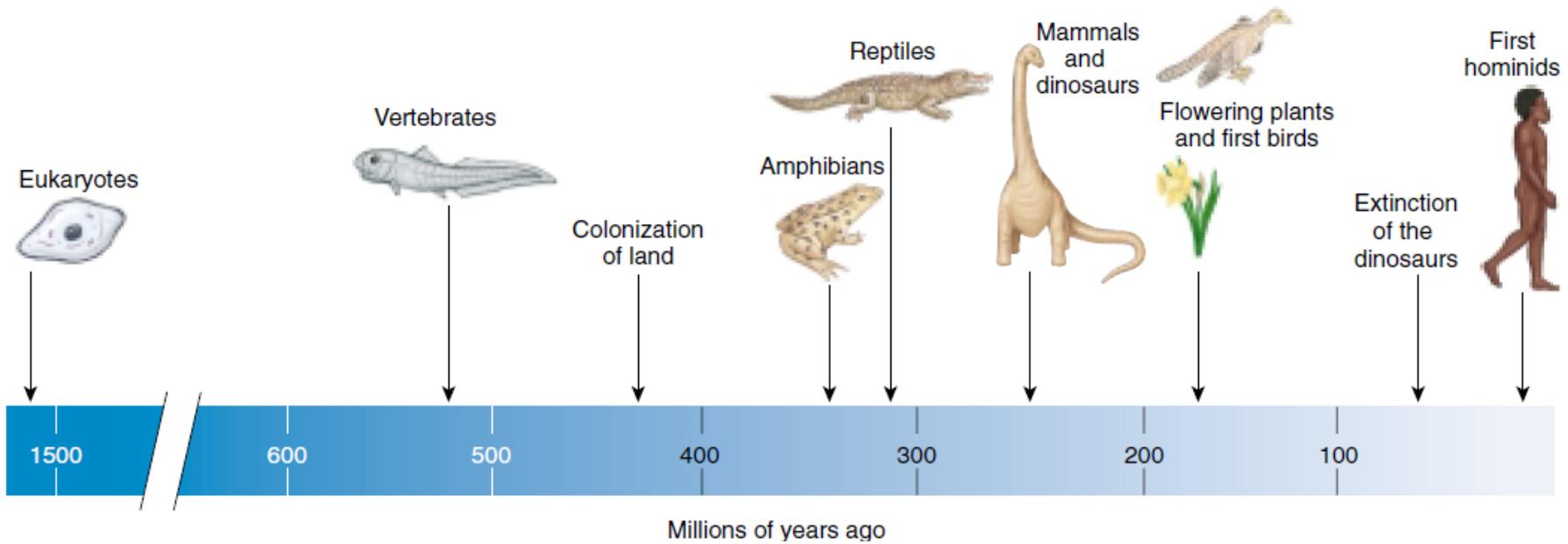


# Evolution

- การเปลี่ยนแปลงของสิ่งมีชีวิต พันธุกรรม สภาพแวดล้อม การดำรงชีวิต
- **Biodiversity** : ความหลากหลายทางชีวภาพ
- **Same ancestor** มี บรรพบุรุษร่วมกัน
- **Similar structure**
- **Natural selection** การคัดเลือกตามธรรมชาติ
- **How mutation occur** การผ่าเหล่าเกิดขึ้นได้อย่างไร

