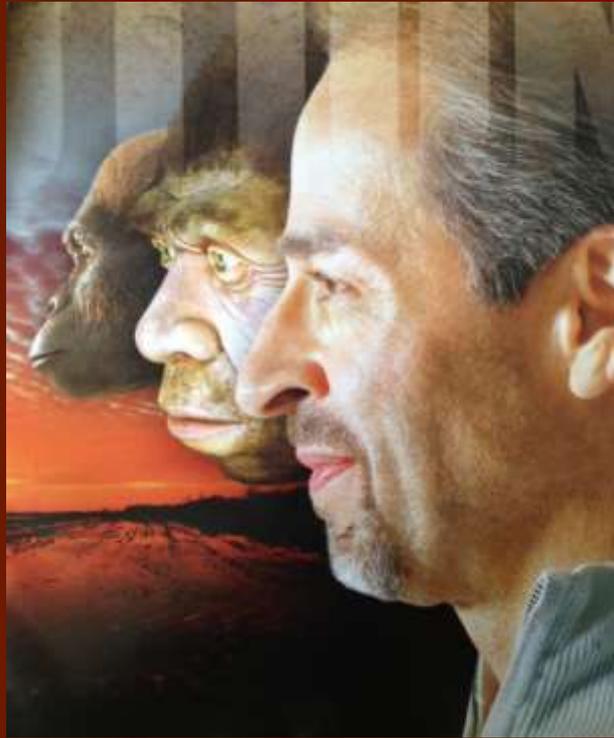


THE ORIGIN OF MAN

人類源起與演化



VW2016

Content

- Prelude : the Development of Life on Earth & the basic concept of Evolution 引言：地球生命源起與演化
- The Origin & Evolution of Man 人類源起与演化
- Human Explosion 人口大爆炸
- Identification of Hominids 識辨人科動物
- Key Fossil Records 化石紀錄
- What is wrong with us ?
- Recapitulation 結語

Prelude :

The Development of Life on Earth & the basic
concept of Evolution

- 13.82 Ba : The Big Bang 大霹靂 & creation of the Cosmo
- 4.567 Ba : Earth formed, no signs of life, hot with poisonous gas
- 3.85 Ba : Heavy Bombardment by meteorites – source of “water”
- 3.6 Ba : simple cells (prokaryotes 原核生物)
- 3.4 Ba : Blue green algae (cyanobacteria 藍綠菌), the source of Oxygen through photosynthesis
- 1.8 Ba : Earliest multiple cell fossil (eukaryotes 真核生物)
- 600 Ma : Snow Ball Earth



Ba: billion years ago Ma : million years ago

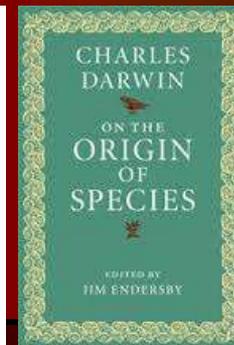
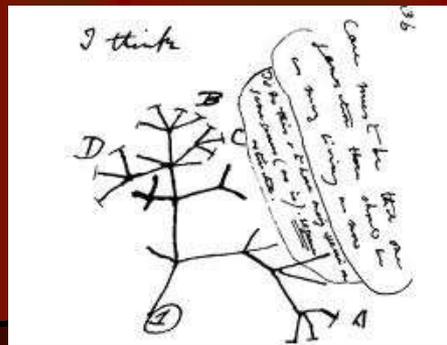
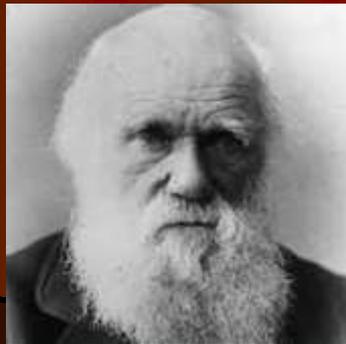
Darwin Theory of Evolution

The diversity & complexity of life on Earth can be explained by Darwin's theory of Evolution 演化

Evolution of living organism is changes through time by mutation with natural selection 天擇 eliminating the harmful ones whilst favorable ones are preserved & passed down by heredity - "Survival of the fittest" 適者生存;

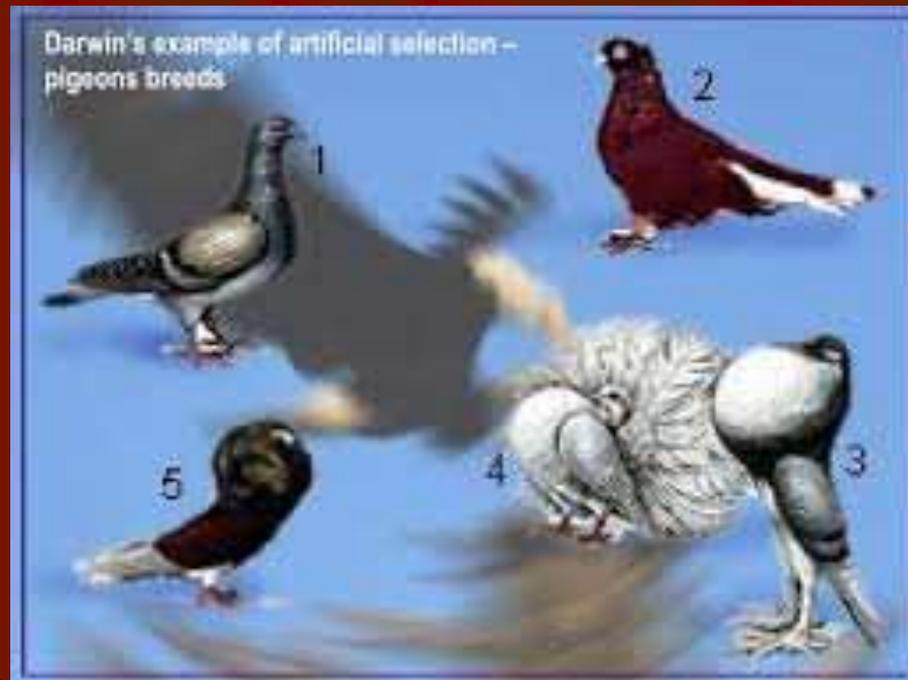
Mutation is to a large extent triggered by the changes in the living environment (climate, food, chance to mate) ;

All living things descend from a common ancestor LUCA 萬物共祖 that lived at 3.8 -3.5 billion years ago

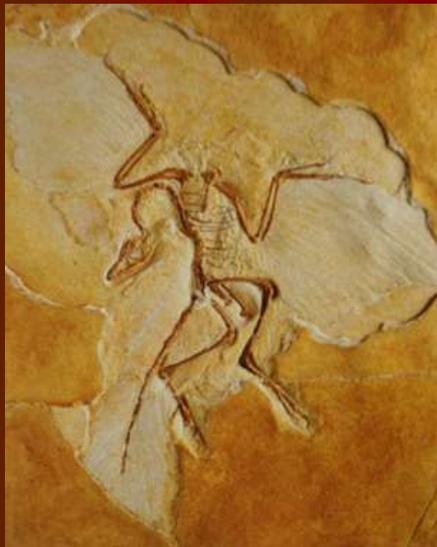
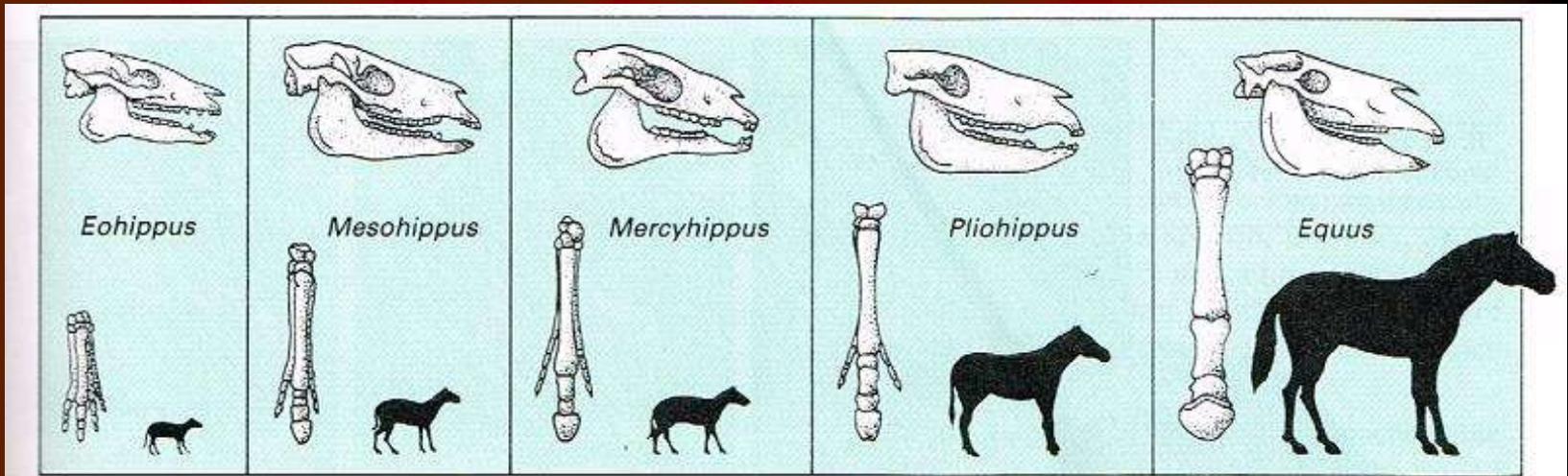


Where are the Evidence ?

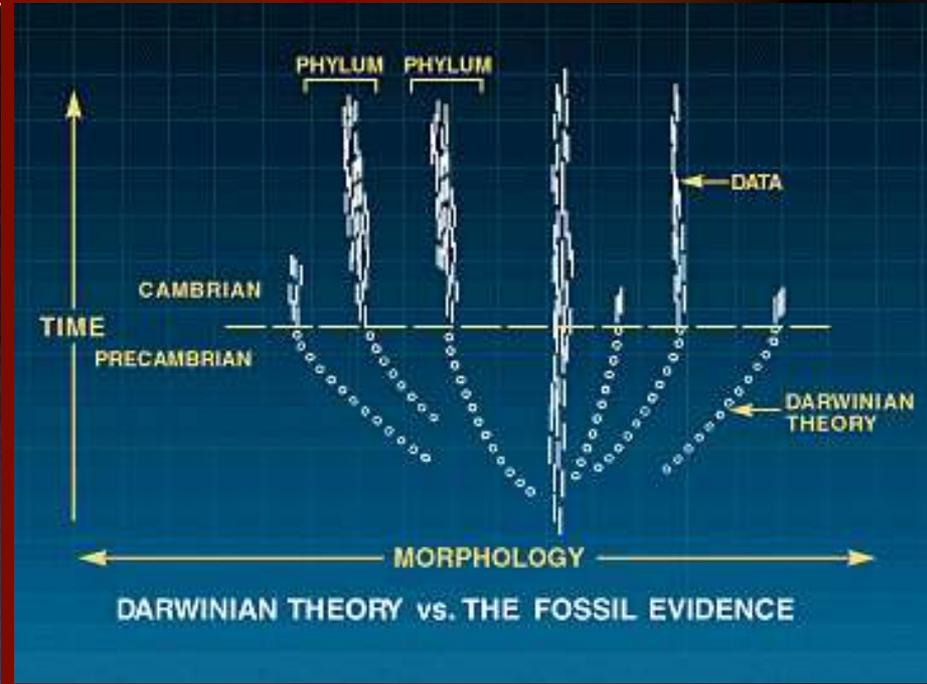
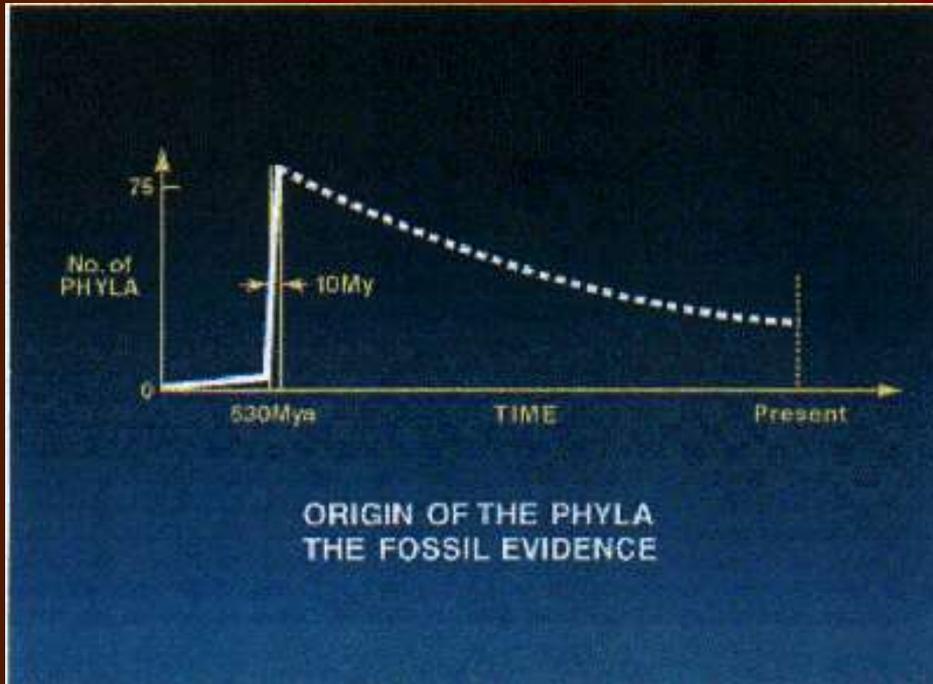
- 1. By Comparative Anatomy
- 2. By studying products of domestication of wild animals & plants through Artificial selection 人擇 e.g. Fancy Pigeons hundred of subspecies all come from one species *Columbia livia*



- 3. By studying fossils – horses & archaeopteryx

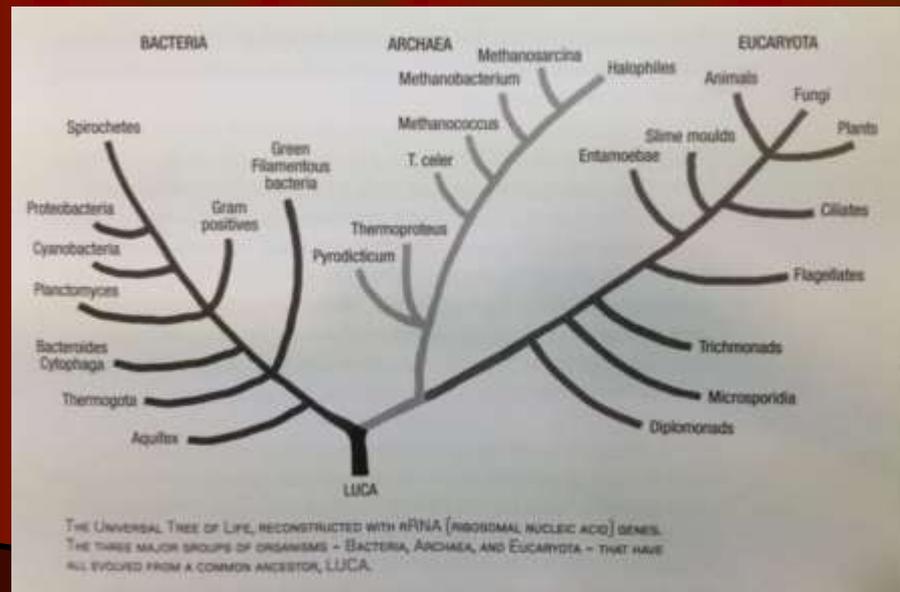


No fossil support for the Cambrian Explosion ?



Molecular Biology & DNA Sequencing

All living organisms are composed of cells formed by different types of protein which in turn are made up of the same 20 amino acid (C, H, N). The recipe for producing the right type of protein is recorded in DNA (Deoxyribonucleic acid) 脫氧核糖核酸 which is a molecule 分子 encoding the genetic instructions used in the development and functioning of all living organisms. DNA in turn is packed into tiny rods called Chromosomes 染色體. By comparing the genome which is an organism's complete set of DNA, we can trace back the Universal Tree of Life originated from LUCA

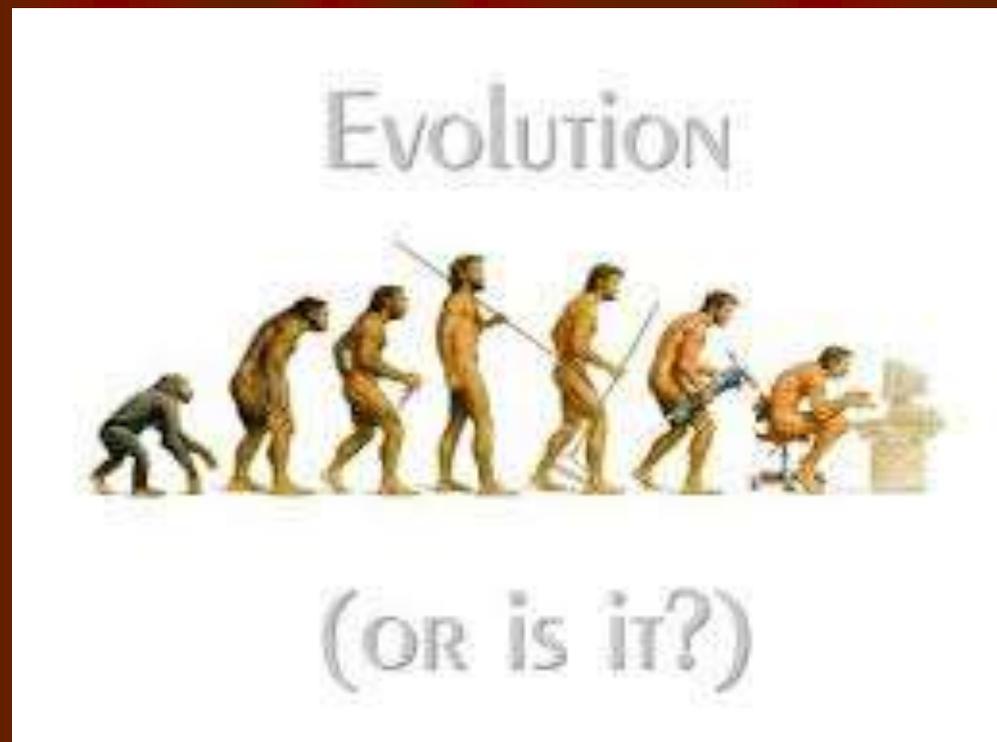


Darwin's view on the origin of man

- "On the Origin of Species" Darwin wrote "light would be thrown as the origin of man & his history"
- In his book "The Descent of Man" he suggested that Africa was the most likely evolutionary homeland for human because it was where our closest relatives the African Apes could be found today

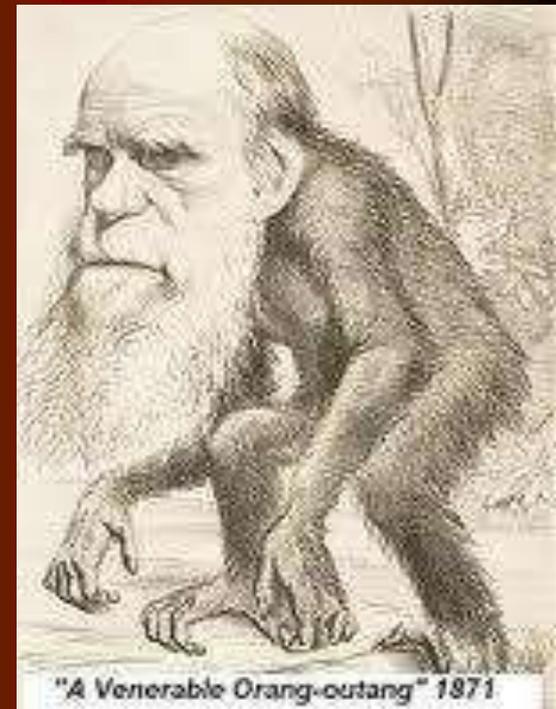
THE ORIGIN OF MAN

人類的源起



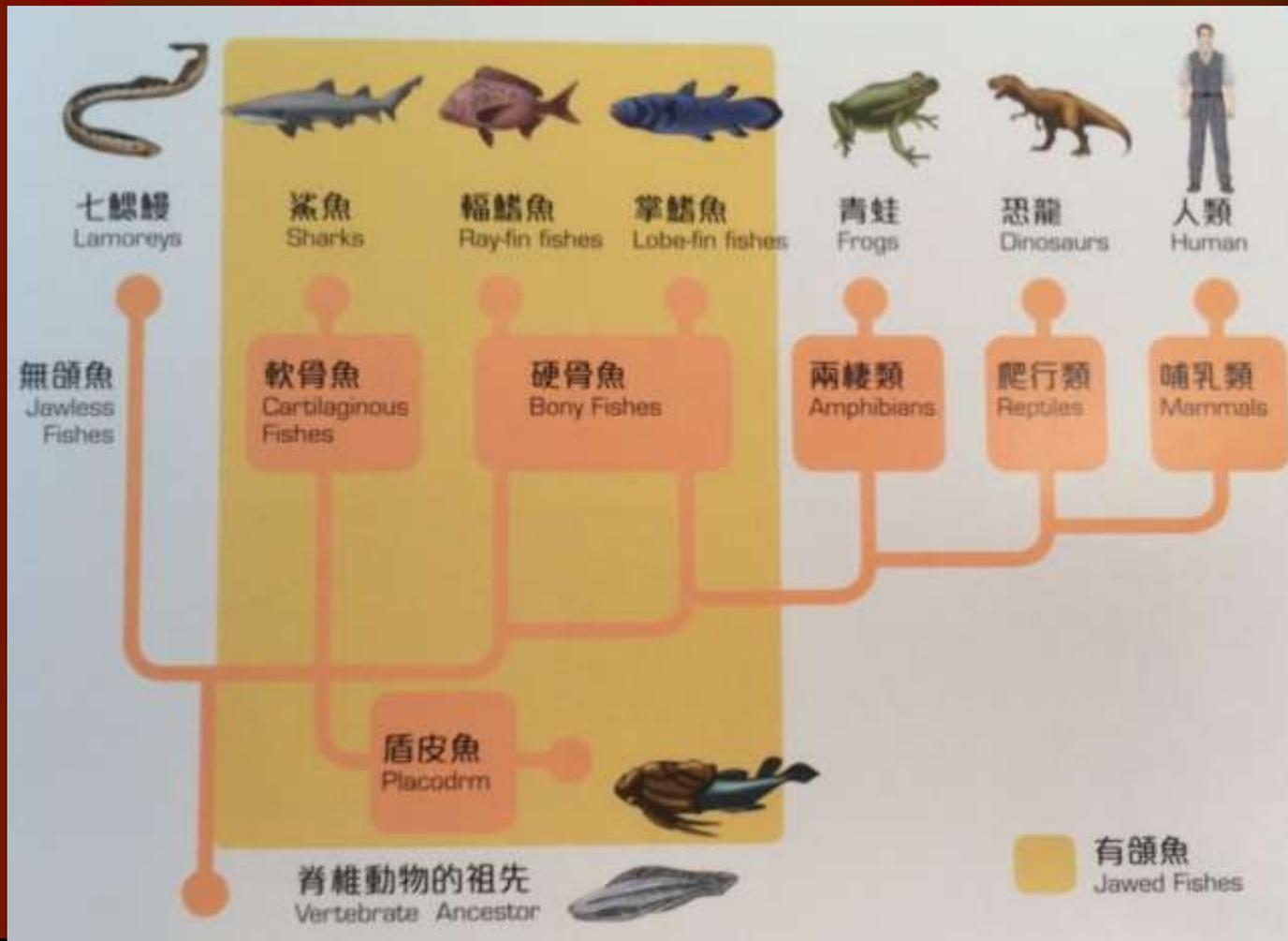
Classification of Human

- Kingdom : Animalia 動物界
- Phylum : Chordates 脊索門 (Subphylum Vertebrata 脊椎亞門)
- Class : Mammalia 哺乳綱
- Order : Bipedal Primates 靈長目
- Family : *Hominid* 人科
- Genus : *Homo* (Human) 人屬
- Species : *sapiens* ("wise") 智人種



Subphylum Vertebrata

脊椎動物亞門的演化



From reptiles to mammal 從爬行類到哺乳類

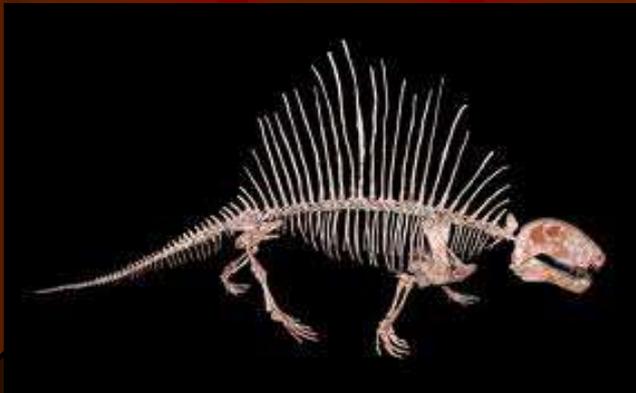
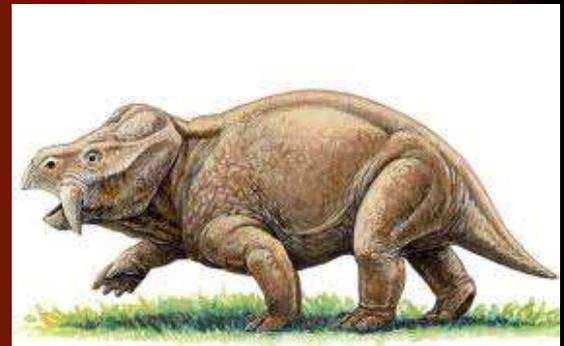
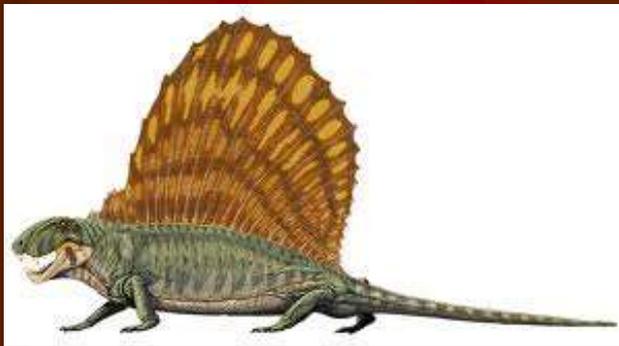
- Anapsid 缺弓類 : turtles, early “reptiles”
- Synapsid 單弓類 : mammal like reptiles *
- Euryapsid 闊弓類 : ichthyosaurs, plesiosaurs & placodonts
- Diapsid 雙弓類 : dinosaurs & crocodiliformes, snakes, lizards

*Only one **Synapsid** remained to become **Therapsids** 獸孔類 which eventually evolved into Protomammal (弓 = 顛顛孔)



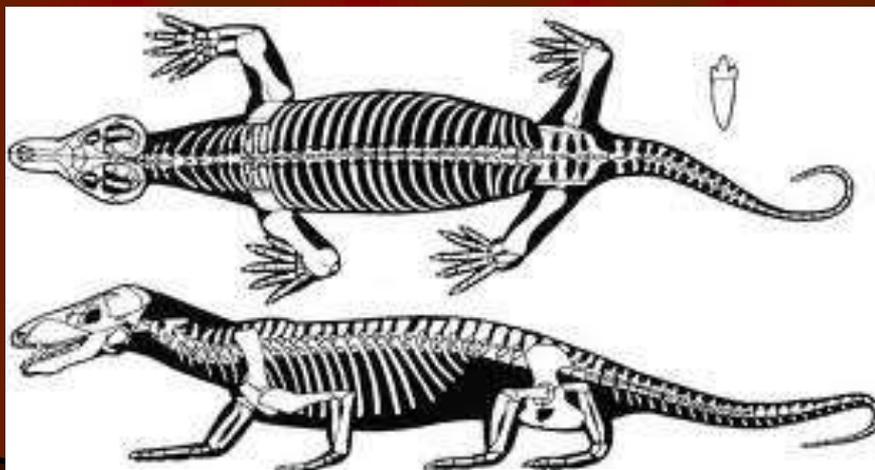
Class Mammalia 哺乳綱

Mammal's synapsid ancestor first appeared at the end of the Carboniferous 320 Ma. Some early mammal like reptiles such as *Dimetrodon* 異齒獸, *Sinokannemeyeria* 中國肯氏獸 / 二齒獸 lived in the Permian period. True mammal however only appeared in the Mesozoic & they were very small in size living together with the dinosaurs



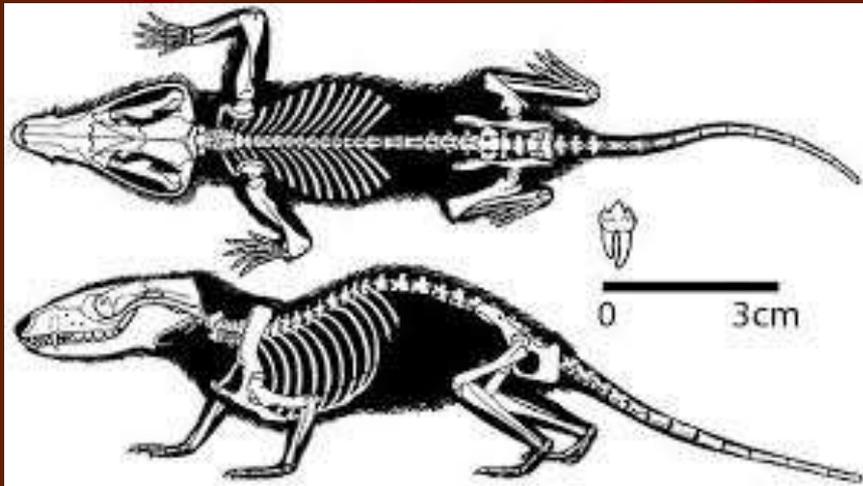
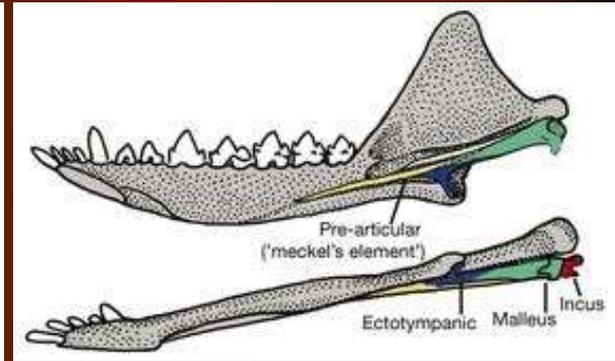
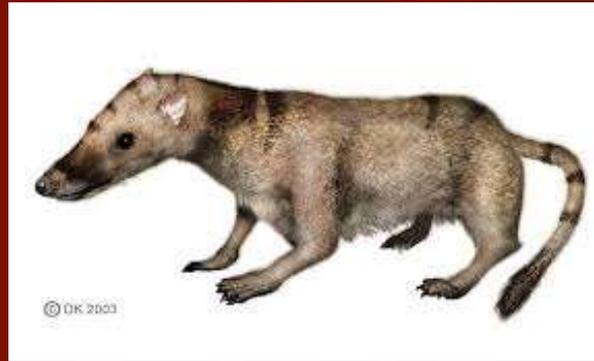
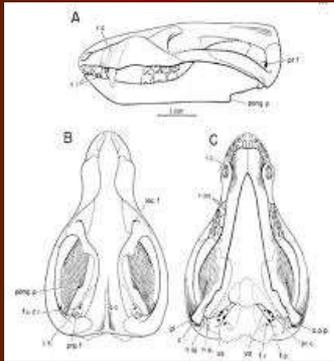
Procynosuchus

255 Ma Late Permian 60 cm long, it was considered one of the earliest & most basic cynodont (meaning a “dog toothed” therapsid) found in Germany, Zambia & S. Africa



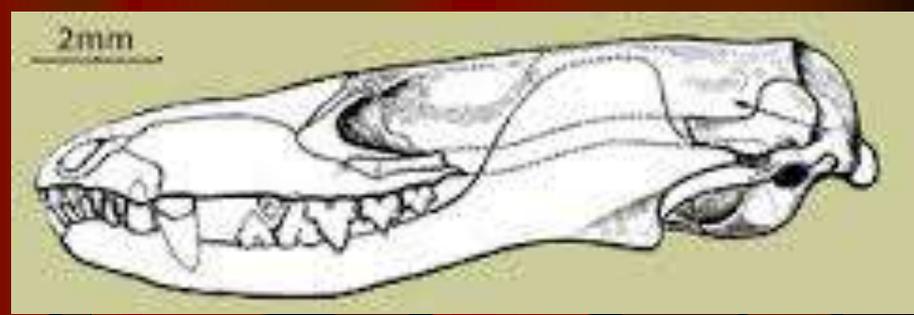
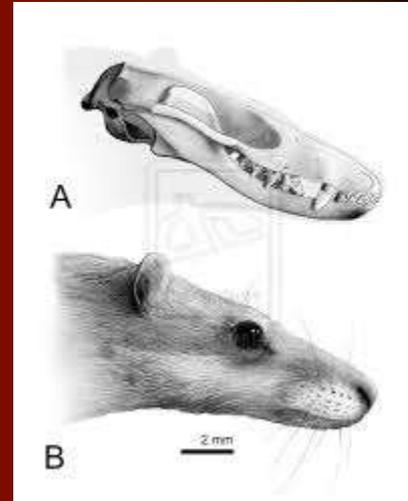
Morganucodon

205 Ma Late Triassic early Mammalia form found in Wales, Yunnan, various parts in Europe & North America. Total length 14 cm



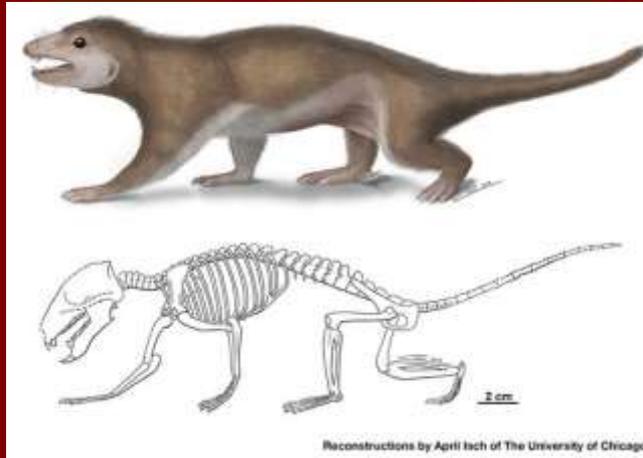
Hadrocodium wui

3.2 cm in length & weighs only 2 gm. Its skull was discovered in the Lufeng basin in Yunnan & dated to be 195 million years old. The animal exhibits earliest stages of mammalian evolution with relatively large brain & advance ear structure



Megaconus mammaliaformis

Weighed about 250 grams, this “Jurassic squirrel” is a mammal ancestor living 165 Ma in Inner Mongolia.

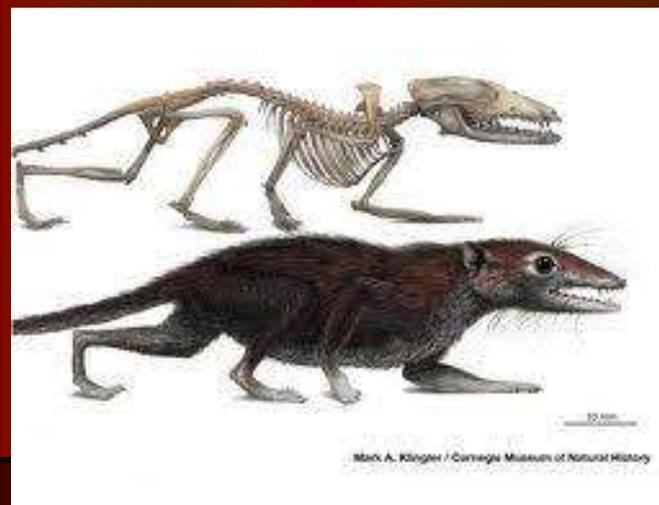


Juramaia sinensis

Dated 160 Ma, this 22 mm long "Jurassic Mother of China" is a small shrew 鼯鼠 like placental mammal discovered in Liaoning in 2011 which pushed back the divergence of placental mammal from marsupial by millions of year



Juramaia sinensis - the earliest-known eutherian
Photo: Dr. Zhe-Xi Luo / Carnegie Museum of Natural History

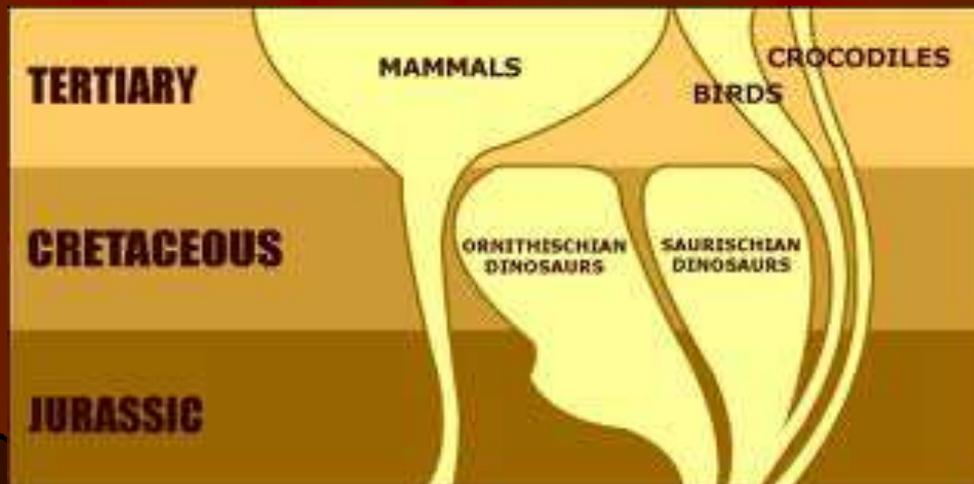


Mark A. Klingler / Carnegie Museum of Natural History

- Mammal had no chance to dominate if not because of the KT Event 65 Ma which was a Mass Extinction caused by asteroid impact. It wiped out the dinosaurs & ended the Age of Reptiles

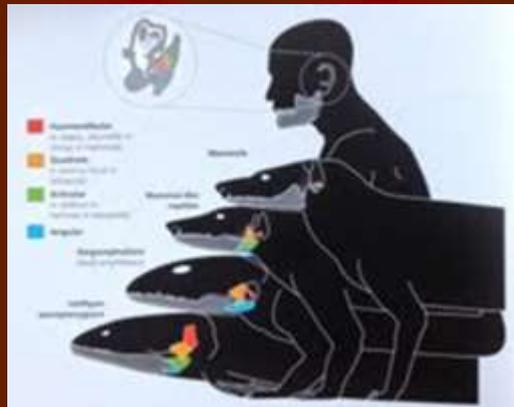


- Entered the Cenozoic 新生代 & the Age of Mammal began



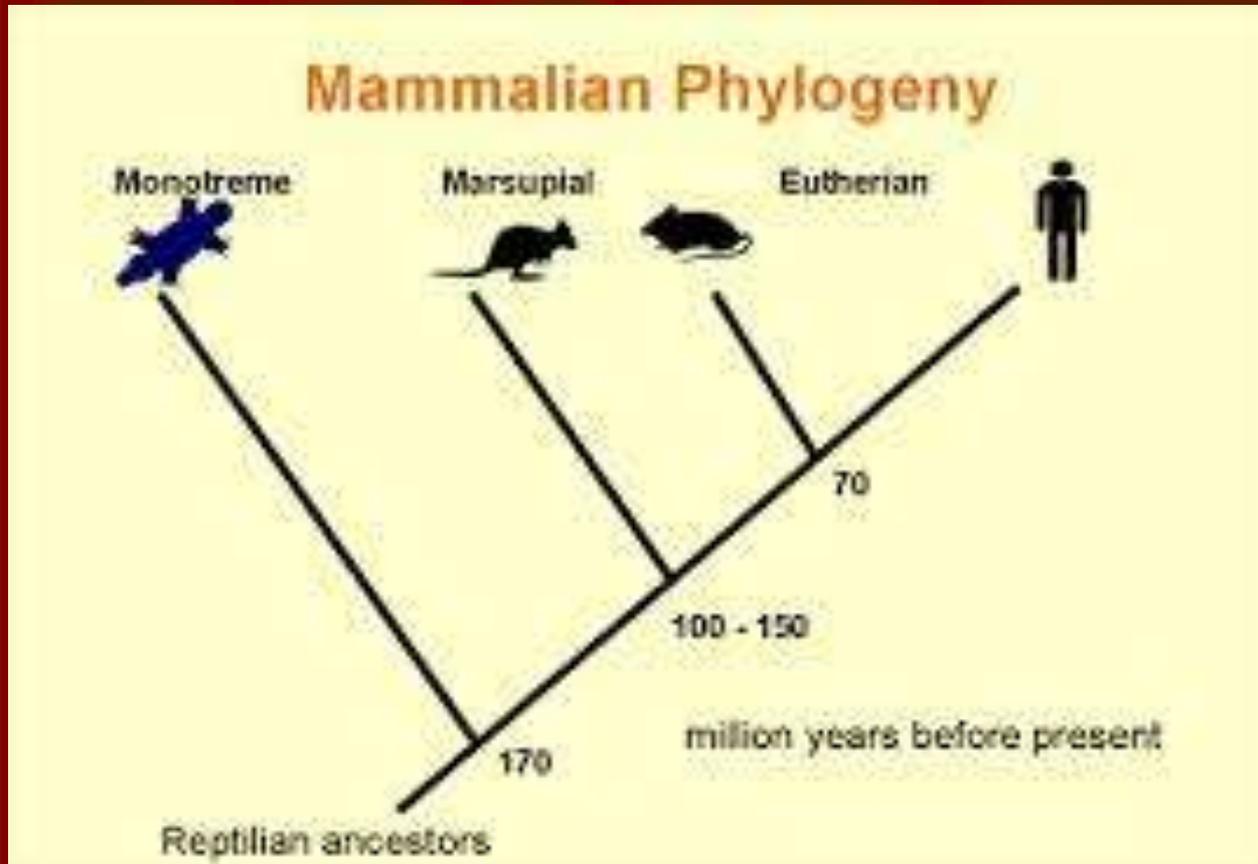
Mammal Characteristics

- 4 Chambered heart, Warm-blooded & Endothermic 恆溫
- With hair or fur on their bodies instead of scale
- Lungs to breath air with diaphragm separating heart & lung from other internal organs
- Single jaw bones & 3 small bones in middle ears



- Only 2 sets of heterodontic tooth replacing only once in life
- Most young are born alive
- Feed young with milk produced from mammary gland

Mammalian Evolution History



All nonplacental Eutherian already extinct. All living Eutherian are placental mammals

