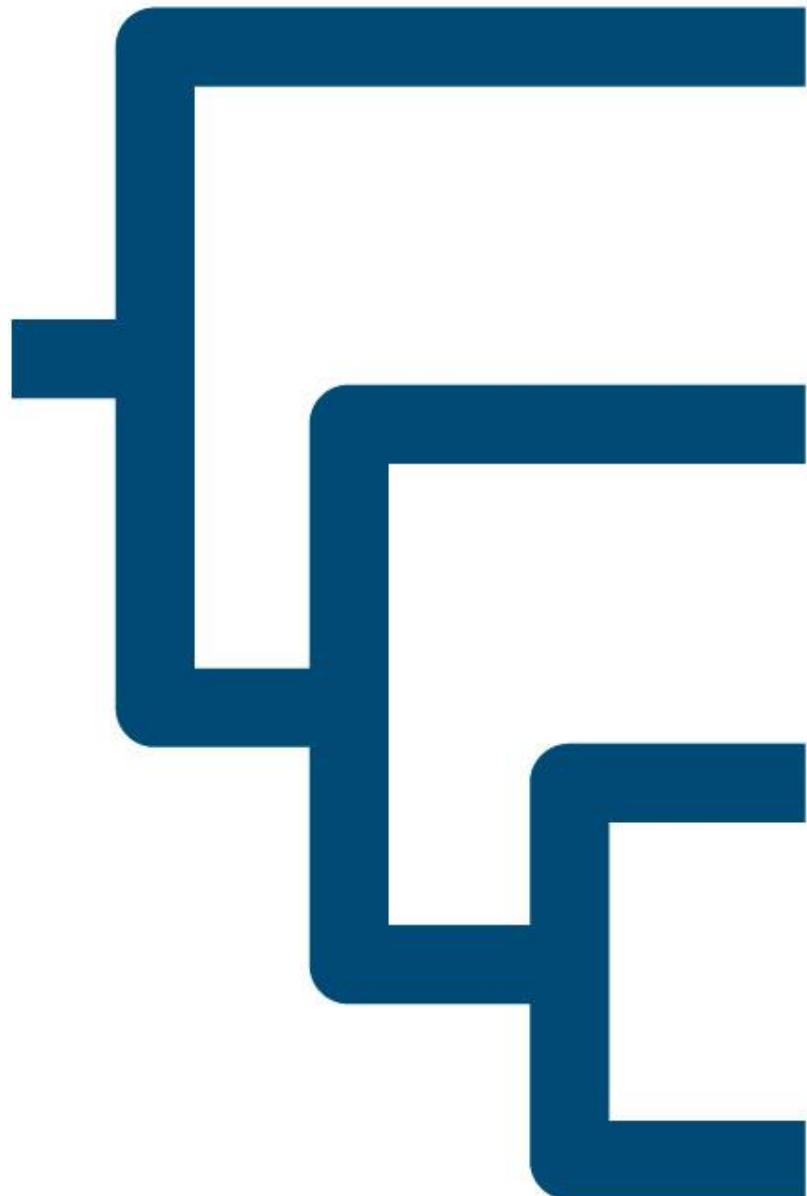


Hominid evolution

- **Driven by life on the ground.**
- **Not all traits at the same time!!**
 - **Mosaic Evolution**
- **We walked upright for several million years before an increase in skull size**

Chromosome anomaly:

- **Other extant hominoids have $2n=48$.**
- **Hominids (at least humans) have 46.**
- **Two ape chromosomes fused into the human chromosome number 2 (our largest).**
- **Changed happened after with out last common ancestor with the chimpanzee lineage.**



Orangutan
48 chromosomes



Gorilla
48 chromosomes



Chimpanzee
48 chromosomes



Human
46 chromosomes

Hominid life on ground:

- **Bipedalism, upright walking**
- **Jaw shape -smaller with specialized teeth with an omnivorous diet. Pronounced chin.**
- **larger brain size, increased cerebrum, by paedogenesis**
- **Reduced size difference between sexes**
- **tool use, language, social behavior**
- **Extended parent care time- longer juvenile period**
- **More learning**
- **Reduced sense of smell**
- **Increased size of brain for vision and co-ordination with muscles**
- **Eyes are larger and directed forward**

Chimpanzee

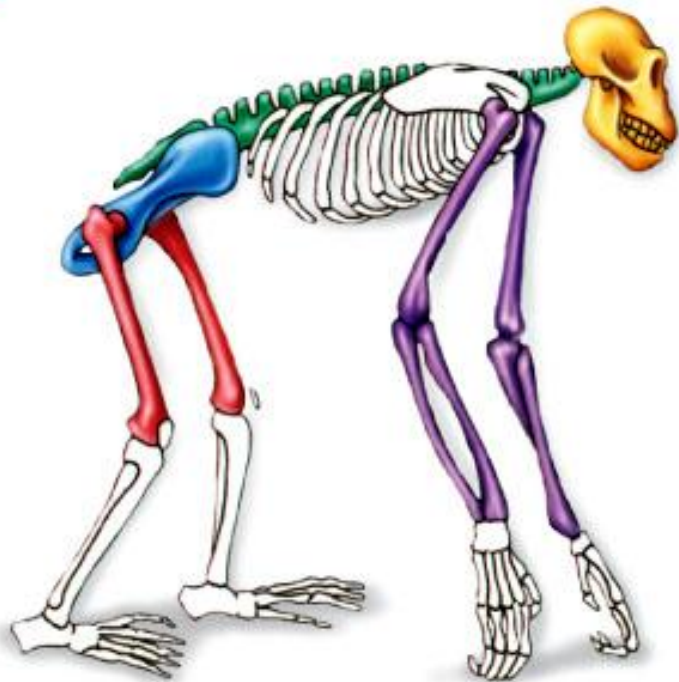
Skull attaches posteriorly

Spine slightly curved

Arms longer than legs and also used for walking

Long, narrow pelvis

Femur angled out



Australopithecine

Skull attaches inferiorly

Spine S-shaped

Arms shorter than legs and not used for walking

Bowl-shaped pelvis

Femur angled in

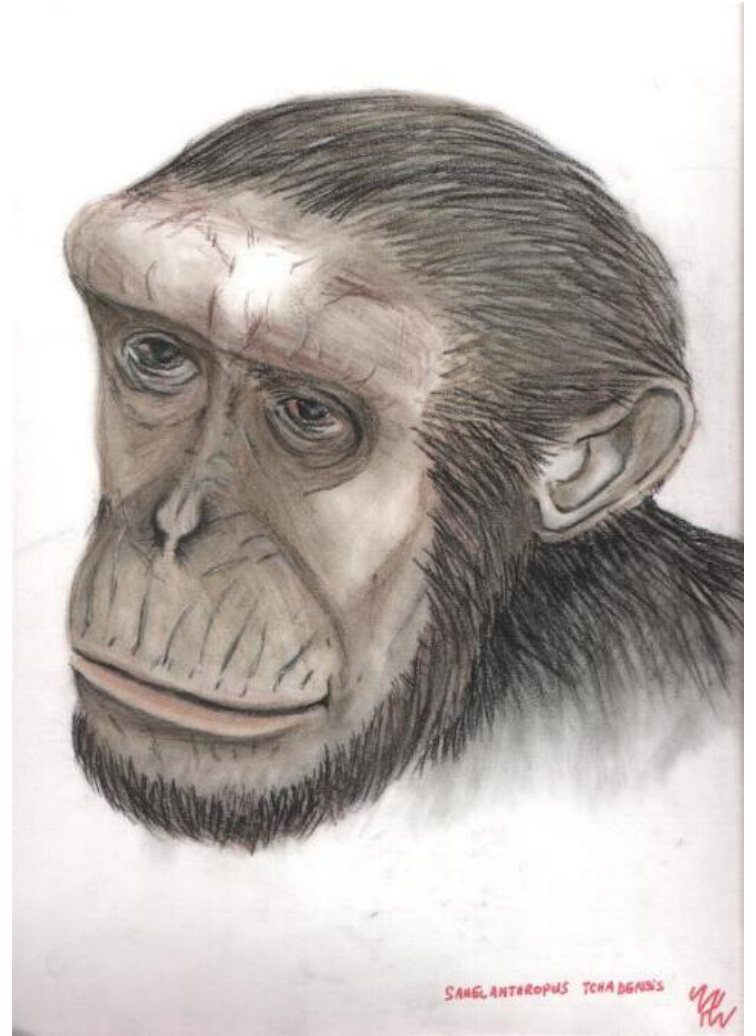


Origins

- ***Sahelanthropus tchadensis* current oldest fossil at 6-7 million years ago.**
 - **Reduced canine teeth**
 - **Flatter faces**
 - **More upright and bipedal than other hominoids**
- **Fossils discovered in 2002**



Sahelanthropus



Orrorin tugenensis

- **Dates to 6.1-5.8 MYA**
- **Discovered in 2000**
- **Thought to be in evergreen forest, not open grassland**
- **Oldest bipedal fossils**
- **Fossilized bones from 5 individuals**
- **Only a few femurs and teeth**