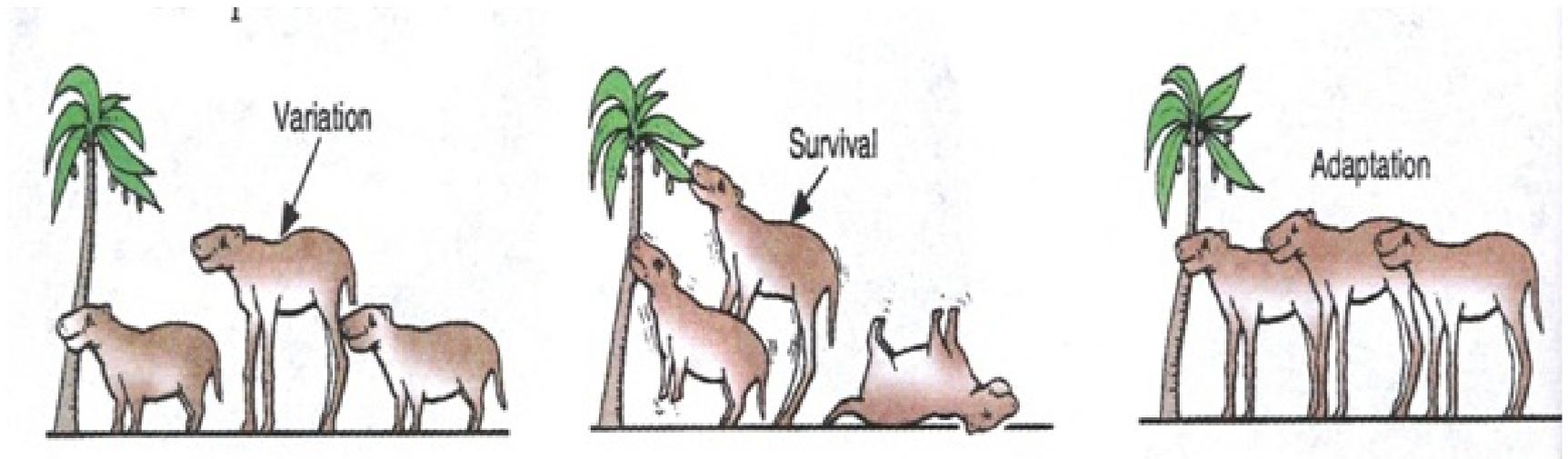


# Evolution

- Evolution means **descent with modification**, or change in the form, physiology, and behavior of organisms over many generations of time. The evolutionary changes of living things occur in a diverging, tree-like pattern of lineages.
- Evolution is then **change between generations** within a population lineage. Darwin defined evolution as “**descent with modification,**” and the word “descent” refers to the way evolutionary modification takes place in a series of populations that are descended from one another. Recently, Harrison (2001) defined evolution as “change over time via descent with modification.”