Three subclass of Mammal

- Monotreme mammal (one hole) 卵生類 : Platypus 鴨嘴獸 Echidna 針鼹



- Marsupial mammal 有袋類 e.g. Kangaroo, wombat, koala bear

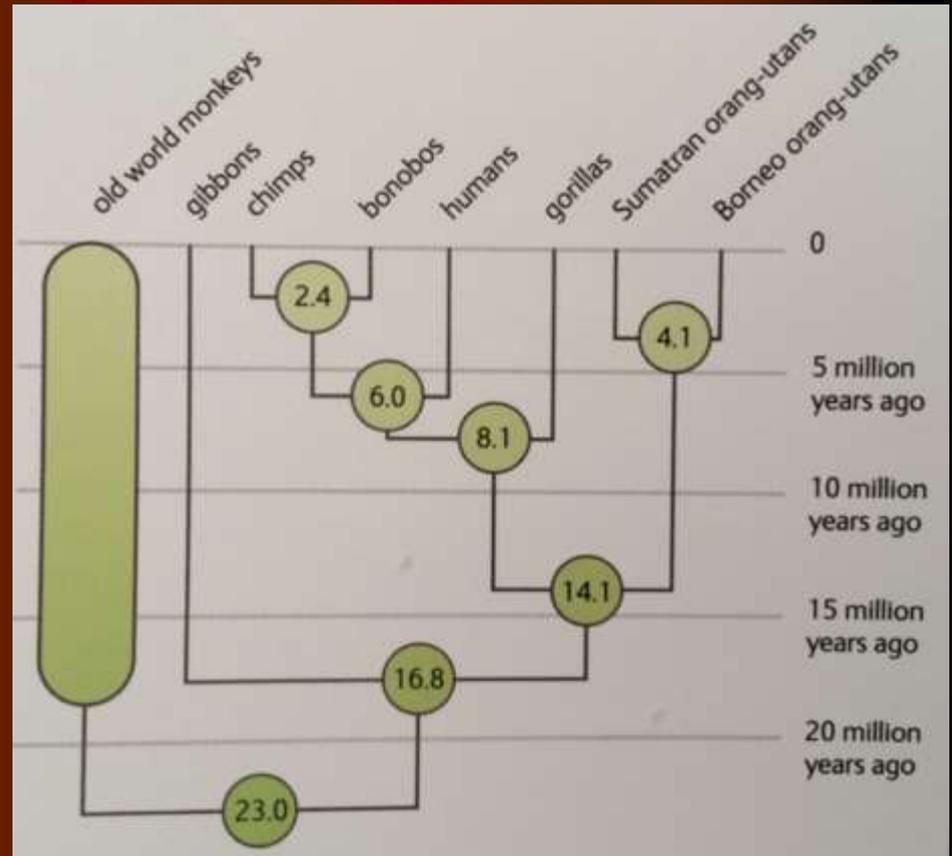
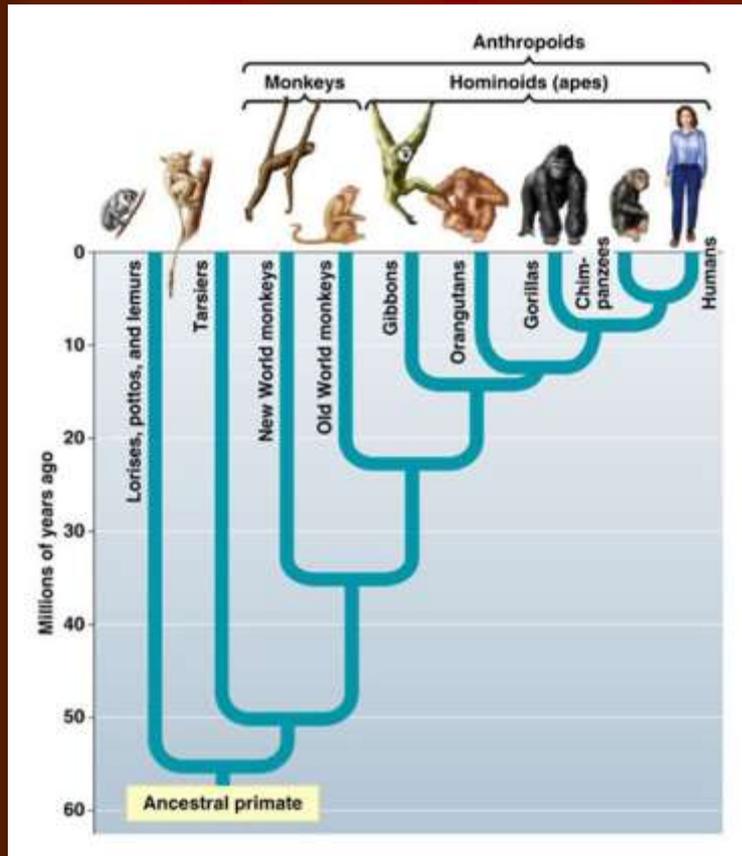


- Placentals mammal 胎盤類



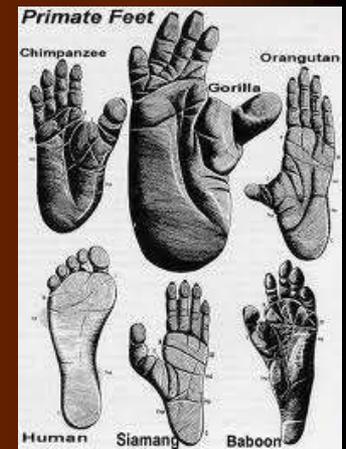
Order Primate 靈長目

First appeared 65 Ma (Cretaceous) now having 360 species



Primate characteristics 靈長目 特徵

- Large brains relative to other mammals
- Arboreal with grasping hands & feet
- Nails instead of claws
- Padded digit with finger print
- Torso upright
- High degree of shoulder mobility
- Binocular vision (provide sense of depth)
- Vision dependent rather than smell
- Pendulous penis & testes (erectable & dangling instead of close to the body)





Two Primates Suborders

1. Prosimians 原猴/原始靈長亞目 : “Before Monkey” or “Lower primates”
2. Simians or Anthropoids 真猴/類人猿亞目 : “Higher Primates”
include monkeys 猴, apes 猿 & human 人類

Prosimians 原猴目 / 原始靈長亞目

Shrews 鼯鼠, Tarsiers 眼鏡猴, Lories 懶猴 & Lemur 狐猴



Tarsier



Loris



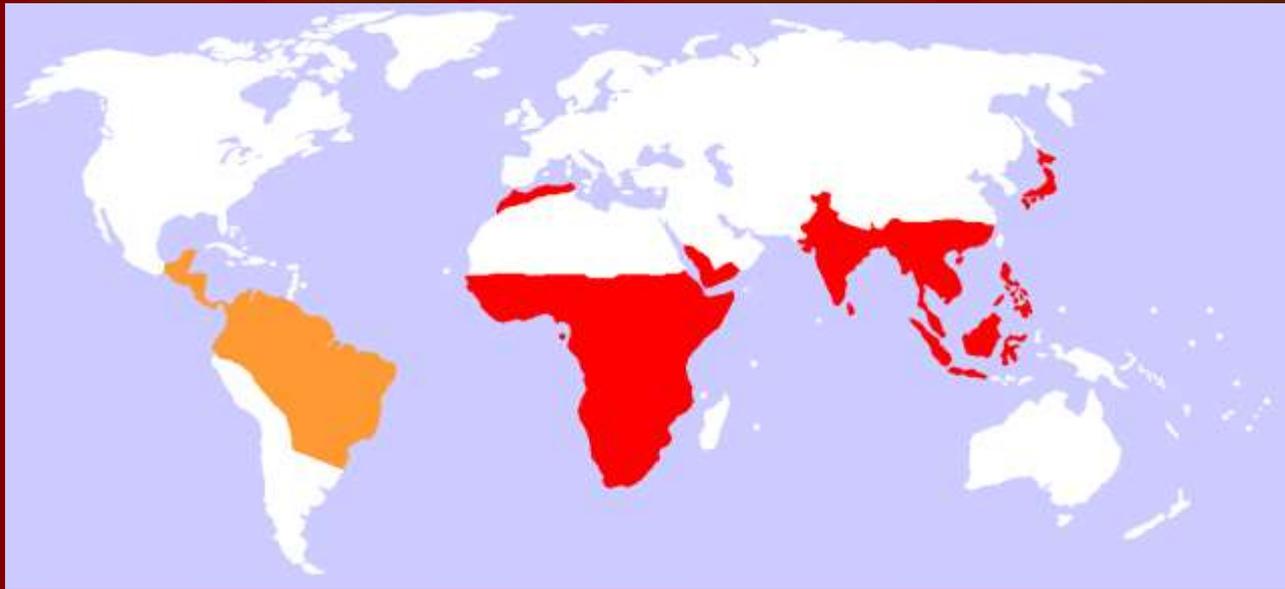
- 103 different species of lemur 狐猴 unique in Madagascar appeared 62 -65 Ma ranging in size from 30 g to 7 kg (eg. Sifakas 跳狐猴, Aye-aye 長指狐猴, Indris 光面狐猴, Catta 節尾狐猴)



Simians 真猴亞目 / 類人猿亞目

At about 40 Ma the common Simian ancestor split into :

- New World Monkeys (Central /South America)
- Old World Monkeys & Apes (Africa/Europe/Asia)



New world monkeys : (*Platrrhine*) 闊鼻猴類群

120 species : Capuchin, Hauler, Papio, Mamoset, Squirrel, Lion, Saki, Red Uakari, Spider monkey & Emperor tamarin – smaller, long nose & arboreal



Old World Monkeys : (*Catarrhine*) 狹鼻猴類群

Some 140 species including Colobus, Baboons, Macaque, Mandrills, Big nose, Golden & Lesula monkey – bigger, snup nose, both arboreal & ground dwelling



Apes 猿

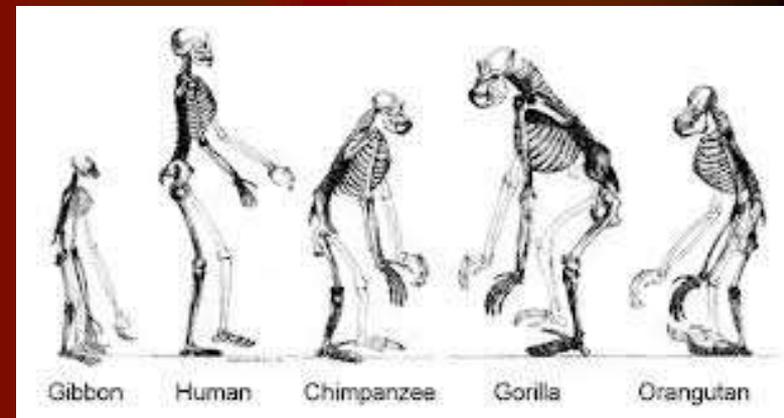
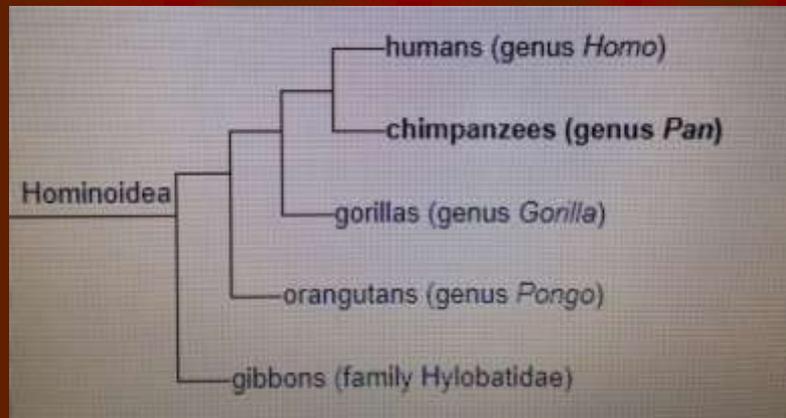
Apes eventually split into :

Lesser Ape

- By 18 Ma - Gibbon/ Siamang 長臂猿

Great Ape

- By 14 Ma - Orangutan 紅毛猩猩
- By 7 Ma - Gorilla 大猩猩
- By 6 Ma - Chimpanzees 黑猩猩, Bonobo 侏儒黑猩猩 & Human



Apes only live in the Old World

Gibbons 長臂猿, Orangutan 紅毛猩猩, Gorillas 大猩猩, Chimpanzees 黑猩猩,
Bonobo (pygmy chimpanzee) 侏儒黑猩猩/布猿



Characteristic of Apes

猿的特徵

- No tail
- Large with upright body
- Sit & stand a lot
- Broad chest
- Highly mobile arms
- Large brain to body size
- Use tools
- Have social life

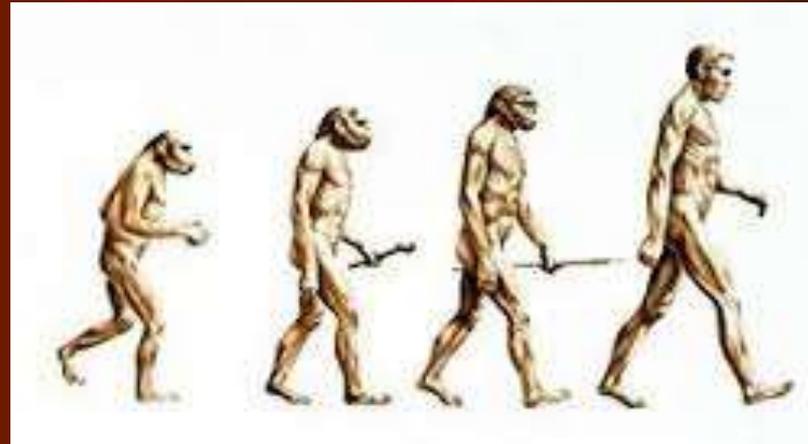


Family Hominid 人科動物

("Humans & relatives of Humans closer to chimpanzee)

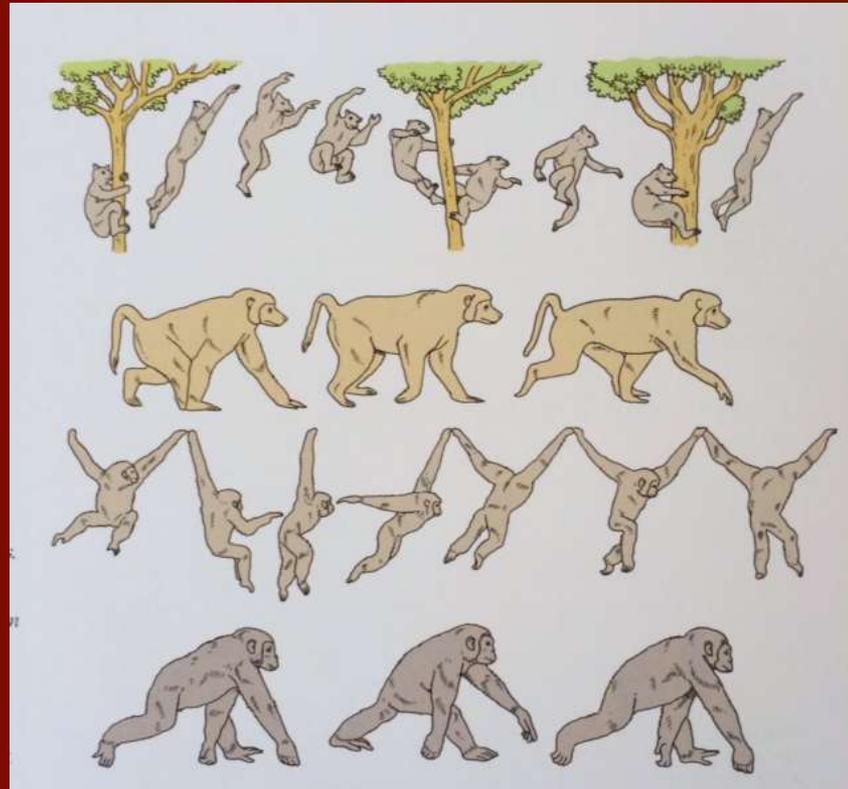
Living humans diverged from chimpanzees 6/7 Ma

- Erect posture & bipedal gait
- Hair instead of fur better for cooling especially when running long distance – the so called "Naked Ape" 裸猿 Sweat glands also matters
- Large brain
- Made & Used tools

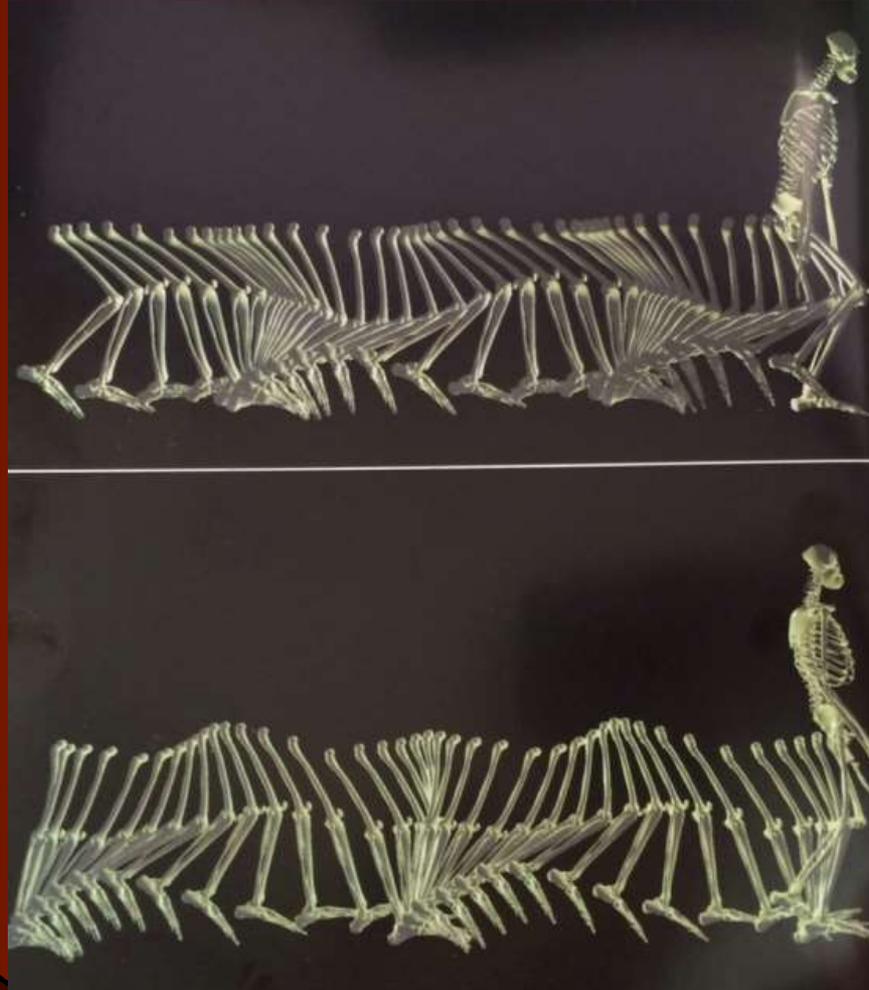


Development of Bipedalism 雙足走動

Primates have 4 distinctive ways of locomotion namely leaping, quadrupedal locomotion, brachiating & knuckle-walking 指節行走. Apes & chimpanzees occasionally walk upright but only hominid is truly bipedal meaning moving by means of its two rear limbs leading to erected posture, long legs & short stiff feet



- Basis on discovered fossil records it is almost certain that bipedalism was well developed before human has large brain or development of tools say around 4/5 million years ago



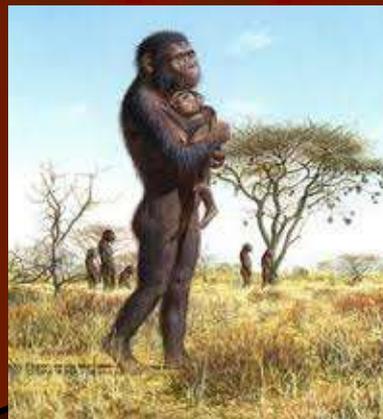
● There are at least 12 hypothesis for such development. Key ones include :

1. Moving with two feet is more energy efficiently than other primates

2. Changing of climate & habitat from jungle to savanna – easier to see through tall grass aided in survival



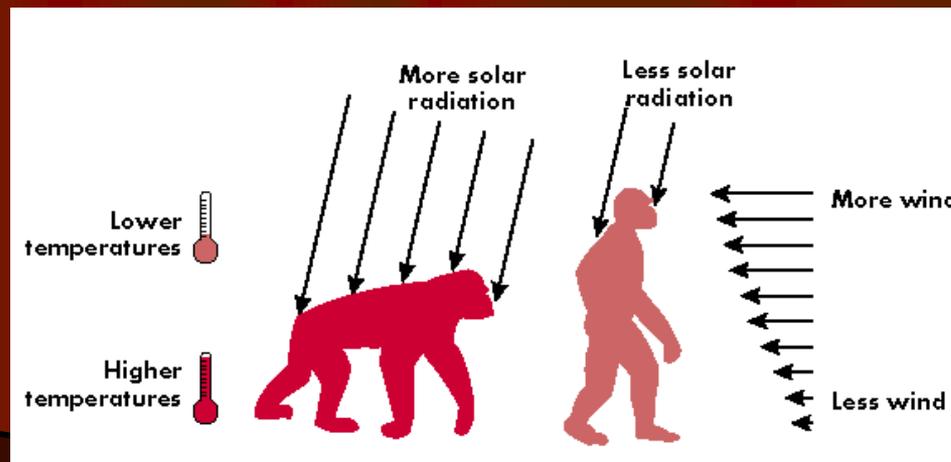
3. Freeing the hands for picking fruit, tool use & carrying



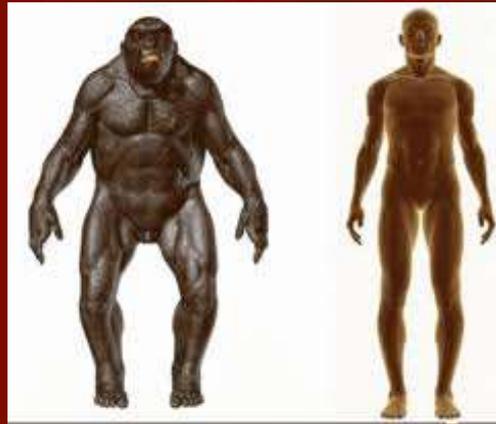
4. Sexual dimorphism for women to better bear lumber load during pregnancy



5. Reduce the amount of skin exposed to the tropical sun overhead whilst exposing the greatest amount of surface area for cooling by wind



6. Enabling early humans to appear larger, more intimidating & "sexier"



7. Need to wade through water



8. Running for food & from danger

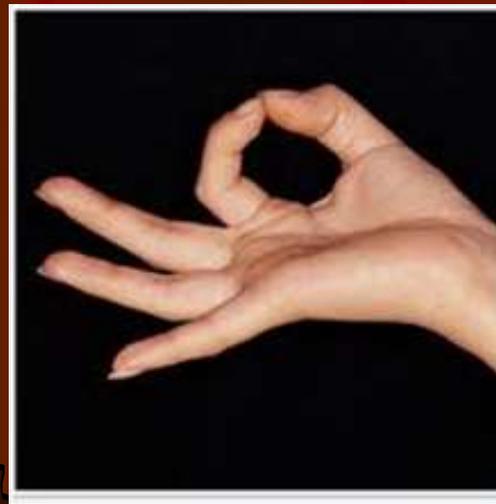
Large Brain

Functioning of the brain requires a lot of energy - even at rest it accounts for 25% of our energy. Brain size increased by changing the diet from all vegetarian to the consumption of meat being a source of protein & more importantly by having cooked food which is much easier to eat & digest & therefore able to extract more energy



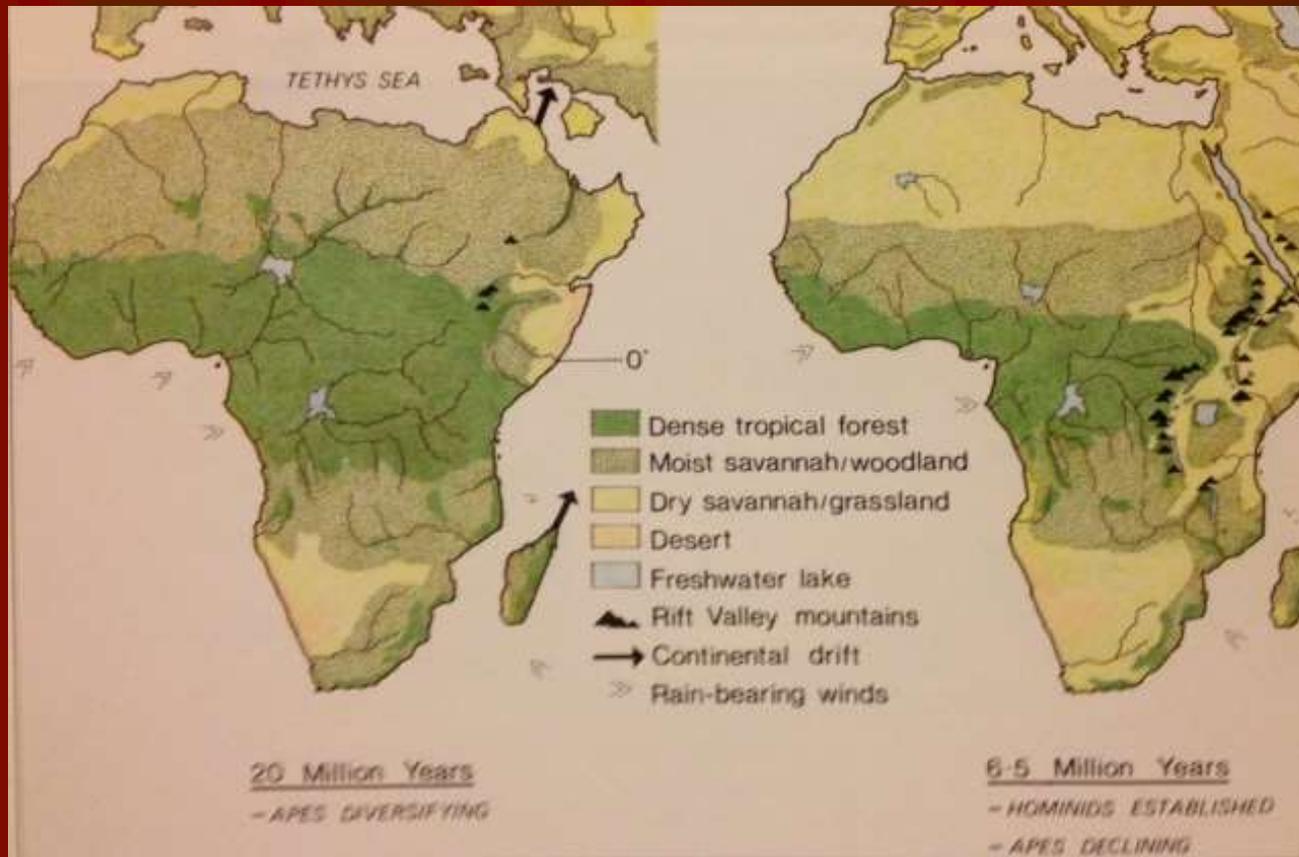
Made & use tools

Human's large "opposable thumbs" allow precise manipulation of tools & other objects



Hominid Evolution & Climate Change

20 Ma Apes diversifying & dominate, 6-5 Ma Hominids established



Genus Homo 人屬 (“Human”)

23 Species discovered so far & only one subspecies remains being us *Homo sapiens* with population exploded from 1 billion in 1800 to 7 billion world wide in 2012 & estimated to grow to 9 billion by 2050 !



5 Key Reasons for Human explosion 人口爆炸原因

- 1. Long reproduction period – continuous female sexual receptivity & man stays fertile up to his 80s ?
- 2. Not restricted to Spring or Full Moon – Panda only have a 36 hours window to get pregnant per year !
- 3. Sexual intercourse is enjoyable not just for the sake of reproduction (painful for tigers !)
- 4. Malthus Theory of population 1798 : control by war, disease & famine in check no longer valid, development of farming & industry is key
- 5. Advance in medical science prolongs life

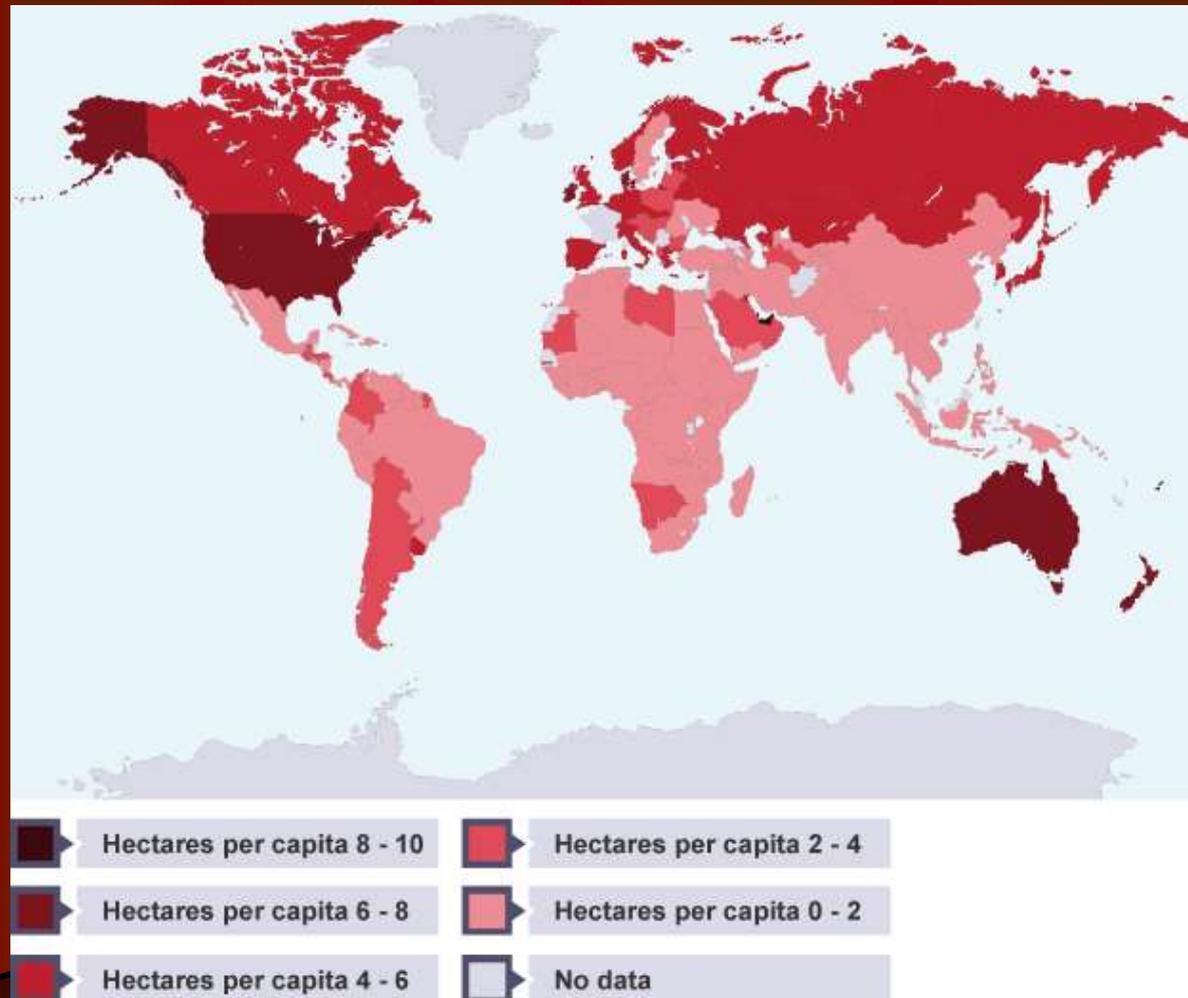


5 key reasons for the Human Explosion



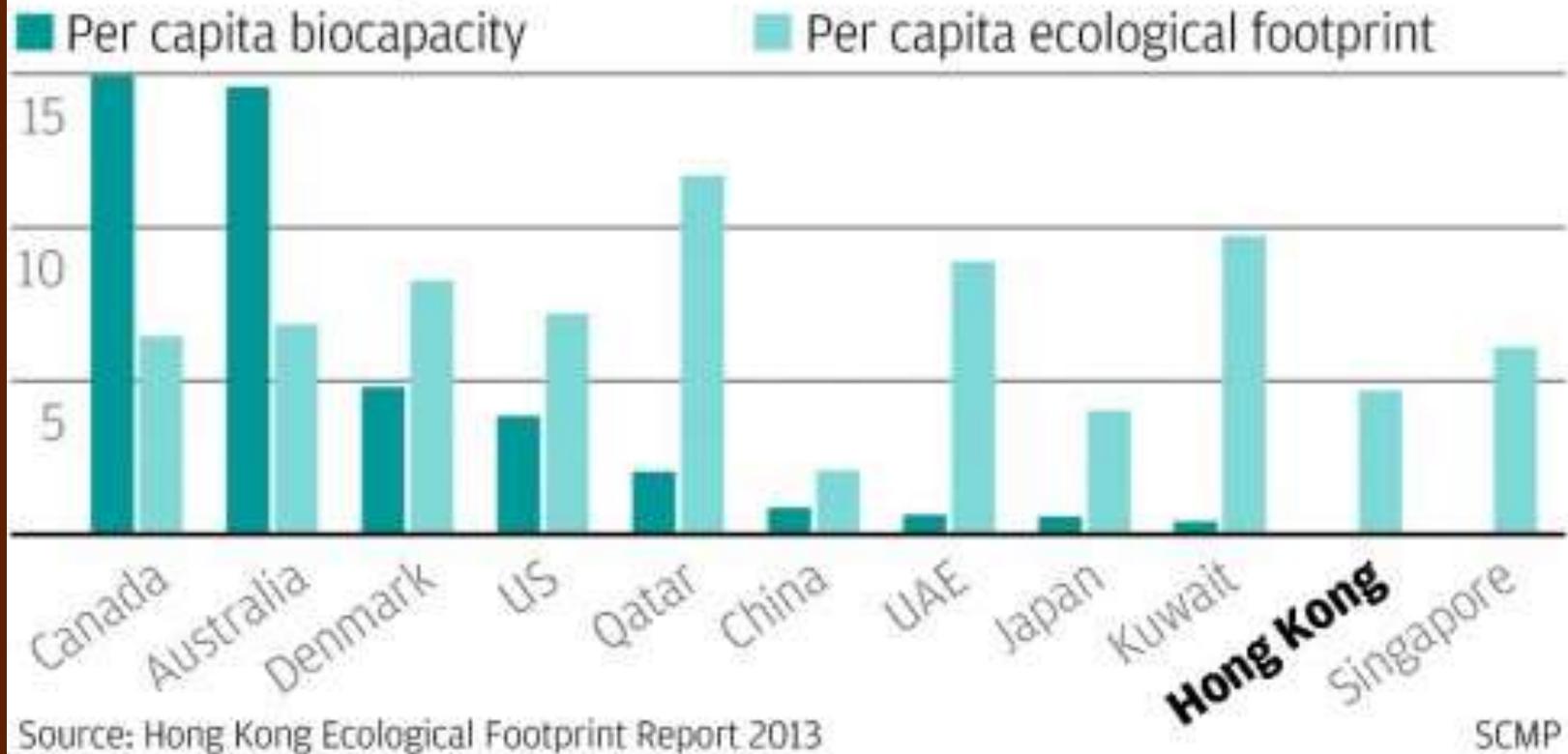
IMPACT OF POPULATION EXPLOSION

- Ecological footprint is a measure of human demand on Earth's ecosystems. In 2010 the ecological footprint was estimated at 2.6 global hectare or 1.5 of planet earth ! HK's footprint is 4.7 hectare or 150 times of its bio capacity

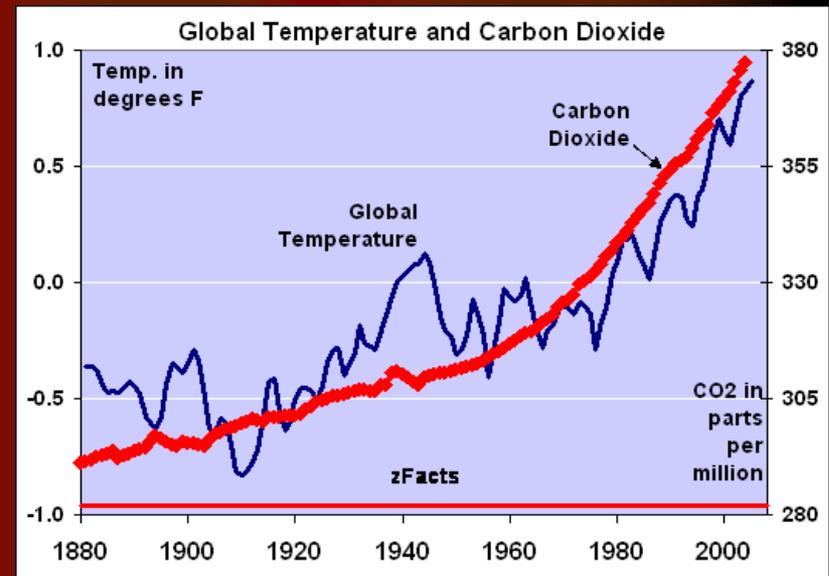
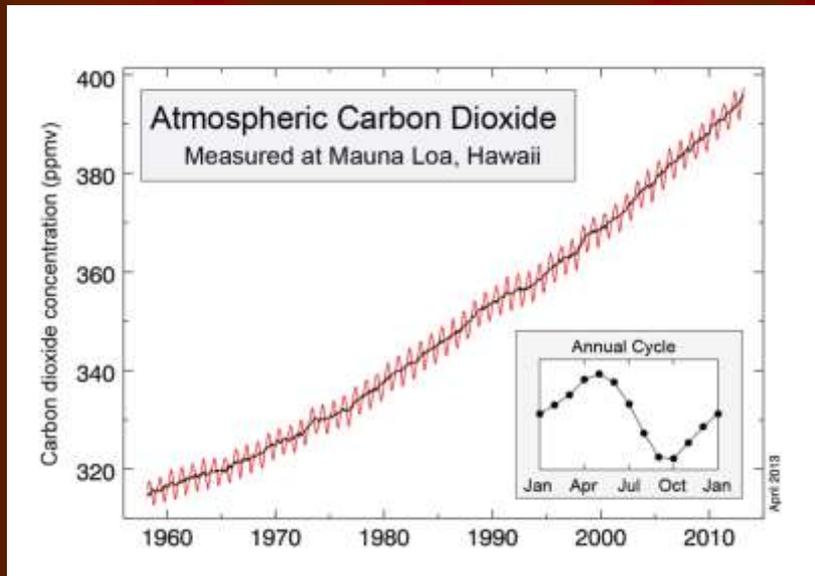


Hong Kong has practically no biocapacity of its own

How we compare

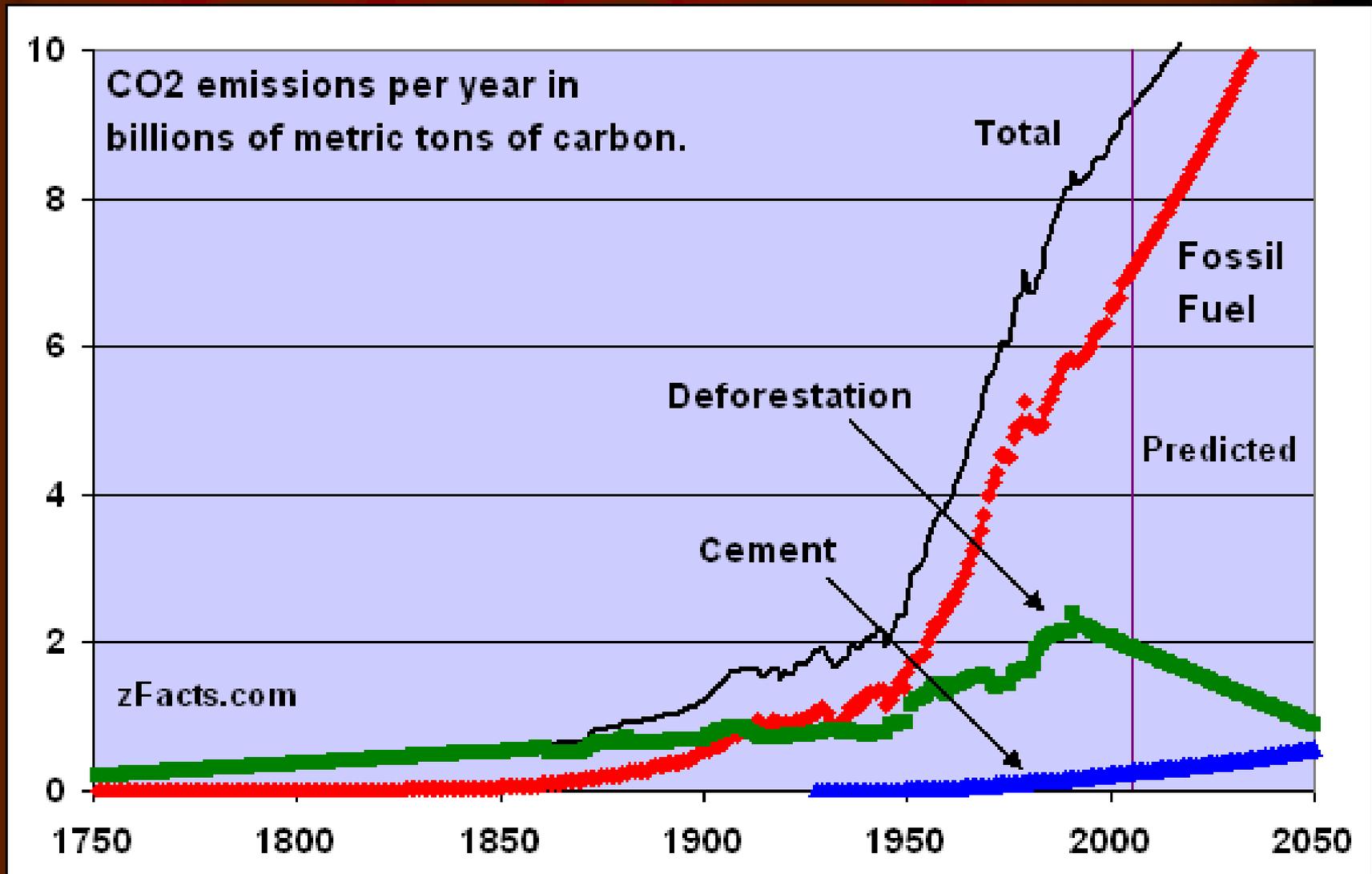


- With the use of fossil fuel, we are polluting the earth & destroying the environment - CO2 emission already led to global warming, melting of ice cap, rising sea level & climatic changes. CO2 content 2014 was at 400 ppm highest in the last 0.8 m years almost reaching *the point of no return in terms of sustainable living & no way we can support 9 billion people



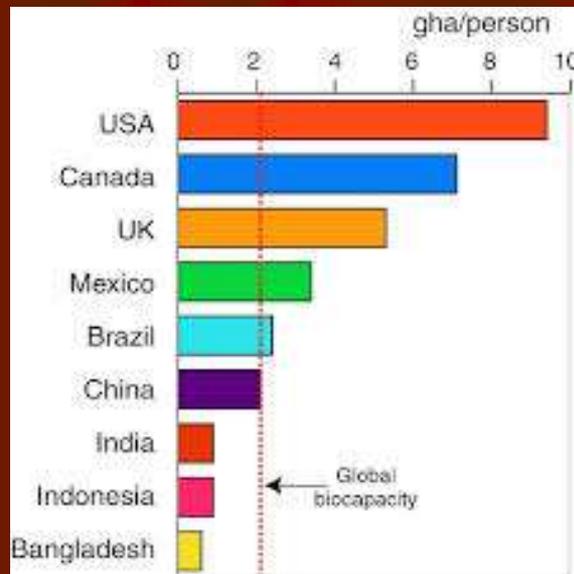
*temperature will rise by 2 C when CO2 content reaches 450 ppm

Global CO2 emission by source



NEED TO ACT NOW

1. Curb population growth by birth control
2. Slash consumption : Current Global Bio Capacity is 1.7 hectare per person. Bio capacity is the capacity of an area to provide resources & absorb waste



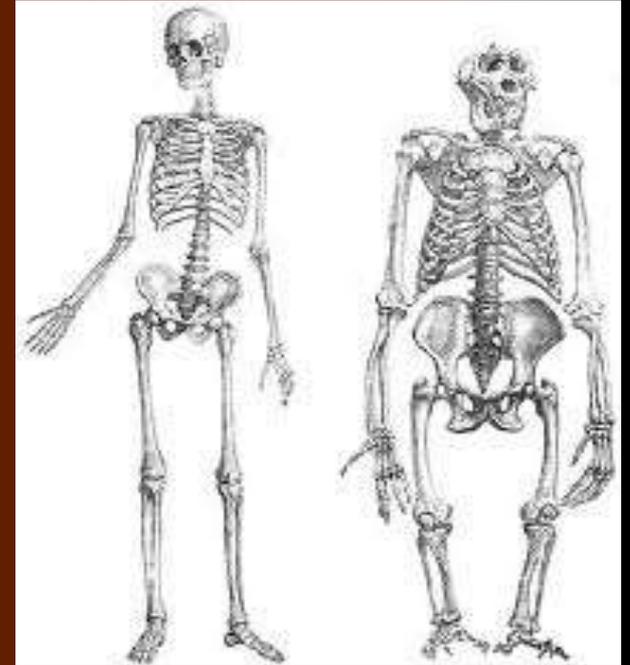
3. Develop new environmental friendly technology
(CO2 emission USA 18 ton HK 5.5-6 ton Philippine < 1 ton)