Orrorin tugenensis

Leg bones →

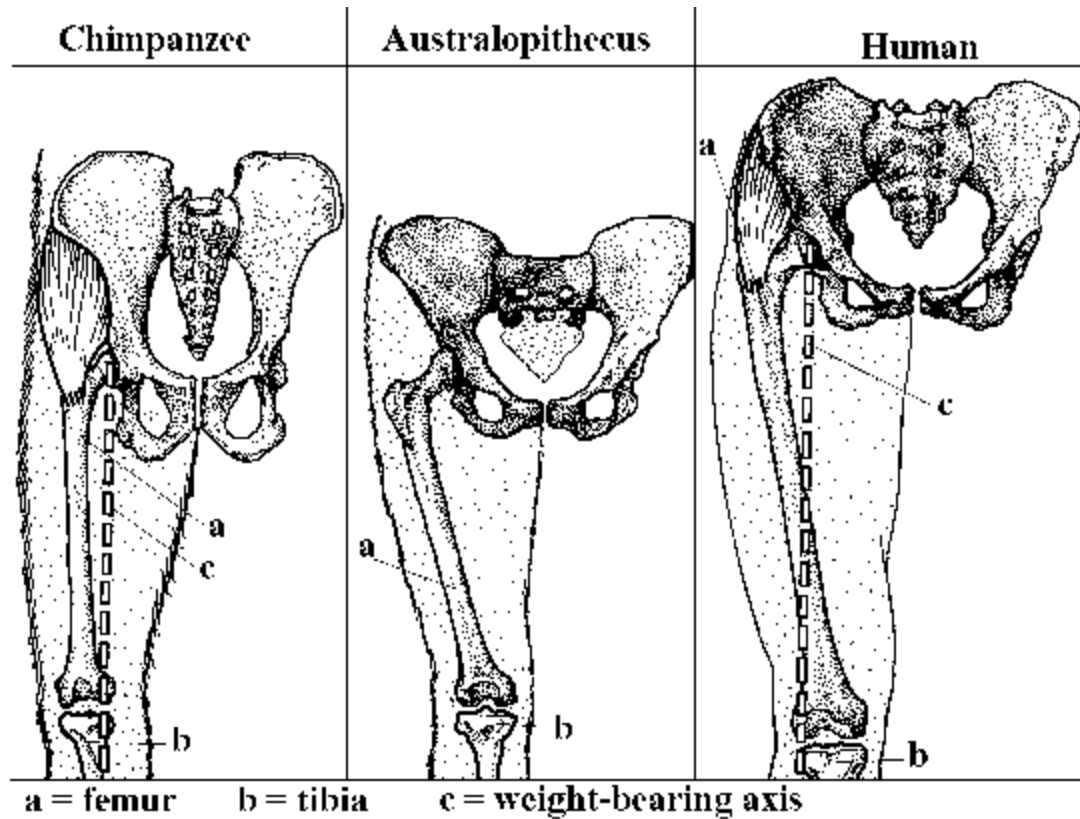
Teeth →



Neck bones ↑

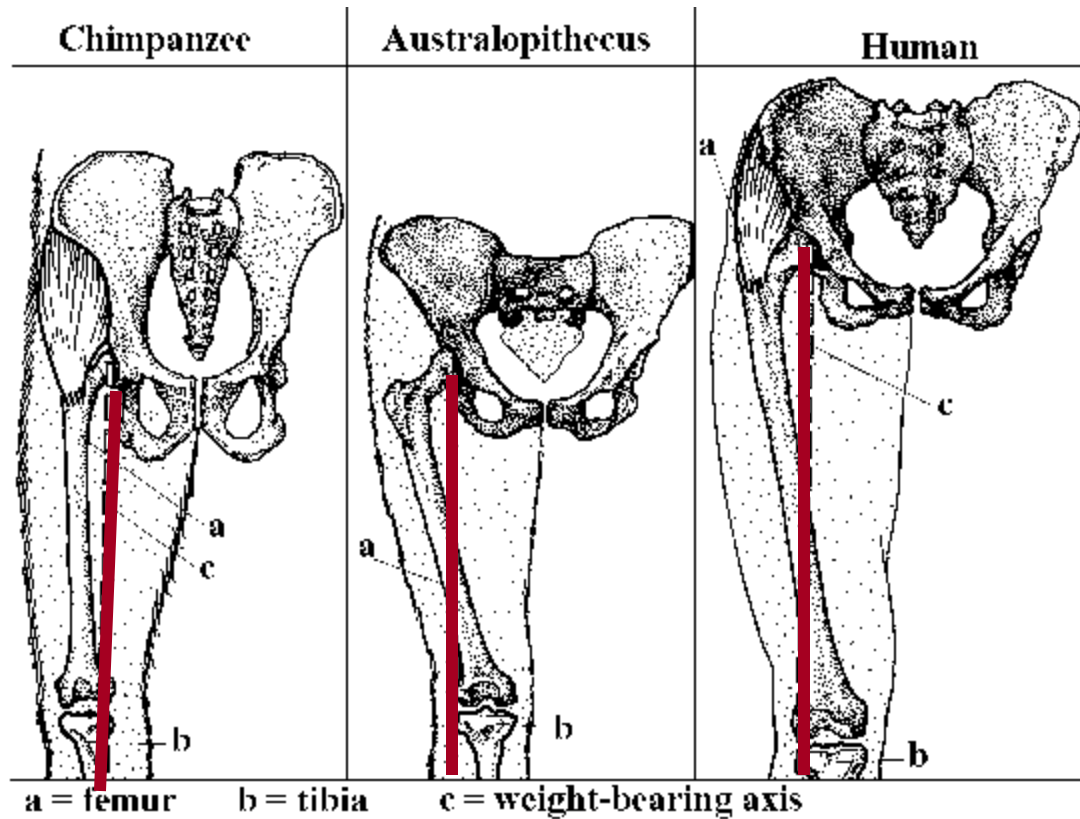
- **(Tattersall 1996):**
- **"In a quadruped – an ape, say – the feet are held far apart, and each hind leg descends straight to the ground beneath the hip socket. In bipedal humans, on the other hand, the feet pass close to each other during walking so that the body's center of gravity can move ahead in a straight line. If this didn't happen, the center of gravity would have to swing with each stride in a wide arc around the supporting leg. This would be extremely clumsy and inefficient, wasting a lot of energy. So in bipeds, both femora angle in from the hip joint to converge at the knee; the tibiae then descend straight to the ground. In the human knee joint, this adaptation shows up in the angle – known as the "carrying angle" – that is formed between the long axis of the femur and tibia."**