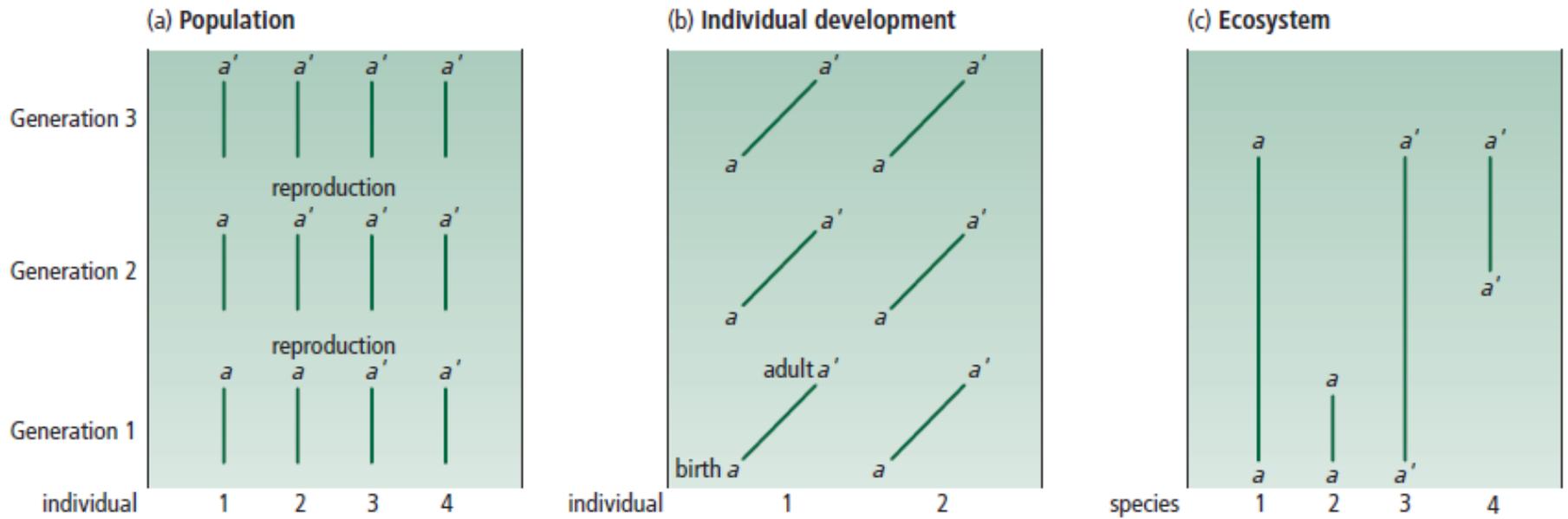
# Evolution

- Living things possess adaptations: i.e., they are well adjusted in form, physiology, and behavior, for life in their natural environment.

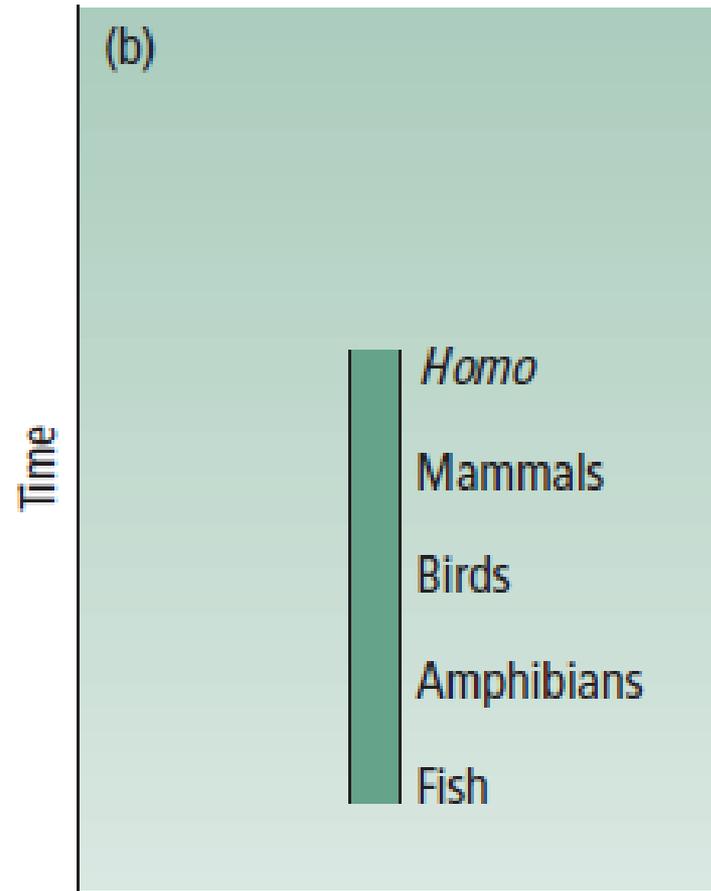
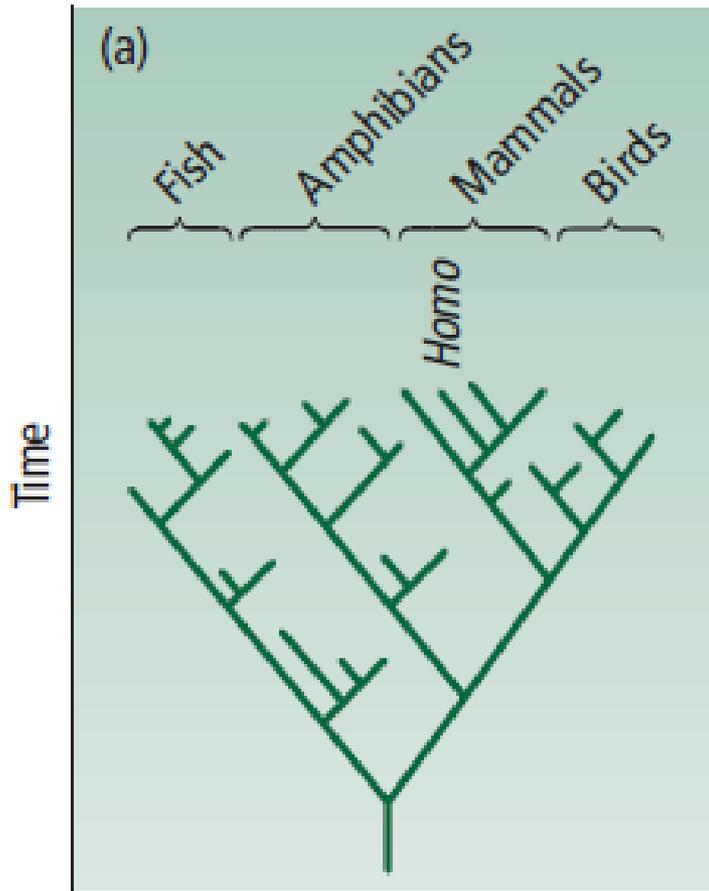