Hominid Identification 識別人科動物

Hominid Identification 識別人科動物

I. Comparative Anatomy 比較解剖學

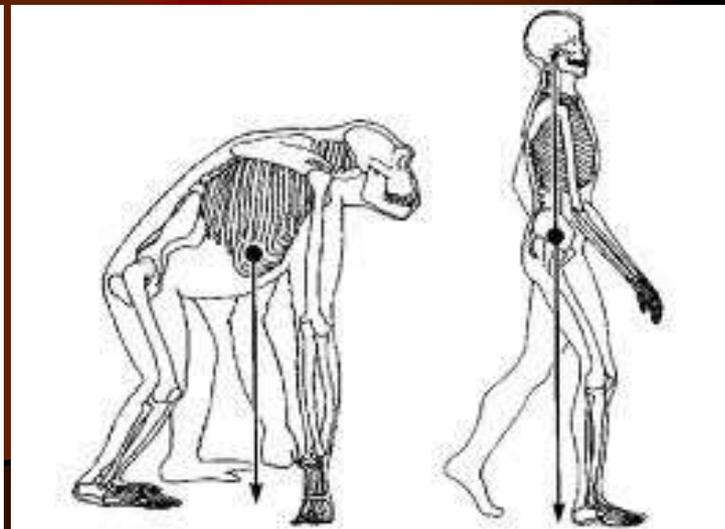
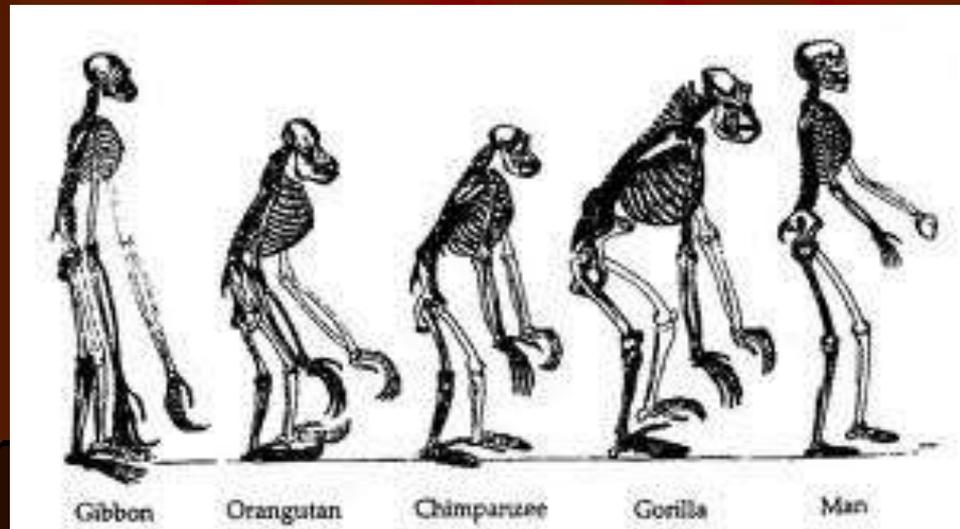
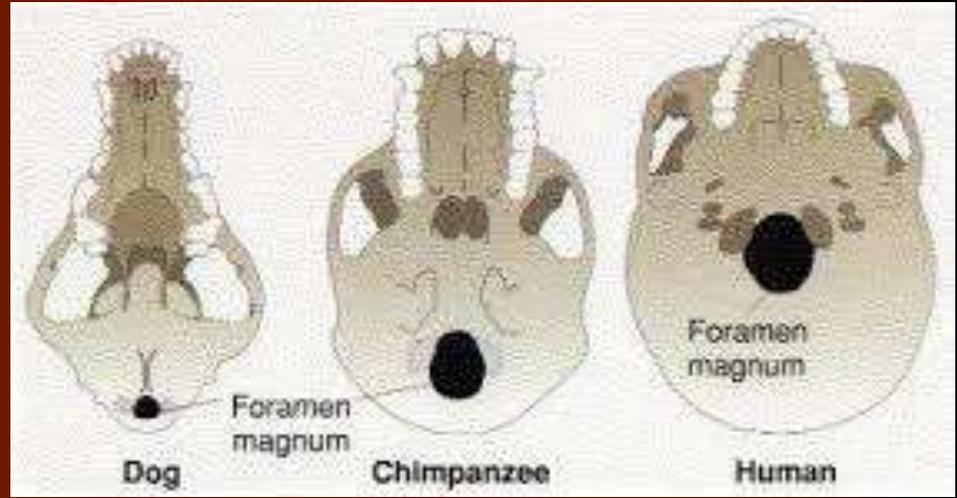
- Shape of Foramen magnum
- Skull shape & size
- Brain size
- Teeth & Jaw
- Vocal tract & larynx
- Skeletal comparison



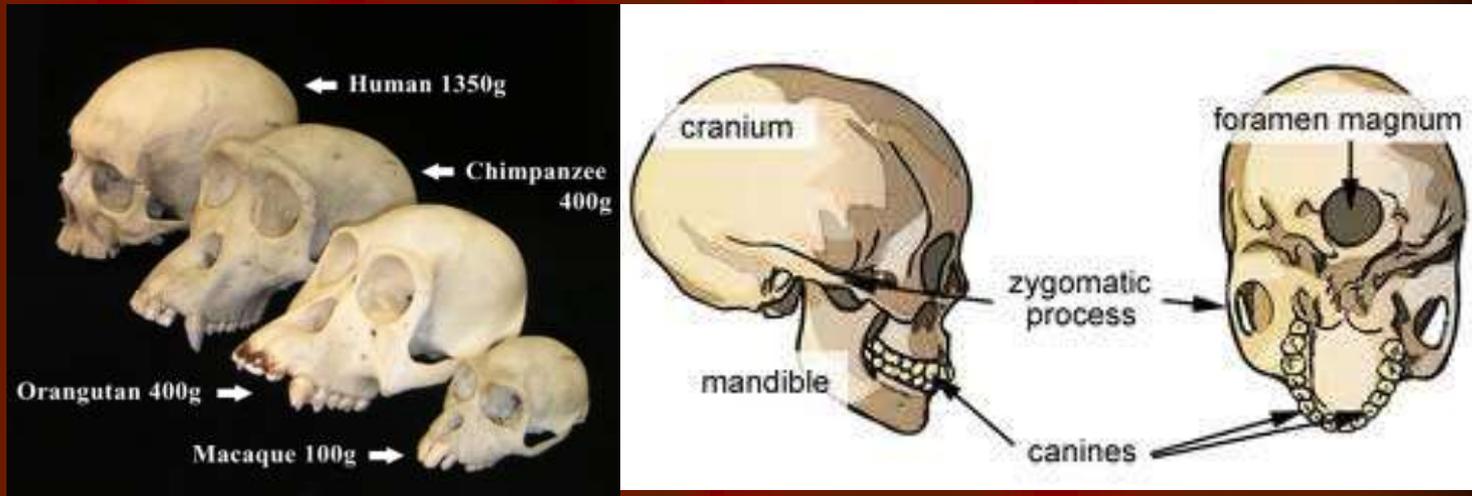
II. DNA Comparison 基因鑑別

I. Comparative Anatomy

a. Position of Foramen Magnum 枕骨大孔 which is the spinal cord opening in the base of the skull, a good indicator for upright posture & bipedalism

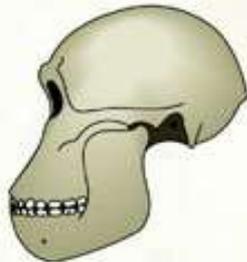


b. Skull shape & size



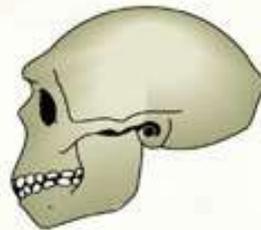
EVOLUTION OF THE SKULL

Australopithecus,
man-ape



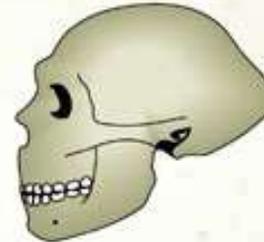
between 2 and 3
million years ago

Homo erectus,
Java man



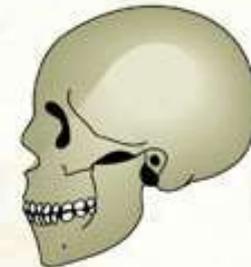
750 000 years ago

Homo sapiens neanderthalensis,
Neanderthal man



between 100 000 and
400 000 years ago

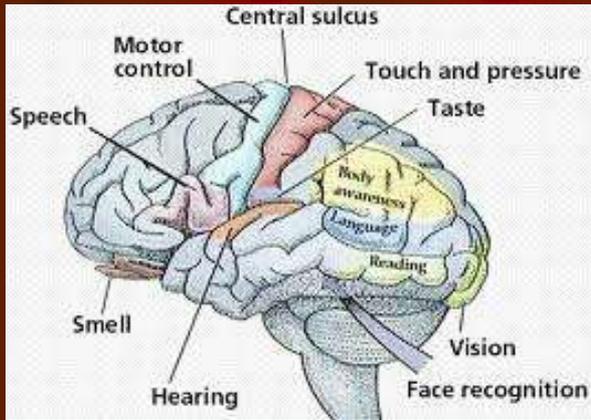
Homo sapiens sapiens,
L'homme sage



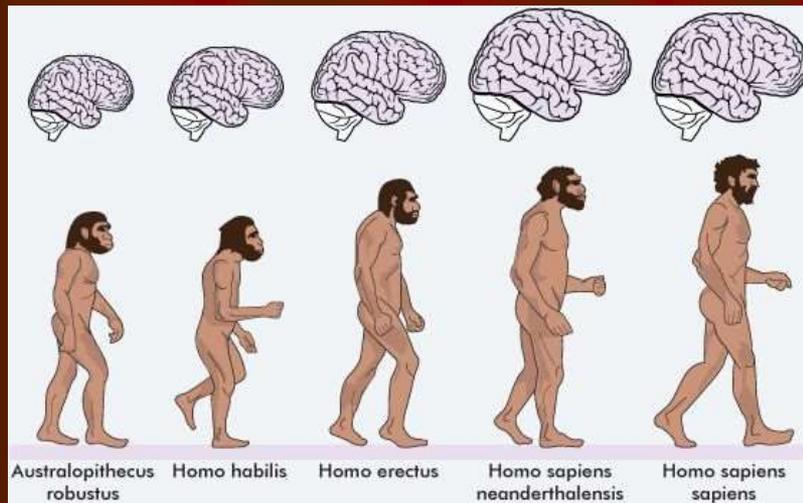
40 000 years ago
to the present

c. Brain Size Comparison

By studying the size of the cerebral cavity & endocast 腦腔內鑄模 .
Relative to body mass human has the largest & most complex brain
averaging 1400 cc weighing 1.4 Kg (3 times that of chimpanzee)

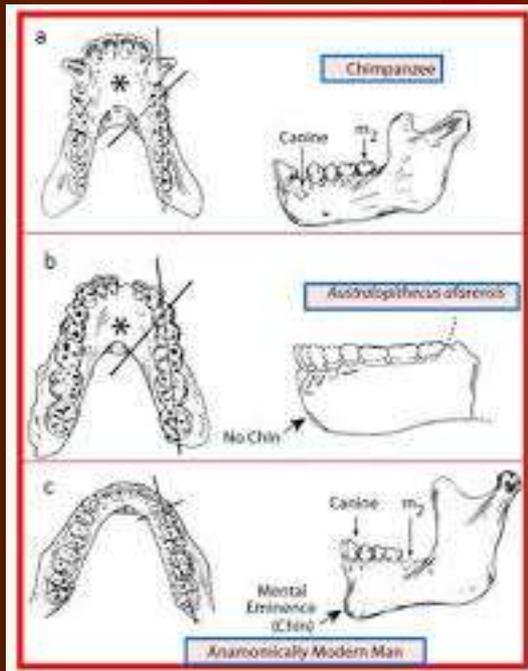


- *Australopithecus* : 400-500 cc
- *A. afarensis* – Lucy : 410 cc
- *Homo habilis* : 510-752 cc
- *Homo threshold* : 800/850 cc
- *Homo erectus* : 600-1251 cc
- *Homo Neanderthal* : 1200-1900 cc
- *Homo sapiens* : 1300-1400 cc
- *Homo sapiens sapiens* : 1000-1600 cc



d. Teeth & Jaws comparison

Shape of the mandible 顎片, thickness of the enamel & size/shape of the incisor 門牙, canine 犬齒 & molar 磨齒 can tell us what they eat as well as their health & age. Meat eating instead of just vegetarian resulted to smaller teeth & jaw & a flattened face – a legacy to our wisdom teeth



Comparison of Chimp (left), *A. afarensis* (middle), and human (right)

Teeth under the microscope. Teeth is the strongest part of our body



a

b

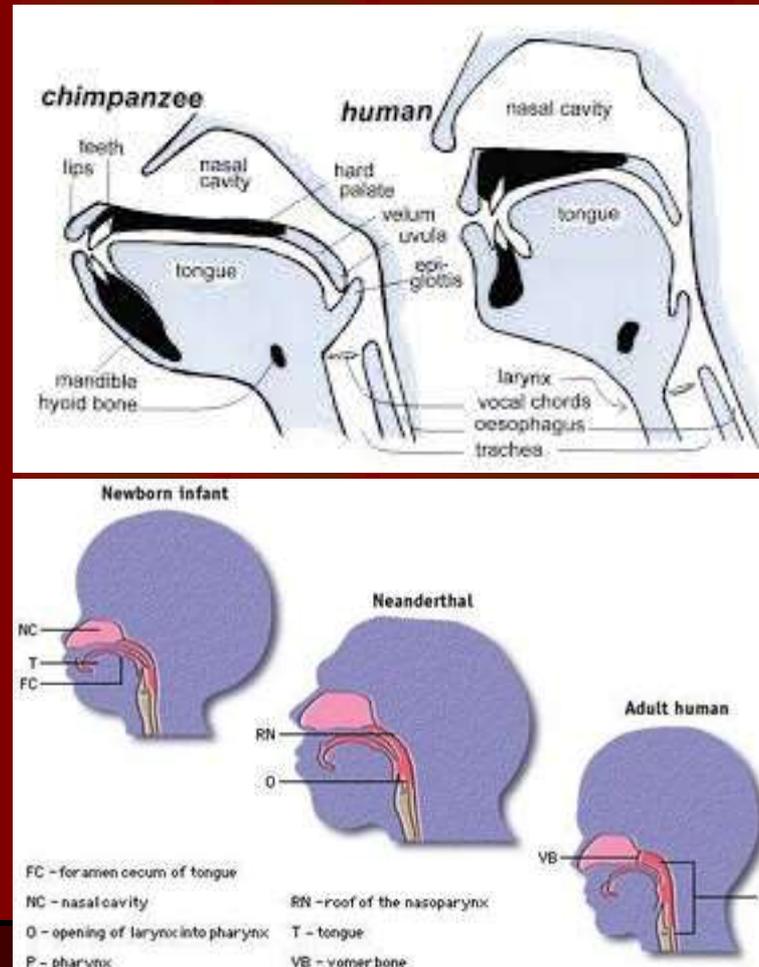
c

a : vegetarian

b : meat eater

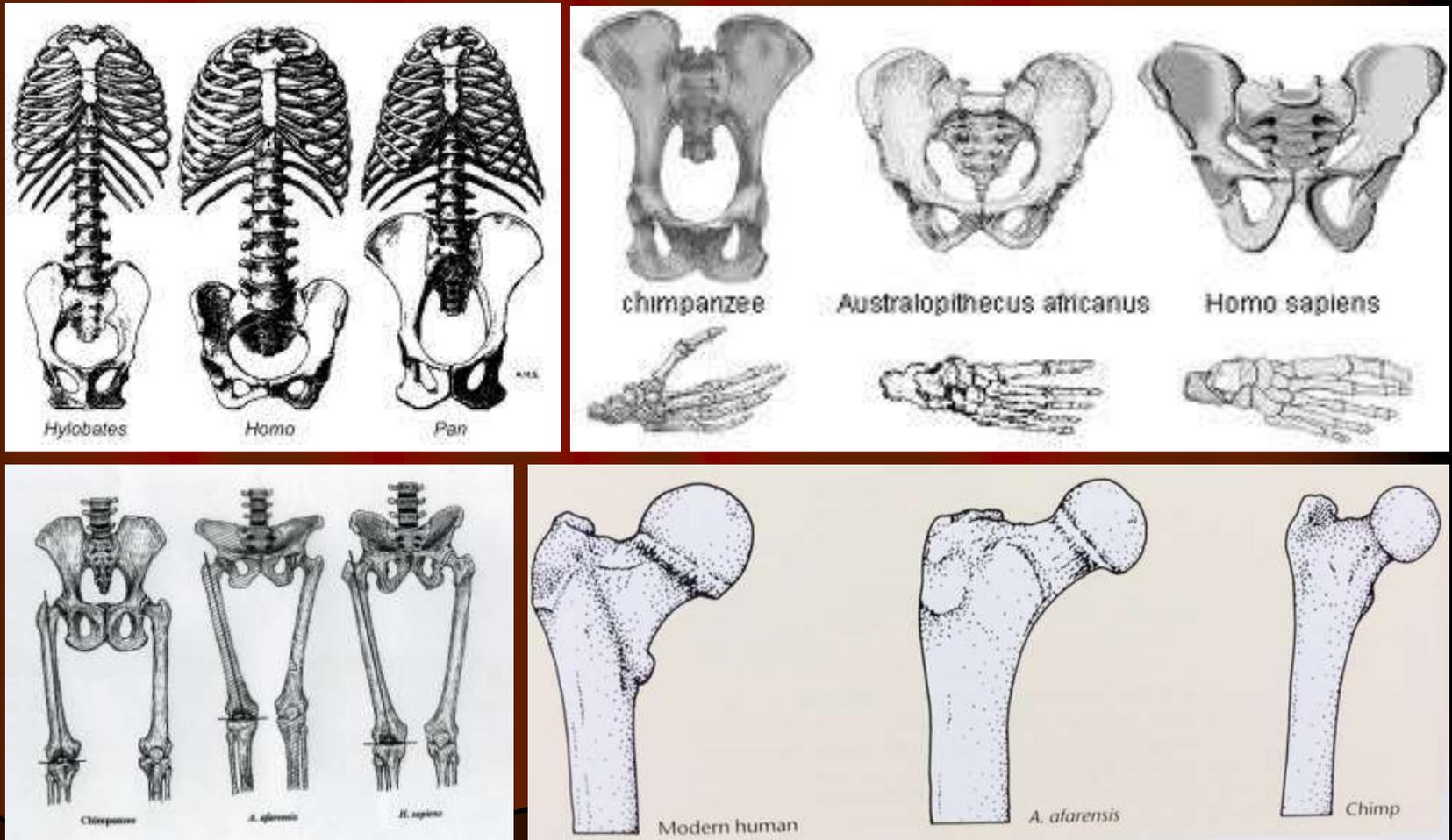
c : teeth of *Australopithecus robustus*

e. Comparison of the vocal tract 聲帶 & larynx 喉頭
between modern Human, Chimpanzee & Neanderthal
 Ours are much more complex allowing us to make a variety of sounds
 for developing speech



f. Skeletal Comparison 骨骼比較

Human have short arm but long waist, low shoulder, boarder pelvis, long legs, arch in the foot well equipped to walk & run. Note the Rule of Bilateral symmetry 左右對稱



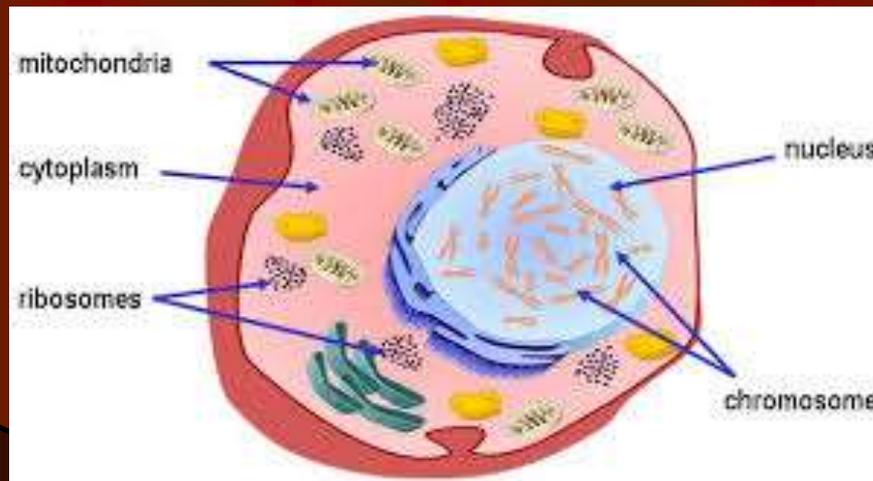
Femur joint, size of thumb & ankle angle



II. MOLECULAR BIOLOGY & DNA STUDY 基因鑑別

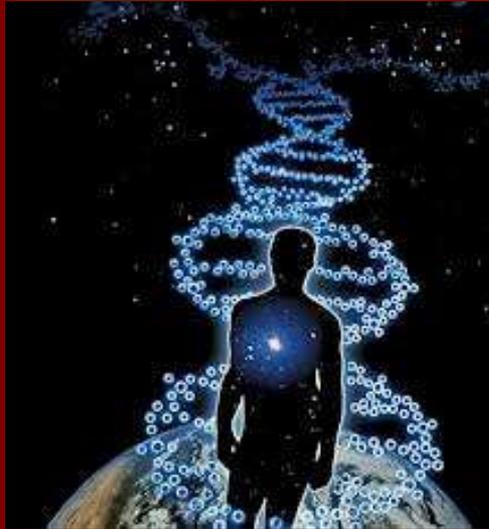
The Human body has 100 trillion (10^{14} : 一兆) cells 細胞 composed of 2 main types : body cells form our skin, hair, bones, muscles, nerves, brains & other body tissues. Sex cells are for reproduction carrying the hereditary material from parents to offspring

A cell has a protective membrane which keeps out most damaging substances but allows nutrients to enter and wastes to leave. Deep inside the cell is the nucleus which is the information center where all instructions for making and maintaining a human being are stored

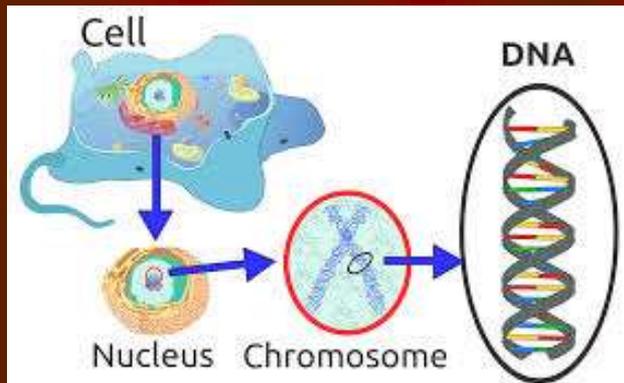


Different cells are formed by different types of protein 蛋白質 e.g. Collagen 膠原蛋白 for bones & skins and Keratin 角質素 for hair & nails. Protein in turn is made up of 20 different types of amino acid 胺基酸 (C,H,N)

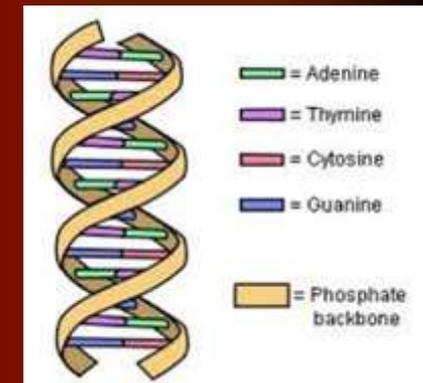
The recipe for producing the different types of protein is recorded in DNA (Deoxyribonucleic acid) 脫氧核糖核酸



DNA 脫氧核糖核酸 which is a molecule 分子 encoding the genetic instructions used in the development and functioning of all living organisms. Its chemical structure is a double helixes 雙股螺旋 make up of two complementary strands of sugar phosphate linked up by 4 types of bases called nucleotides 鹼基對 which pair in specific ways. For simplification scientist use the first letter of the bases A,T, C & G to record the different types of DNA



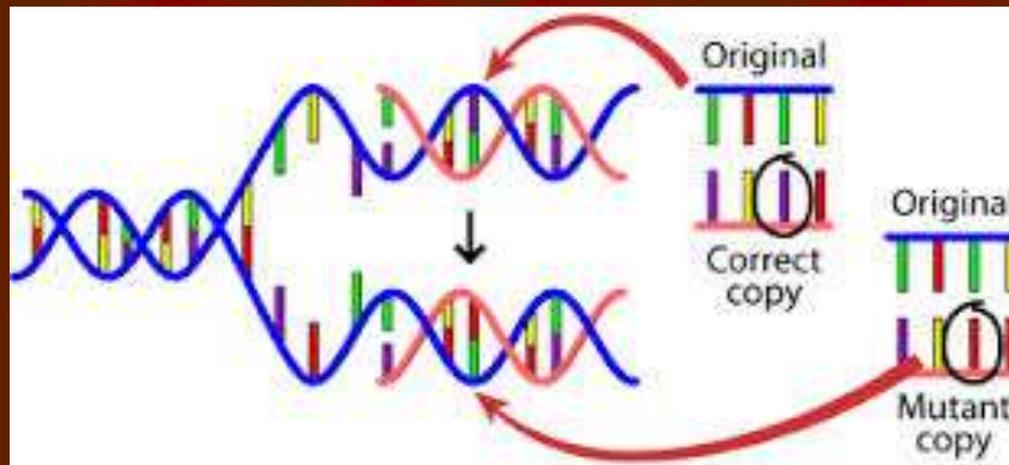
- (A) Adenine 腺嘌呤
- (T) Thymine 胸腺嘧啶
- (C) Cytosine 胞嘧啶
- (G) Guanine 鳥嘌呤



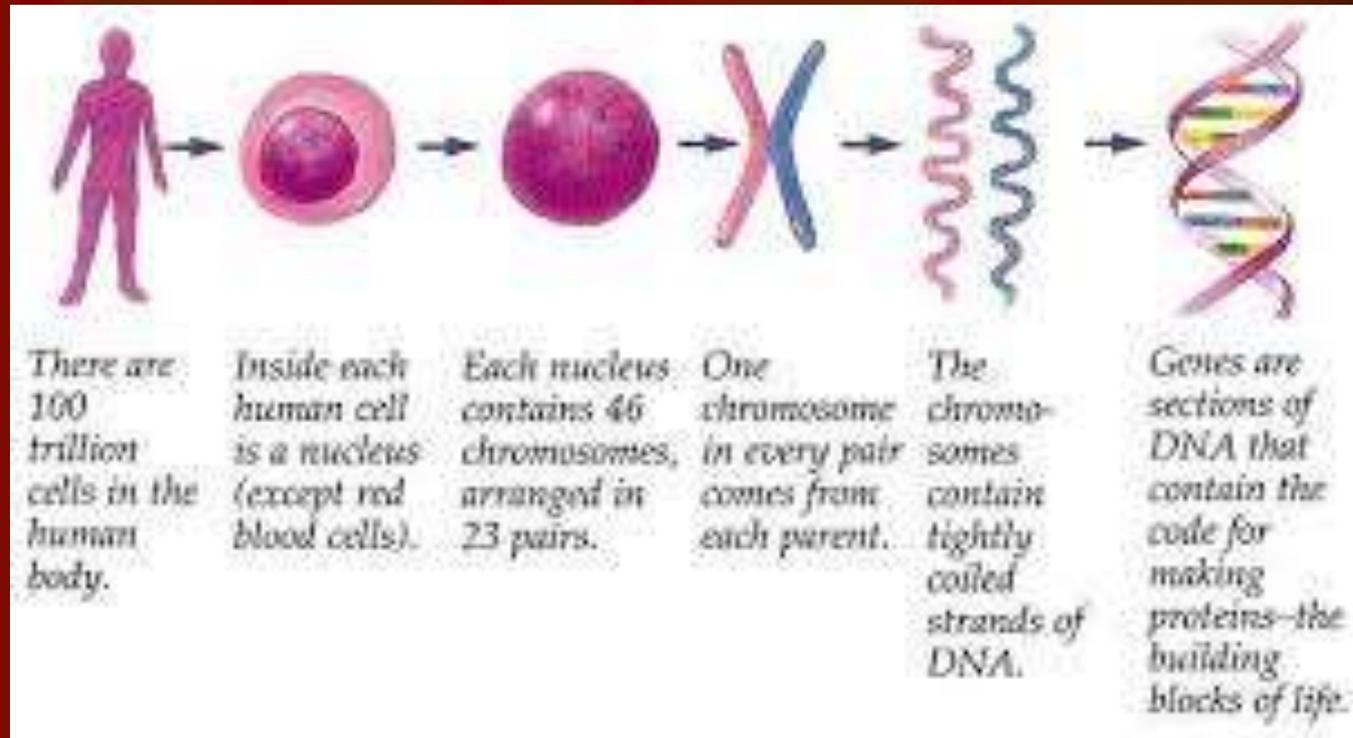
DNA in turn is packed into tiny rods called Chromosomes 染色體

DNA has 3 attributes

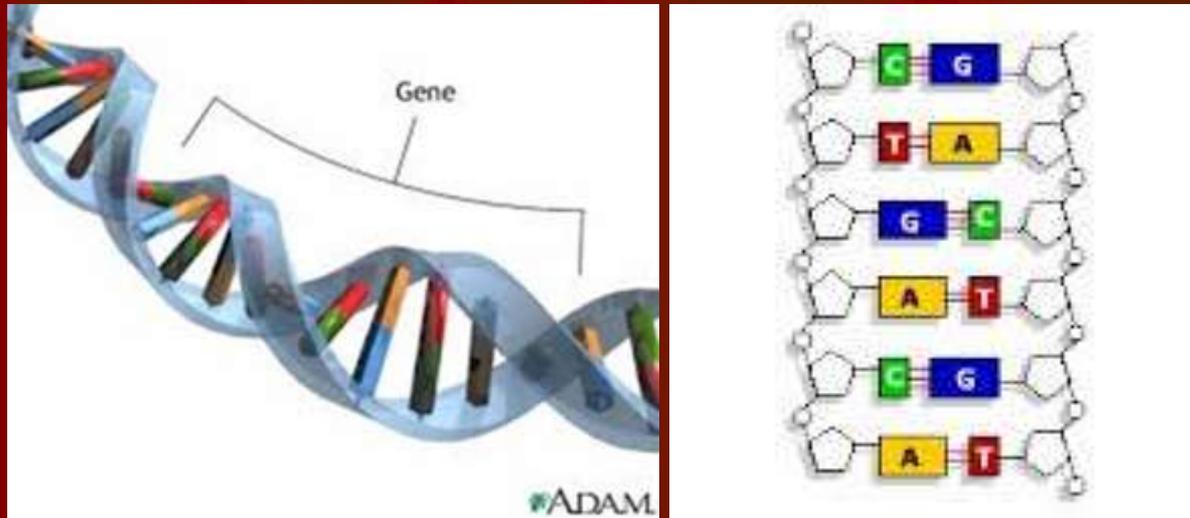
- Holding the genetic information that directs all life process
- Accounts for the precision of biological heredity
- Mutation 突變 : are permanent change in the DNA base sequence through deletion, duplication, inversion, insertion & translocation. Mutation can be neutral, harmful or beneficial to the living organism



DNA of eukaryotic organism is very long & for storage packed into tiny rods called Chromosomes 染色體 which are stored in the nucleus of the cell. Chromosomes occur in pairs one each from mom & dad. The number of chromosomes of each species varies. Human has 46, chimps & gorillas have 48 and gibbons have 44. In both human & ape include a pair accounting for their individual sex - XX for female, XY for male



A Gene 遺傳基因 is a section of the DNA along a chromosome. Each gene programs the cell for a specific task holding the information to build & maintain an organism's cell allowing metabolism & pass genetic traits to the offspring e.g. FOXP2 is responsible for speeches.



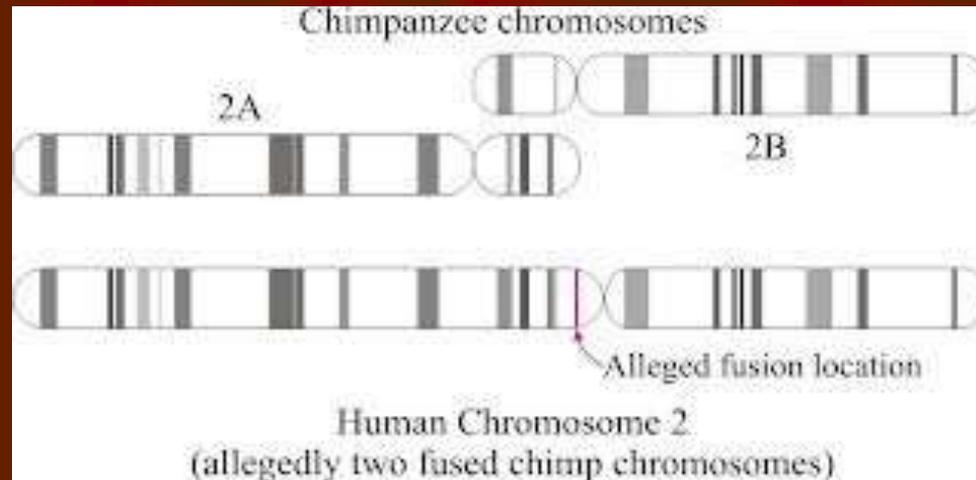
We inherited one complete set of genes from each of our parents which means for every gene we have two versions which are called alleles

Humans have about 23,000 genes* which make up the human genome , the blue print to make up a human which in turn has over 3 billion nucleotides !

(* representing only 2% of the body DNA , the rest are "Junk DNA")

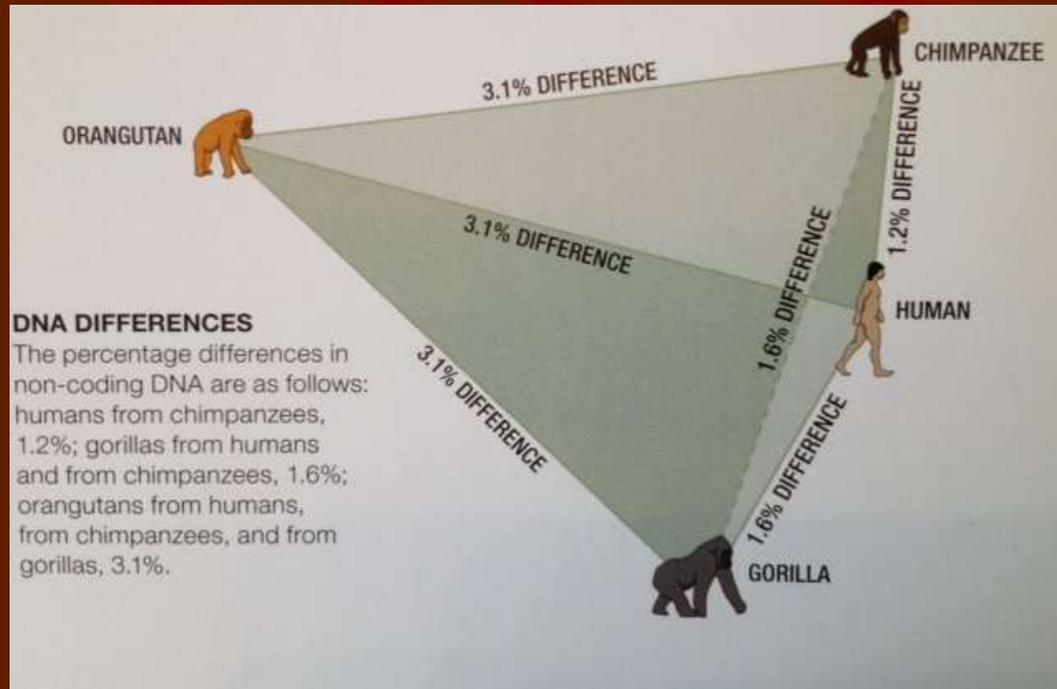
Human & Chimpanzee Genomes 基因序列

Difference identified in 1, 2, 4, 5, 9, 12, 15, 16, 17 & 18



XY or XX is one pair. M stands for Mitochondrial DNA (MtDNA 線粒體) which is stored outside the cell nucleus

Close relatives – DNA Differences



Note humans have 22,000 genes with 3 billion DNA base pairs so even 1.2% variation with chimpanzee will equal to considerable differences not to mention latest study shown that the difference is likely to be 6.4% !

Genome comparison between Man, Neanderthal & chimpanzee on chromosome number 5

智人

TACTACTCACATTTTTTTTGCATATTATCTAGTCCCATGACATTA

尼安德塔人

TACTACTCACATTTTTTTTACATATTATCTAGCCCCATGACATTA

黑猩猩

TACTACTCACA-TTTTTACATATTATCTAGTCCCATGACATTA

智人、尼安德塔人與黑猩猩第五號染色體的同一段基因組。
(感謝 Ed Green 提供)

The Fossil Records

Paleoanthropology

Paleoanthropology 古人類學 is the study of prehistorical human. It is detective work with painstaking effort in the field as well as back at the laboratory



Modern technology helps

Electron microscope, radiocarbon accelerator, computerized tomography (CT Scan), stereo lithograph, geometric morphometric & DNA analysis not only used for identification but also enable to study the growth & development



Hominid Fossils

- 1. Unaltered & altered remains such as bones & teeth - Biological remains
- 2. Apart from foot prints, "Trace fossils" 生痕化石 of hominids include cultural remains such as tools, artifacts, cave arts, architectural relics (tombs, temples, cities) as well as written & spoken languages & religion thus crossing over to the field of modern anthropology 人類學 which includes physical anthropology, cultural anthropology, archaeology as well as linguistics

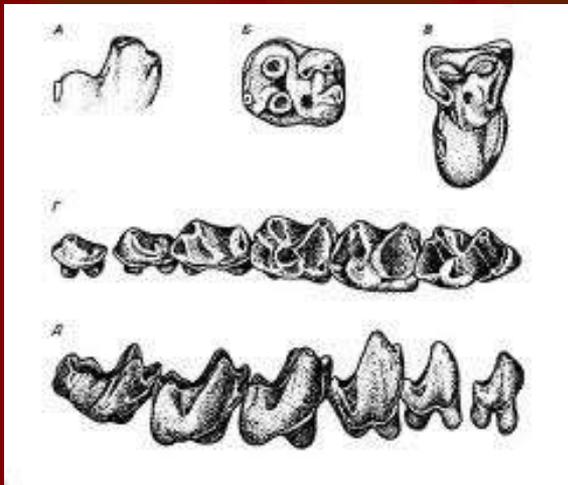


From Early Primate to Apes

從古靈長類到猿

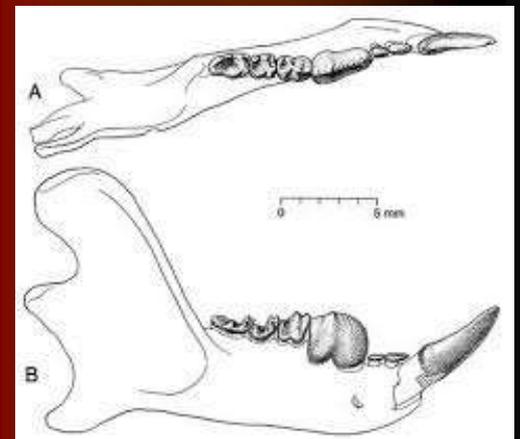
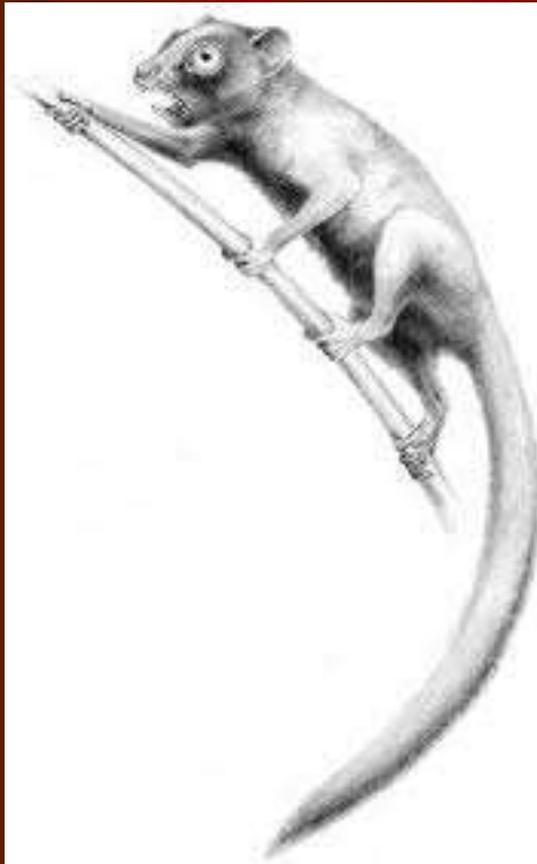
Purgatorius unio

65 Ma late Cretaceous from Montana USA. A rodent like climber. Based on a few teeth and jaw fragments. Believed to be the earliest example of a primate or proto primate



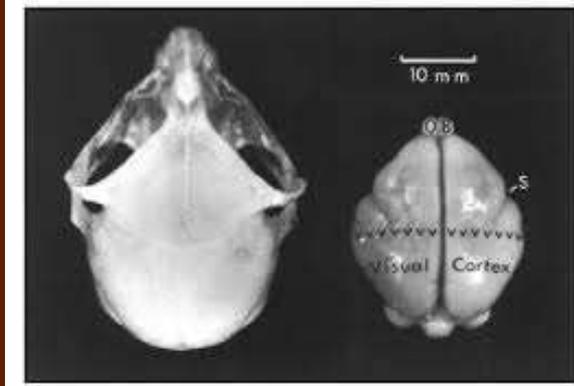
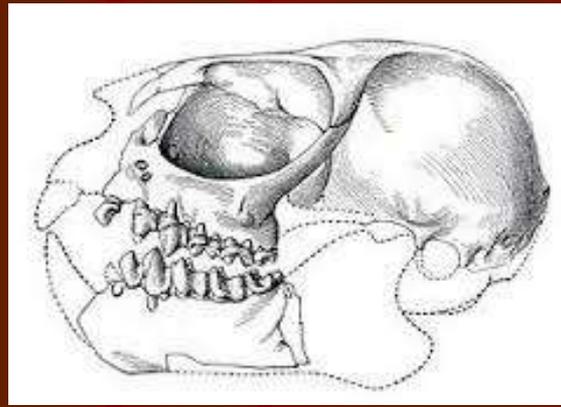
Carpolestes

58 Ma Only 35cm long & weighed less than 100 grams. Looking like a squirrel it is one of the earliest primate like mammal living in North America during the Paleocene



Tetonius homunculus 帝多獸

54 Ma Early Eocene with fossils found in Colorado & Wyoming.
Weighed only about n 90 grams, it is probably an insectivore
resembling small nocturnal primates such as bush babies &
one of the world's oldest known fossil primate