Weight bearing on knees



- **Zihlman, Simmons 2000**

Weight bearing on knees



- **Zihlman, Simmons 2000**

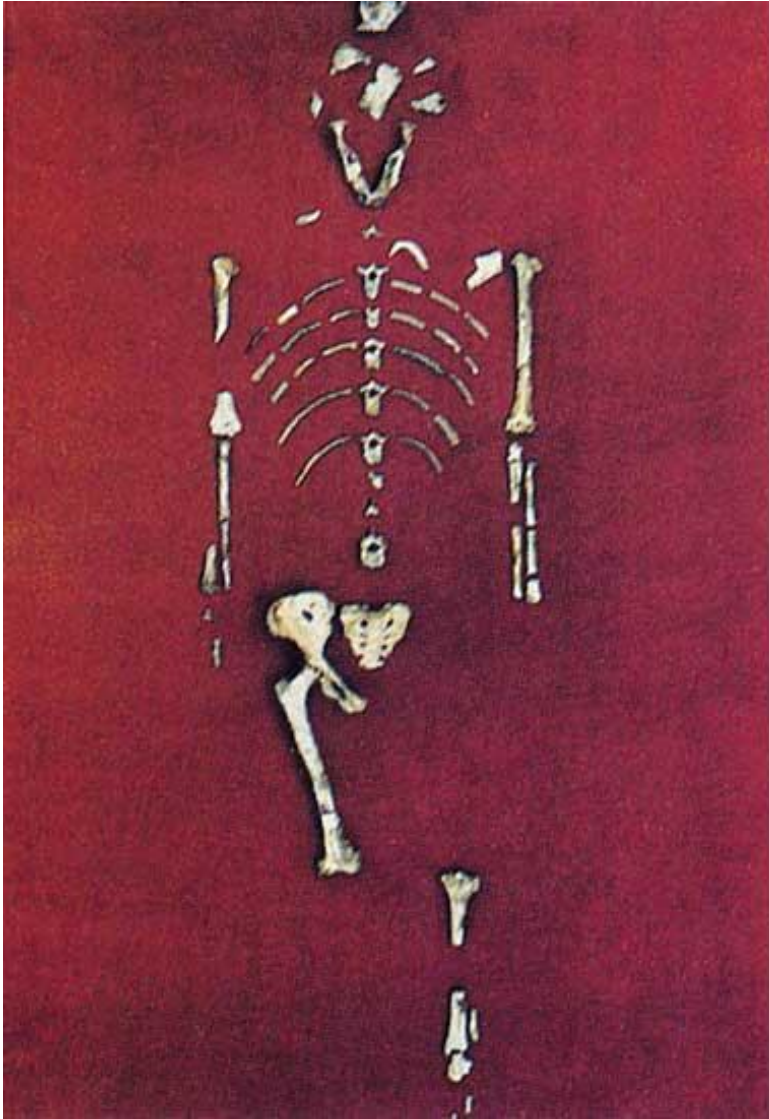
Australopithecus

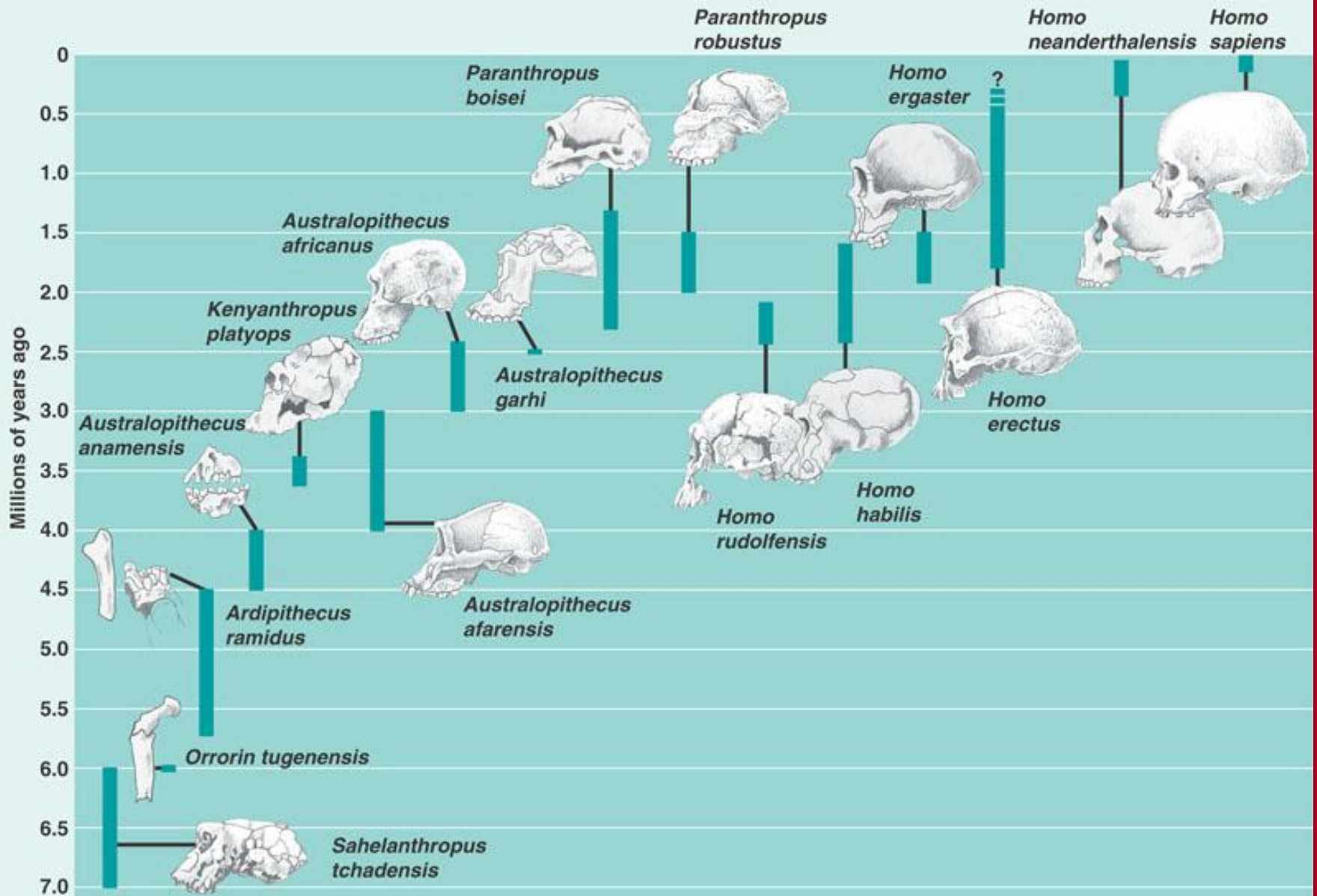
First “humans”: Australopithecus, about 4.4 MYA.

- **Walked fully upright with humanlike teeth and hands.**
 - **Fossil evidence of hip, hands.**
- **Skull, capacity about 1/3 modern human size.**
- **lasted 3 MY.**
- **All fossils from Eastern and Southern Africa**