# How ???

- Evolution refers to change within a lineage of populations between generations.



  
Evolution



Evolution is more like a tree than a ladder

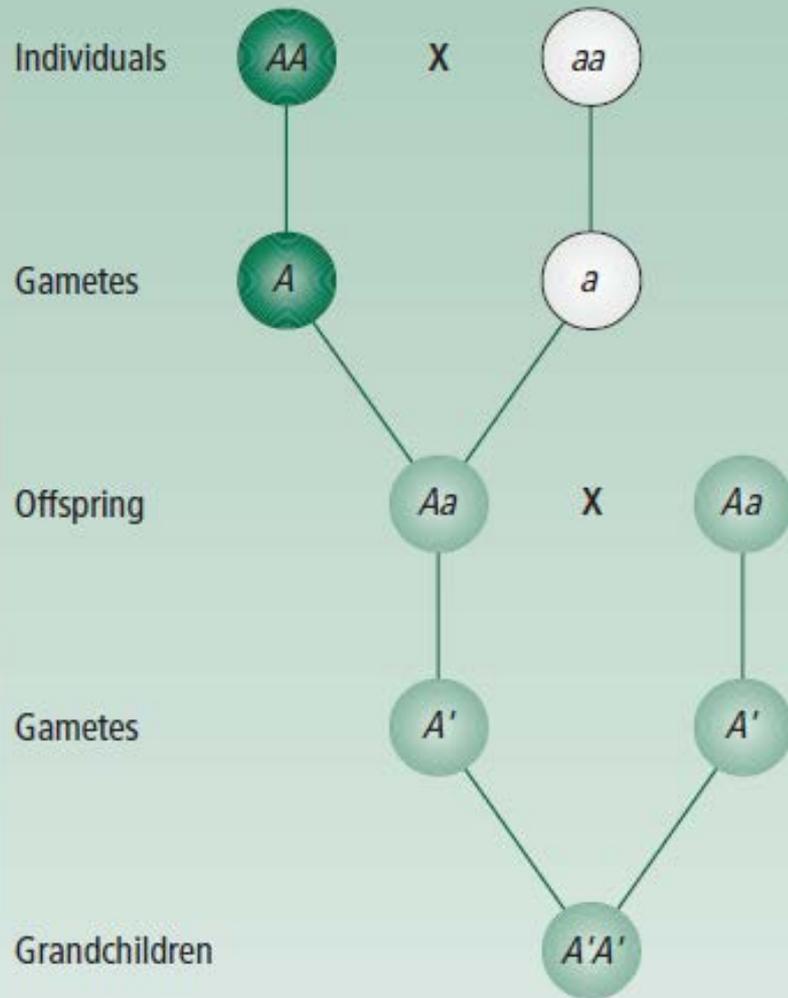
# How evolution occur

- Heredity ????? พันธุกรรม
- Direct mutation or direct variation
- Mendelian heredity and natural selection are com-patible
- Heredity is determined by a molecule called DNA. The structure and mechanisms of action of DNA are understood in detail.