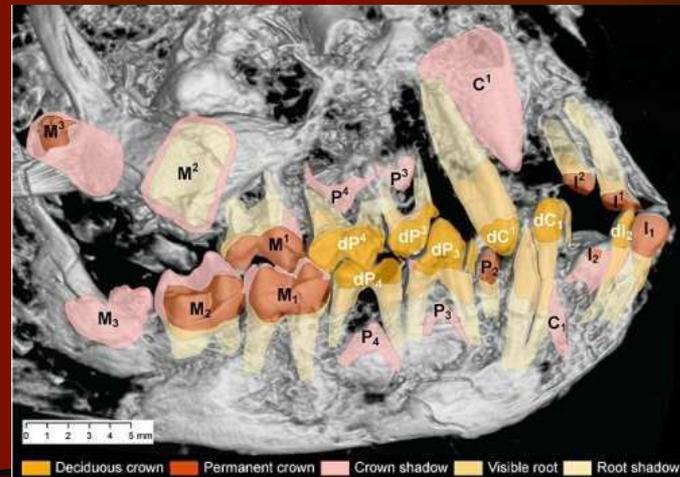
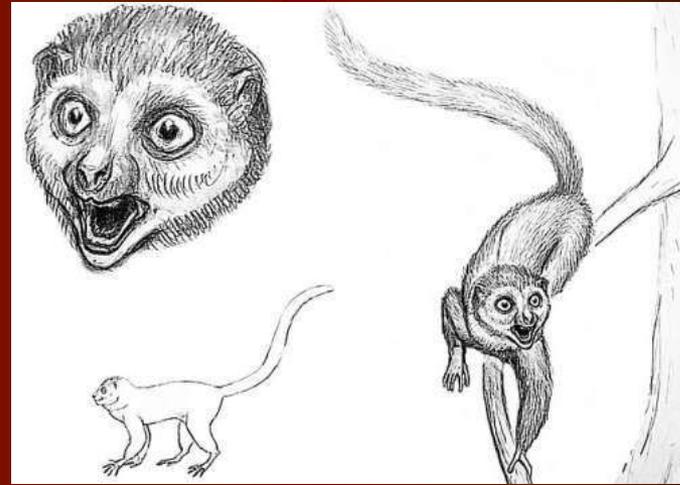
"Adapis"

A 50 Ma primate resembled a small lemur. 3 specimens found with male larger than female living in Eocene Europe



"IDA"

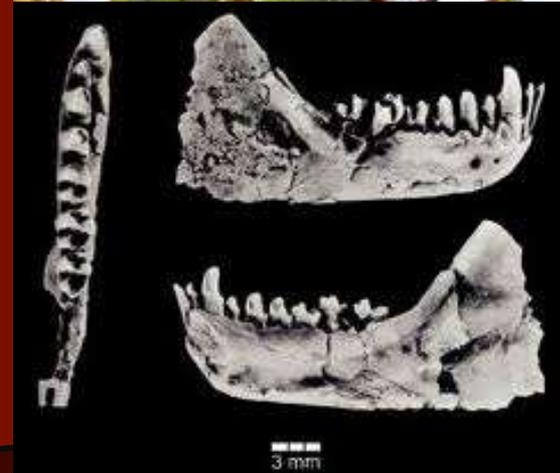
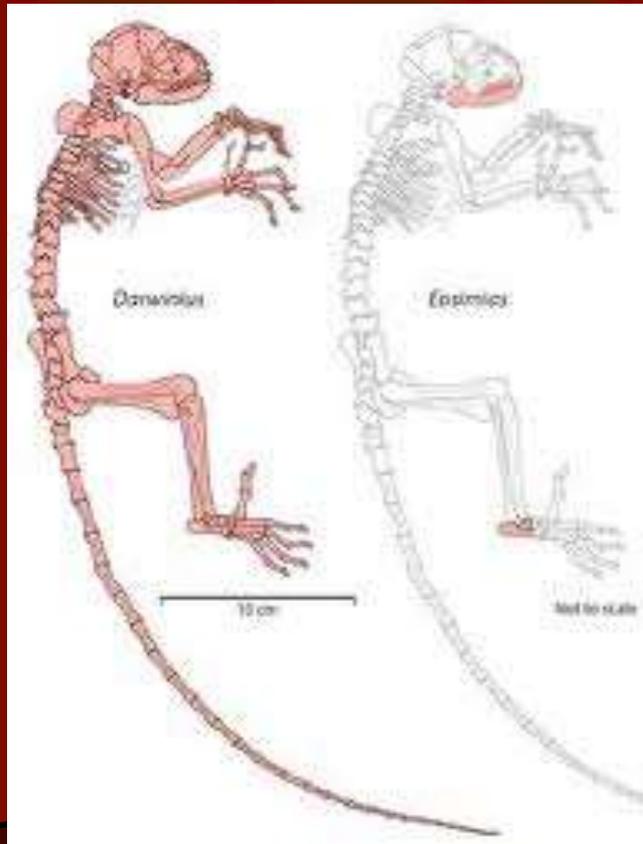
A 47 Ma (Eocene) lemur like primate called *Darwinius masillae* from Messel Pit, Germany total length 58 cm. Many scientists dispute its claim as the "missing link" in the human line



Eosimias sinensis or Shu Ape meaning "Dawn Monkey"

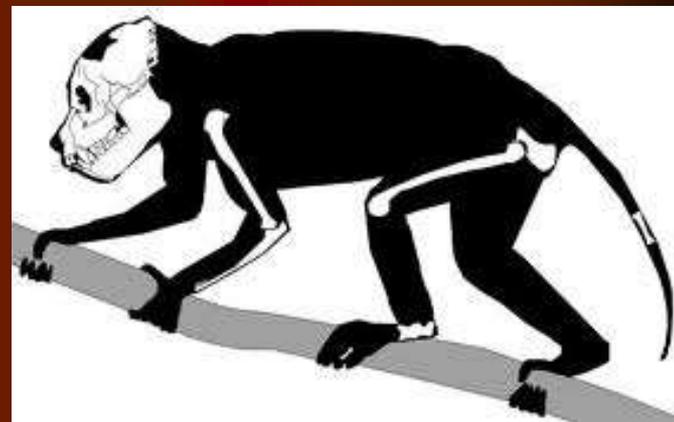
中華曙猿

45 to 40 Ma, a mouse size primate found in Shanghuang 上煌, Jiansu in 1994 weighing only 10 grams not much bigger than our thumb & could easily fit in our palm. Probably a nocturnal solitary tree dweller relied on a diet of insects & nectar



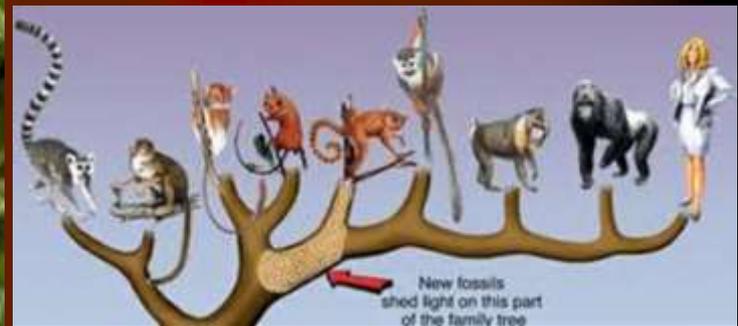
Aegyptopithecus 埃及古猿

Meaning Egyptian primate, 35-33 Ma (Oligocene) 56-92 cm long 14.6 cc brain



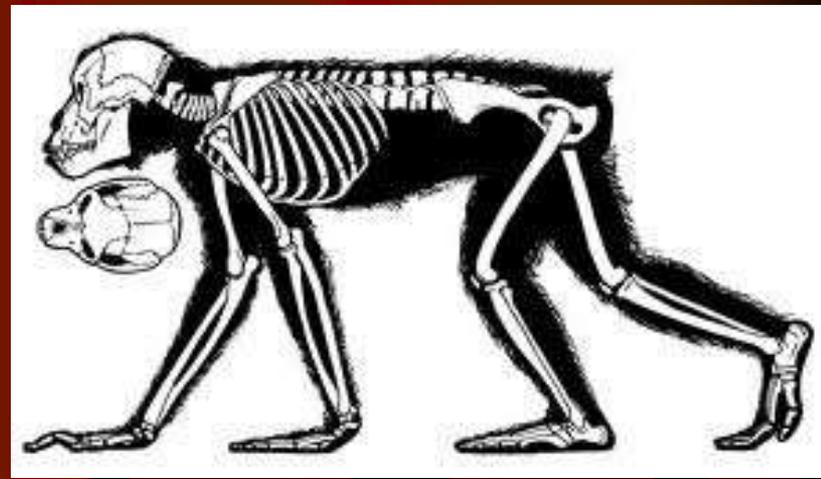
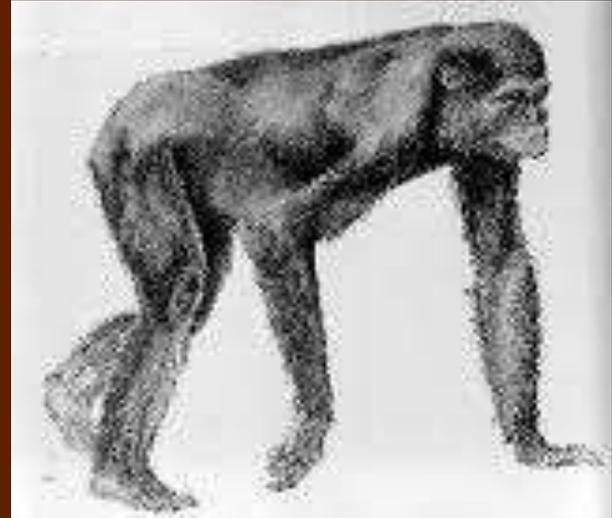
Rukwapithecus fleaglei

25 Million year old Ape - Rukwa Rift Valley, Tanzania 2012 living together with a monkey named Nsungwepithecus (the one at the back of the picture)



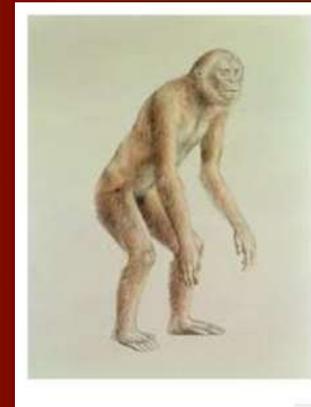
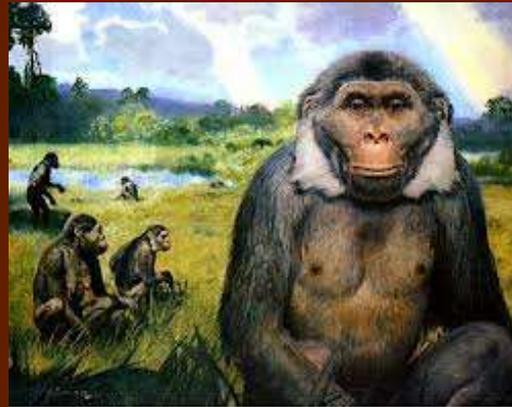
Proconsul africanus 祖猿/普羅猿

23-15 Ma Oligocene era primate found in Kenya, 65 cm long size like a monkey but no tail. It is a possible common stock of both Apes & Man



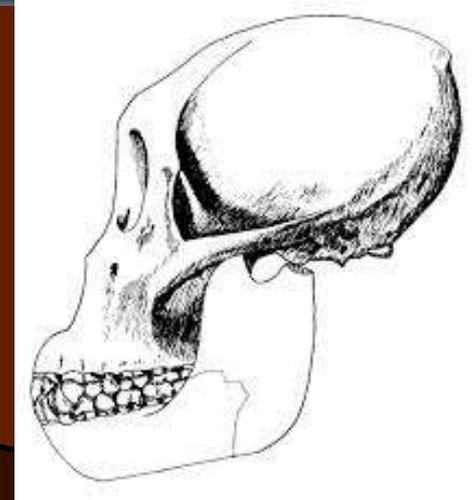
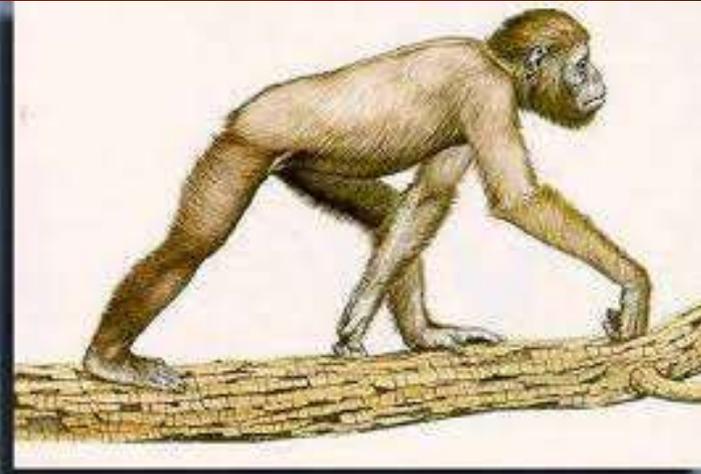
Sivapithecus 西瓦古猿

16-8.5 Ma fossils found in India, Pakistan & China. 1.5 m long.
Probably the ancestor of orangutan. Large canine & heavy molar suggest tough food diet like seeds & grasses



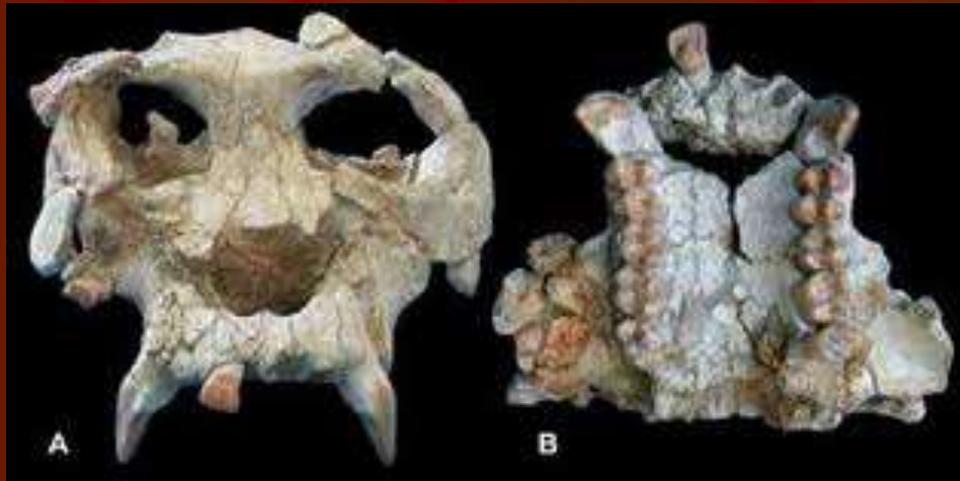
Dryopithecus

14 Ma fossils found throughout Eurasia. 60 cm long Miocene ape.
May be common ancestor of chimpanzees, gorillas and human

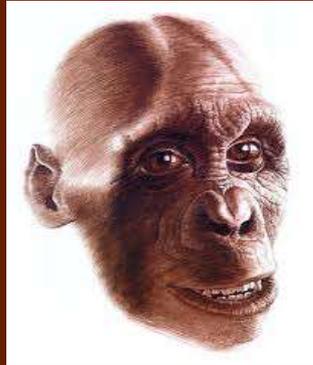


Pierolapithecus catalaunicus

13 Ma Miocene fossils found in Catalonia Spain. Shares many features with modern great apes but controversial as to whether they are really the ancestor of modern great apes including human as claimed by some scientist.



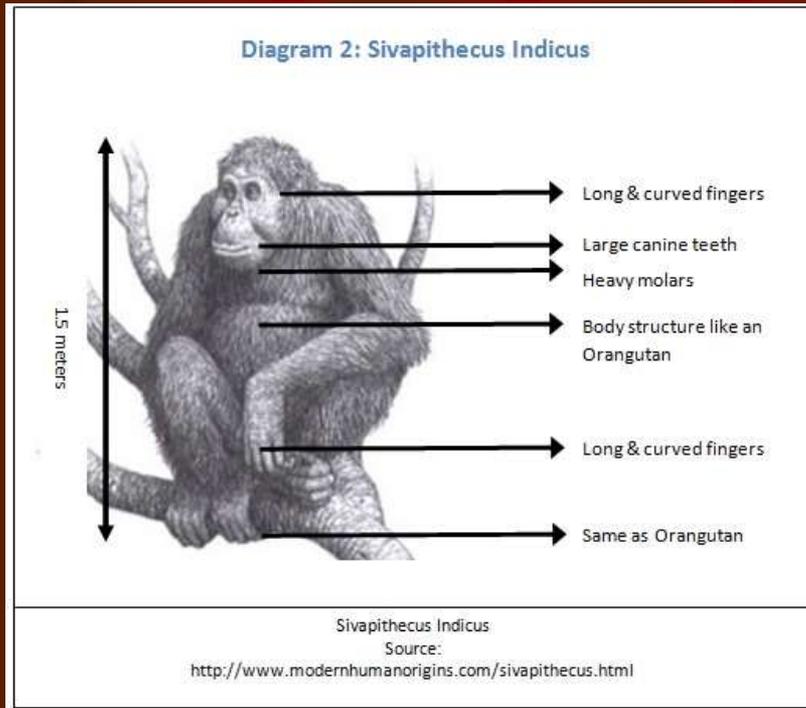
Rudapithecus hungaricus : Hungary, 10 Ma



Ouranopithecus macedoniensis : Greece, 9.5 Ma

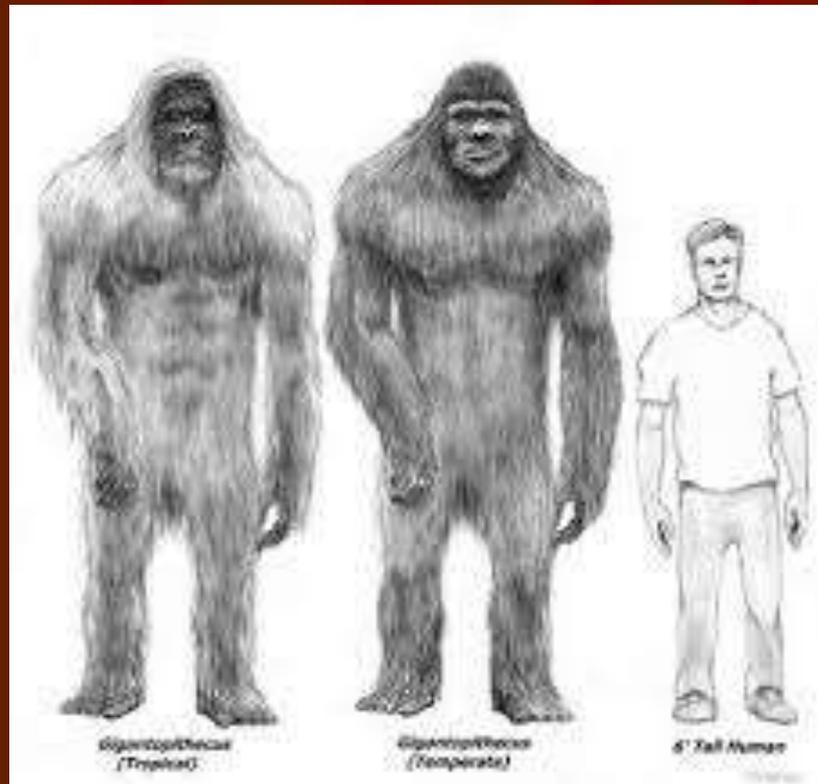


Sivapithecus indicus : Pakistan, 9 Ma may be ancestor of orangutan ?

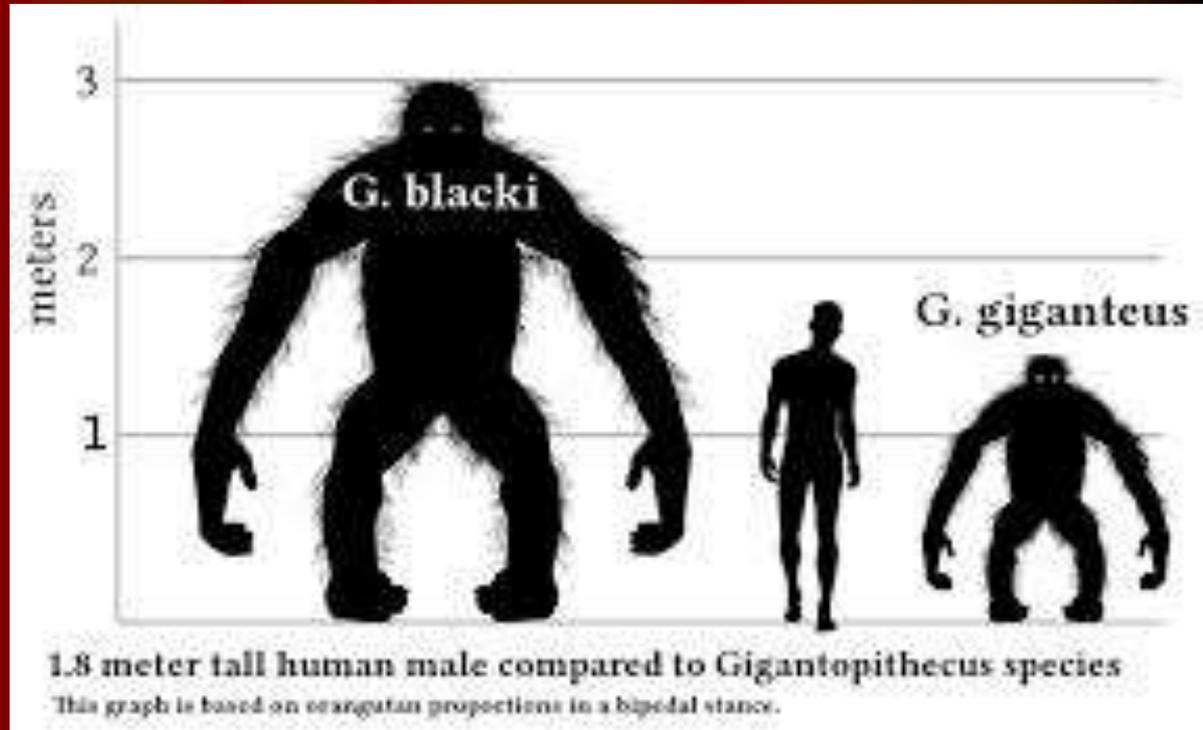


Gigantopithecus 巨猿

China, Nepal, India & Vietnam 9 Ma – 100 Kya. Stood 3m weighed 540 kilos. One species *Gigantopithecus blacki* probably even bigger but not yet fully proven as the estimation was based only some fossil teeth and a large mandible !



A tooth of *Gigantopithecus* was first discovered in a apothecary shop in China in 1935 to be used as medicine. A tooth of *Gigantopithecus blacki* was also found among a shipment of "Dragon Bones" also in China in 1955 !

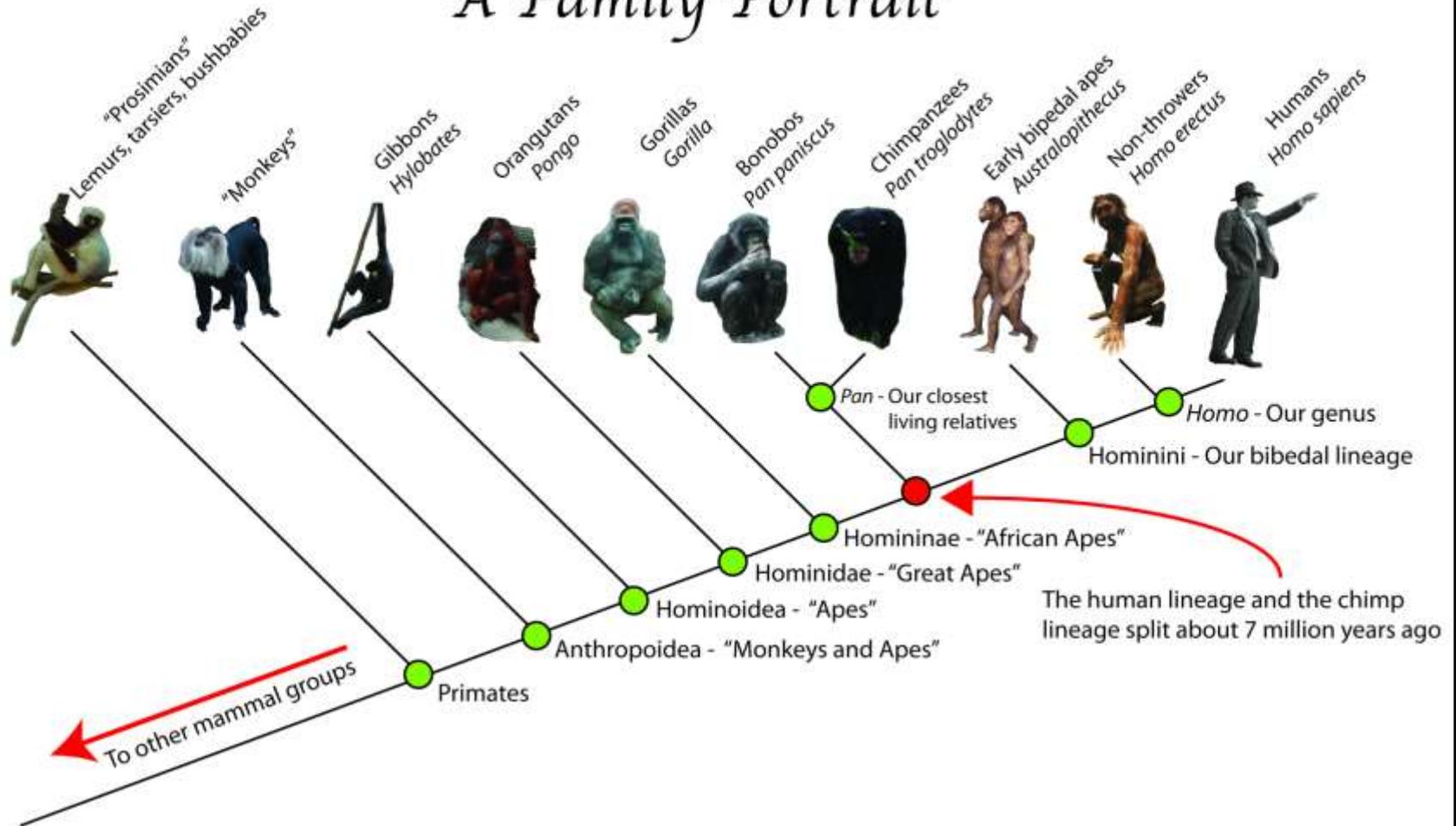


From Apes to Hominid

從猿到人科動物

Primates Evolution

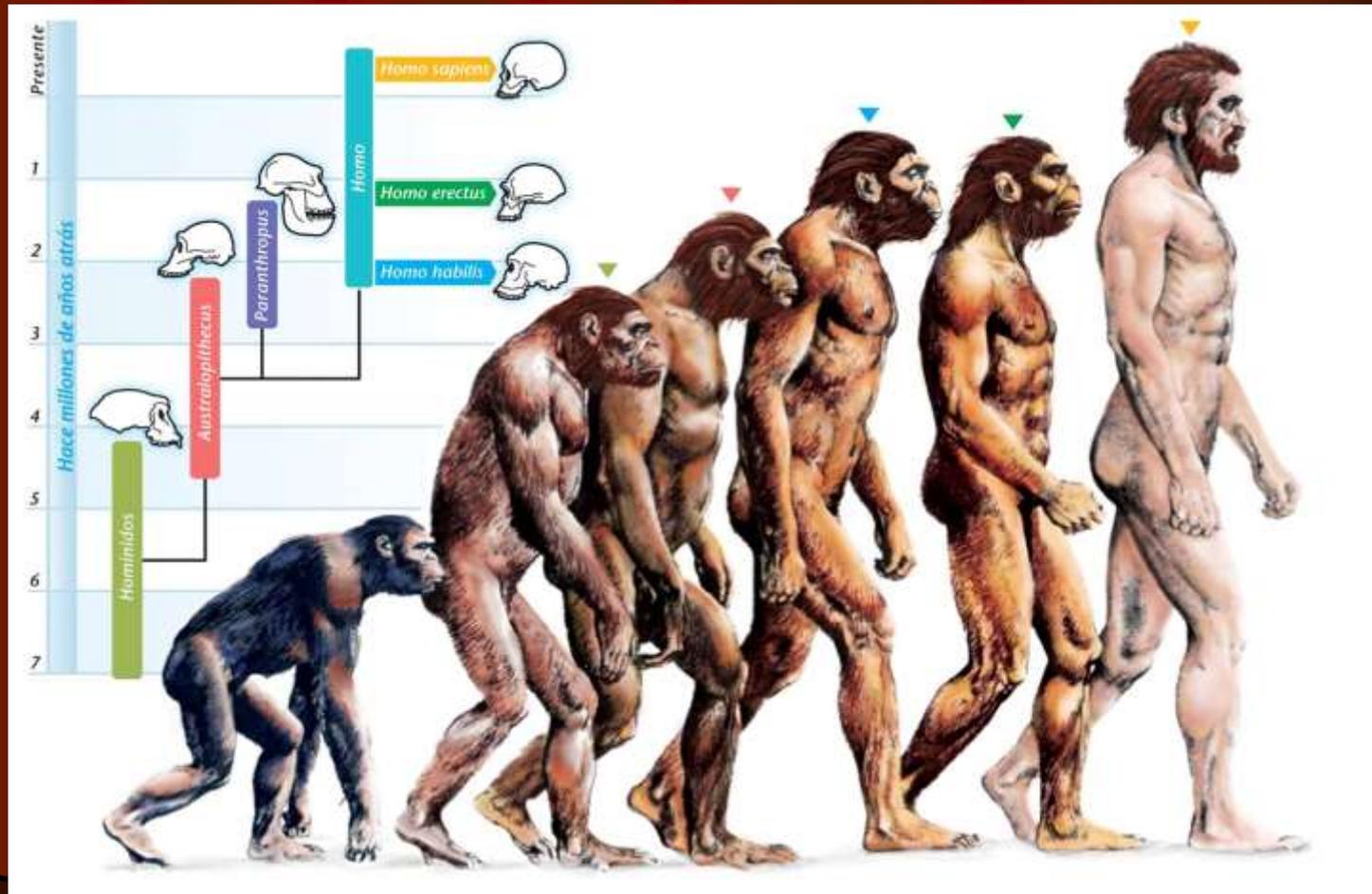
A Family Portrait



Hominin Ancestry

Four groups

Early *Hominids* 早期人科動物 (7-4 Ma); *Australopithecus* 南猿屬 (4-2 Ma); *Paranthropus* 傍人屬 (3-1Ma); *Homo* 人屬 (2-3 Ma)

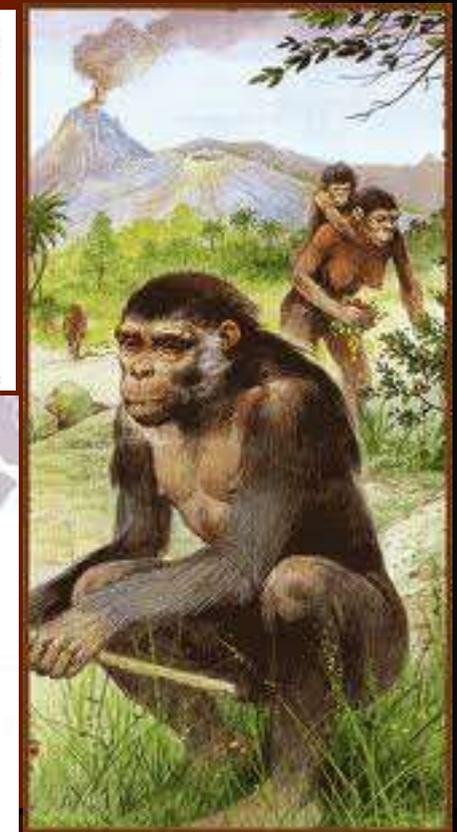
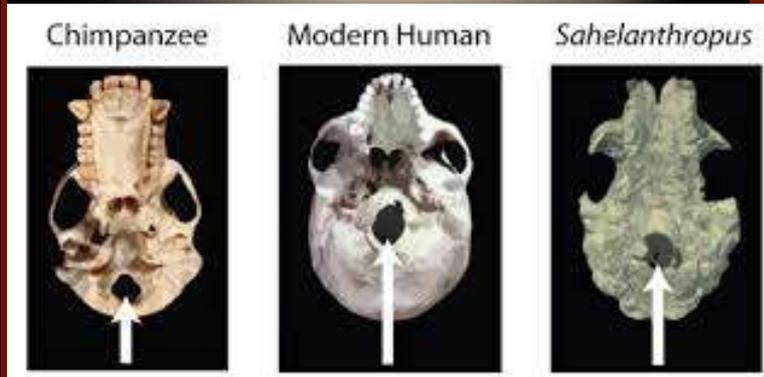
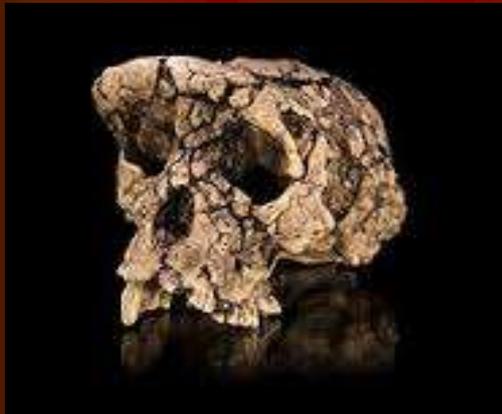


Early Hominid 早期人科動物

Between 7 to 4 Ma

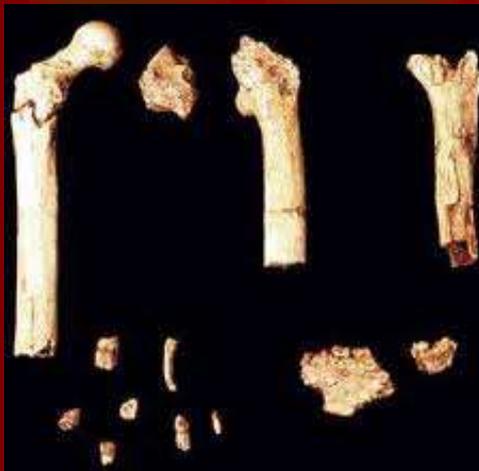
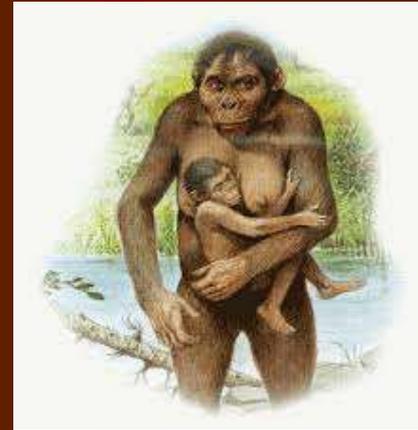
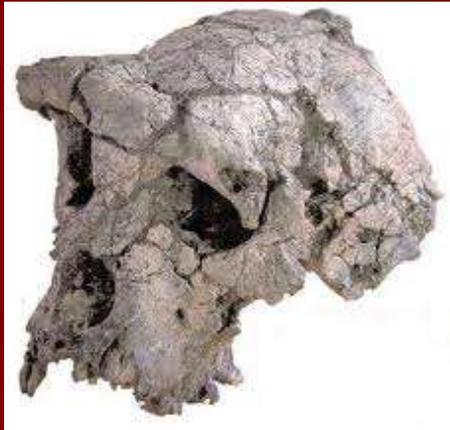
Sahelanthropus tchadensis 查德沙赫人

Nicknamed "Toumai" meaning the "Hope of Life" it is the oldest known Hominid living 7 to 6 Ma found at Toros Menalla in Chad's Djurab Desert in 2001. Only 9 specimen found so far. Brain size approximately 300-400 cc similar to that of a chimpanzee but the foramen magnum is close to human



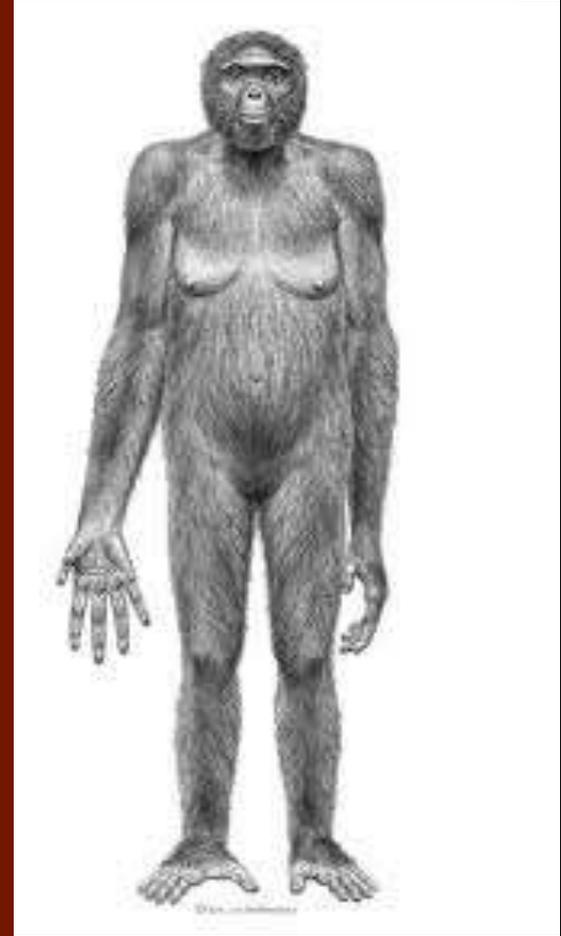
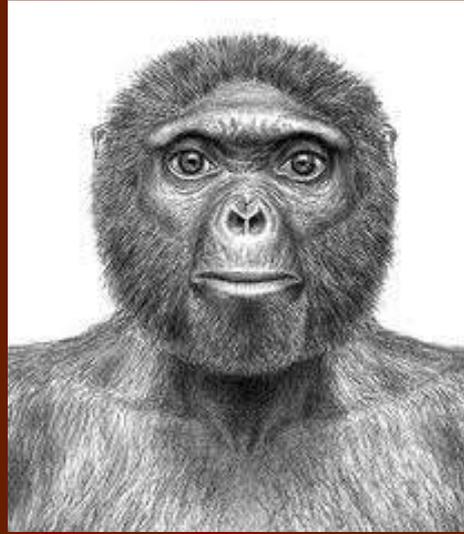
Orroin tugenensis 千禧猿屬土根種

Discovered in year 2,000 & nickname “Millennium Man” 6 Ma ,Tugen Hills, Kenya, 12 specimens found, approximately the size of a chimpanzee with a small brain, large canine and may be the oldest known biped



Ardipithecus kadaba 地猿屬始祖種

6-5 Ma by Tim White at the Apha Depression Ethiopia 1992/3
300-350 cc small brain probably an omnivore & frugivore (fruit eater)



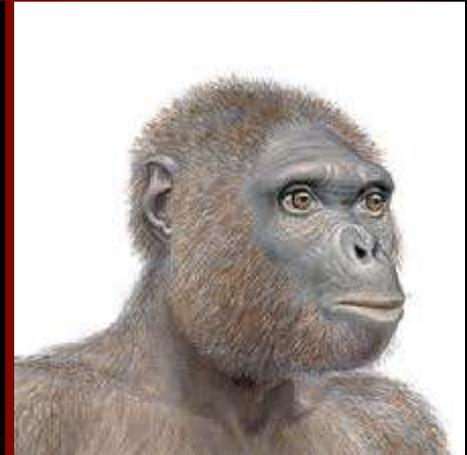
古猿

6 Ma fossil cranium of a juvenile ape in Yunan Zhaotong



Ardipithecus ramidus 根源基盤人

Nick named "Ardi" 5 to 4 Ma, 1.3 m tall, 100 specimens found in Ethiopia also by Tim White. Small 300-350 cc brain, indicate both arboreal & bipedal walking when on the ground. Still being debated whether it is a hominid



Profiles



Chimpanzee



Ar. ramidus



Australopithecus

Kenyanthropus platyops 肯尼亞平臉人

3.5 Ma Pliocene fossil from Lake Turkana Kenya. Still being debated whether it is a new hominid genus or a species of *Australopithecus*.



Distribution of early hominids in Africa

Just as Darwin had expected ! The Olduvai Gorge in Tanzania is called the “Cradle of Humankind”



Hominin fossils in Africa

1
Australopithecus afarensis
 (including the famous "Lucy")
 Laetoli, Tanzania; sites in Ethiopia's Afar region include Hadar and Dikika
2.9-3.8 million years ago
 (Lucy is 3.2 mya)

2
Australopithecus deyremeda
 Afar region, Ethiopia
3.3-3.5 mya

3
Australopithecus anamensis
 Kanapoi and Allia Bay, Kenya
3.9-4.2 mya

4
Undescribed Homo
 (species as yet unnamed)
 Ledi-Geraru, Ethiopia
2.8 mya

5
Kenyanthropus platyops
 Lake Turkana, Kenya
3.2-3.5 mya

6
Australopithecus prometheus
 (including "Little Foot")
 Sterkfontein
3.67 mya

7
Australopithecus africanus
 Taung, Sterkfontein, Makapansgat, Gladysvale
2.1-3.3 mya

8
Australopithecus sediba
 Malapa
1.98 mya

9
Homo naledi
 Dinaledi Chamber, Rising Star cave system
Age not yet determined

Other Key Finds

10
Australopithecus bahrelghazali
Central Africa
 Koro Toro, Chad
3.58 mya

11
Homo habilis
 Olduvai and Koobi Fora (east); Swartkrans (south)
1.5-2.4 mya

12
Homo erectus/ Homo ergaster
Africa, Europe, Asia
 African sites include Turkana, Olduvai Gorge and Bouri (east); Swartkrans (south); Ternifine and Sale (north)
150,000(?) - 1.9 mya



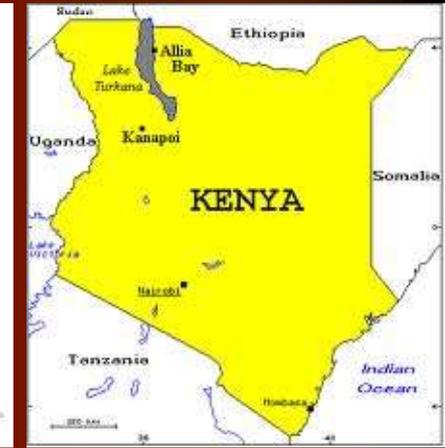
Australopithecus

南猿屬

Between 4 to 2 Ma

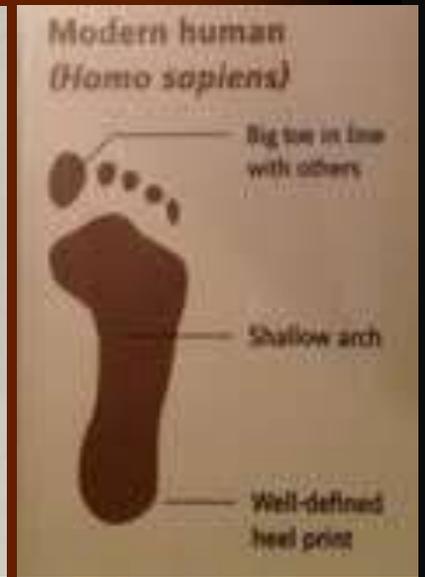
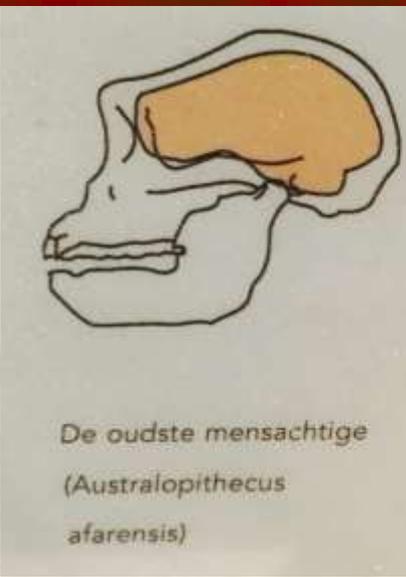
Australopithecus anamnesis 南猿屬湖濱種

4.2-3.9 Ma Kenya, weigh 50-55kgs, brain size 1/3 of human & comparable to that of a gorilla, probably ancestral to *Australopithecus afarensis*



Australopithecus afarensis 南猿屬亞法種

4.1-2 Ma which is closely related to the genus *Homo*



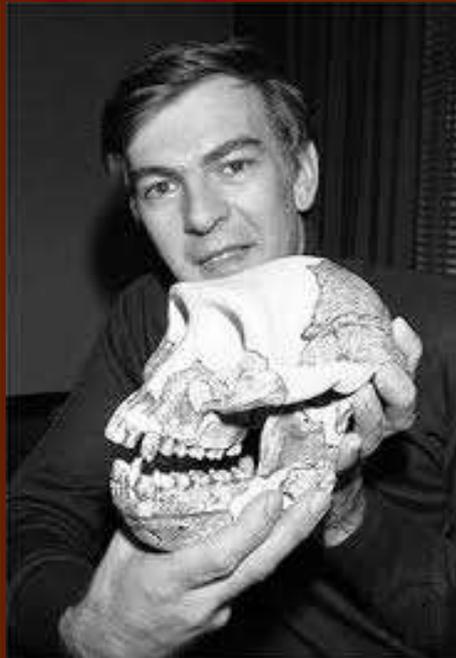
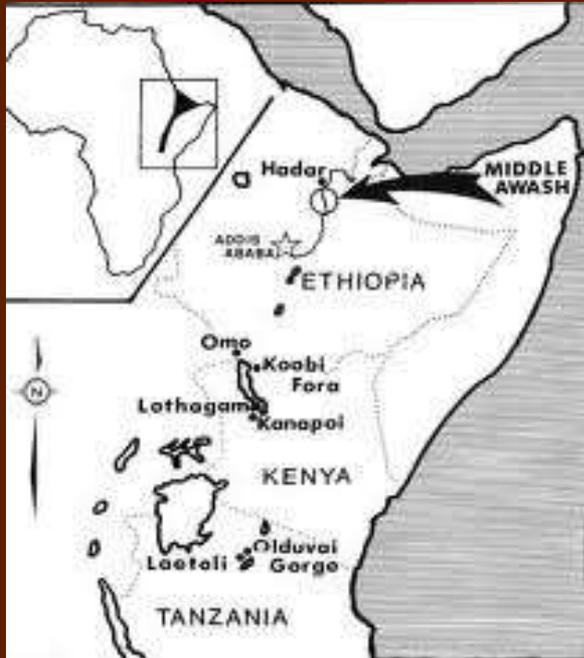
Laetoli footprint

Australopithecus afarensis foot prints made 3.6 Ma at Laetoli Tanzania discovered 1976 by Mary Leakey shows clearly bipedal movement by two adults and a smaller individual



"LUCY"

The famous A.L.288-1 akin "LUCY" is an *Australopithecus afarensis* found at the Afar locality in the Hadar region in Ethiopia dated 3.2 Ma discovered by Donald Johanson 1974. The skeleton is over 40% complete. Today 360 afarensis skeletons have been found in the region

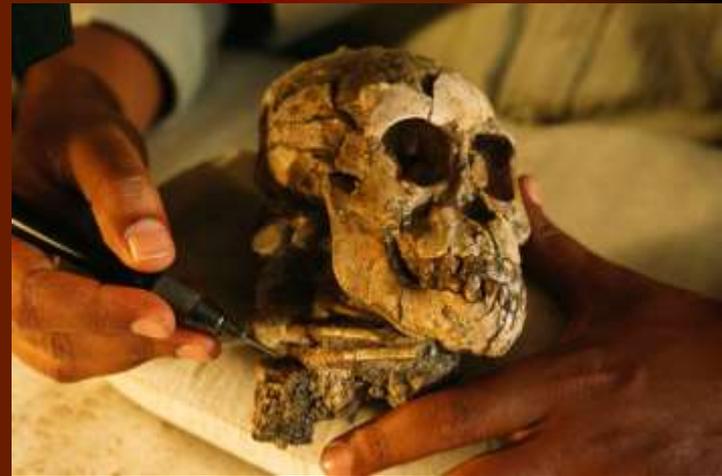


Lucy's fossil remains is only 1.2 meter tall weighed 30 kgs with long arms, hooked figures & a small brain of 450 cc. Also controversial as to whether she actually is a "He" ?