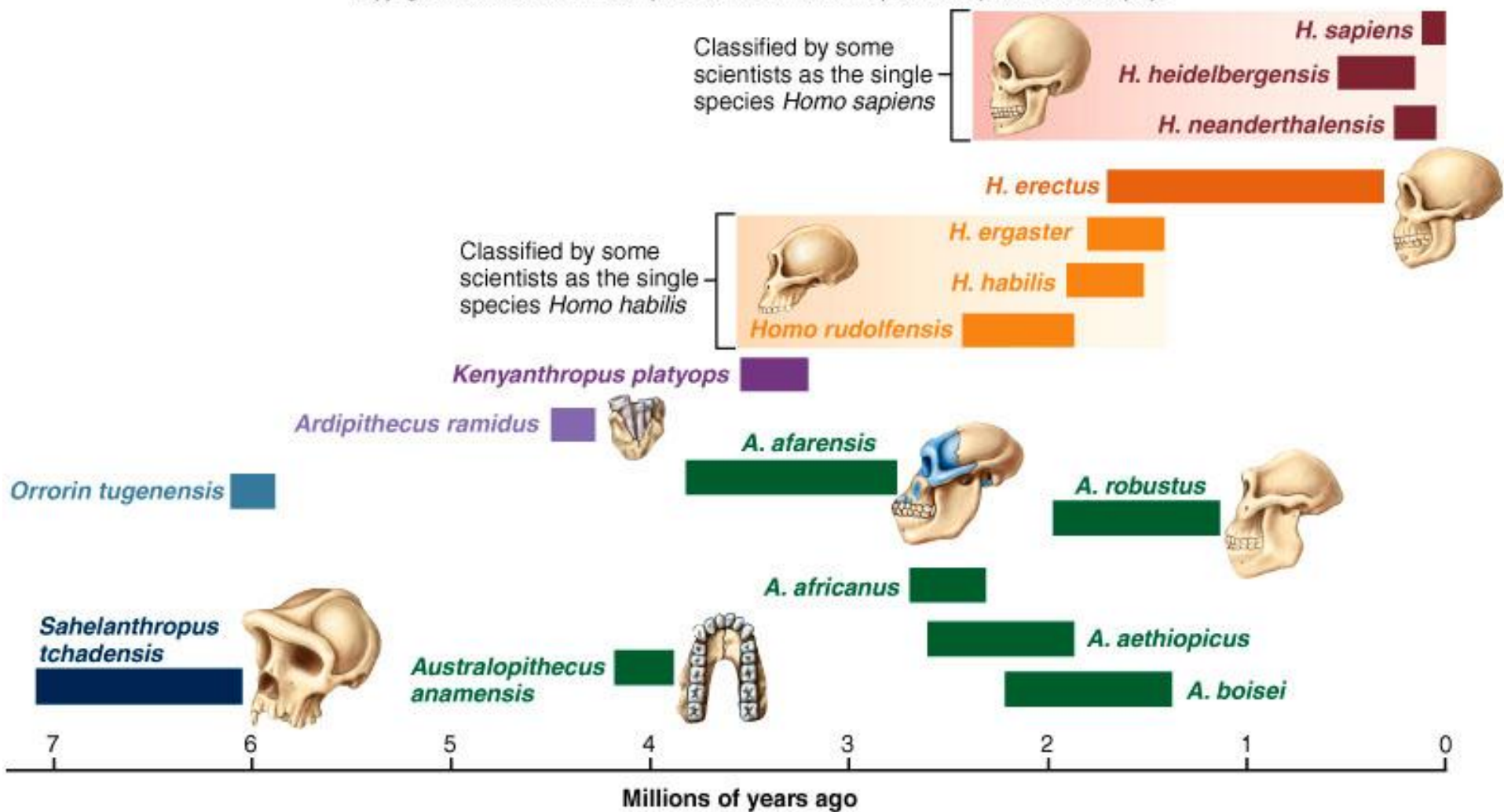


“Lucy” *Australopithecus afarensis*
3.24 million years old





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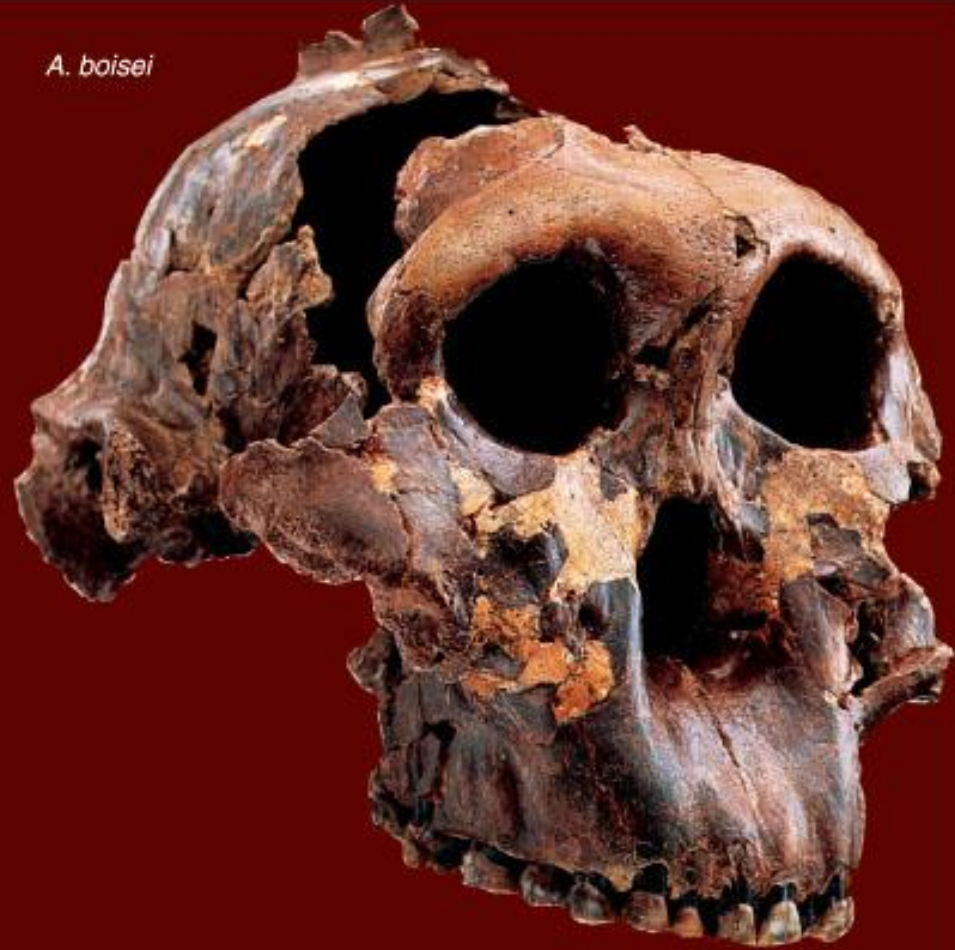


(c) An artist's reconstruction of what *A. afarensis* may have looked like.

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A. robustus



A. boisei

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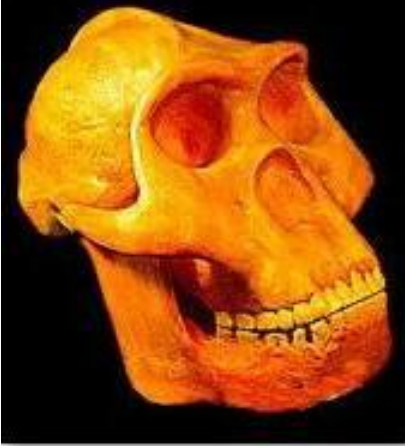