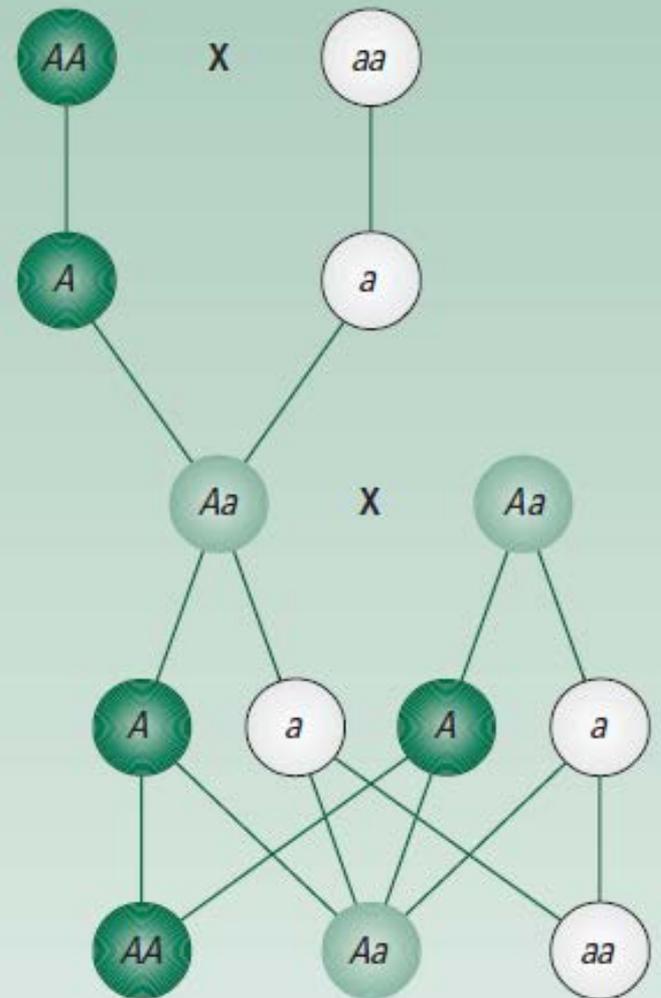
# How evolution occur

- New genetic variation originates by mutational changes= ผ่าเหล่า in the DNA. Rates of mutation can be estimated by direct observation.
- Different genes are preserved over the generations under Mendelian heredity, and this enables **natural selection** to operate.