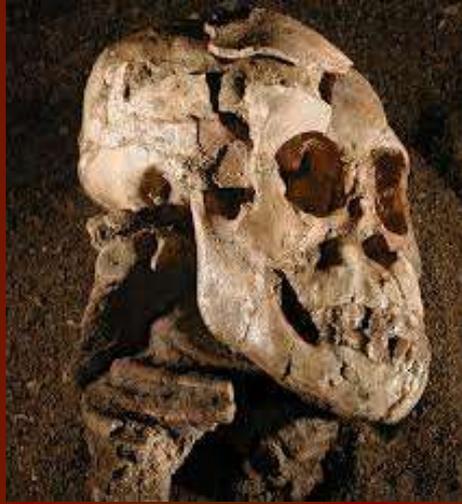


"Dikika Baby" Dik-1/1 or "Selam" meaning "peace"

A three years old *Australopithecus afarensis* living 3.3 Ma in Dikika Ethiopia. It is the world's oldest known baby & also called "Lucy's baby" probably killed & buried by flooding of a river

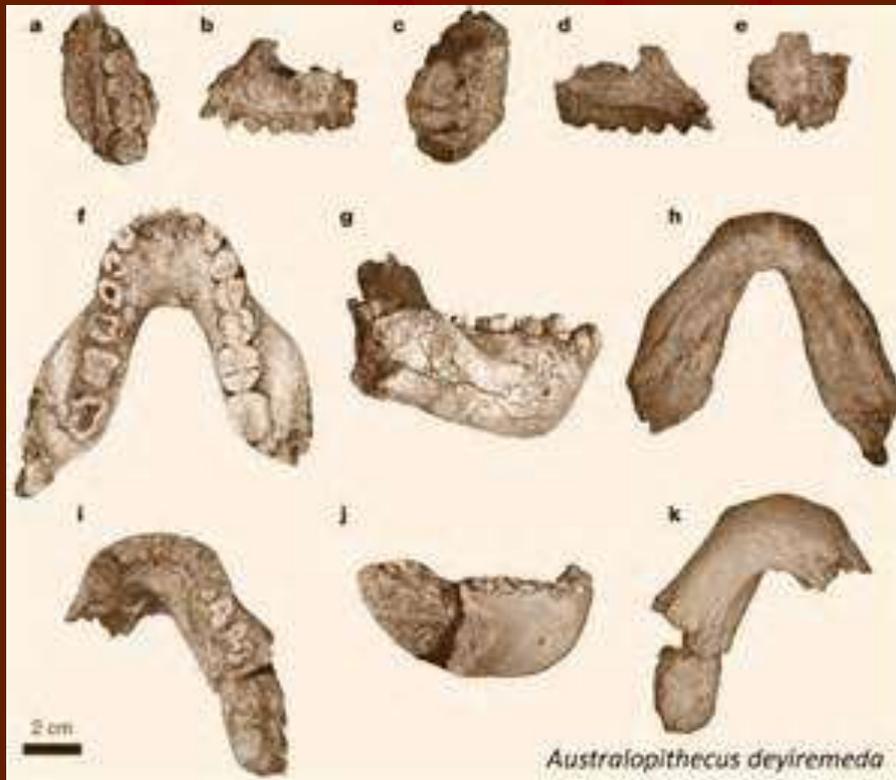


More pictures of "SeLam"



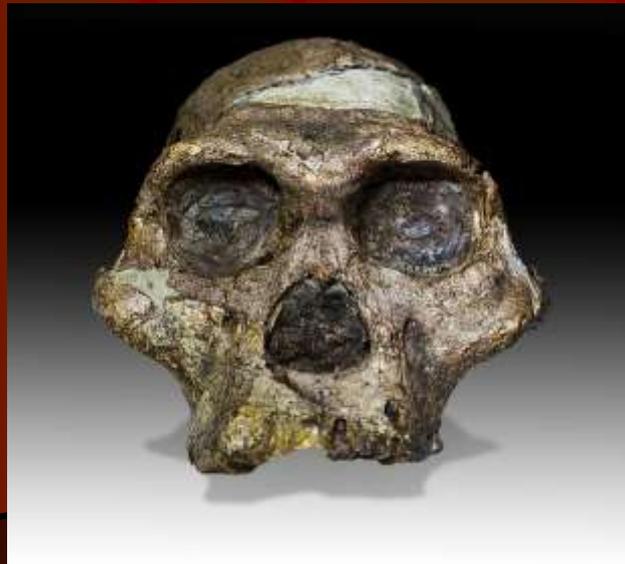
Australopithecus deyiremeda

Deyiremeda means "close relative". Discovered in 2011. Claimed to be another homo species living in Ethiopia 3.3 to 3.5 million years ago coinciding with *Australopithecus afarensis* (Lucy)



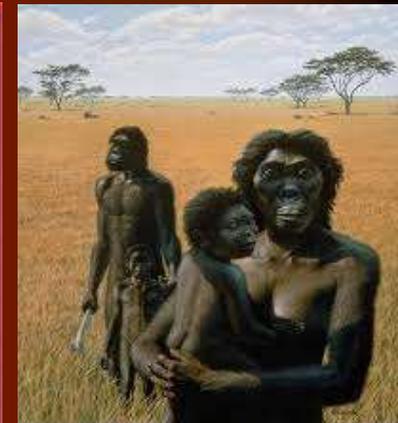
Australopithecus africanus 南猿屬非洲種

An early homonid living between 3.3-2.8 Ma significantly more like human than *Australopithecus afarensis*. They were mainly found in South Africa. Famous ones are the "Taung Child" & "Mrs. Ples"



“The Taung Child” (455cc)

A 3-4 year old *Australopithecus africanus* child living 3.3 Ma in S. Africa
Discovered by Dr. Raymond Dart in 1924 from a limestone quarry it is the first hominid fossil found. However Dart received a lot of harsh criticism from other scientists at the time & refused the fossil to be further examined in later days



Australopithecus africanus



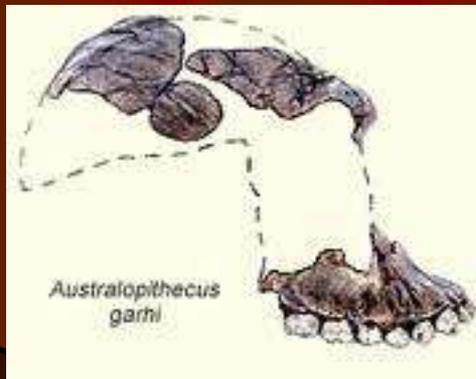
'Mrs. Ples'

2.05 Ma it is the most complete skull of *Australopithecus africanus* ever discovered by Robert Broom & John T. Robinson at the Sterkfontein cave in S. Africa in 1947. Brain size 485 cc.



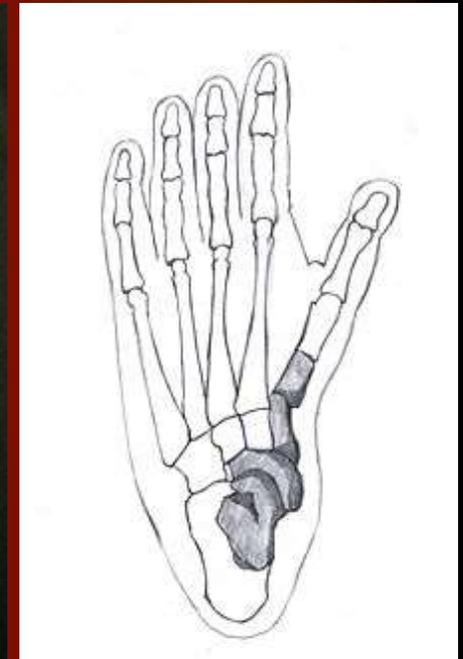
Australopithecus garhi 南猿屬驚奇種

3-2 Ma found by Tim White in the Afar Depression in Ethiopia 1996 with brain size 450 cc similar to chimpanzee. May have been the first hominid to make stone tools as primitive stone tools dated back 2.5 Ma were found nearby

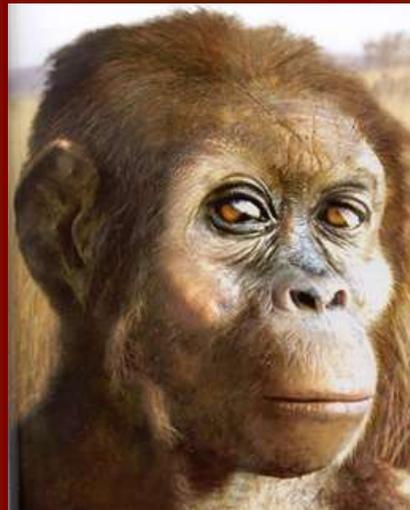


Australopithecus prometheus

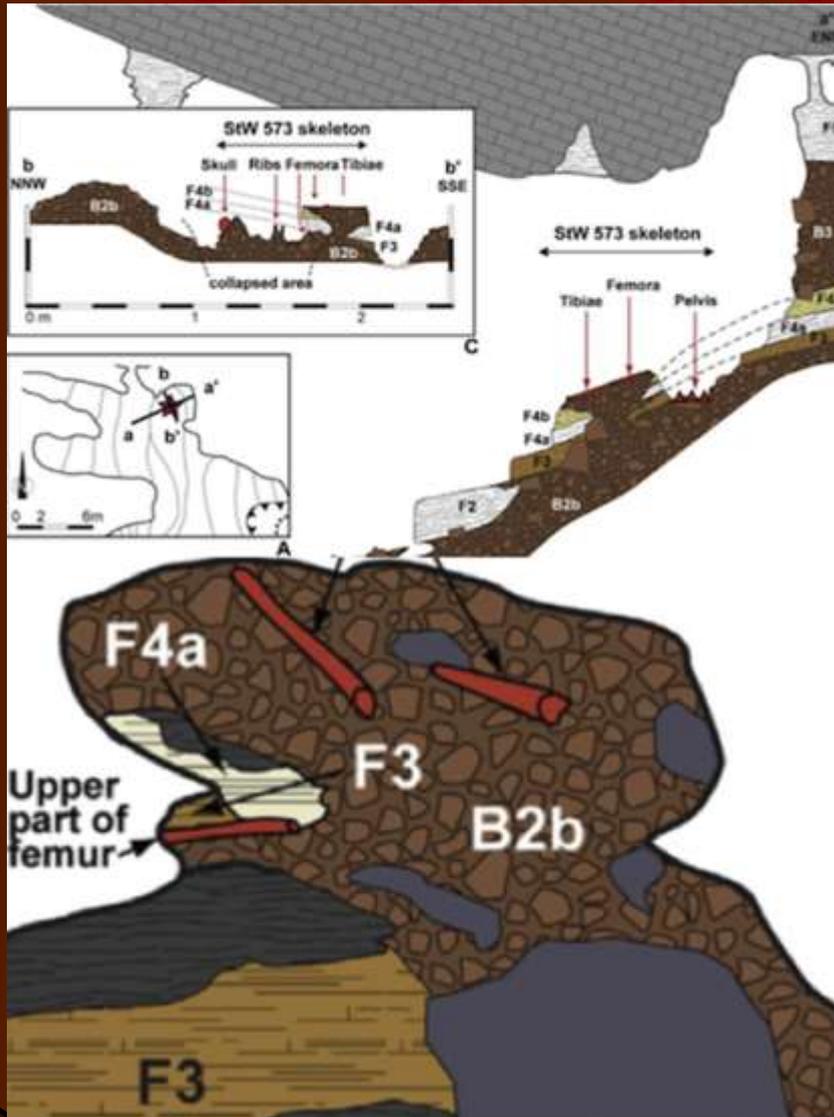
2.5 million years old. Discovered by Ron Clarke at Sterkfontein S. Africa in 1994. Also called "Little Foot", *A. prometheus* represents a more primitive, separate species from *A. africanis*



The "Little foot" is the most complete ape-man ever unearthed

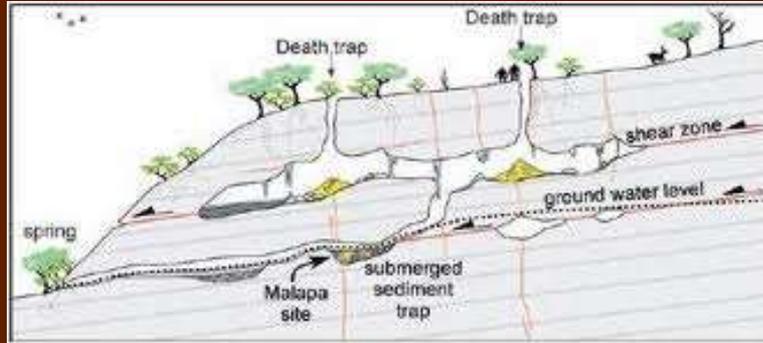


The excavation site



Australopithecus sediba

Dated 2 Ma with 6 skeletons discovered by Lee Berger in S. Africa including a young male researchers named "KARABO" approx. 1.3 m tall probably behaved like modern day savanna chimpanzees

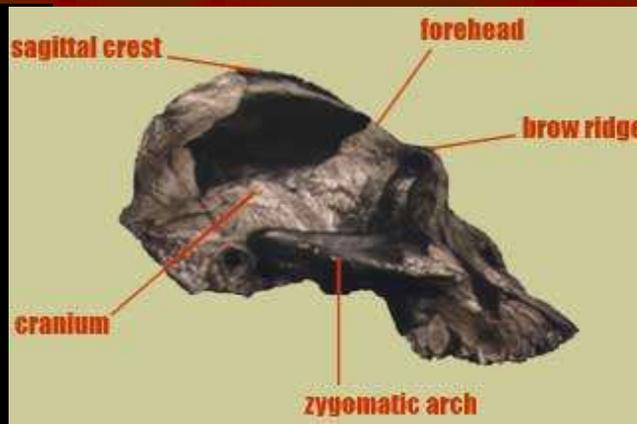


Paranthropus 傍人屬

A genus of extinct “sidelined” hominid
living between 3 to 1 Ma

Paranthropus aethiopicus 傍人屬伊素比亞種

First specimen Omo 18 lived 2.7 -2.3 Ma in present day Kenya. Possible ancestor of australopithecines but died out due to environmental changes or competition by newly evolving human species. Note massive jaws for chewing & crest on top of the skull



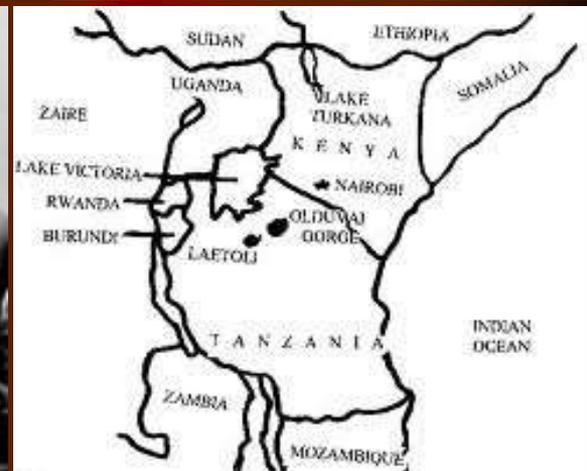
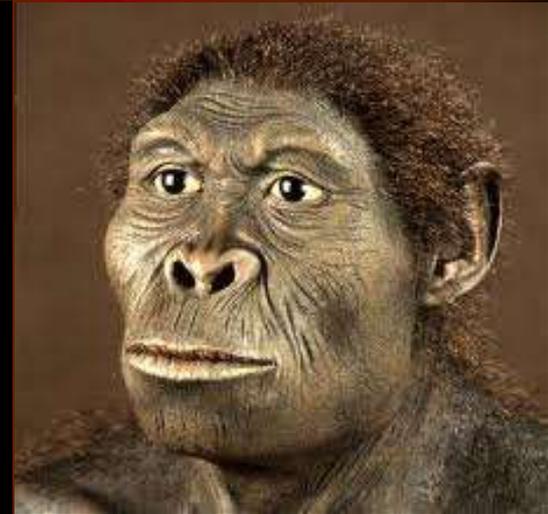
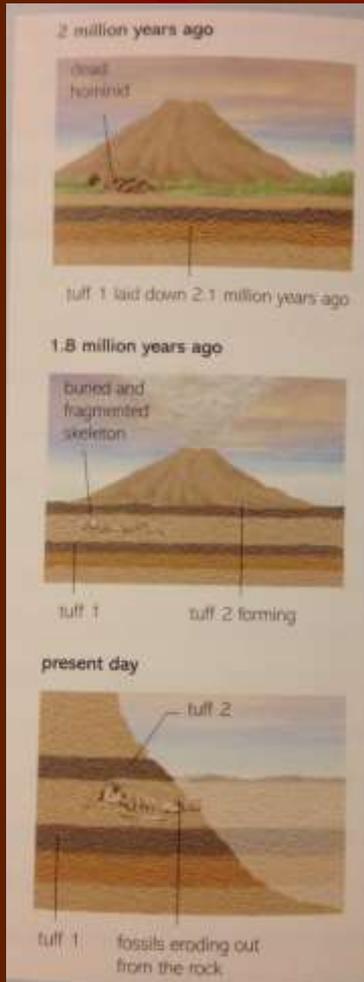
Paranthropus bosei 傍人屬鮑氏種 (525cc)

2.5-1.2 Ma The "Nutcracker man" or "Dear Boy" or "OH5" by Mary Leakey at Omo, Ethiopia. Vegetarian & the largest of the Paranthropus genus



Paranthropus robustus 傍人屬粗壯種

1.8-1.4 Ma discovered by Louis & Mary Leakey in South S. Africa 1938 – probably another vegetarian



Homo 人屬

2.3/2.4 Ma to now

A genus of hominid including modern humans
& species related to them

LD 350-1

A 2.8 million year old lower jaw bone & 5 teeth were found in the Afar region, Ethiopia in 2013 pushing back the origin of the Homo lineage by 400,000 years earlier than previously believed

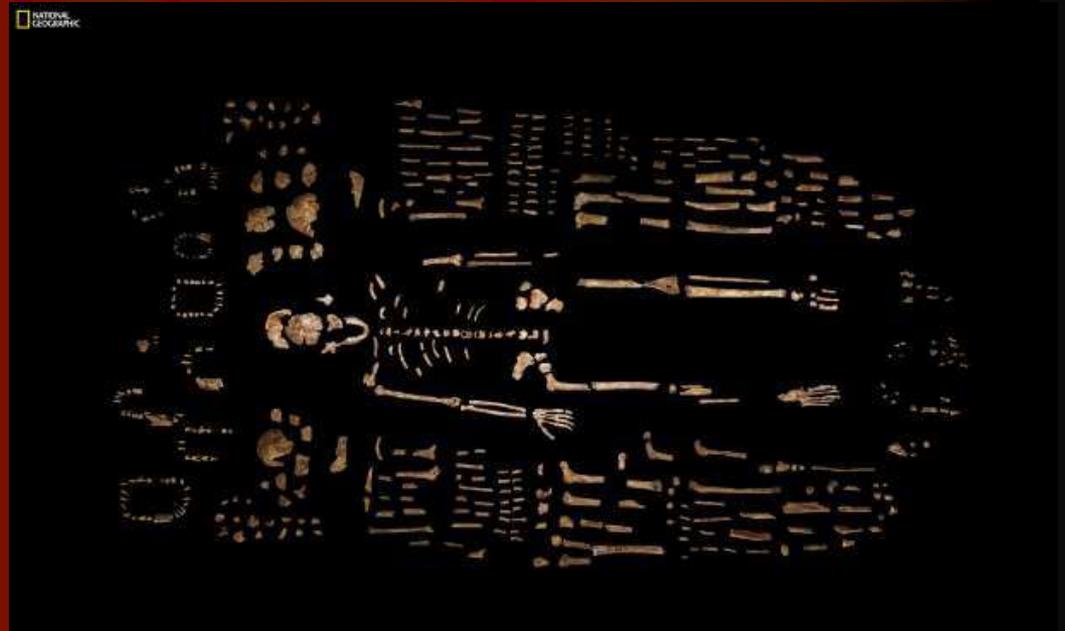


Where the fossil was found

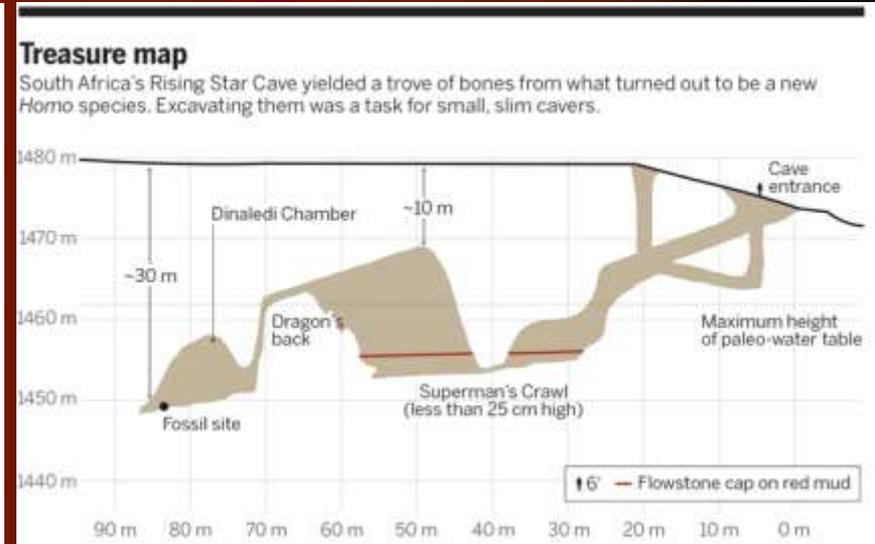


Homo naledi (465-560cc) 纳莱蒂人

15 incomplete skeleton fossils of adult and child discovered 2015 by Prof Lee Berger at Maropeng "Cradle of the Human Kind" in Magaliesburg in the Rising Star cave (Naledi Cave) which is 50 km from Johannesburg South Africa. Height 1.45-1.5 m, weight 45 kilos, fist size brain (540cc), human like hand and feet, probably mastered fire & burial ritual. No accurate dating done but likely between 2-3 Ma. May be a transition from Australopithecus to Homo

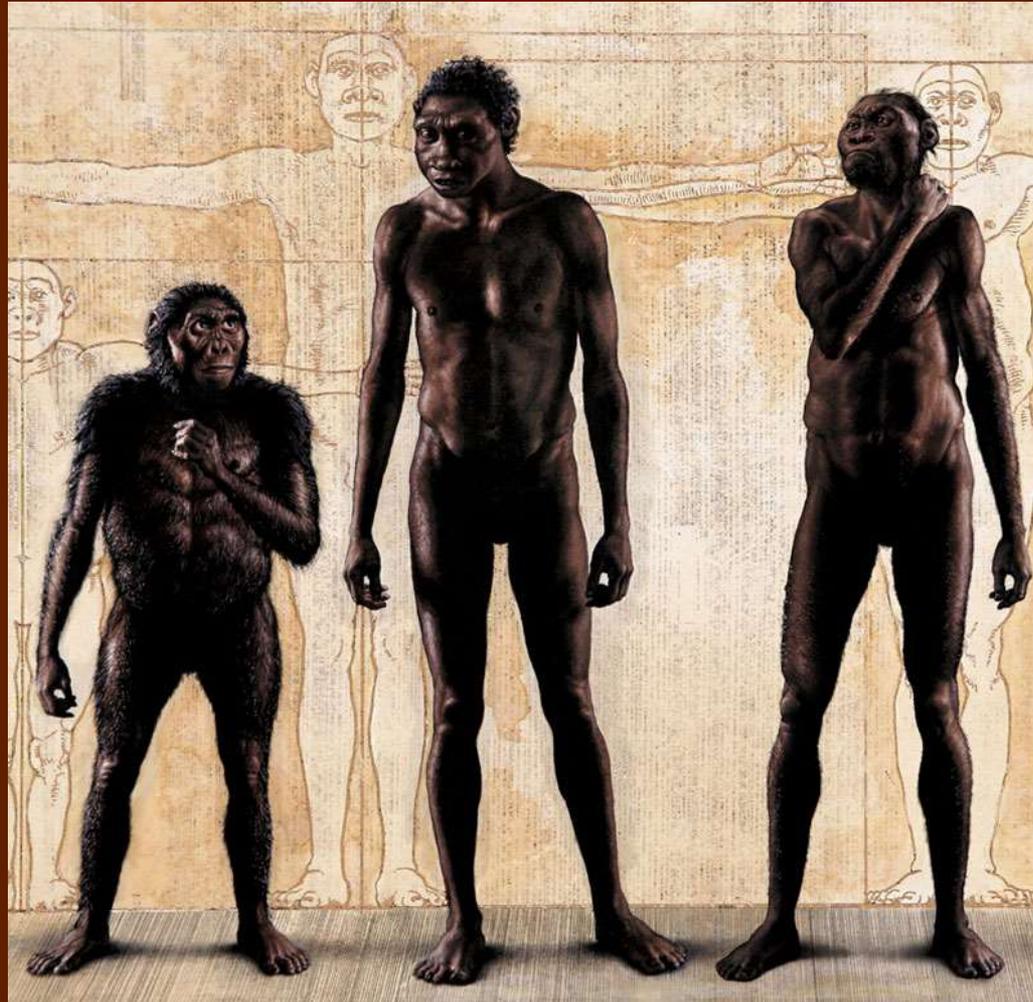


Unusually no animal bone was found in the cave & the passages are so narrow which indicates the bones were purposely buried





Homo naledi (465-560cc)



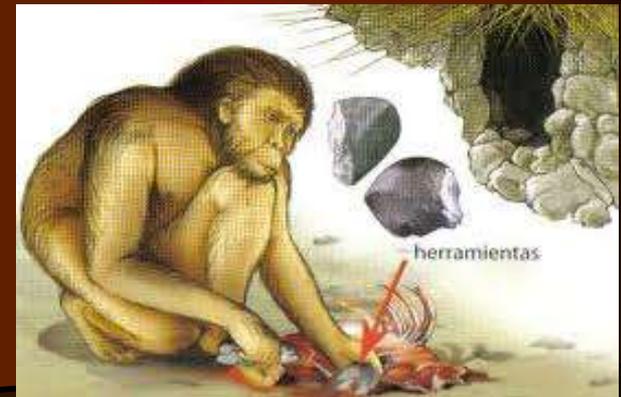
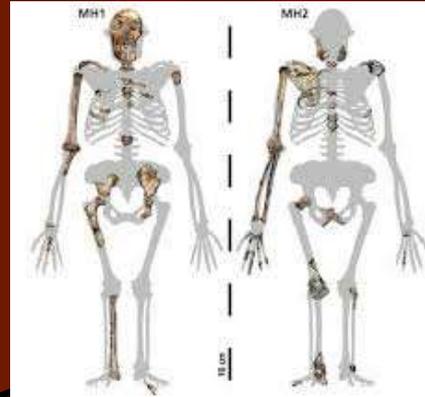
Lucy

Homo erectus

Homo naledi

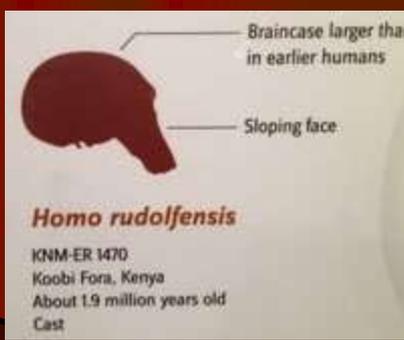
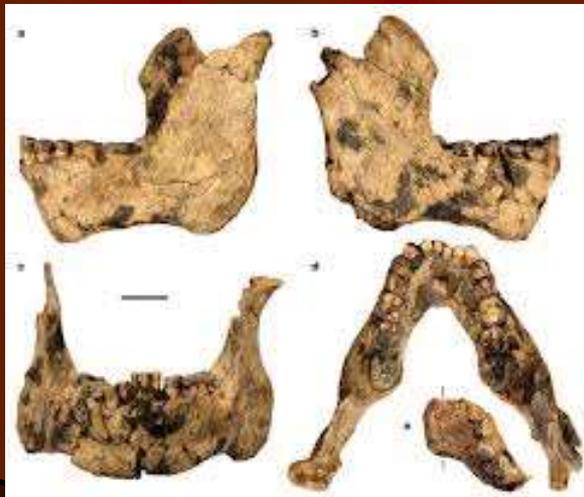
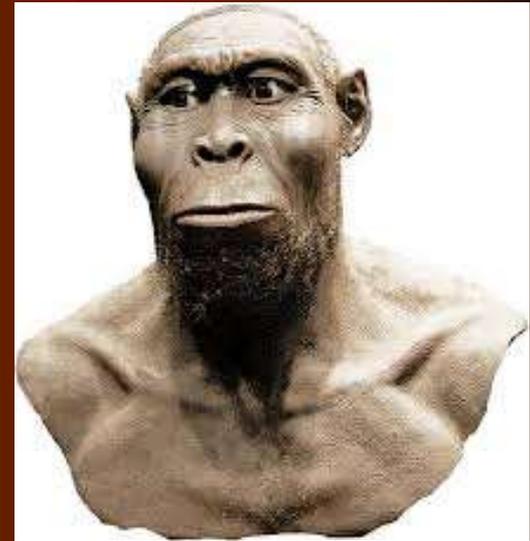
Homo habilis 巧人

“Handy Man” or “Skilled Man” as they are the first homo to make simple stone tools, 2.4 – 1.6 Ma discovered by Louis Leaky at Olduvai Gorge, Tanzania. Generally recognized as the very first “HOMO” due to their 870 cc brain which is above the Homo threshold and probably the true author of the “Oldowan culture”

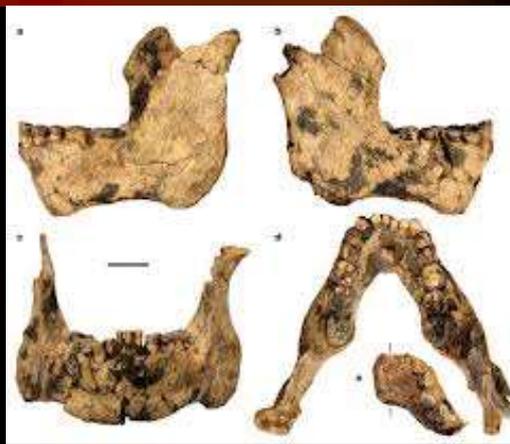
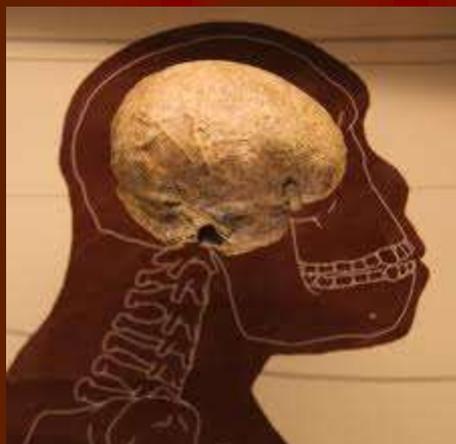
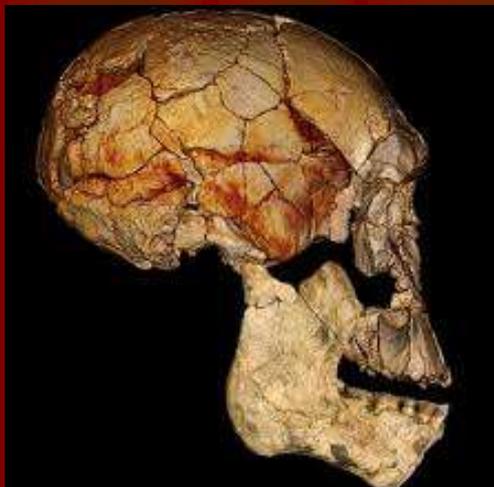
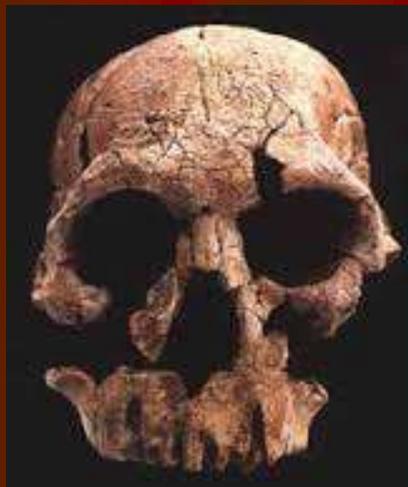


Homo rudolfensis 盧道夫人 (750cc)

1.9 Ma. Only a handful of fossils discovered in Kenya. Still debating whether it should be classified as *Homo* or *Australopithecus*. If it is the former than it is the very first *Homo* rather than *Homo habilis*

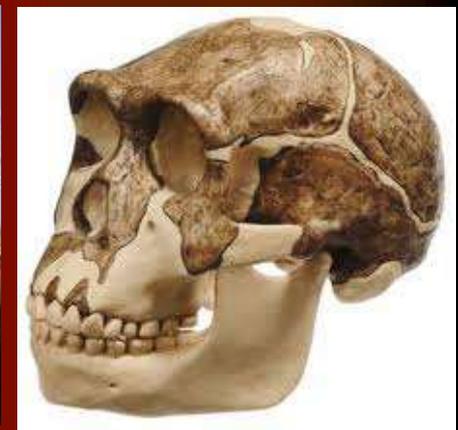
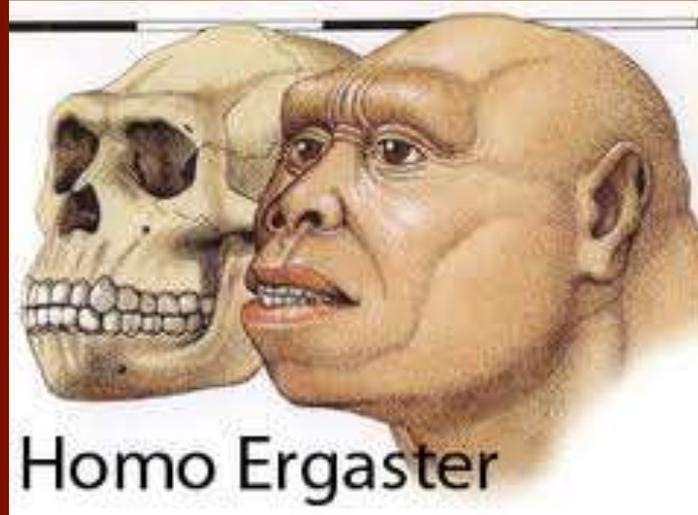


A very recent discovery of a 2 Ma *Homo rudolfensis* in South Africa



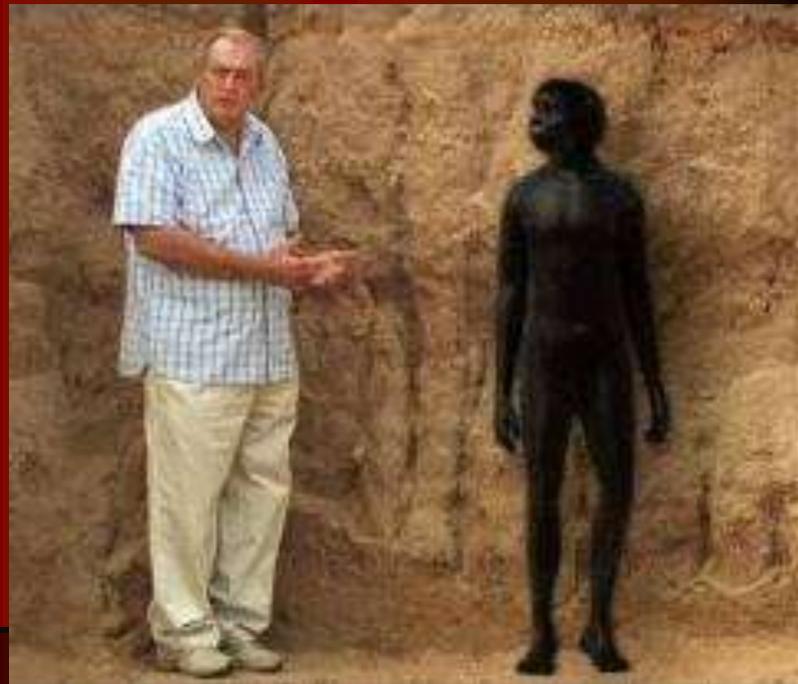
Homo ergaster 能人/匠人 (6-900cc)

1.8-0.6 Ma. Meaning "workman". 2 m tall, long legs, arched feet & barrel ribs, brain size 600-900 cc . Found in Turkana Lake , Kenya 1971



"Nariokotome Boy"

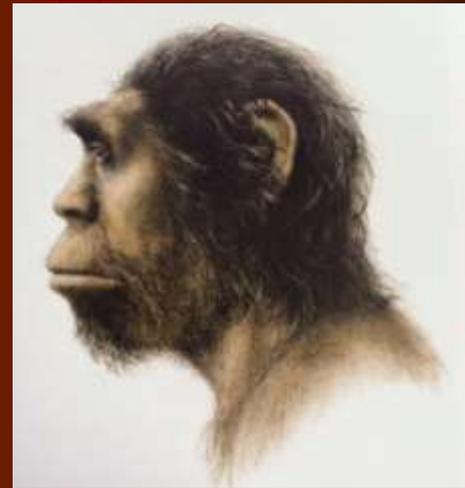
1.6 Ma KNM-WT 15000 previously called "Turkana Boy" is a near complete *Homo ergustus* aged 11-12 with a 880 cc brain, low sloping forehead, strong brow ridges & absence of a chin. Discovered by Richard Leaky in Lake Turkana, Kenya in 1984



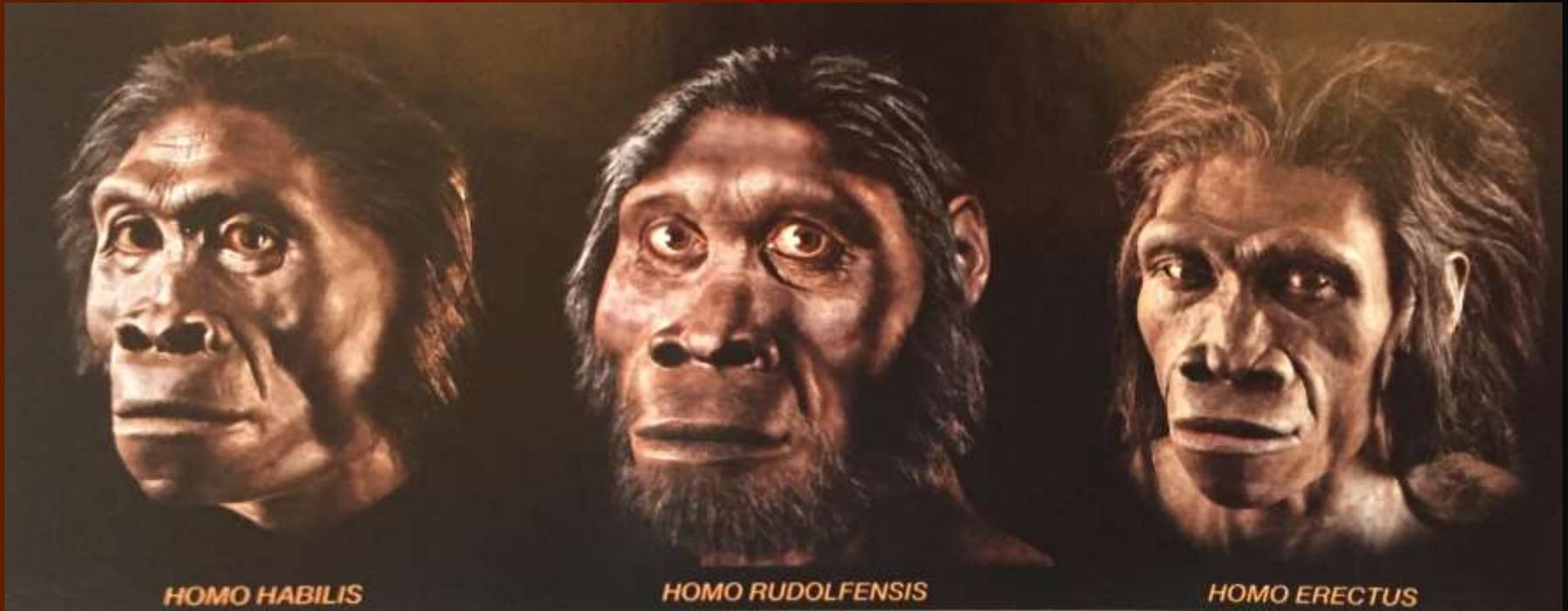
Homo erectus 直立人

Homo erectus 直立人 (900cc)