A. afarensis

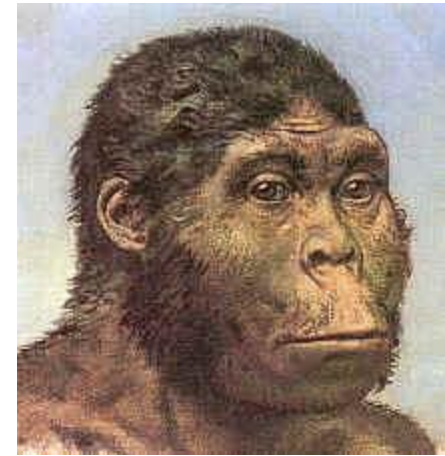
A. africanus



LUCY
San Diego Museum of
Man

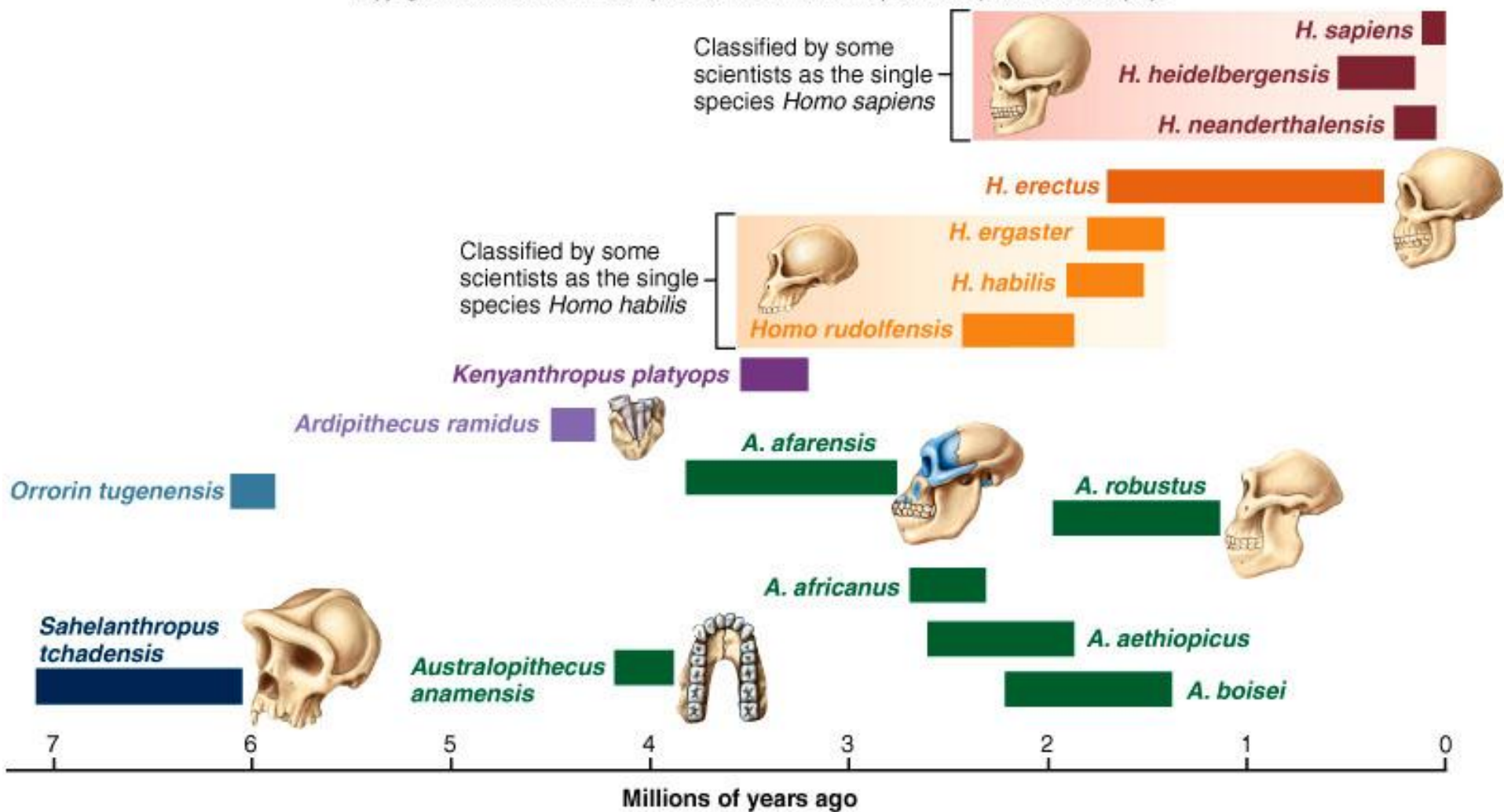


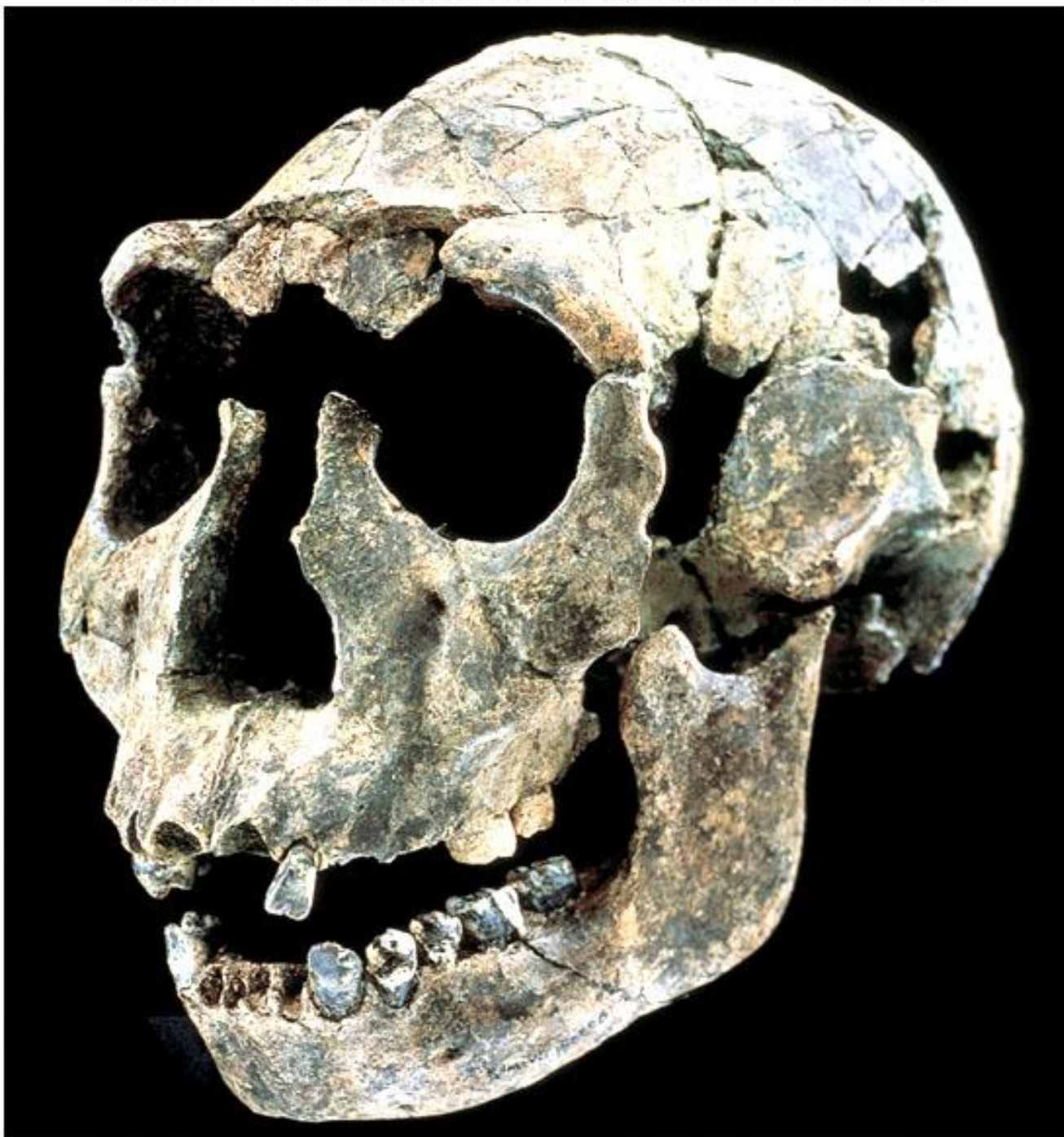
Homo habilis



- **Homo habilis fossils from 2.5 to 1.6 MYA.**
- **After walking upright for 2 MY these hominids now used their brains and fashioned simple stone tools.**
- **Co-existed with smaller-brained Australopithecus for nearly 1 MY.**
- ***Australopithecus africanus* was a dead end, no new lineages.**
- ***Homo habilis* lead to *H. erectus*, to *H. sapiens*.**

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- **Intermediate fossil between *Homo habilis* and *H. erectus***
- **1.7 million years old**





Homo ergaster

- **Less sexual dimorphism, more pair bonding**
- **Larger brain**
- **Slender legs, distance walking**
- **Short straight fingers. No longer climbing trees**
- **Smaller teeth, foods more prepared less hard chewing**
- **More advanced tools**
- **More habitats**
- **1.9 - 1.6 MYA**



Homo erectus

- **Homo erectus was the first to migrate out of Africa into Europe and Asia.**
 - **Java man and Peking man are Homo erectus.**
 - ***H. erectus* 1.8 MYA - 300,000 YA.**
 - **gave rise to larger populations, had to continually expand to find food, hunt farther out.**

Homo heidelbergensis

- **Descended from H. ergaster in africa, spread out.**
- **Northern populations in Europe under ice age conditions became The Neanderthals 200,000 -40,000 years ago in Europe**
- **Reaming population in Africa adapted to drought conditions, became homo sapiens, spread out to rest of world.**

- **Intermediate fossil between *Homo habilis* and *H. erectus***
- **1.7 million years old**