(a) Blending heredity

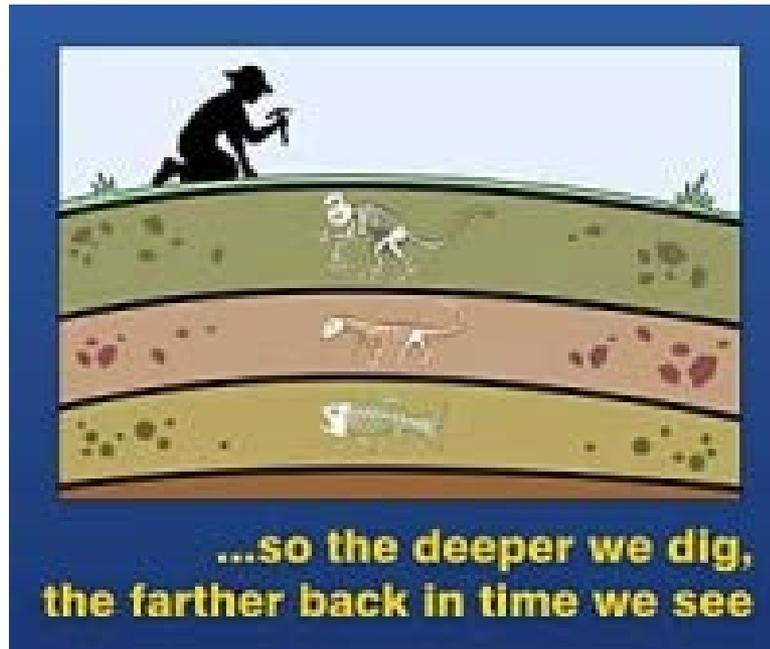


(b) Mendelian heredity



# Evidence of Evolution

- three main classes of evidence for evolution:
- observation on the small scale
- from homology
- from the order of the main groups in the fossil record