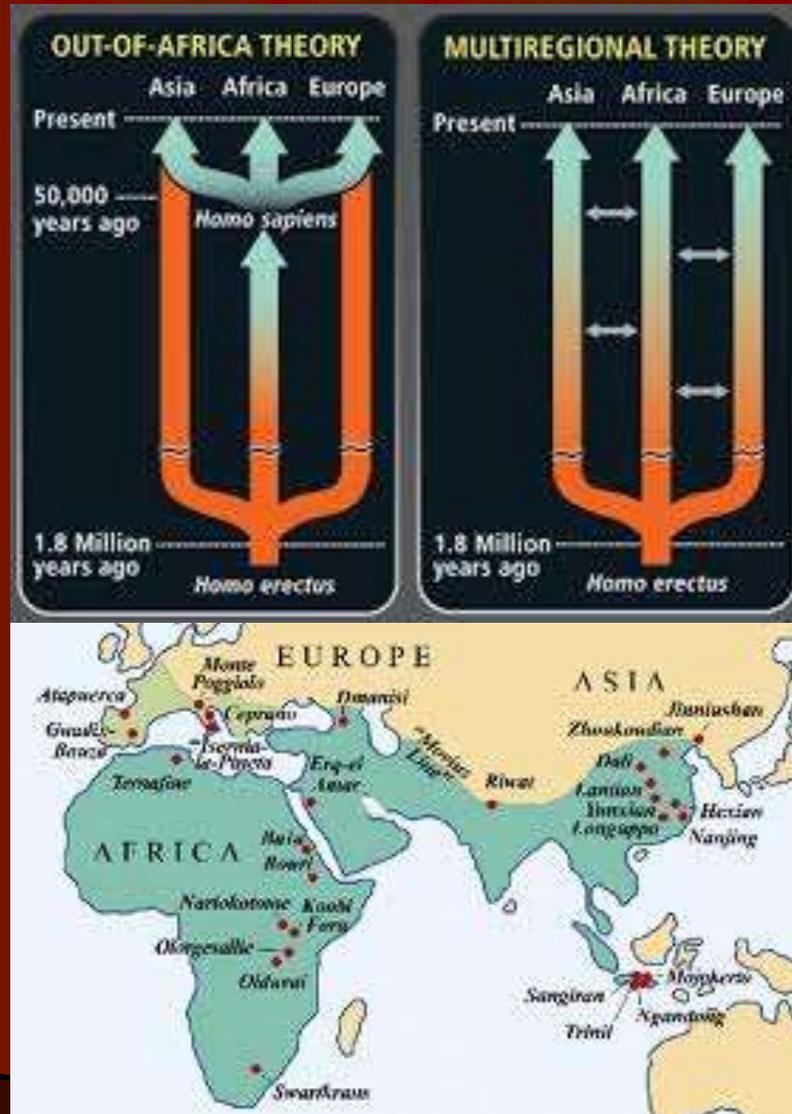
The "Upright man" 1.8 -0.05 Ma, made tools & believed to be the first hominid to control fire & probably can speak. They were also the first Homo to travel but their brain power only equivalent to a modern baby. Still not sure whether they are a separate branch of hominid or the "missing link"



Facial comparison between *homo habilis*, *homo rudolfensis*
& *Homo erectus* all first appearing around 2 ma

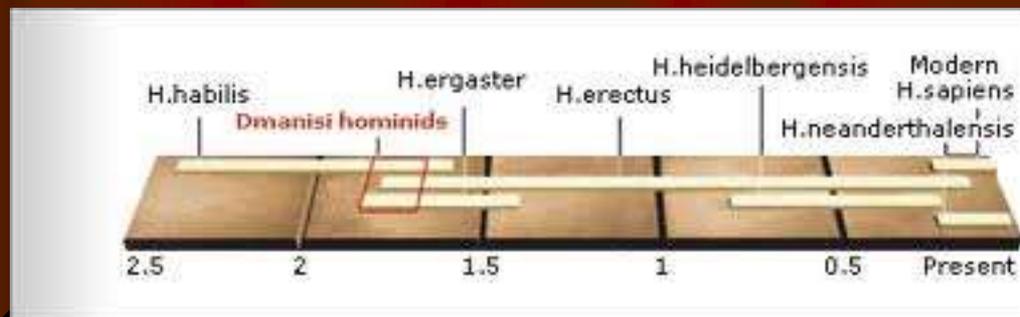
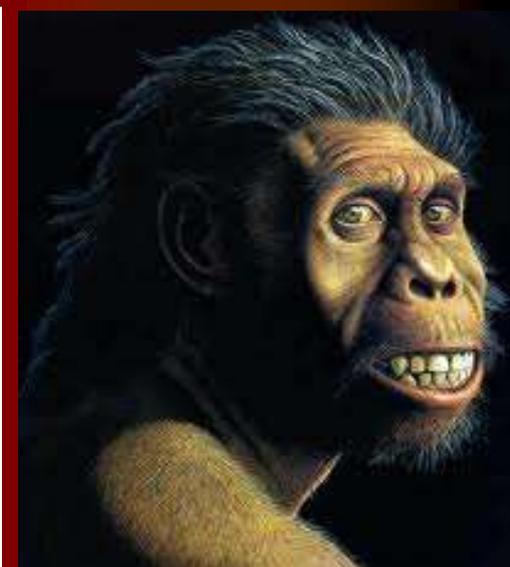


Homo erectus is the first Homo to travel out of Africa spreading to Asia & Europe some 1.8 Ma – **“Out of Africa 1”**



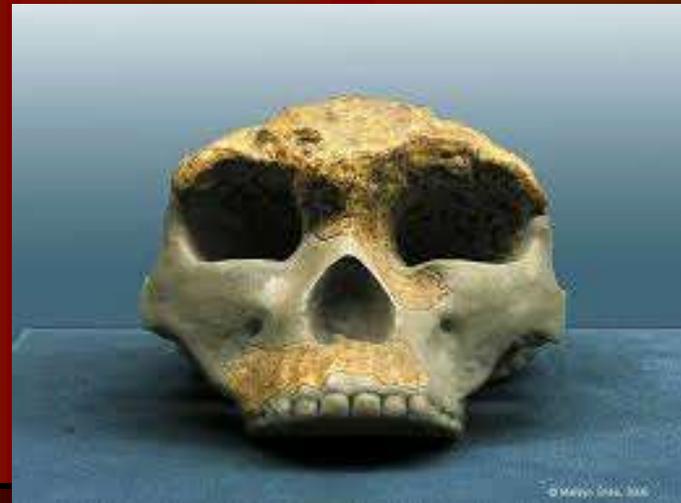
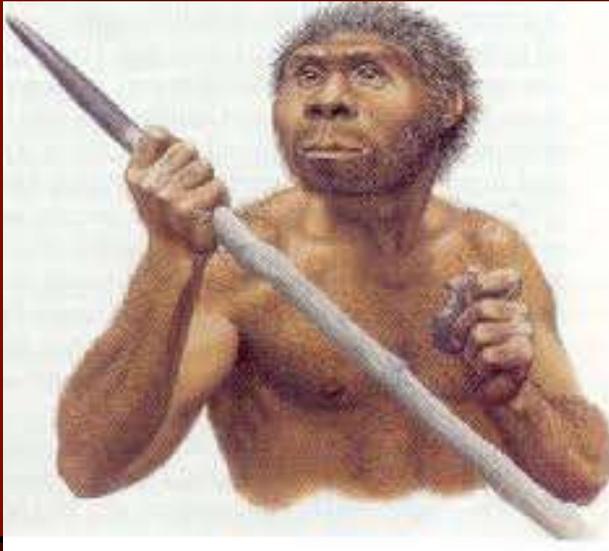
Homo georgicus (Skull 5) 格魯吉亞人

Discovered in Dmanisi, Republic of Georgia 1.8 Ma, one of 5 skulls found in underground animal dens. Claimed to be the earliest & most complete *Homo erectus* pointing to single evolving human species



Wushan Man 巫山人

1.8 Ma Discovered in Wushan, Szechuan Province in 1985.
Still controversial whether it is a sub species of *Homo erectus*
or an extinct ape



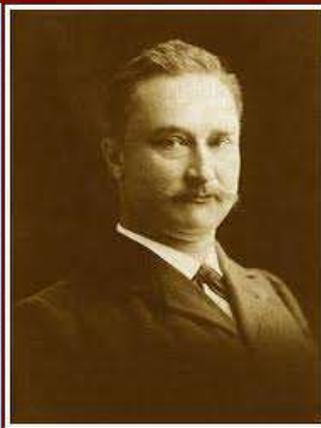
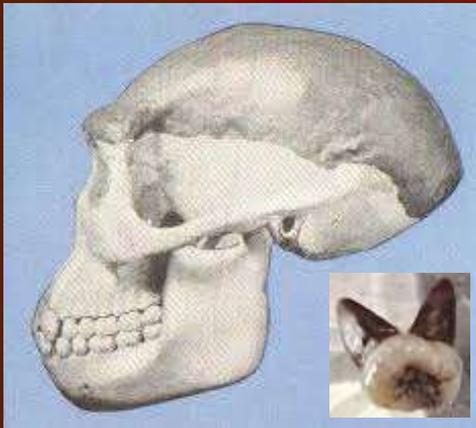
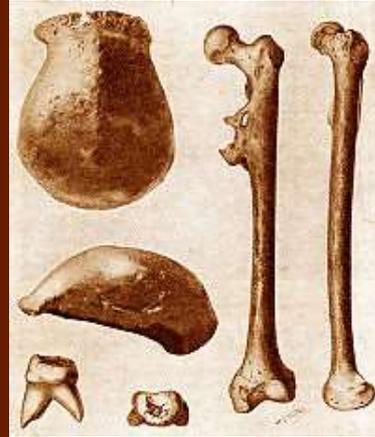
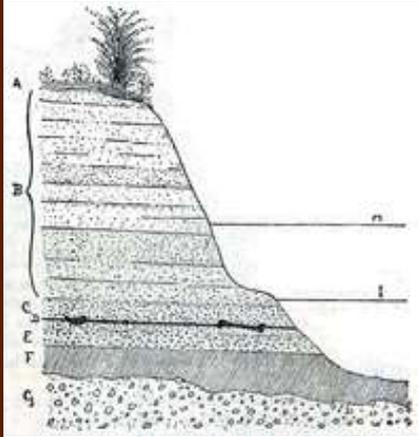
Yuanmou Man 元謀人

1.7 Ma Homo erectus discovered in Yuanmou, Yunnan 1965

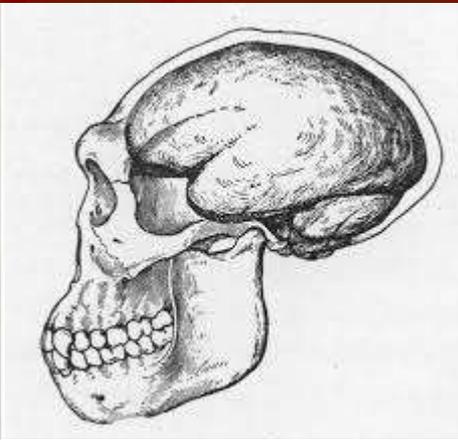
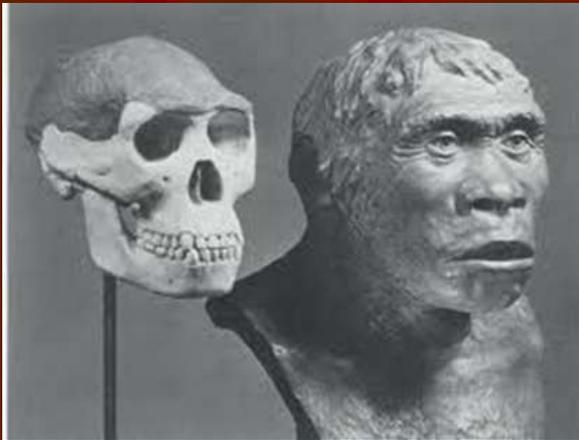


Java Man 爪哇人

A 1.6 Ma *Homo erectus* discovered by Eugene Dubois in 1891/1892 near the Solo River in East Java – this is the first Hominid fossil ever discovered by man and include a molar (Trinil 1) skull cap (Trinil 2) & a femur



More "Java Man" fossils have subsequently been discovered in the island between 1930 & 1940



Lantian Man 藍田人

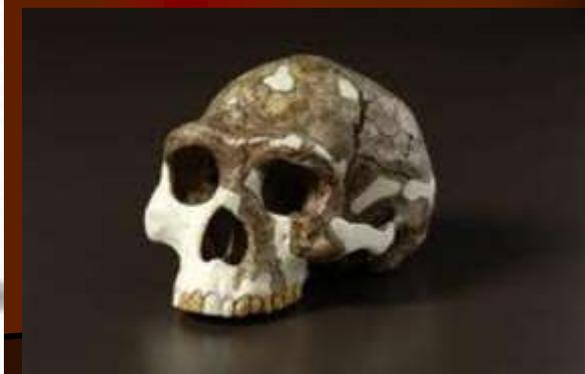
1.15 Ma Discovered in Lantian Shaanxi province 1963/64



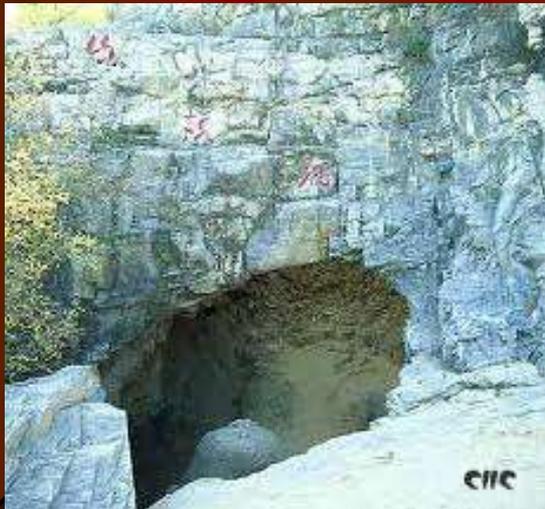
Peking Man 北京人

Homo erectus pekinensis 0.75-0.2 Ma

skeletal remains for a group of 40 including 4 skulls, animal bones and tools discovered in Zhoukoudian 周口店雞骨山, Beijing in 1923-27



The Peking Man Site at Zhoukoudian & Dr. Pei Wenzhong 裴文中

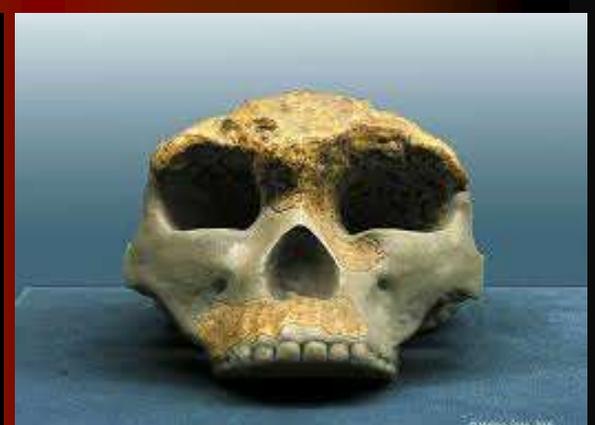


The team that discovered the Peking Man including
Dr. 裴文中 & Dr. 賈蘭坡 All the fossils were missing
during the invasion of the Japanese in WWII



Hexian Man 和縣人

0.30 to 0.40 Ma Excavated from Longtandong Cave in Hexian County
Anhui Province in 1980



Dali Man 大荔人

0.2 Ma 1978 Shanxi



Maba Man 馬霸人

0.2-0.1 Ma Shao guan, Guangdong 1958 likely to be the ancestor of the ancient Yue 古越族 people of South China



Maba Man 馬霸人

0.2-0.1 Ma Shao guan, Guangdong 1958

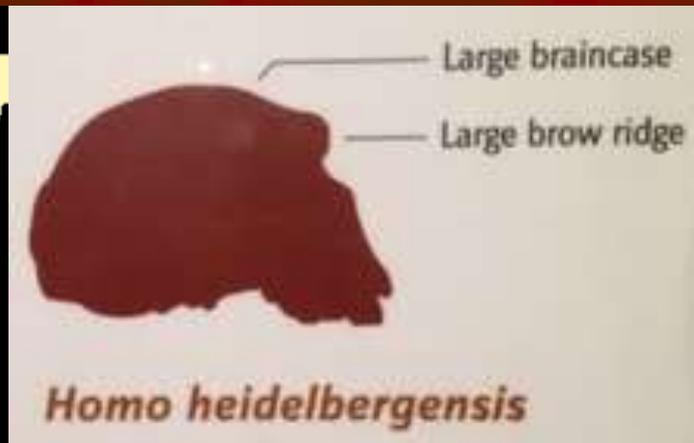


Homo heidelbergensis 海德堡人



Homo heidelbergensis 海德堡人

600,000-250,000 ya originated from Africa & lived in Europe & western Asia.
With brain size almost the same as ours it is generally accepted to be the ancestor of Neanderthal, Denisovans human & Homo sapiens



Eight 400,000 year old wooden spears were found in a coal mine at Schoningen near Hannover Germany. At 2.5 m long they are the oldest weapon known in the world probably used by *Homo heidelbergensis*



Heidelbergensis have three related subspecies

1. *Homo antecessor*



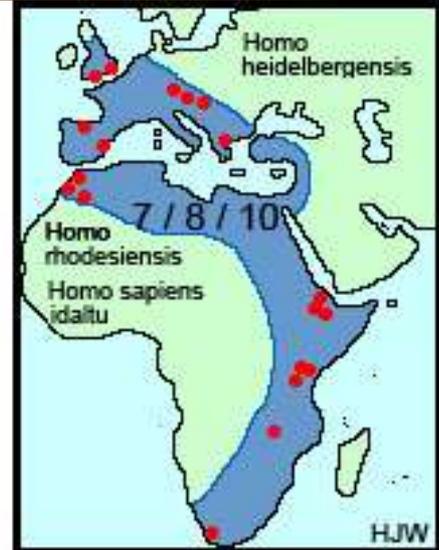
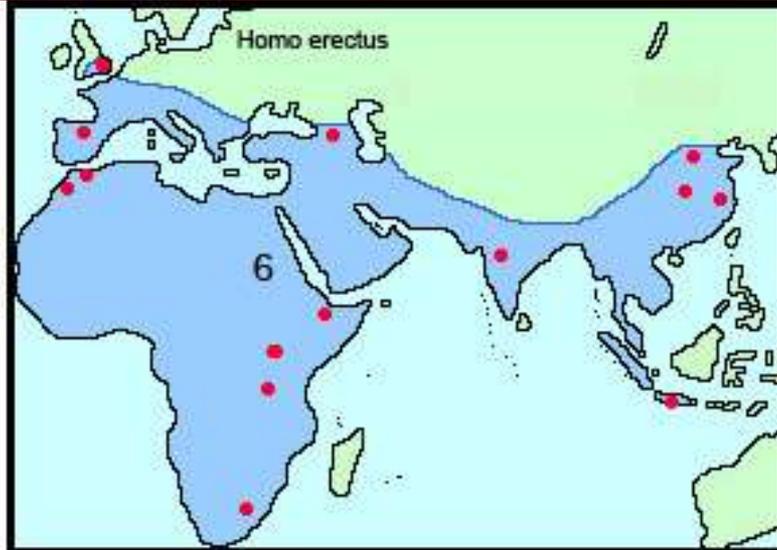
2. *Homo rhodesiensis*



3. *Homo helmei*



Geographical coverage of *Australopithecus*, *Homo erectus* and *Homo heidelbergensis*

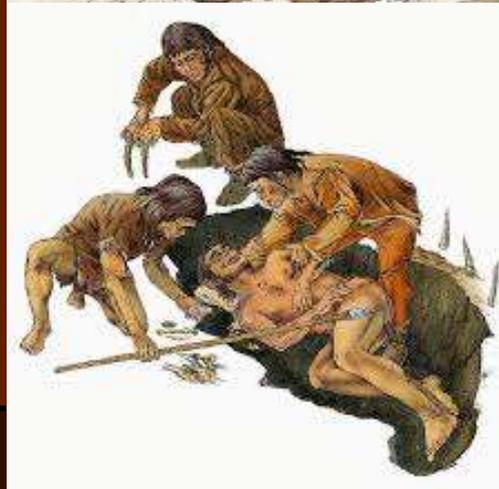
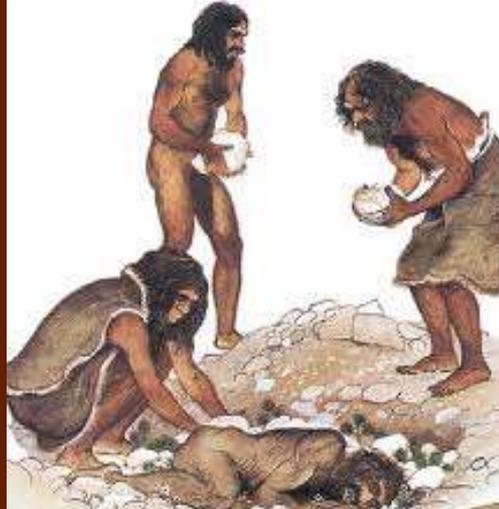


Homo neanderthal 尼安德塔人 (Neander Valley Germany 1856)

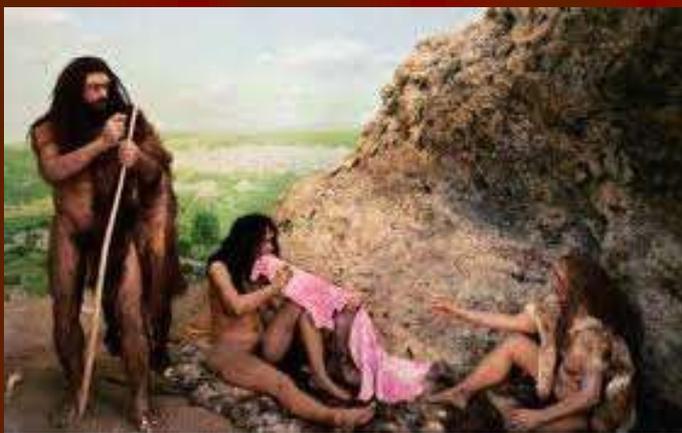
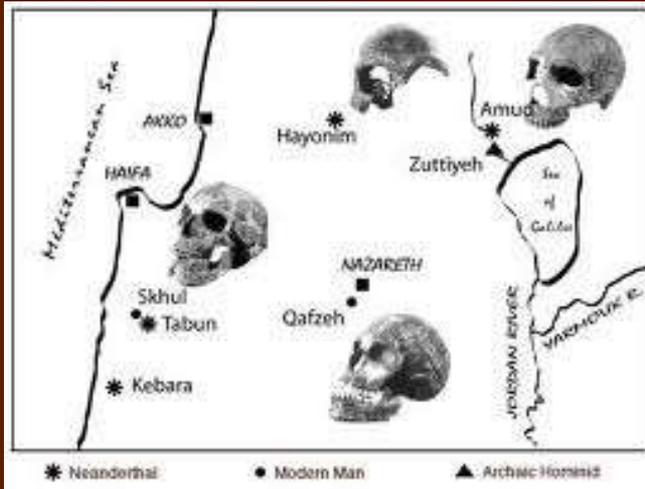
The so called "Cave Man" 穴居人 in Europe & Asia, 350,000 to 28,000 ya. Used to be considered dumb & brutal. Actually they were skill hunters making good tools, practiced ceremonial burial & likely able to speak. Characterized by stocky body, heavy brow ridge, large nose & bow shaped legs. Coexisted with *Homo sapiens* when they arrived in Europe around 40,000 Ma



Neanderthal burial sites & ornaments found in their caves. Some 500 remains have been found. Recent discovery however also included evidence of cannibalism probably occurred when facing extreme climate during the Ice Age



45,000 years old *Homo neanderthalensis* found in Amud Cave, Israel

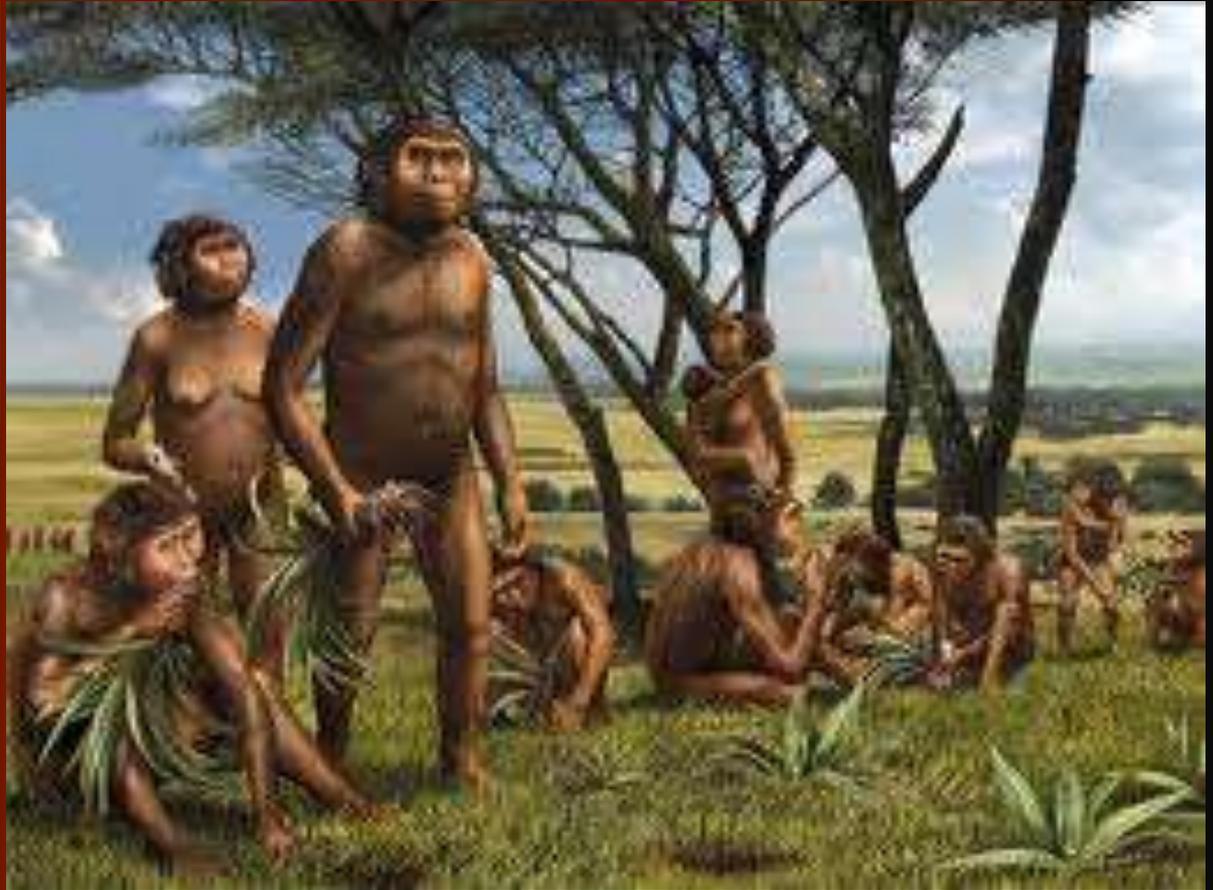


Gorham Cave, *Homo Neanderthal's* last stand 28,000 ya in Gibraltar.
Latest DNA study indicated they had interbreed with *Homo sapiens* especially in Europe (Tuscany) retaining 1 to 4 % of their DNA & also inherited to us immunity system against certain diseases so it is not really a "Evolution Dead End"



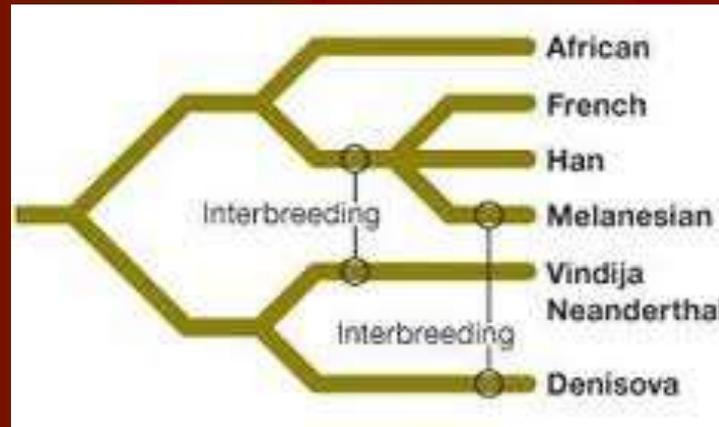
Homo Soloensis

Found in Ngandong Blora, Java Indonesia. Live 900,000 to 300,000 years ago. Brain volume 1300 cc. Skull resembles Neanderthal but cranial capacity smaller



Denisovans Human 丹尼索瓦人

DNA analysis of "X woman" in the Deisova cave in Siberia indicated a species split from human & Neanderthals about 1.04 Ma & also interbreed with modern human with the Blond afros in Melanesian as descendants possessing 6% of their DNA



Melanesians “Blond afros” speaks Papua languages living in East Indonesia, Fiji & the Solomon Islands

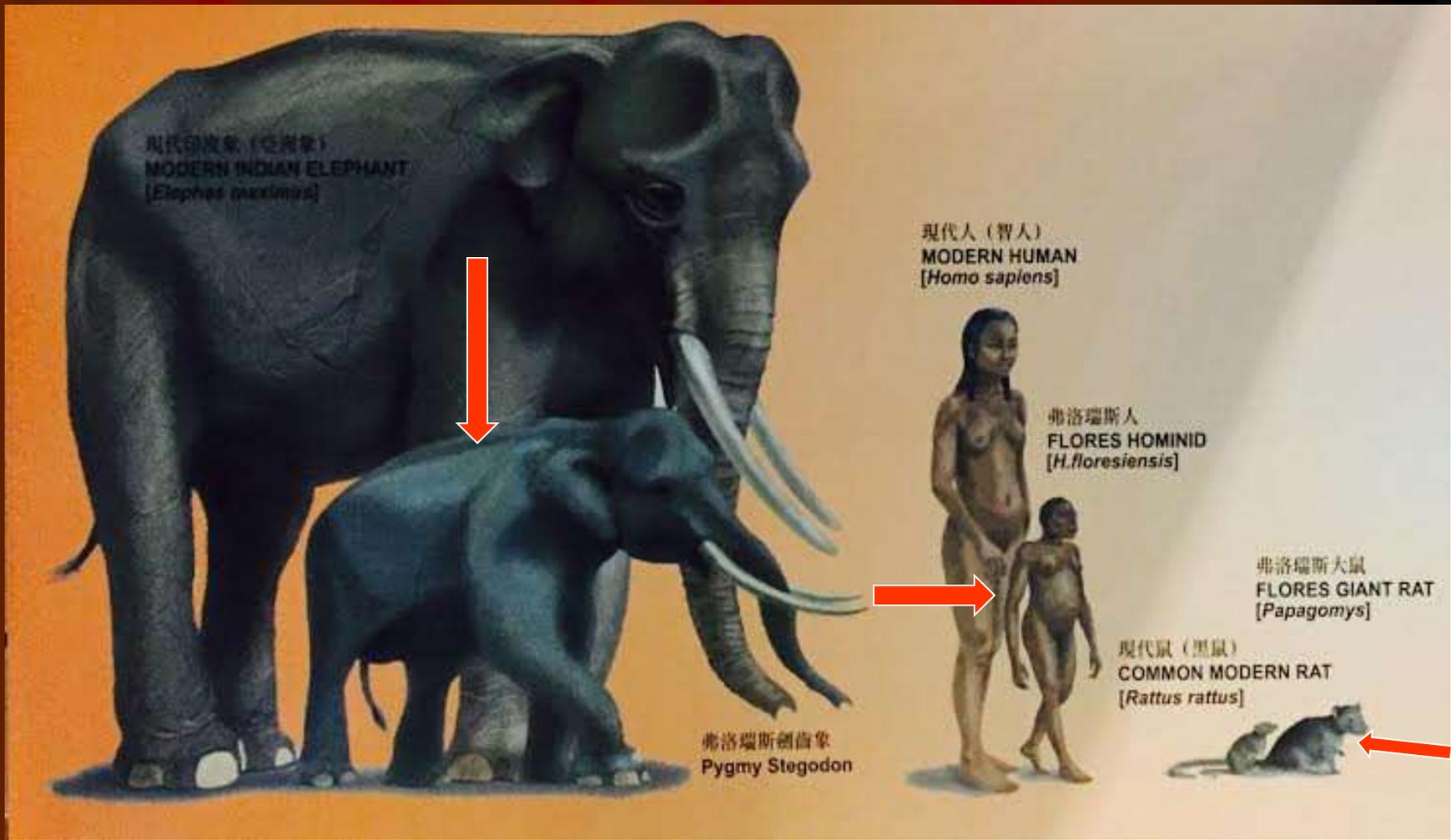


Homo floresiensis 弗洛勒斯人 – an unresolved puzzle

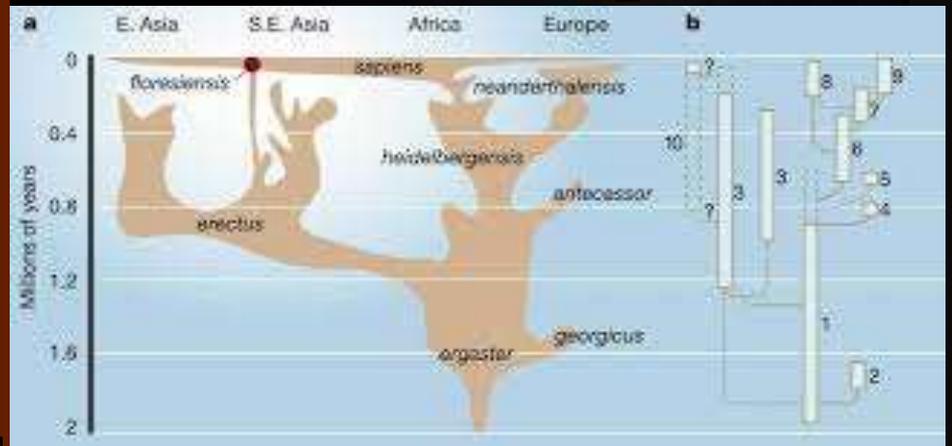
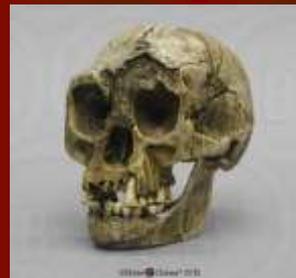
95,000 to 12,000 Ya LB1 “Hobbit” was discovered in Liang Bua cave, Flores, Indonesia in 2004. Only 1 m tall weigh 25 kilos with small brain of 380 cc. Died out after a volcanic eruption. Resemble more to *A. afarensis* & *A. sediba* than later human. Serious debate continues as to whether it a case of “Island Dwarfing” 島嶼矮化 or modern human suffered from a growth stunting medical condition



Flores pygmy elephant, giant rats & *Homo floresiensis*



Despite their small brain size, researchers have discovered respectable stone tools made by them. Are they human pigmies, Homo erectus decedents or a new species ? Latest research suggested they died out 50,000 years ago probably due to the arrival of modern human



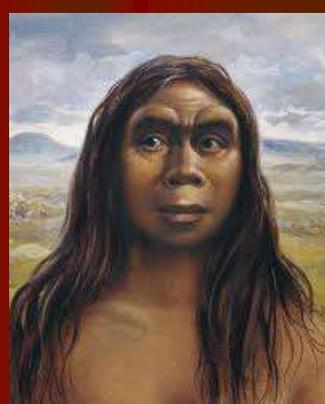
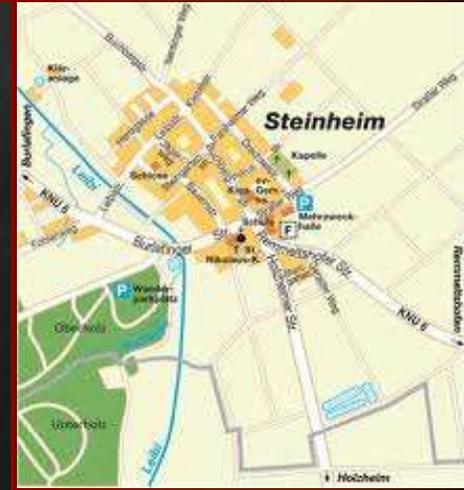
Homo sapiens 智人

200,000 years ago to now

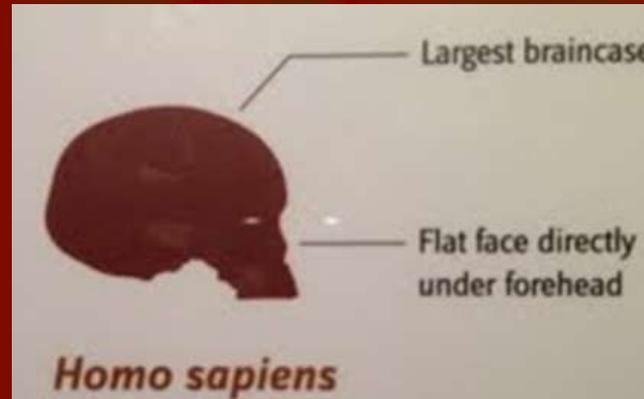


Homo Steinheimensis 智人 (1500cc)

A 200,000 years old primitive form of *Homo sapiens* discovered in Steinheim Germany



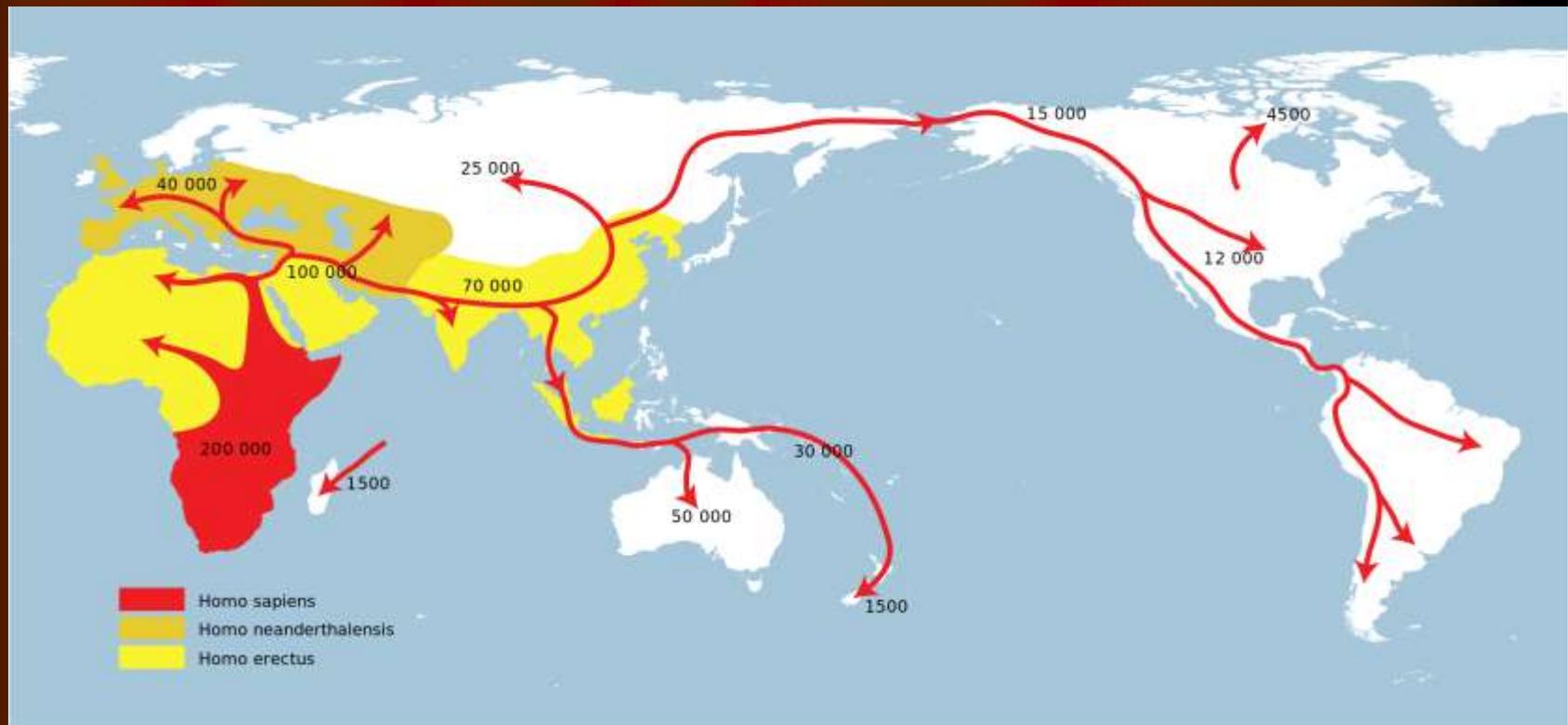
The skull on the left discovered at Omo River in Ethiopia in 1967 is 195,000 years old making it the oldest fossils of our species



Homo Sapiens migration

Also known as *"Out of Africa 2" or RAO (Recent Africa Origin) that Modern man originated from Africa has not been well received until recently due to racial prejudice

- Key 1. Red : Homo sapiens
2. Brownish yellow : H. Neanderthals 3. Light yellow : early hominids



Homo sapiens idaltu : 160,000 ybp at Herto Site in Ethiopia



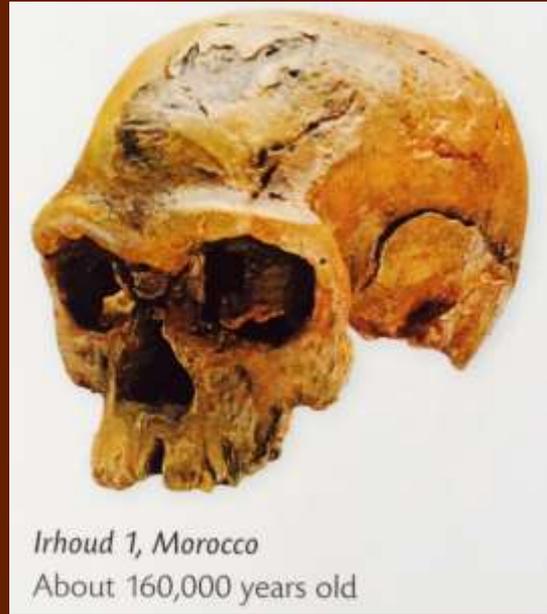
Early *Homo sapiens*

160,000 ybp *Homo sapiens* skull & hippo bone with cut mark discovered at Herto Ethiopia suggested butchery with stone tools