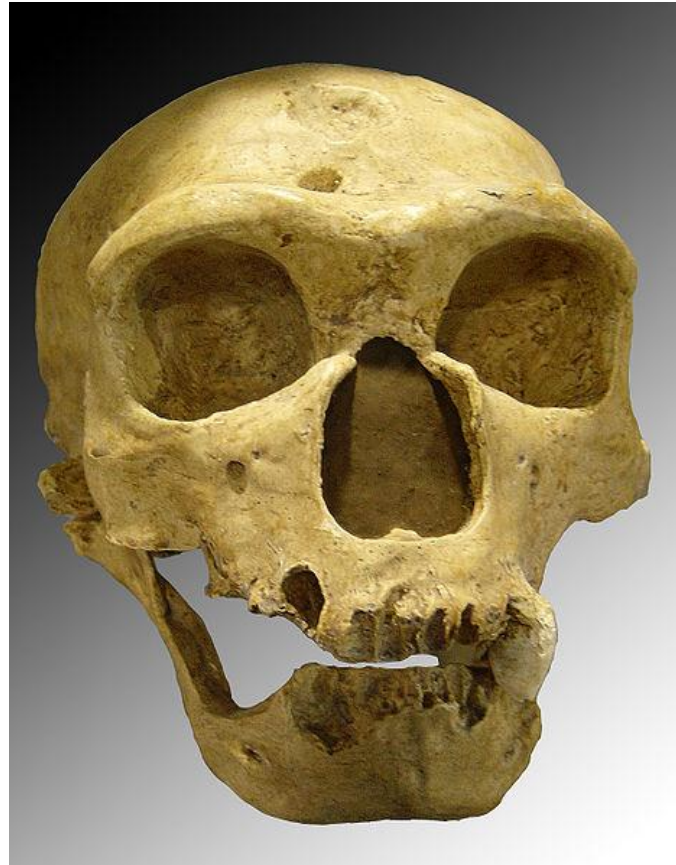


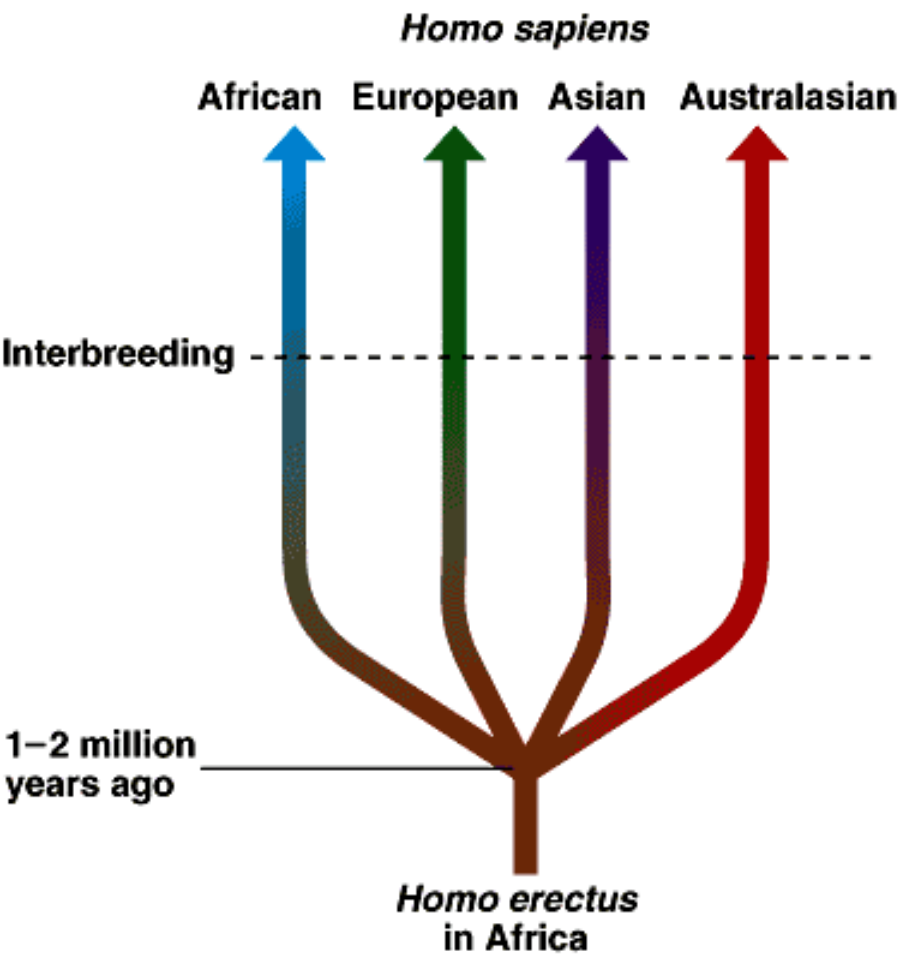


Homo neanderthalensis

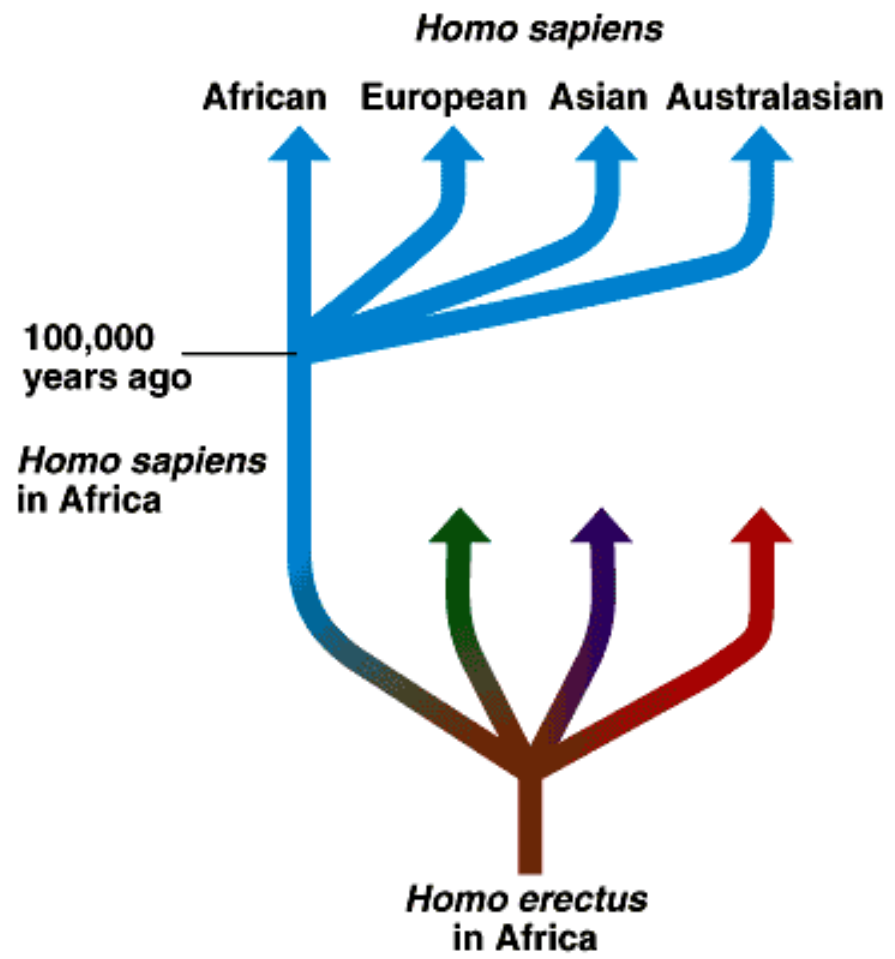
- **The Neanderthals**
- **200,000 -40,000 years ago in Europe**
- **Brain as large or larger than present day humans**
- **Buried their dead**
- **Made hunting tools from stone and wood**
- **Carnivorous**

Neanderthal





(a) Multiregional hypothesis



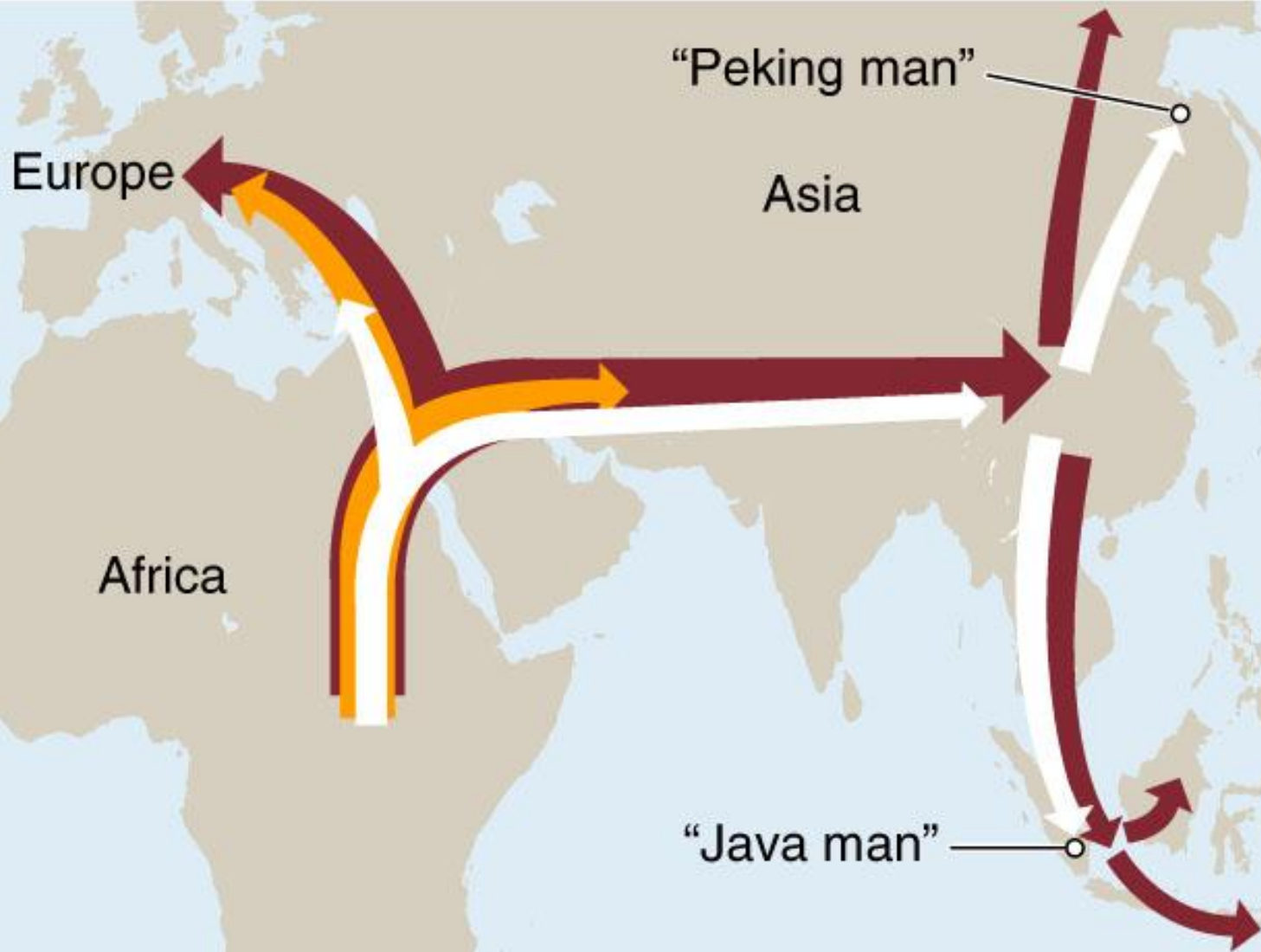
(b) "Out of Africa" hypothesis
(replacement hypothesis)