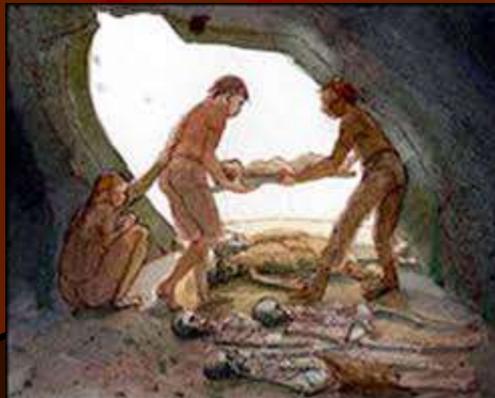
Early *Homo Sapiens*

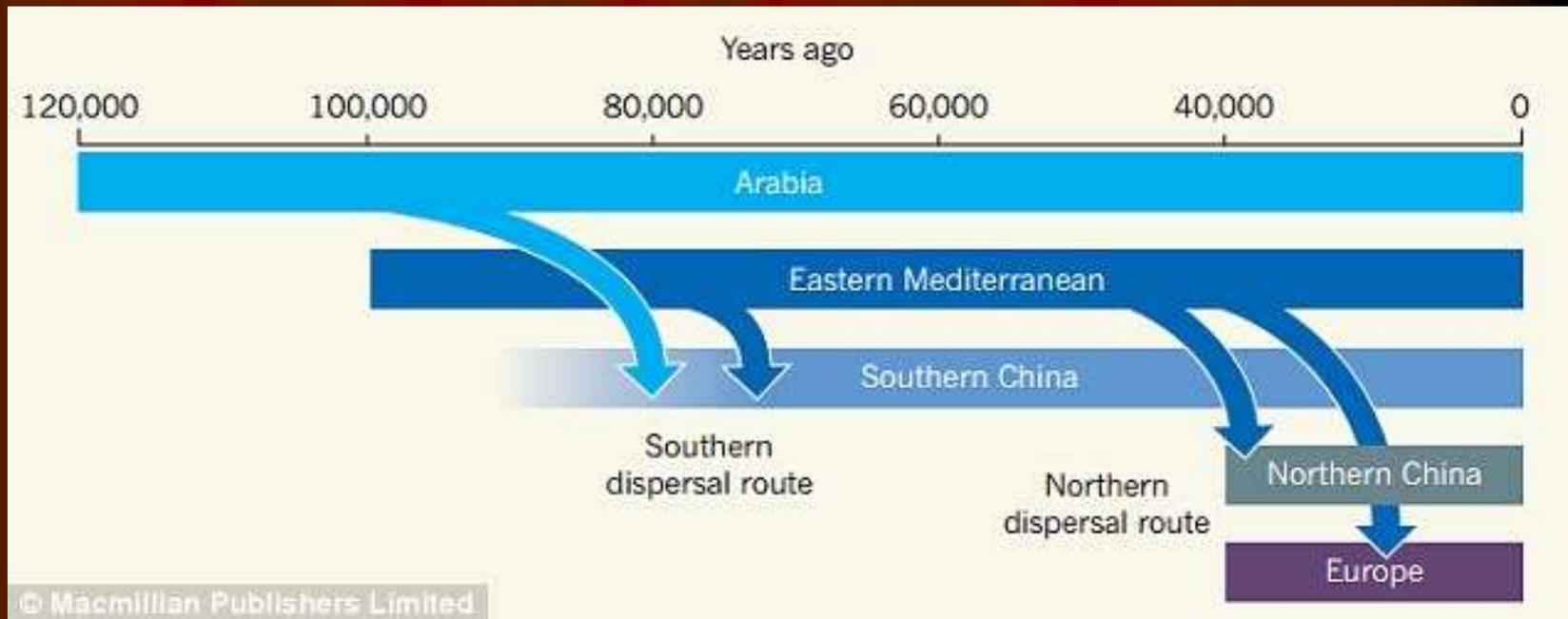
160,000 ybp Irhoud 1 to 4 at Jebel Irhoud, Morocco



Early Homo sapiens

100,000 ybp fossils of up to 15 individuals in a ritual burial in Qafzeh, Israel. Probably the oldest intentional burial site in the world discovered so far





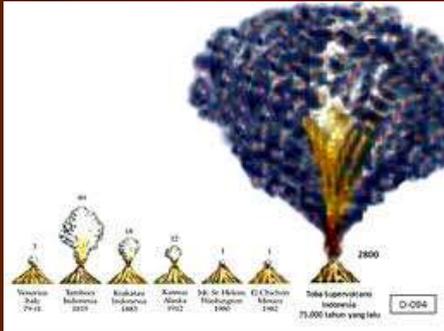
Recent discovery of 47 fossil tooth in Daoxian County 道縣福岩洞 Hunan indicated the early form of modern *Homo sapiens* appeared in the region between 80,000 to 120,000 years ago which is at least 20,000 years earlier than previous estimate. No tools with the remains which were probably carried there by hyenas

The fossil tooth from Daoxian 80,000 ybp



The near extinction of Human

74,000 ybp the Super Volcano Toba eruption in Sumatra, Indonesia. At VEI8 it is over 5,000 times that of Mount St. Helen. With 2500 km³ of magma which is nearly twice the size of Mt. Everest plus 3,000 km³ of ash, it created a "Volcanic winter" that lasted 6 years & believed to have accelerated a one thousand years long Ice Age. The human population almost wiped out having reduced from 1 million to only 50,000 thus created a "genetic bottleneck" & that is why the world's population today are genetically so similar



Early *Homo Sapiens* - Liujiang man 柳江人

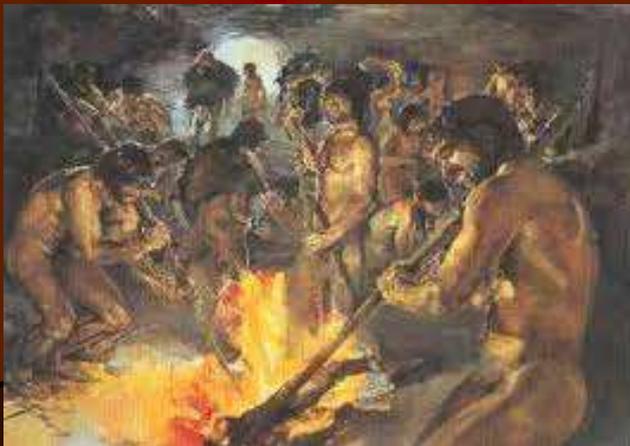
68,000 ybp discovered in Tungtingyang Cave 通天岩 Liujiang, Guangxi South China in 1958. 1567 cc cranium. Among the earliest modern human found in East Asia



Liujiang Cave, China
At least 68,000 years old



Oldest fully modern human ever found.
Liujiang, China, 110,000-140,000bp, lowest possible est. 70,000bp, highest est. >155,000bp



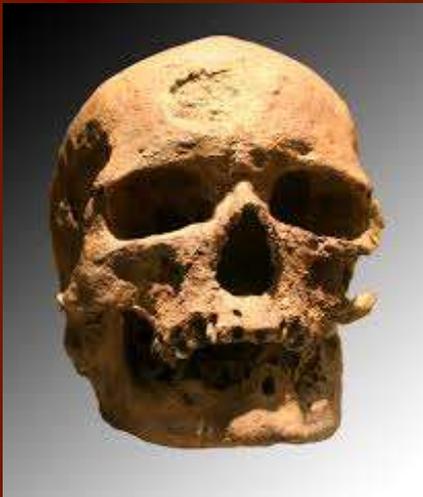
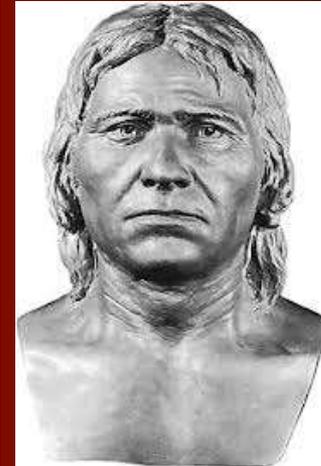
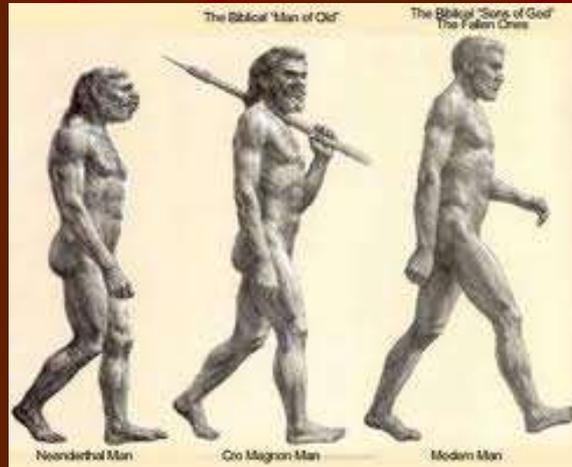
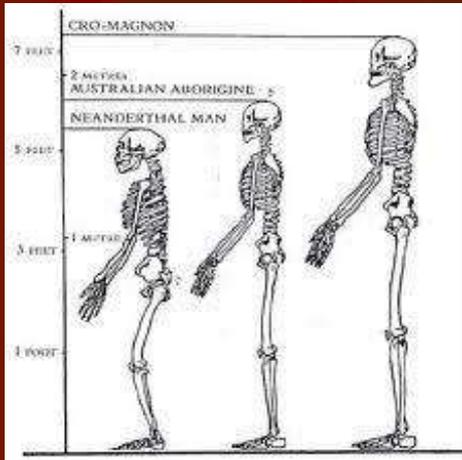
Early *Homo Sapiens* from Ordos Inner Mongolia

50,000 ybp discovered in. Probably the earliest modern human found in East Asia



Cro-Magnon 高馬龍人: 43,000 -10,000 ybp

In French means "Big Hole" also called EEMH – "European Early Modern Human" (Homo sapiens sapiens) or AMH – "Anatomically Modern Human"
現代人, Upper Paleolithic, tall 1.6-1.8m, 1590 cc brain, hunter gatherers



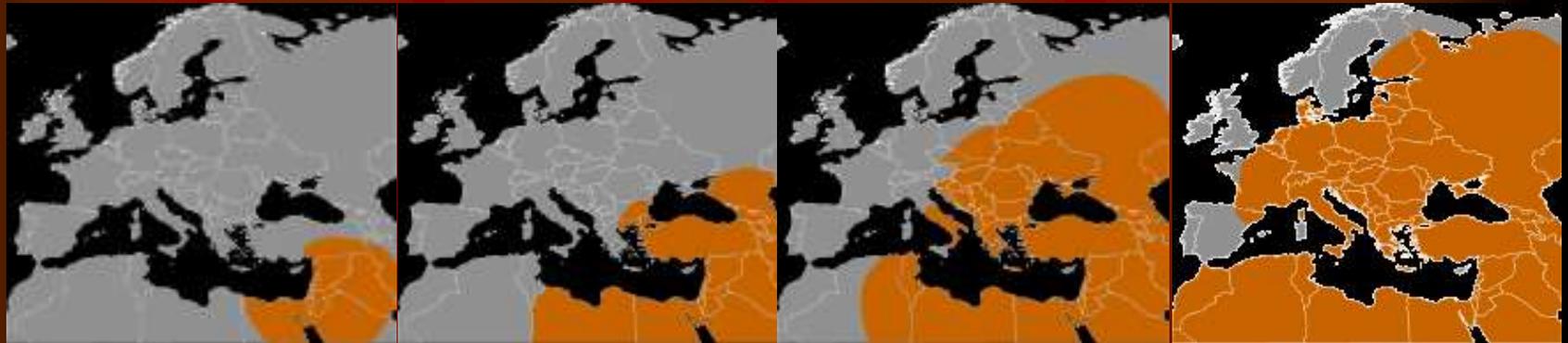
Migration of "Early Modern Human" into Europe (YBP : years before present)

37,000 ybp

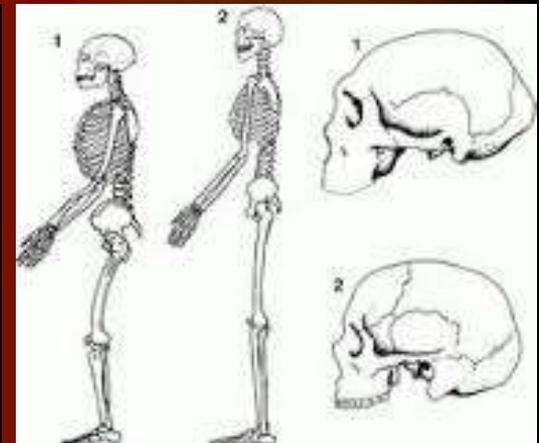
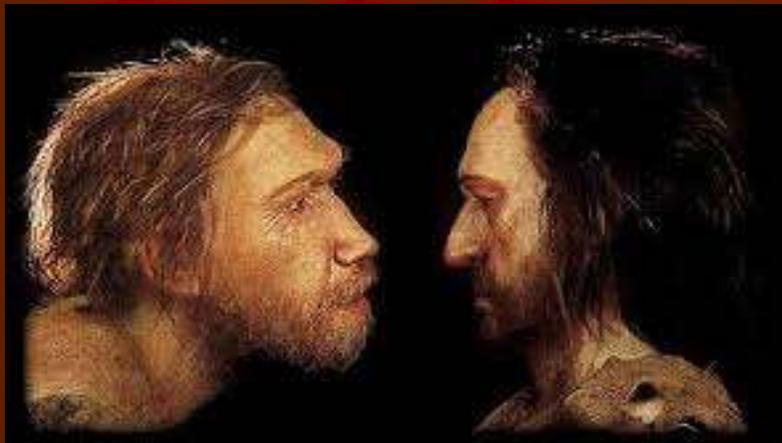
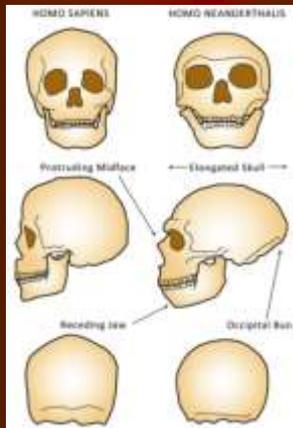
35,000 ybp

32,500 ybp

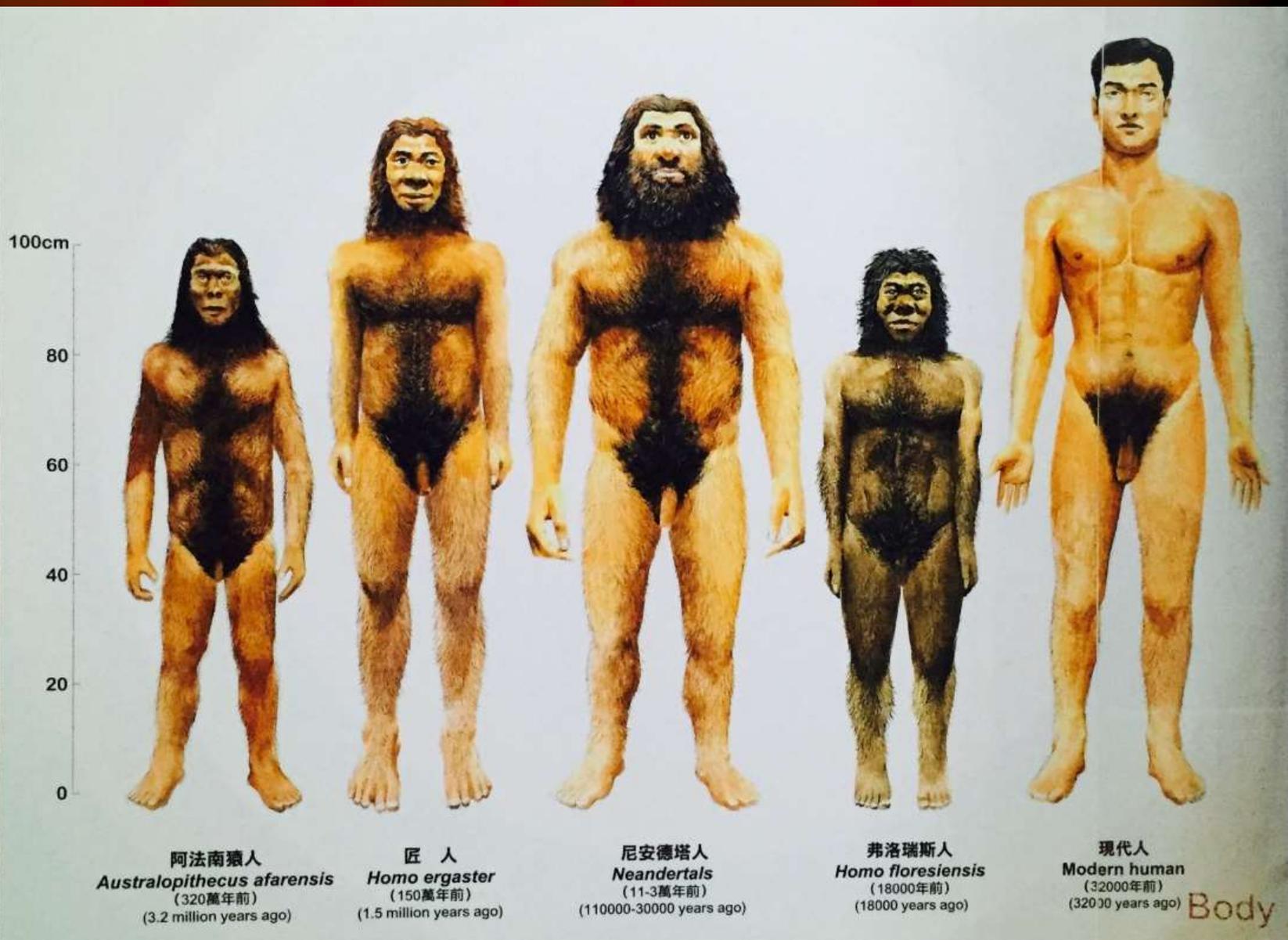
30,000 ybp



They were thought to have driven the Neanderthals into extinction



Modern Human compared to other Hominid

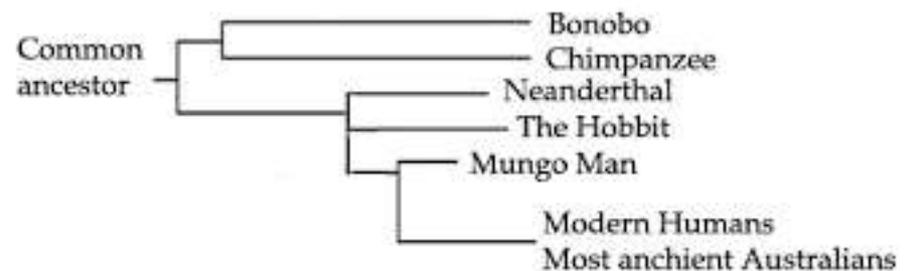


Early *Homo Sapiens*

68,000 - 40,000 ybp 3 sets of bodies discovered at Lake Mungo NSW, Australia. Oldest known modern human remains in Australia & also one of the world's first known cremation

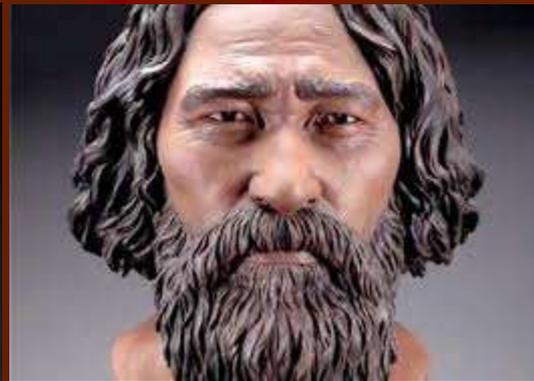


Evolution tree of mitochondrial DNA gene



Kennewick Man

9,000 BC from Kennewick, Washington State. It is the oldest skeletons ever found in America. Its discovery suggested that the first Americans were coastal Asian groups came through from Japan & Kamchatka Peninsula around 15,000 years ago & they were related to the Jomon which was the ancestor of the present day Ainu people of Japan. The man was 5ft 7 inches tall weighing 160 pounds with many injuries



La Brana 1

7,000 BC from N.W. Spain. DNA analysis indicated that this early hunter gatherer has deep blue eyes, dark hair & dark skin – possessed mixture of Africa & European genes !



Otzi the Ice Man 冰人

from the Alps 3,300 BC carrying a copper axe, a flint knife & a quiver with 14 arrows



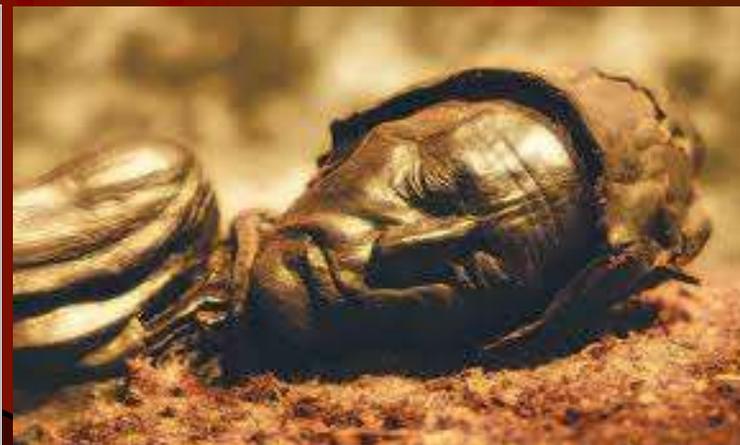
The Salt Man

Died 1,700 years ago preserved in the salt mine of Chehrabad, Iran



The Tollund Man

Died 4th Century BC found in Denmark. Called a "Bog body" which is a natural mummified corpse. Apparently hung to death with rope still attached



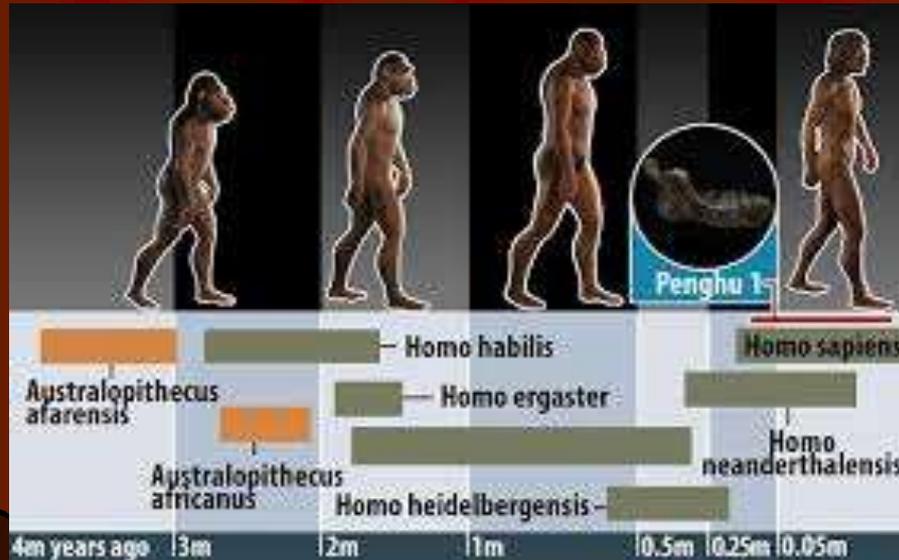
The Skull from burial C7 in HK

Late Neolithic female skull at 40 discovered 1997 in Ma Wan HK. Note two front incisors removed which was the custom at that time



Recent discovery in Penghu

- Penghu 1 a lower right jaw bone dated 10,000 to 190,000 Ya



TRACE FOSSILS

Tools

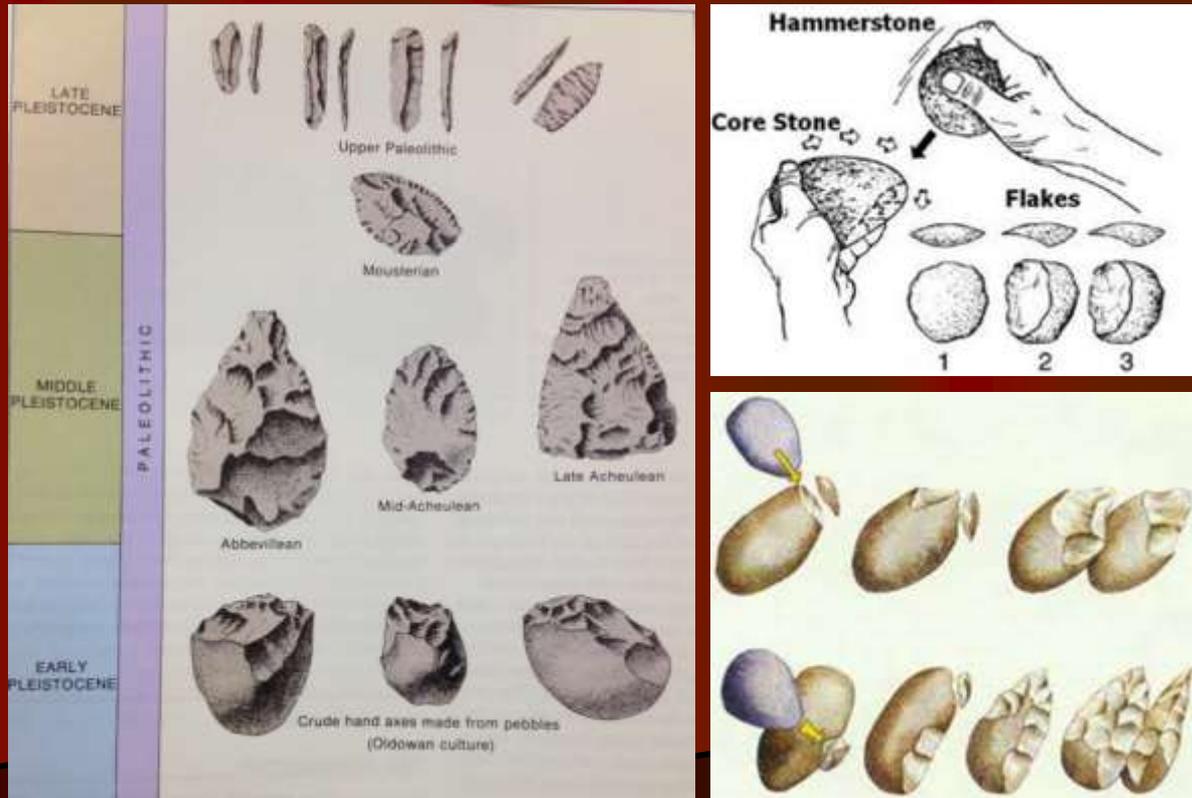
Paleolithic period 舊石器時代

meaning "Old Stone Age" represented by primitive stone tools - "Flaked Stone Culture". This is followed by Mesolithic the boundary of which varies with locality

Lower Paleolithic 2.5 m – 200,000 Year ago

Middle Paleolithic 200,000 – 35,000 Year ago

Upper Paleolithic 35,000 – 10,000 Year ago



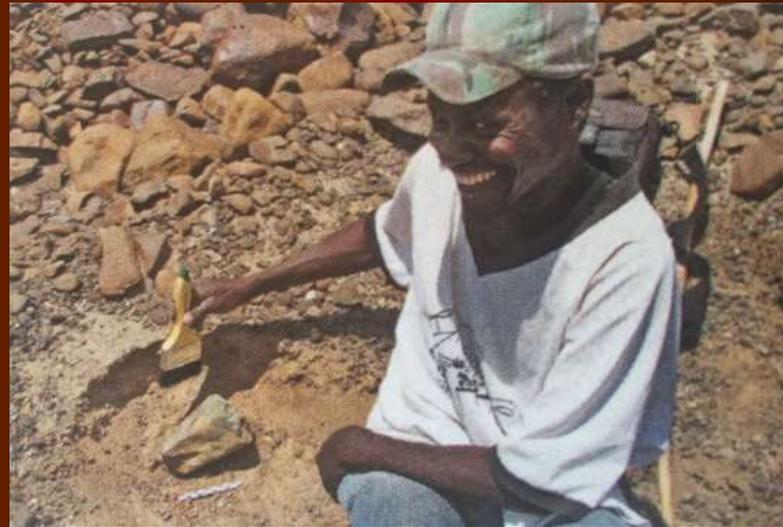
Lomekwi 3

Oldest stone tools predate humans

Discovery of a dozen crude stone tools by Harmand & Jason Lewis near Lake Turkana at Kenya dating to 3.3 ma which was 700,000 years older than any stone tools found and predating the *earliest human in the homo genus ? (**Homo habilis* 2.4 ma)

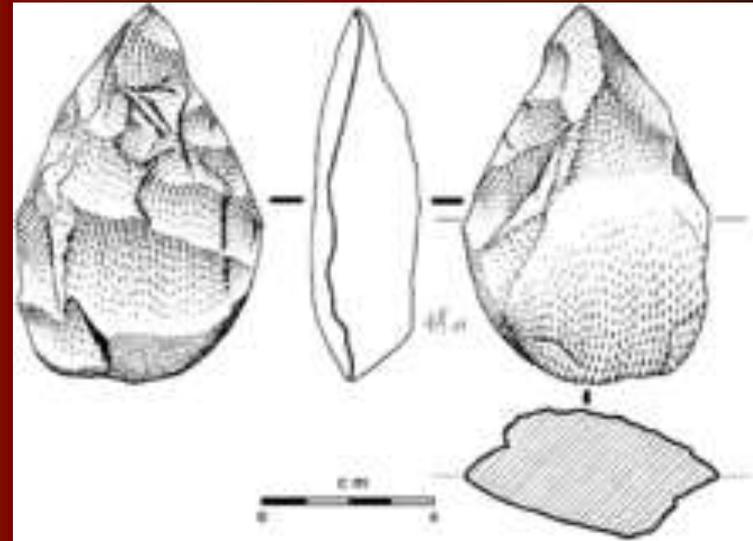


Some paleoanthropologist suspect the tools could be made by *Kenyanthropus platyops* 肯尼亞平臉人, *Australopithecus afarensis* or another yet to be discovered early member of homo



Oldowan tools 奧都曼工具

2.5 to 1.7 million years ago “Oldowan toolkit” or “Pebble Tools” found in Tanzania is the oldest stone tool found. The best flakes came from crystalline rocks such as basalt, quartz or chert. It is proven that a 3 to 5 cm flake is capable to dissect an entire elephant ! Often associated with *Australopithecus garhi* as well as *Homo habilis*



- Oldowan tools discovered by Louis Leakey in Tanzania
(Cambridge Museum of Anthropology)



Acheulian tools 阿舍利石器

1.6 Ma to 200,000 years ago. Acheulian culture stone tools first appeared in Africa but got their name because it was first discovered in Saint-Ache in North France. The major innovation was the manufacture of bifaces – stones with flakes removed from both sides to make hand axes 手斧 and cleavers which are tear drop or pear shaped. Some hand axe are extremely large and may have a ceremonial function. Scientists attributed this technology to *Homo ergaster/ Homo erectus*



Levallois tools 勒伐勒式石片器

250,000 years ago found in Africa & Europe. This “disc core technique” was invented before the Neanderthals but they refined it to make specialized long and flat tools for cutting meat, scraping hides and working wood and bone.



Mousterian tools 莫斯堤尖狀器

100,000 to 30,000 years ago (Middle Paleolithic). These stone tools were found in the near East & Europe. These flaked tools which are smaller and more specialized, were made by both *Neanderthals* and early *Homo sapiens* and may be used with rafts or handles



Cro-Magnon Tools

43,000-10,000 years ago : Stone Tools made by the *Cro-Magnon*

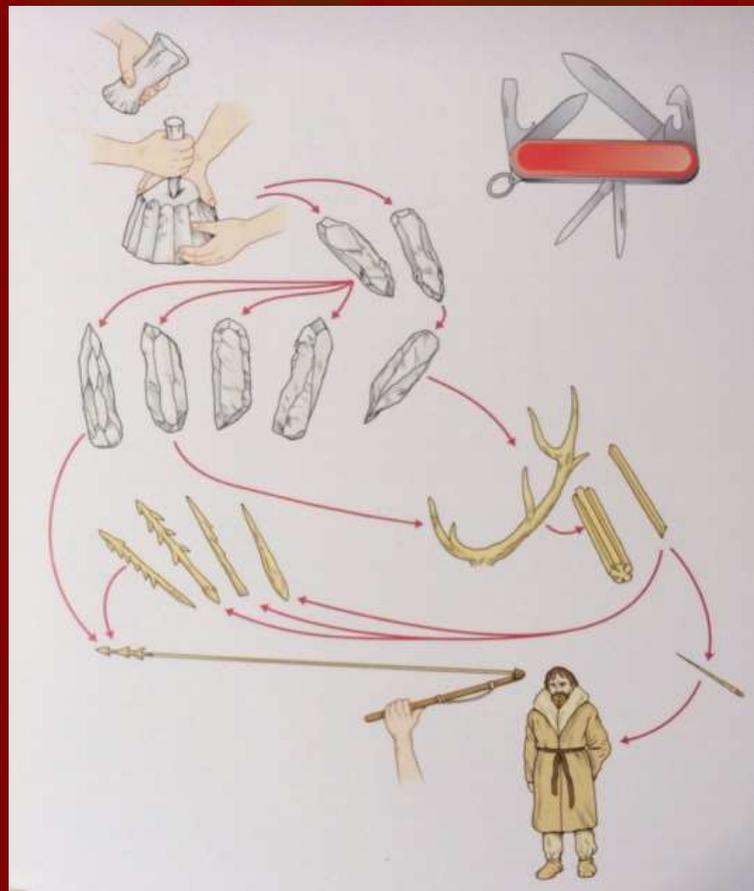


Neolithic Age 新石器時代

Literally means "New Stone Age " represented by
"Polished Stone Culture" 10,000 Years ago to 4,500/2,000 BC



New Stone Age "Swiss Army Knife"



- 3,500 ya : Copper Age 青銅時期
- 2,500 ya : Bronze Age 黃銅時期
- 1,200 ya : Iron Age 鐵器時期



Note each civilization differs in the actual timing
The development of human civilization is largely
a history of how we managed to harness earth's
natural resources

Art Objects

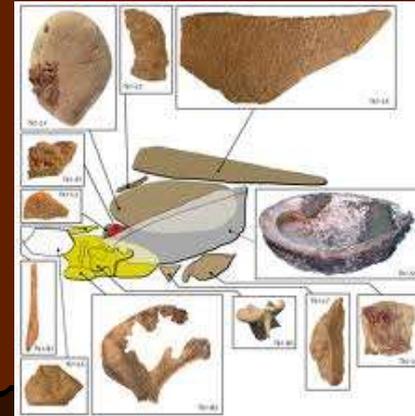
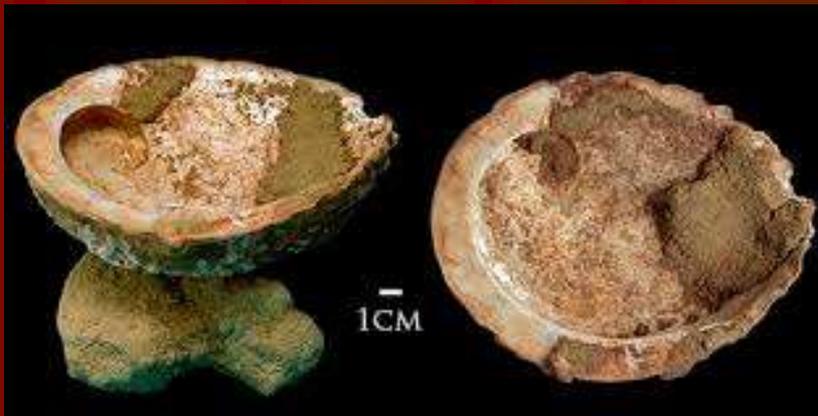
500,000 ya : A team of 21 researchers recently examined the fossil shells associated with the Homo erectus found by Eugene Dubois in Trinil Indonesia and discovered an engraved zigzag geometrical pattern on one of the mussel shells. This is at least four times older than the previously oldest engravings found in Africa



265,000 ya : Venus of Berekhat Ram, Israel - controversial



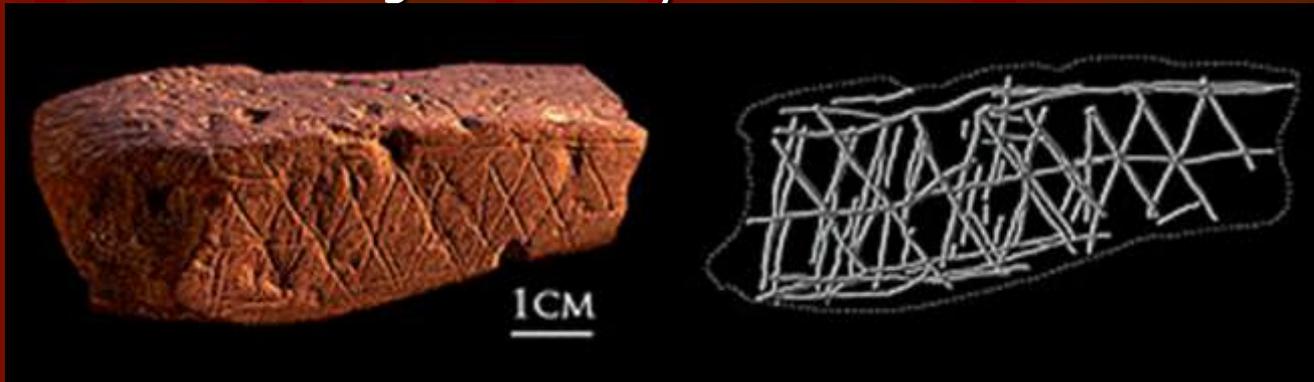
100,000 ya : Pigment & cave art at Blombos Cave, South Africa



100,000 - 75,000 ya : Beads made of Nassarius snails were discovered respectively in Israeli caves and the Grotte des Pigeons, Morocco



75,000 ya : The first evidence of symbolic behavior by man was discovered in the Blombos Cave in South Africa as represented by a block of red ocher with geometric symbols



63,000 ya : Engraved ostrich eggshell, Klipdrift Shelter, South Africa



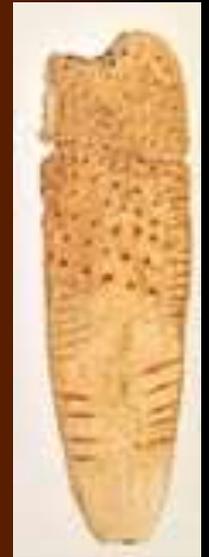
45,000 -35,000 BC Aurignacian Culture : Found in Europe & S W Asia.
 The oldest known figurative art the "Venus of Hohle Fels" comes from this culture. The Hohle Fel bone flute is also the oldest musical instrument ever discovered



At 40,000 years old this ivory sculpture of a “Lion Man” or “Lion Lady” discovered in Stadel Cave Germany was considered to be the oldest known zoomorphic (animal shaped) sculpture as well as figurative art in the world & associated with the Aurignacian Culture



43,000-10,000 ya : art objects made by the *Cro-Magnon*



35,000 ya : Animal figures carved in ivory were found in the Vogelherd Cave in Germany



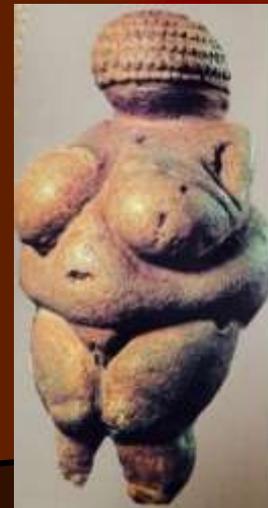
26,000 ya : Ivory head of a young man and Venus of Dolni Vestonice, Czech Republic



At 25,000 years old the “Lady of Brassempouy” carved out of a mammoth tusk was discovered in France in 1894. It is among the oldest representations of a human face



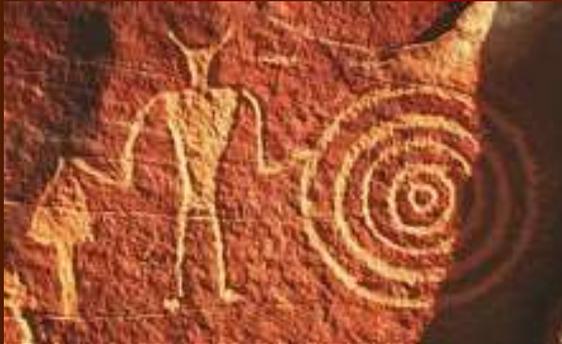
20,000 years old sculptures found in Europe



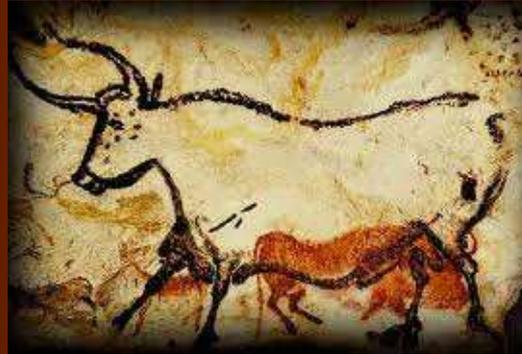
Rock Art 岩畫

There are about 20 million pieces of rock art found in 700,000 spots covering some 70 countries. These include petroglyphs (carved), pictographs (painted) & earth figures (design & motifs e.g. Nazca line) engraved into the ground. The oldest is dated at 290,000 ya

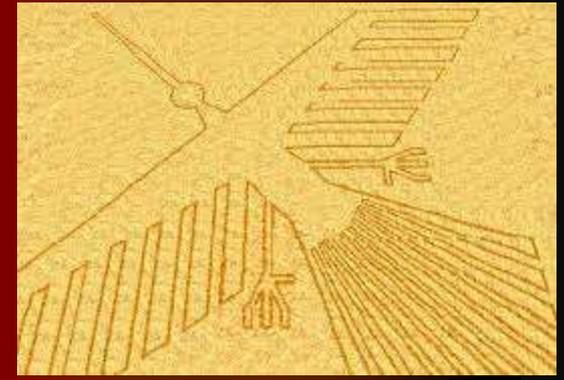
Petroglyphs



Pictographs



Earth figures



Location of key Paleolithic Cave Art in Europe

洞穴壁畫/岩畫

(Black dot – caves; black triangle – artifacts)



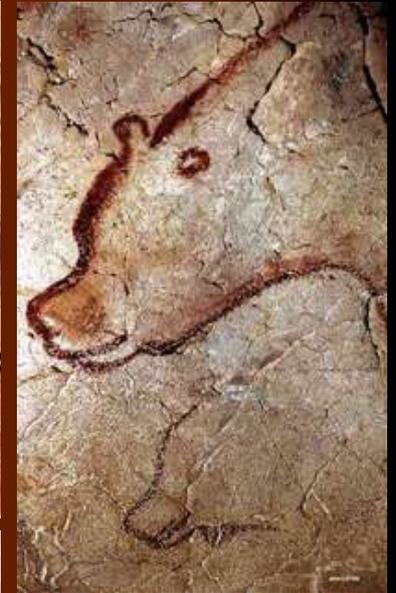
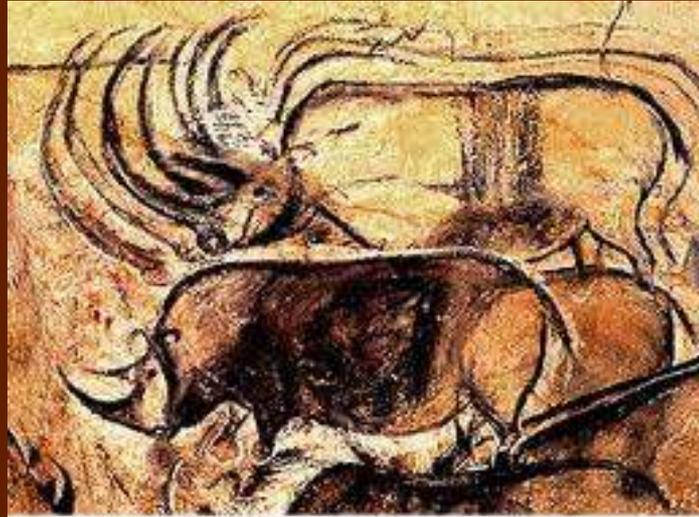
Cueva de El Castillo Cave, Spain

48,000 year old : World's oldest known cave art including stenciled handprints



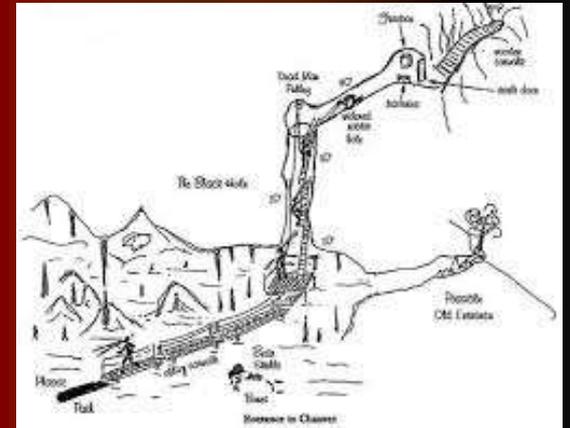
La Grotte Chauvet-Pont-d' Arc Cave France

More than 1,000 wall paintings depicted 442 animals including lions, bison, rhino, bear & mammoth done at 36,000 years ago in the Ardeche region, Southern France. Awarded an UNESCO site in 2014



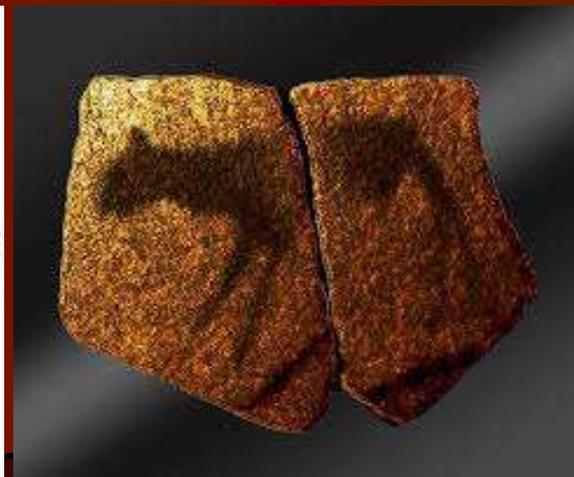
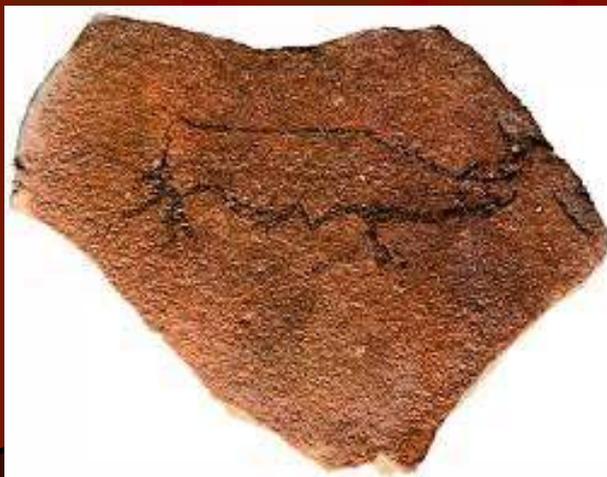
The "End Chamber" or "The Gallery of Lions"

Drawings in charcoal and red ocher



Apolo 11 Cave, Namibia

First painted tablet of animal dated 27,000 ya. The cave contains some of the oldest pieces of mobile art ever discovered in South Africa



Mt. Pech Merle, France 25,000 ya

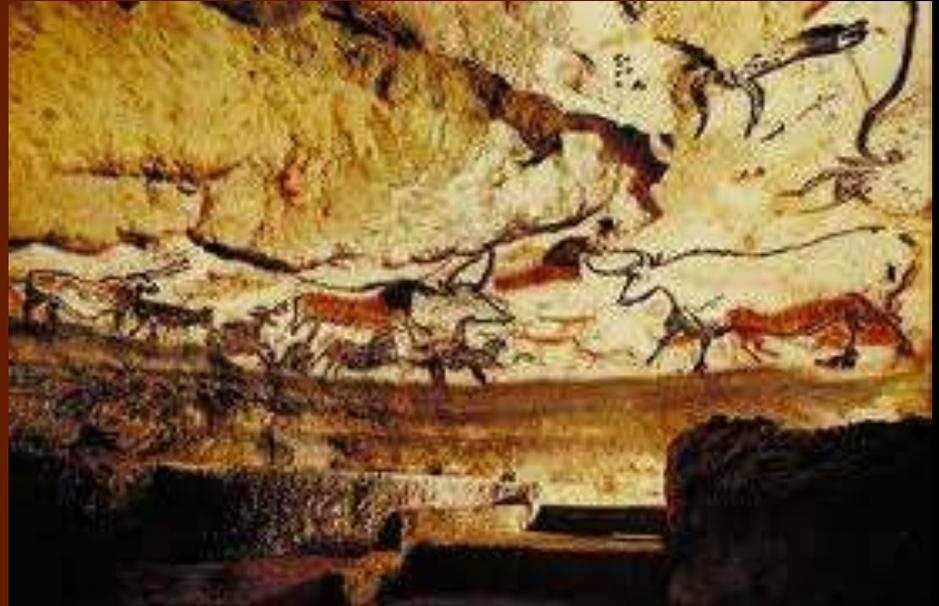


Mt. Borradaile, Arnhem land Australia 20,000 ya



Altamira Cave in Spain

Upper Paleolithic wall paintings estimated to be around 18,500 Ya whilst abstract symbols on the ceiling can be traced back another 20,000 years



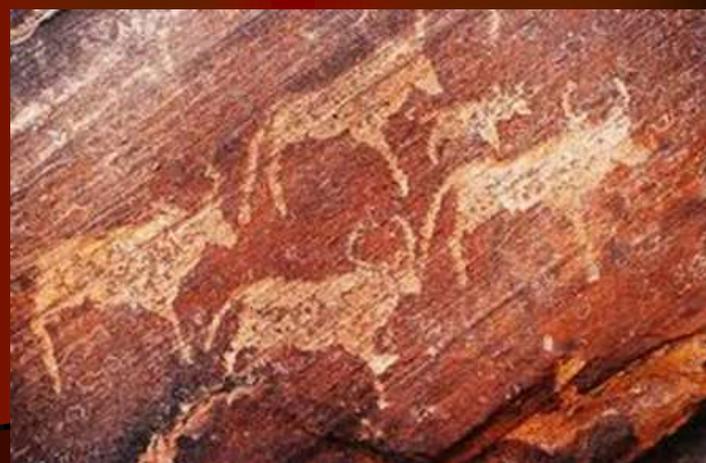
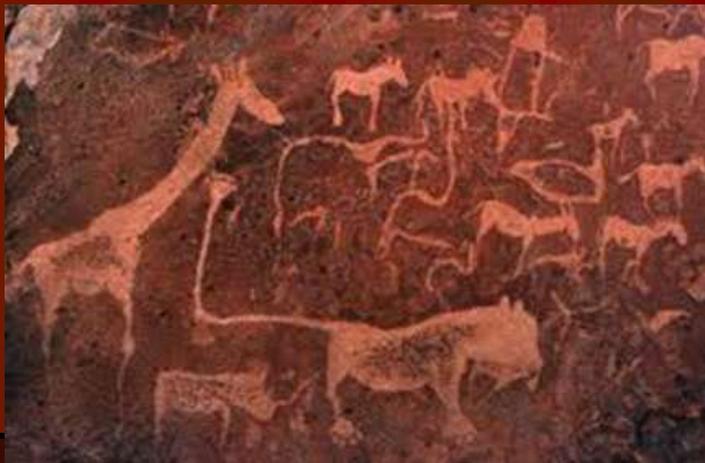
Lascaux Cave, southwestern France

2,000 paintings 19,000 years old Stags & horses. Now closed to the public



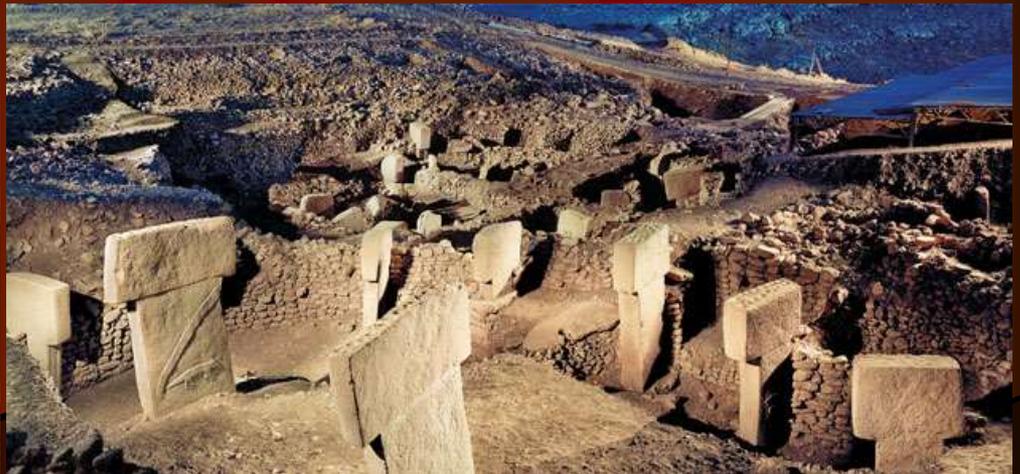
Twyfelfontein Rock Art

Includes 2,500 rock carvings made by stone age hunter-gatherers some 6,000 years ago & later by Khoikhoi herders in Namibia.



The Gobekli Tepe Stonehenge, Turkey 哥貝克力石陣

At 11,500 years old it is probably the World's first Temple used to worship the dead. Archaeologist believed religion was the driving force to push the hunter gatherers to develop farming



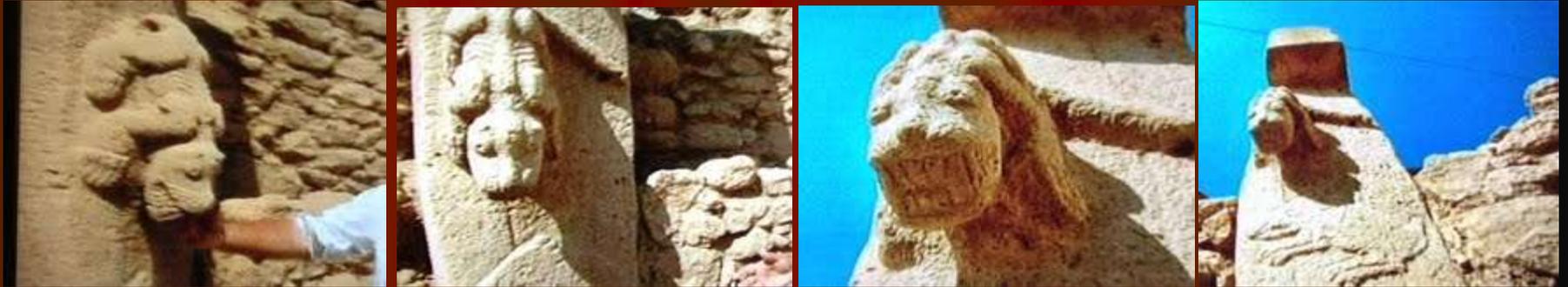
Note headless carvings at the Gobekli Tepe Stonehenge



The Gobekli Tepe Stonehenge, Turkey

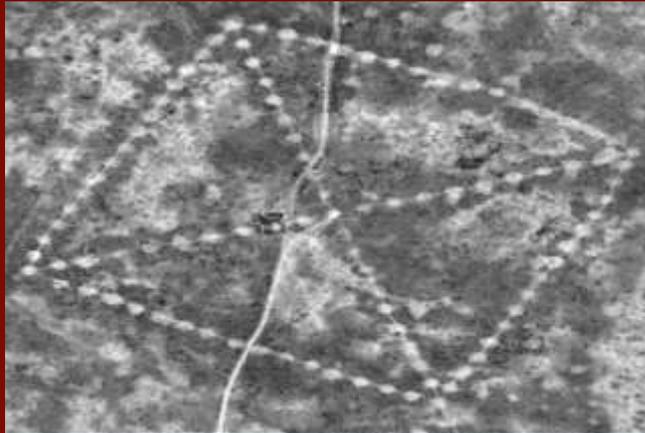


The Gobekli Tepe Stonehenge, Turkey



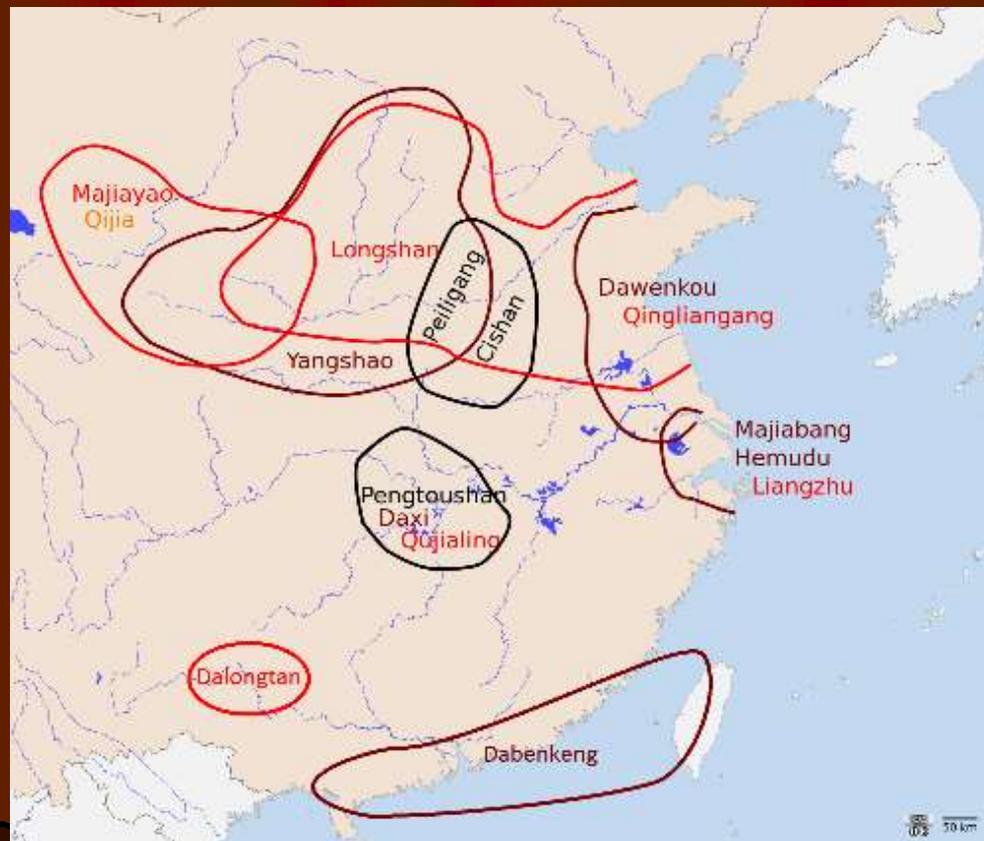
Kazakhstan Steppe Earth Structure

Huge earth structure probably built by the Mahandzhar civilization 8,000 years ago discovered by NASA over Kazakhstan's steppe

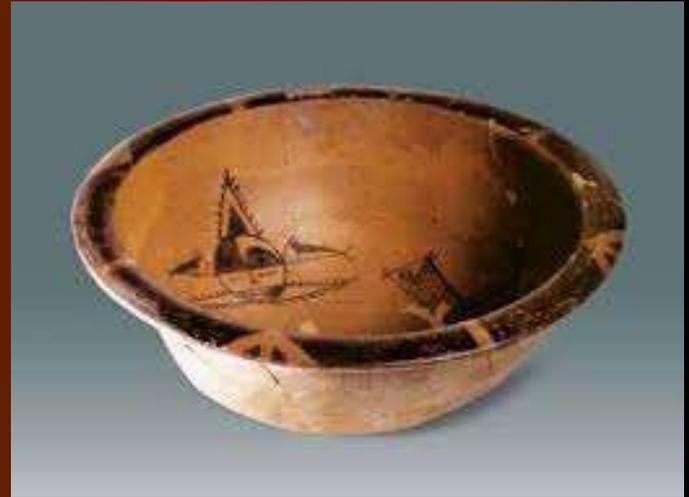


China's Neolithic Culture

Began 8,000 B.C. & ended with the introduction of metallurgy about 8,000 years ago. However every year the starting date is being pushed back with new discoveries. Famous ones include Yang Shao Culture 仰韶文化, Hung Shan Culture 紅山文化, Liangzhu Culture 良渚文化 & Long Shan Culture 龍山文化



Yang Shao Culture 仰韶文化 (彩陶) : 4,000 – 2,000 BC red clay pottery



Hung Shan Culture 紅山文化 (玉器) : 4,000 – 3,000 BC red clay pottery & burial jade



Liangzhu Culture 良渚文化 (黑陶, 璧, 琮) : 3,300 – 2,200 BC jade dominates



Long Shan Culture 龍山文化 (黑陶) : 2,500 – 2,000 BC famous for its black clay pottery & Bronze wares



Sanxingdui Culture 三星堆文化：2,500 – 1,000 BC Bronze Age Culture in present date Szechuan



Writing 文字

Writing 文字

- Jiahu Symbols 賈湖契刻符號 : 16 distinct markings carved on tortoise shells & bones dated 6,000 BC were excavated in Jiahu, Henan province in 1999. They resemble the much later oracle bone script 甲骨文 & are known as the earliest “writing” by man

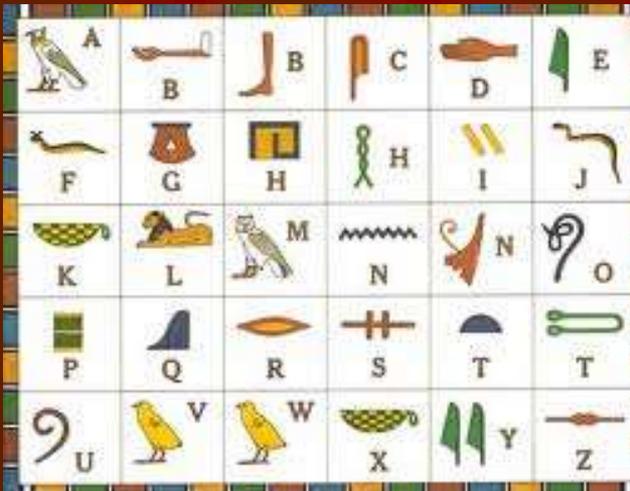


甲骨文 (商朝)	金文 (周朝)	小篆 (秦朝)	隶书 (汉朝)	楷书 (汉末)
日	日	日	日	日
月	月	月	月	月
人	人	人	人	人
目	目	目	目	目
車	車	車	車	車
馬	馬	馬	馬	馬

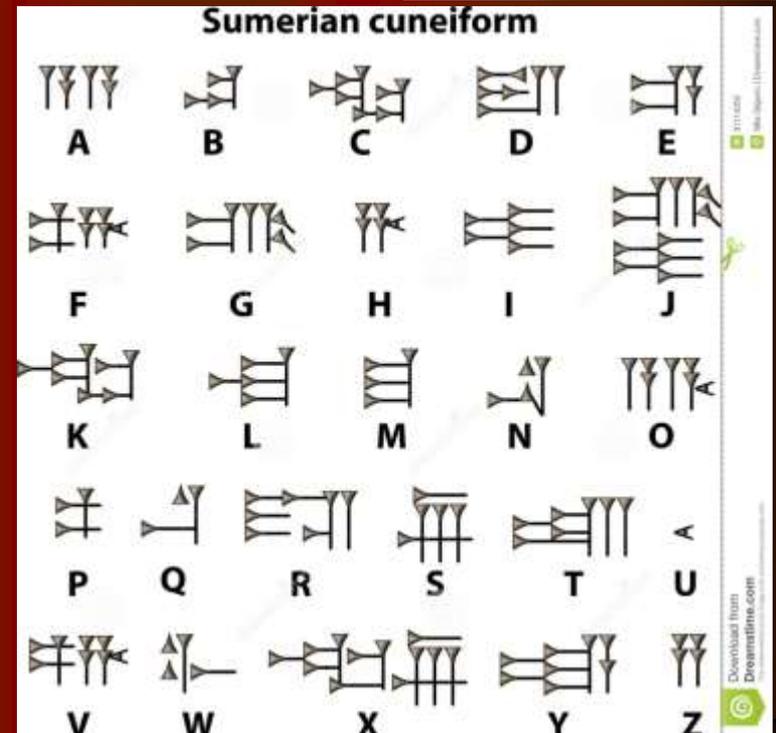
- 4,000 BC : Writing numbers for record keeping preceded written languages. Clay tokens were in use in ancient Iraq to be followed by pictograph



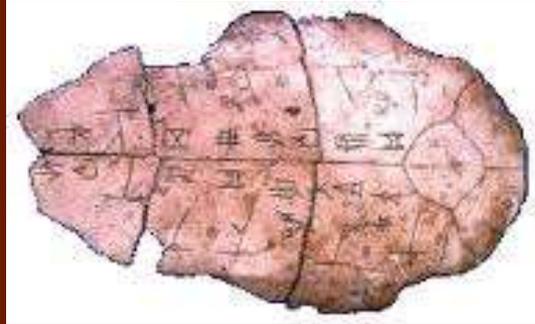
- 3,400 BC : Egyptian hieroglyphics appeared



- 3,200 BC : Cuneiform written language 楔形文字 appeared in Mesopotamia



- 1,500 BC : Oracle script 甲骨文 first appeared in China on bones & shells



- 600 BC : written language appeared in Mesoamerica





“Human Races” today, what is wrong with the term ?



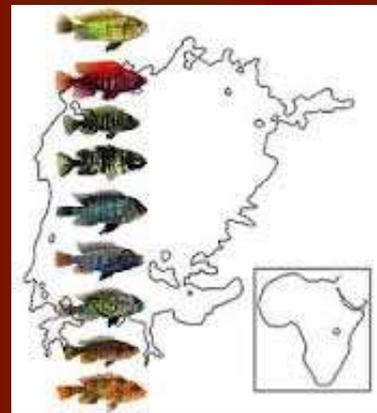
Aren't we all the same ?

- Definition of races – physical (color of hair & skin, body built, facial features) & cultural (social heritage of a group including spoken & written language, custom, religion & behavior)
- Physical variation has a lot to do with the climate eg. bigger body in cold area; the color of skin is controlled by skin pigment called melanin 黑色素 , dark skin protect from the sun – ultra violet light causes skin cancer also destroys a essential nutrient in skin called folic acid 葉酸 which can result in infertility & cause fetal neurological defects in babies, light skin absorb more sun light required for synthesis of vitamin D ; double eye lid also give protection to strong sun light. All are results of natural selection



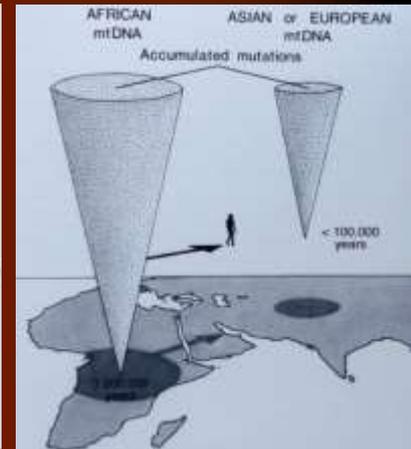
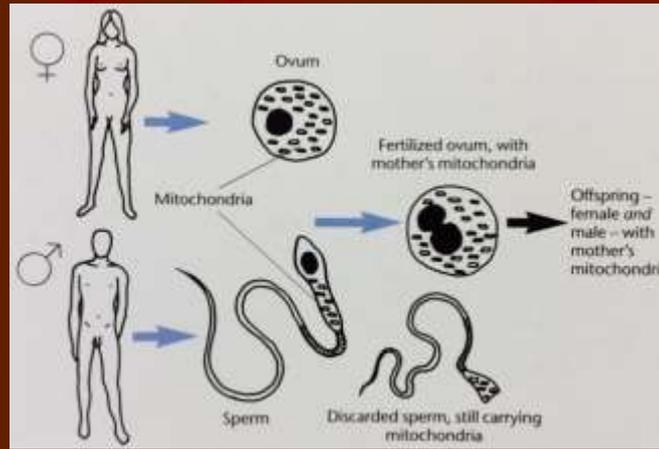
Lake Victoria Cichlid 慈鯛

From one species to 500 species in 14,500 years



Aren't we all the same ?

- So all in all the differences are only "Skin Deep"
- The 13 year long *Human Genome Project completed in 2003 at a cost of US\$3 billion : ** MRCA : "Mitochondrial Eve" "Lucky mother" 線粒體夏娃 (mtDNA) & "Y – chromosome Adam" both dated back to 200,000 year ago in Africa thence moving out of Africa 100,000 years ago !

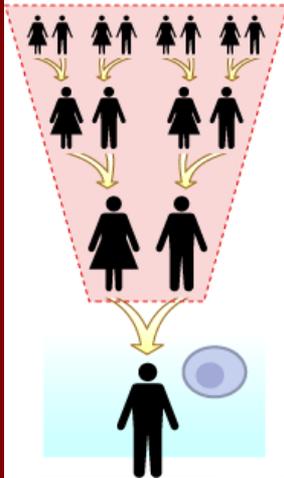


*人類基因圖譜 US National Institute of Health & the US Dept. of Energy Project

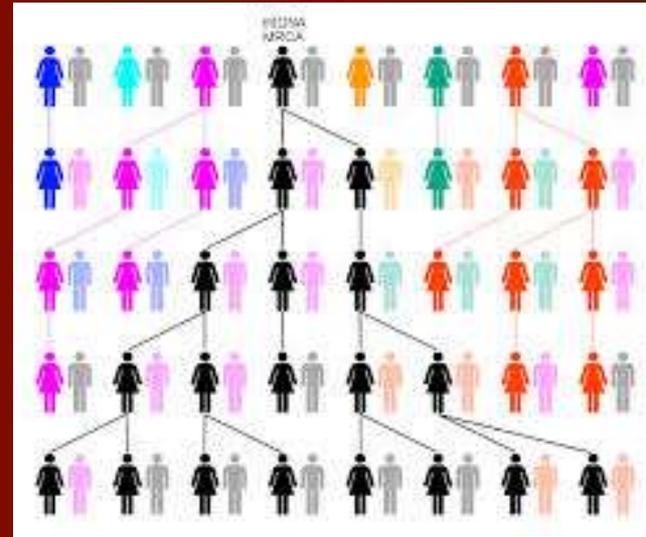
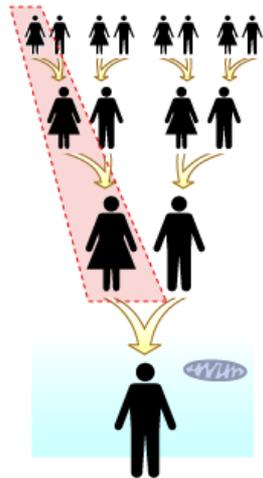
** MRCA : Most Recent Common Ancestor

Tracking "Mitochondrial EVE"

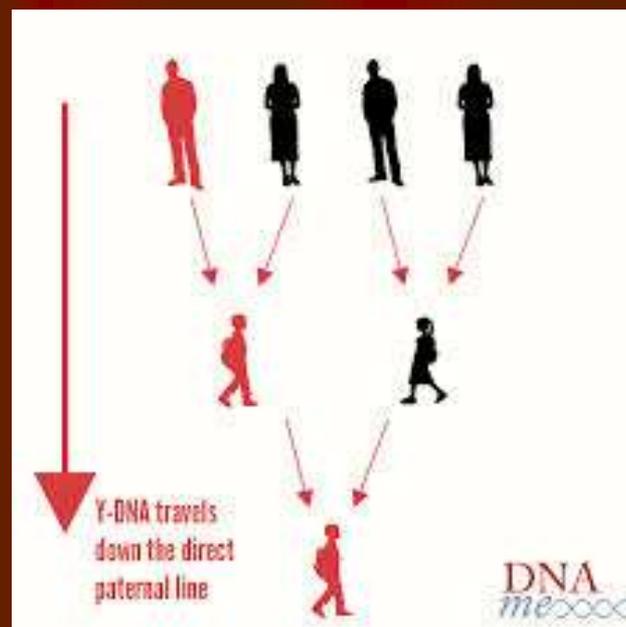
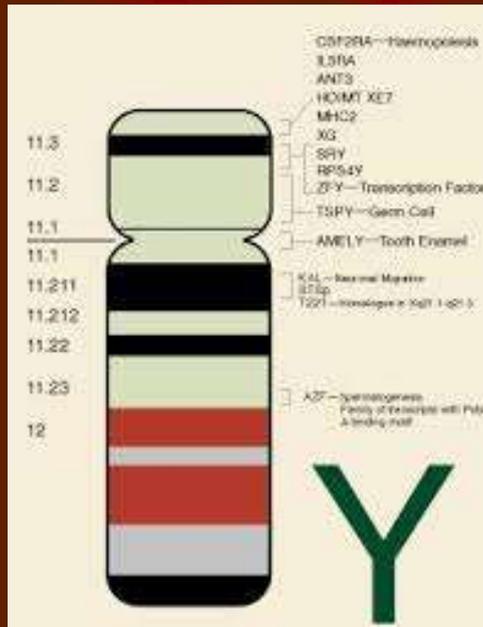
A. Nuclear DNA is inherited from all ancestors.



B. Mitochondrial DNA is inherited from a single lineage.



Tracking "Y - Chromosome Adam"



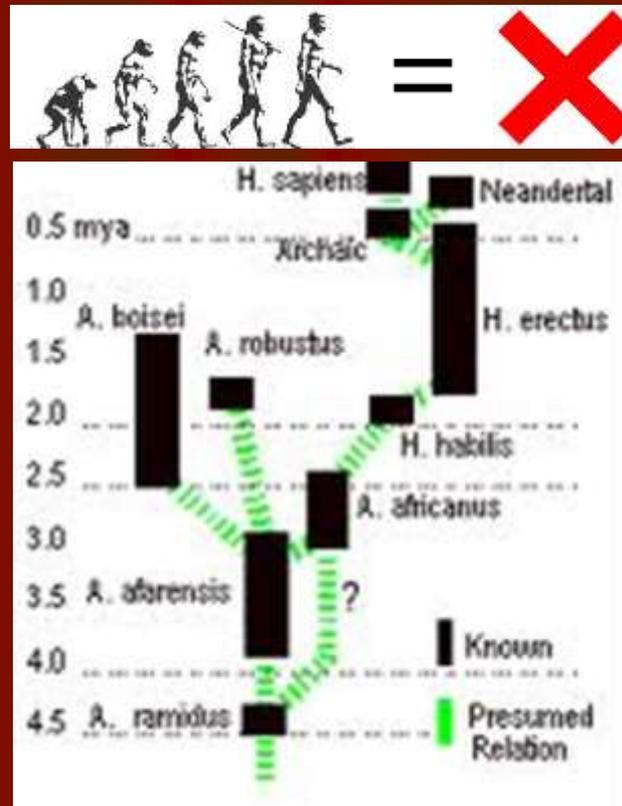
Aren't we all the same ?

Racial Cleansing & Genocide are sinful & unacceptable
Tasmania, Armania, Namibia, Hitler's Germany, Iraq/Kurds,
Serbia/Croatia, Luanda, Angola, Mynamar etc etc



RECAP

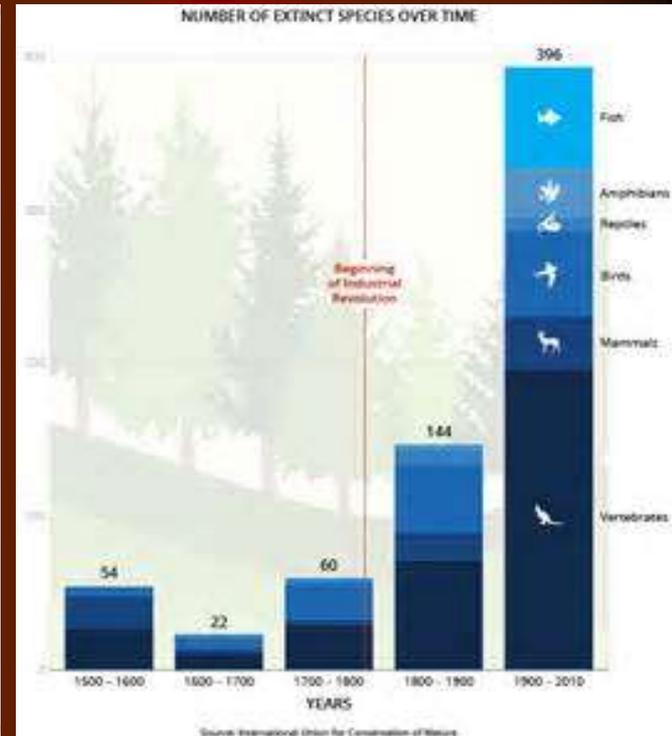
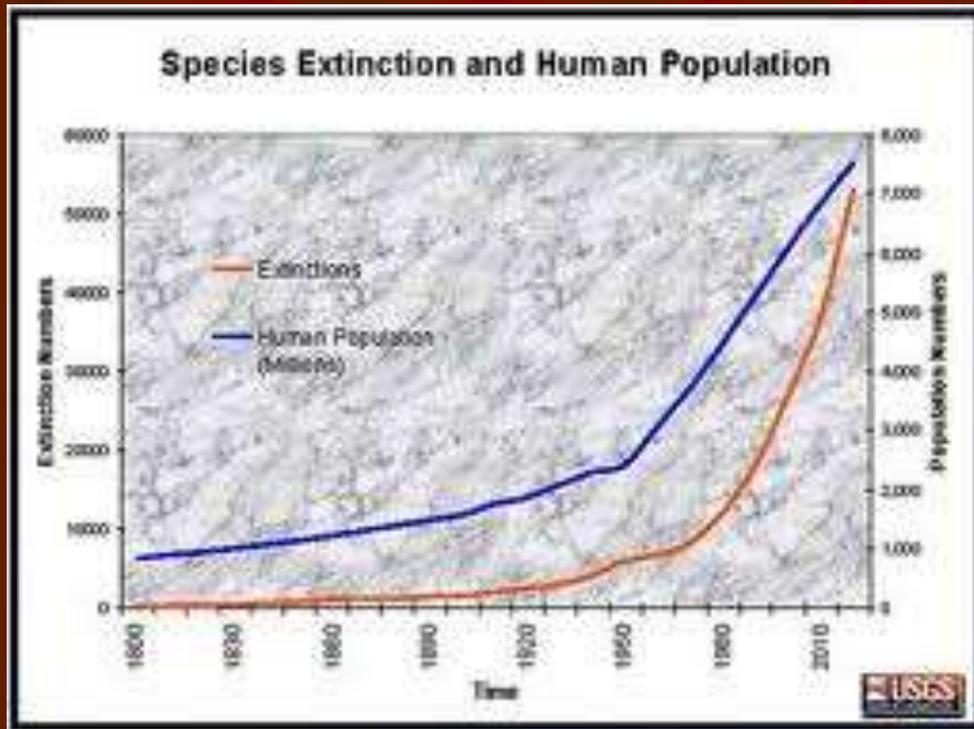
- Not enough fossil evidence, less than 10,000 being discovered
The “Missing Links” are still missing
- Nonlinear – Human evolution did not proceed in a straight line.
Co-lateral relationship between species & Regional Evolution



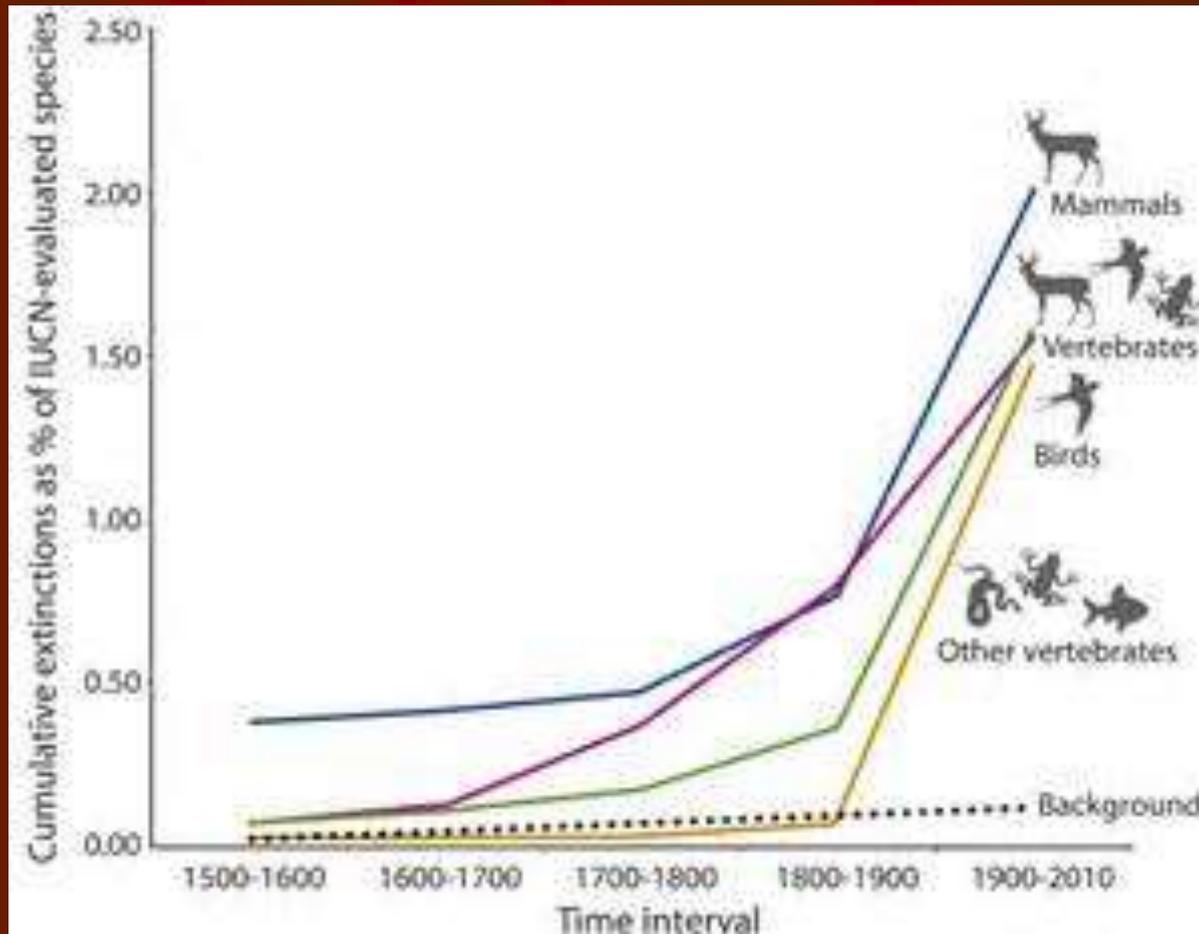
- Evolution is real – also proven by the “imperfect design” of birth canal (one miscarriage in 90 secs), appendix, hernia & wisdom tooth
- Biological Evolution vs Cultural Evolution : **GENE** & ***MEME** 模因
the latter is unique for Human by changing the environment to suit ourselves (*= cultural replicator, term cloned by Prof. Richard Dawkins)
- Is advance in science particularly medical science counter Evolutionary ?
- Is Genetic Engineering a new kind of Evolution ? The danger of Eugenics 優生學 (artificial selection) !

The 6th Mass Extinction is underway which is to a large extent due to human activities !

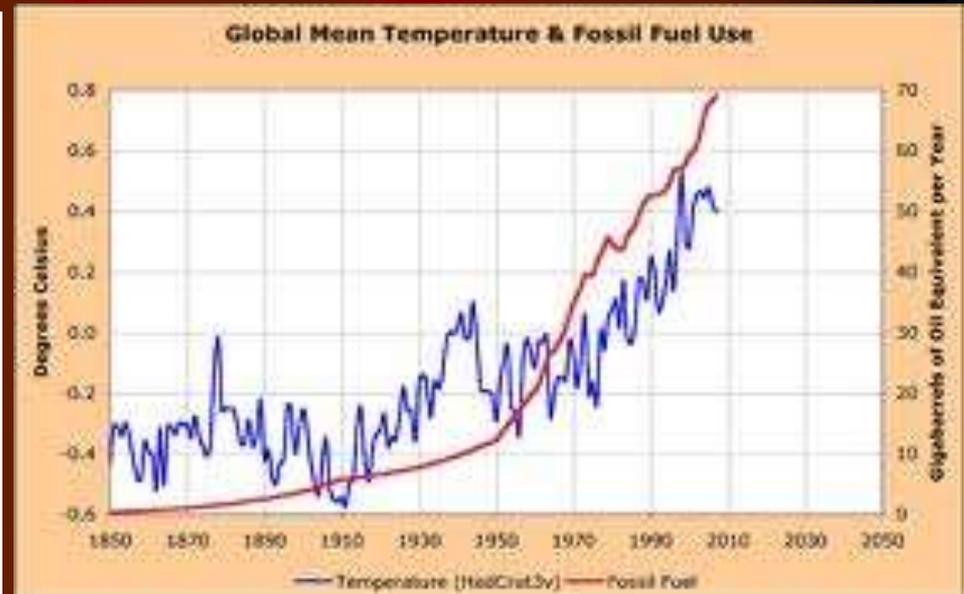
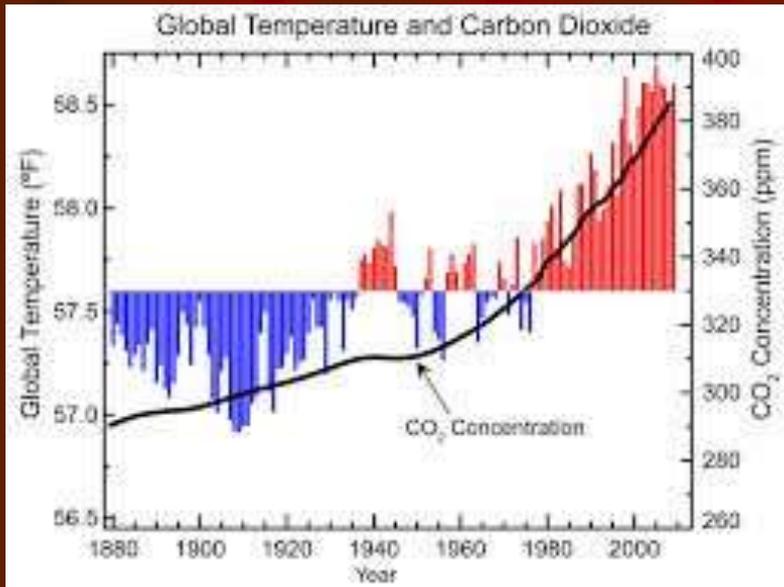
Within the 20th century human have caused the extinction of **593** species of birds, **400** species of animals & **209** species of reptiles by direct slaughtering, destruction of habitat & introduction of foreign species e.g. cats/dogs/goat. On average **3** species now extinct per hour



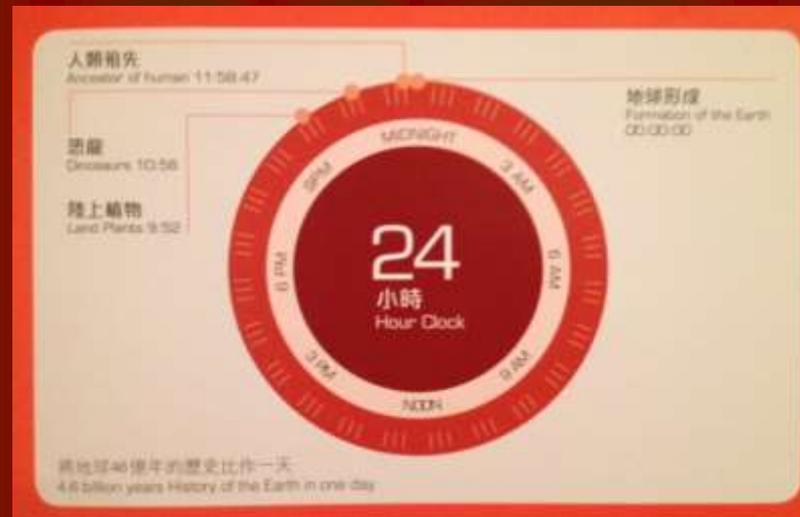
- “Background extinction rate” is 2 per 10,000 species within one hundred years. Now is 140 times as fast due to climate change, pollution, deforestation due to human activities (IUCN)



By using fossil fuel we are also polluting the earth & destroying the environment - CO2 emission already led to global warming, melting of ice cap, rising sea level climatic changes & ocean acidification. 2014 CO2 content already reached 400 ppm which is the highest in the last 0.8 m years almost reaching the point of no return



- If the development of life on earth is 24 hours, Human only represents 1.13 minutes – nothing to be proud of !
- Current living organisms only represents 0.1% of all the living organism ever existed what will be our survival rate ?



Stephen Hawking: “ We must continue to go into space for humanity. We won’t survive another 1,000 years without escaping our fragile planet”. Now that we are destroying it day after day do you agree ?

The End