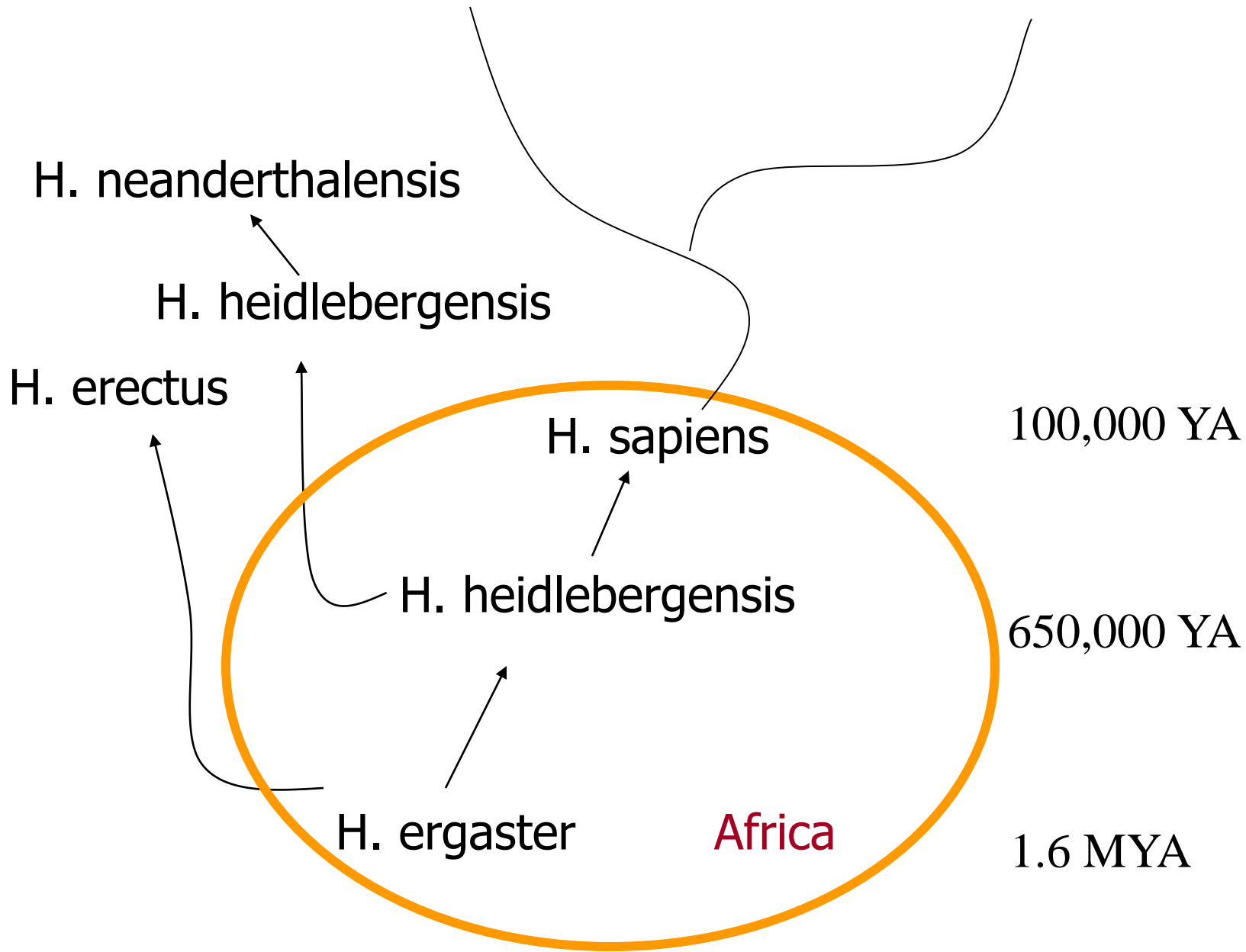
Homo sapiens

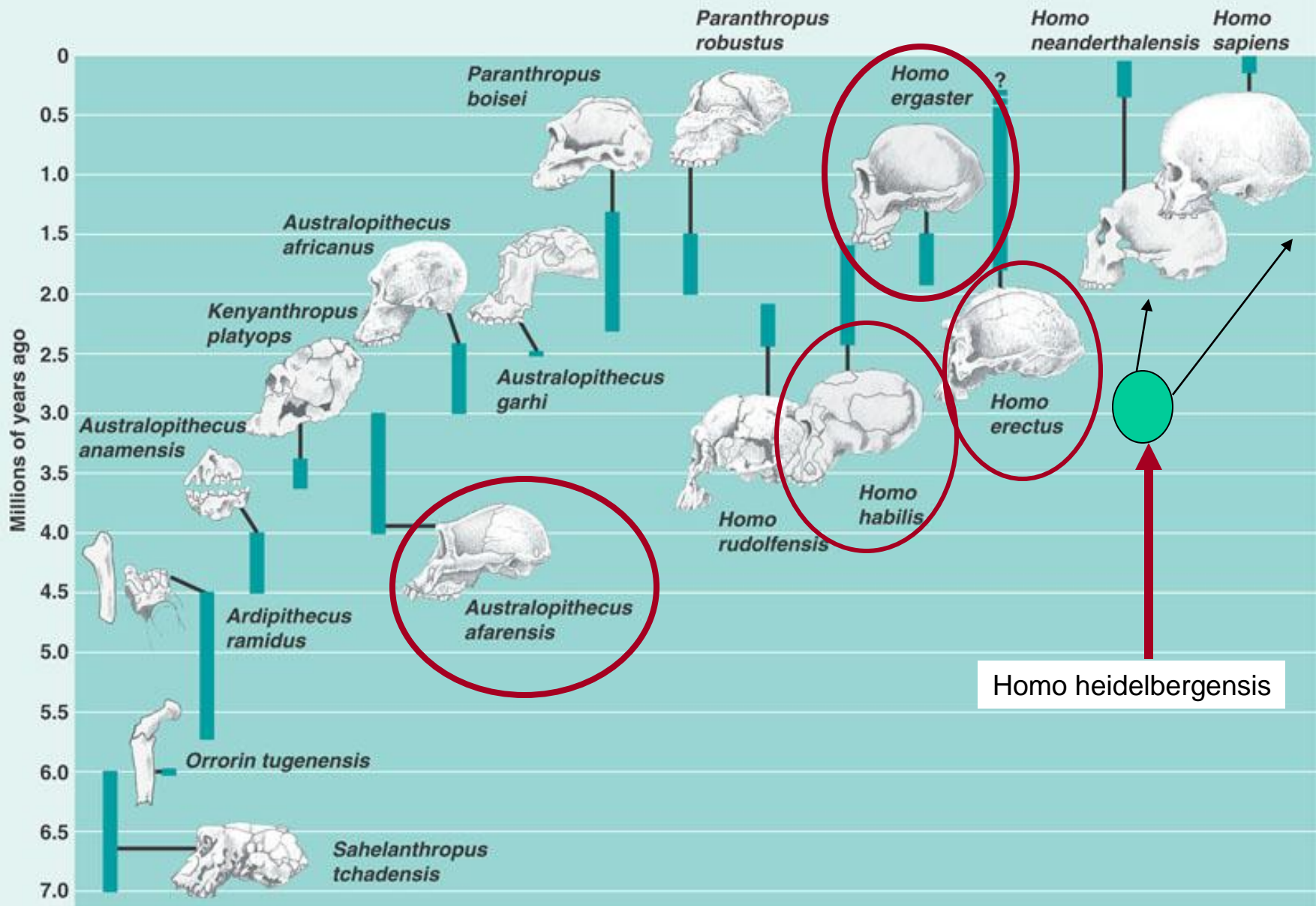
- **Two models for the origins of anatomically modern Humans**
- **Multi regional model has interbreeding among the different H. erectus groups and a common origin for Homo sapiens on the different continents.**

Out of Africa

- **the replacement model has a new *H. sapiens* species forming in Africa 100,000 years ago and radiating out and displacing the *H erectus* populations.**
 - **Supported by molecular data**
- **Three times???**
 - *Homo erectus*
 - *Homo heidelbergensis*
 - *Homo neanderthalensis*
 - *Homo sapiens*

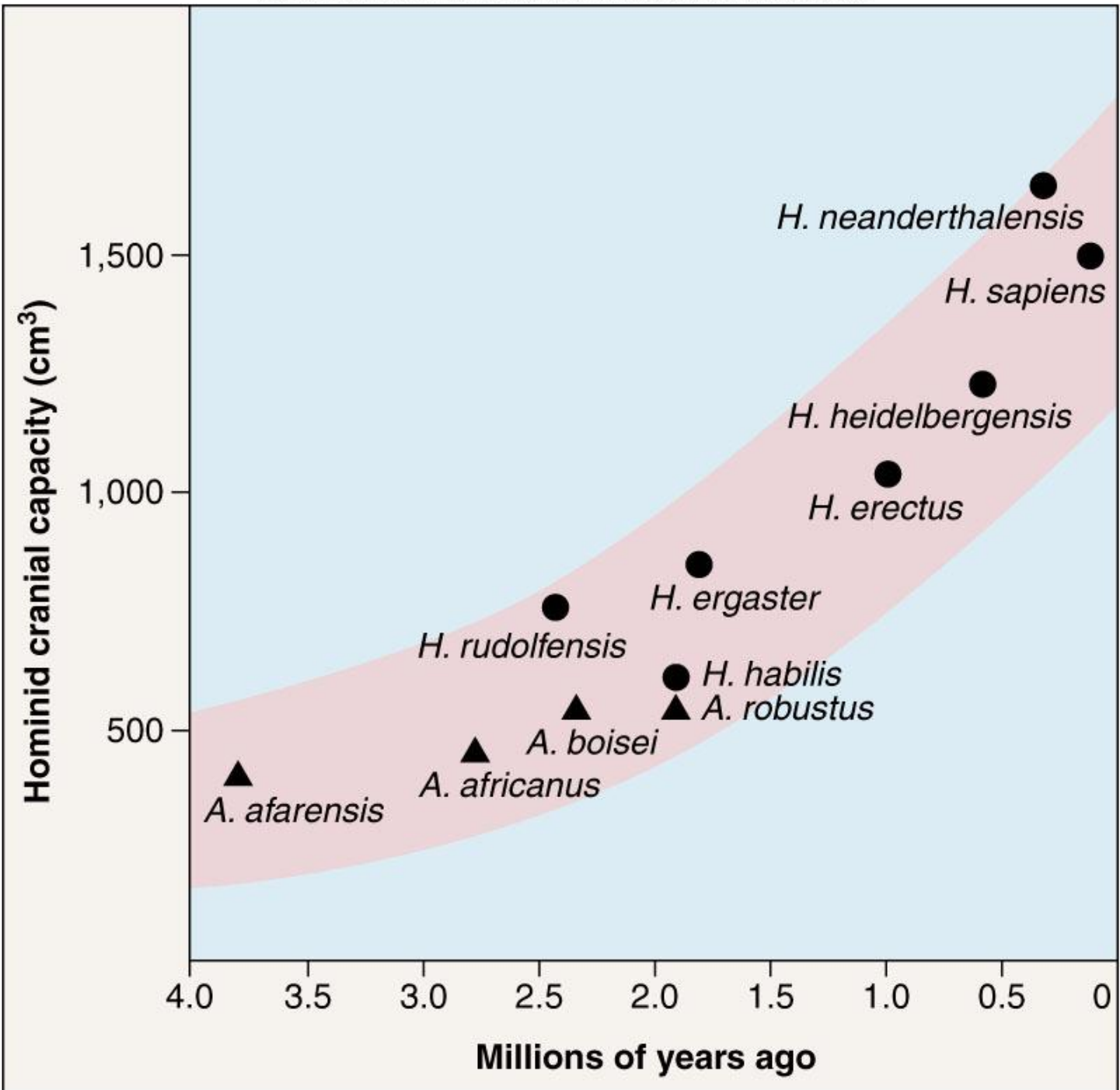


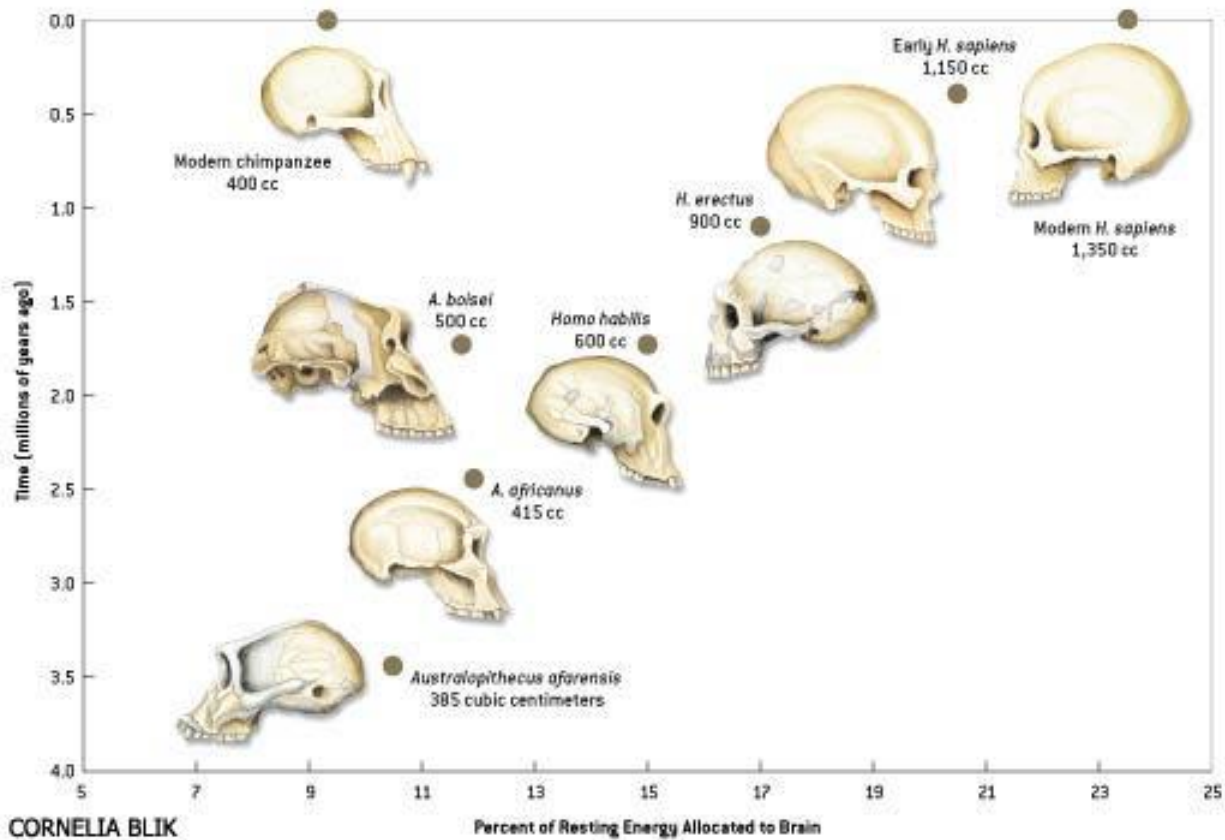




Oldest *Homo sapiens* fossil





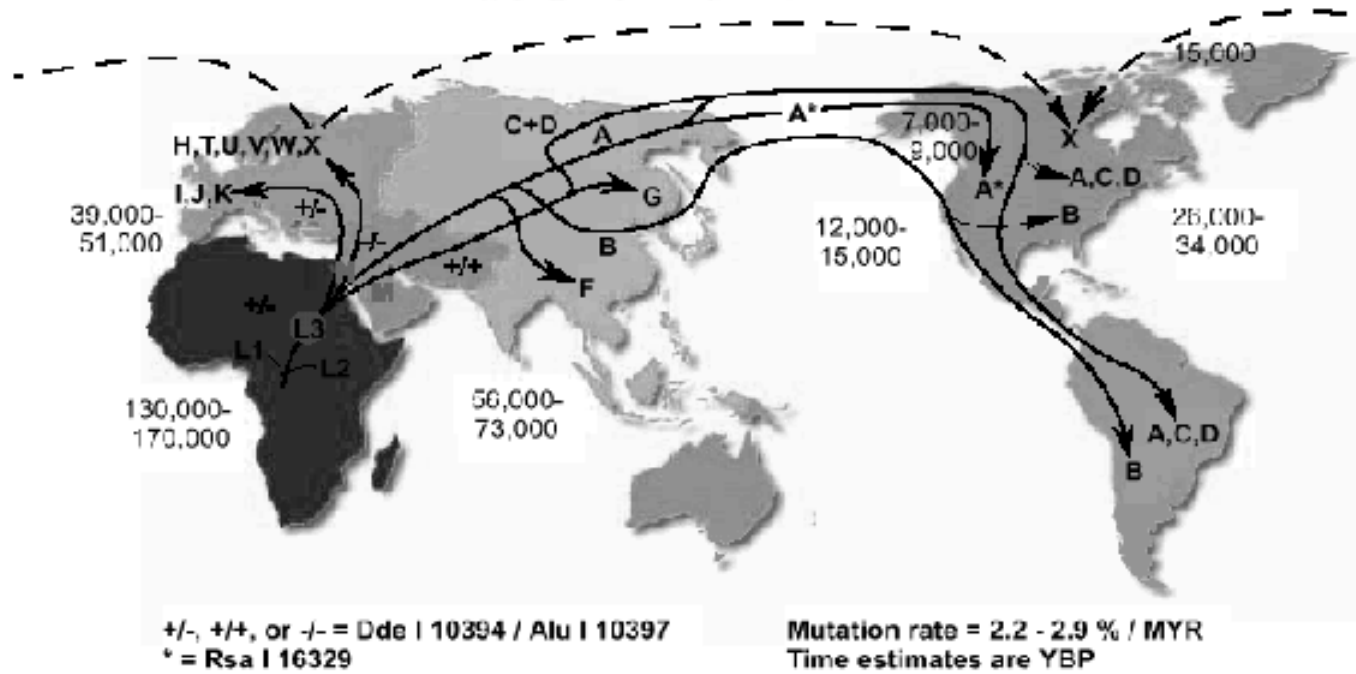




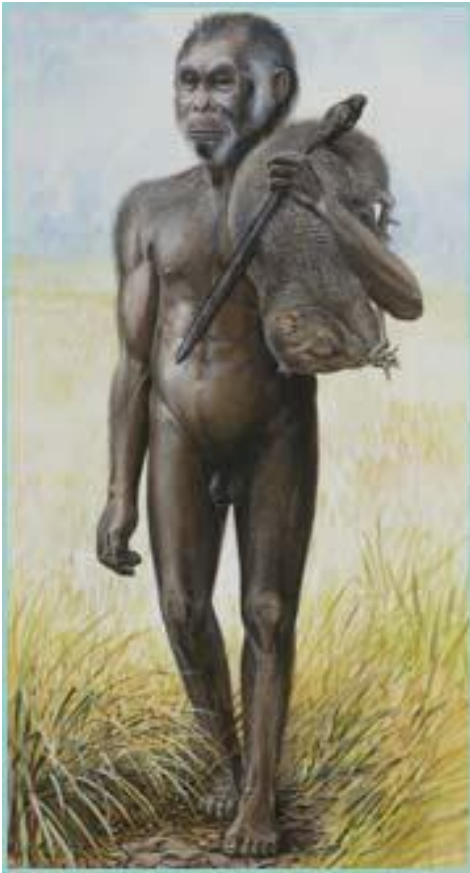
LAURIE GRACE

Human mtDNA Migrations

http://www.gen.emory.edu/MITOMAP/Work_Migrations.pdf
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Homo florensis



- **Discovered in 2003**
- **Lived until as recently as 18,000 years ago**
- **Very small- Island effect**
 - **Pygmy elephants**
- **Descent from larger H. erectus**