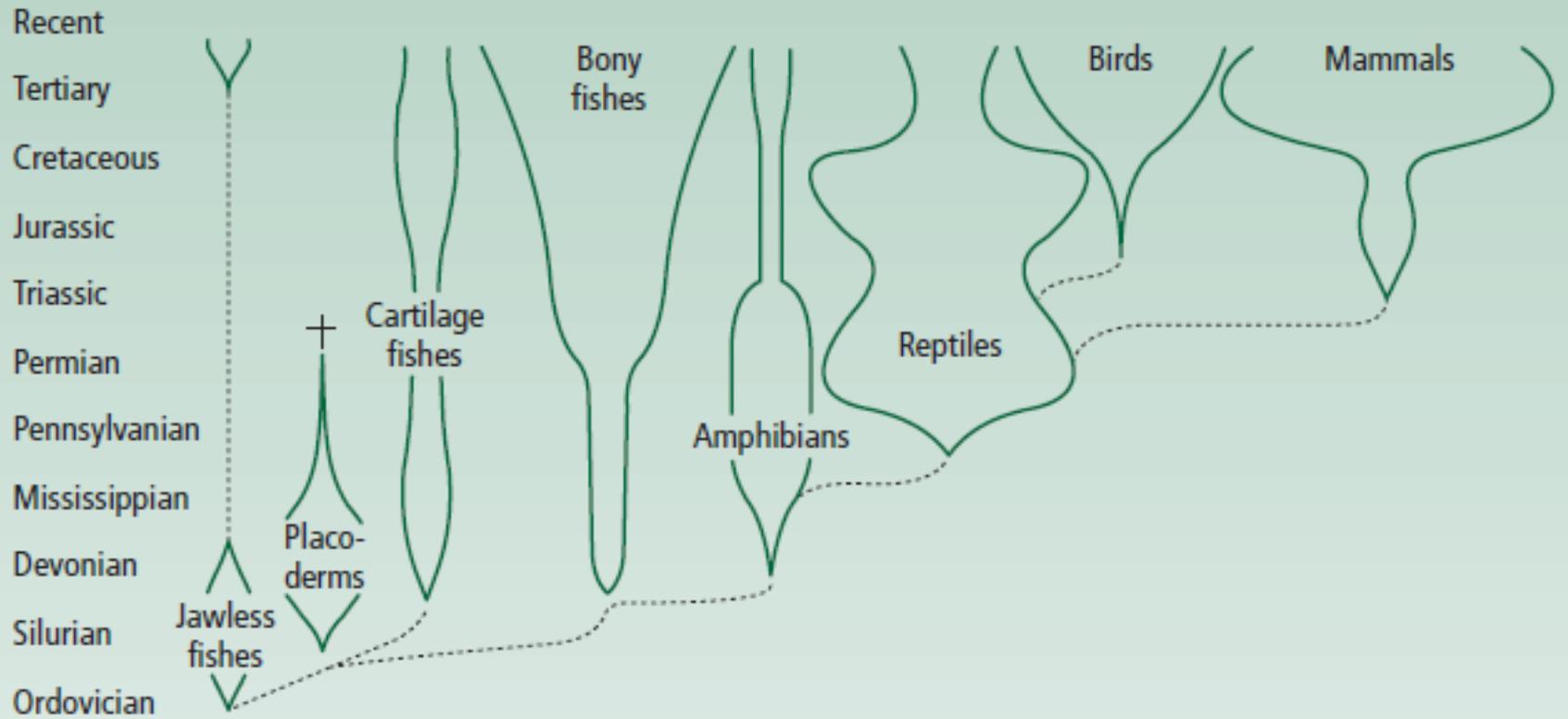


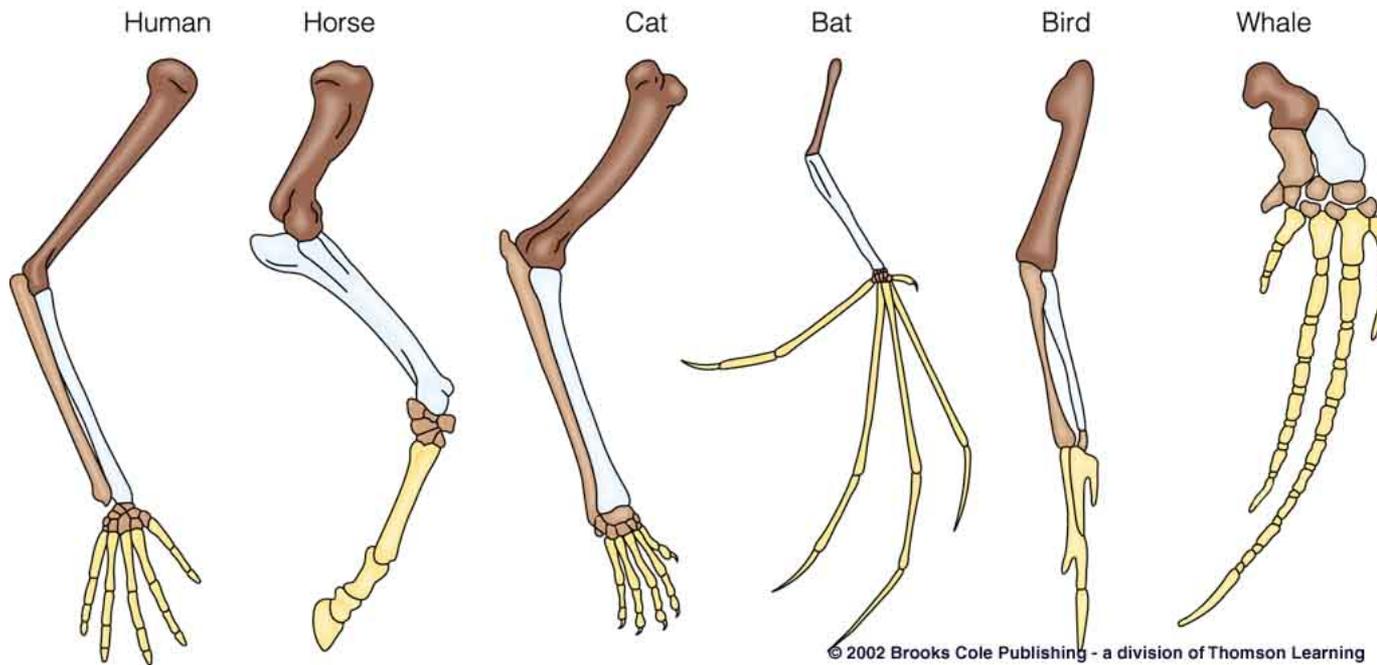
(a)

Correct order **Fish** → **Amphibians** → **Reptiles** → **Mammals**

Incorrect order **Fish** → **Mammals** → **Amphibians** → **Reptiles**

(b)





## Anatomical homology

If two or more species share a unique physical feature, such as a complex bone structure or a body plan, they may all have inherited this feature from a common ancestor. Physical features shared due to evolutionary history (a common ancestor) are said to be **homologous**.

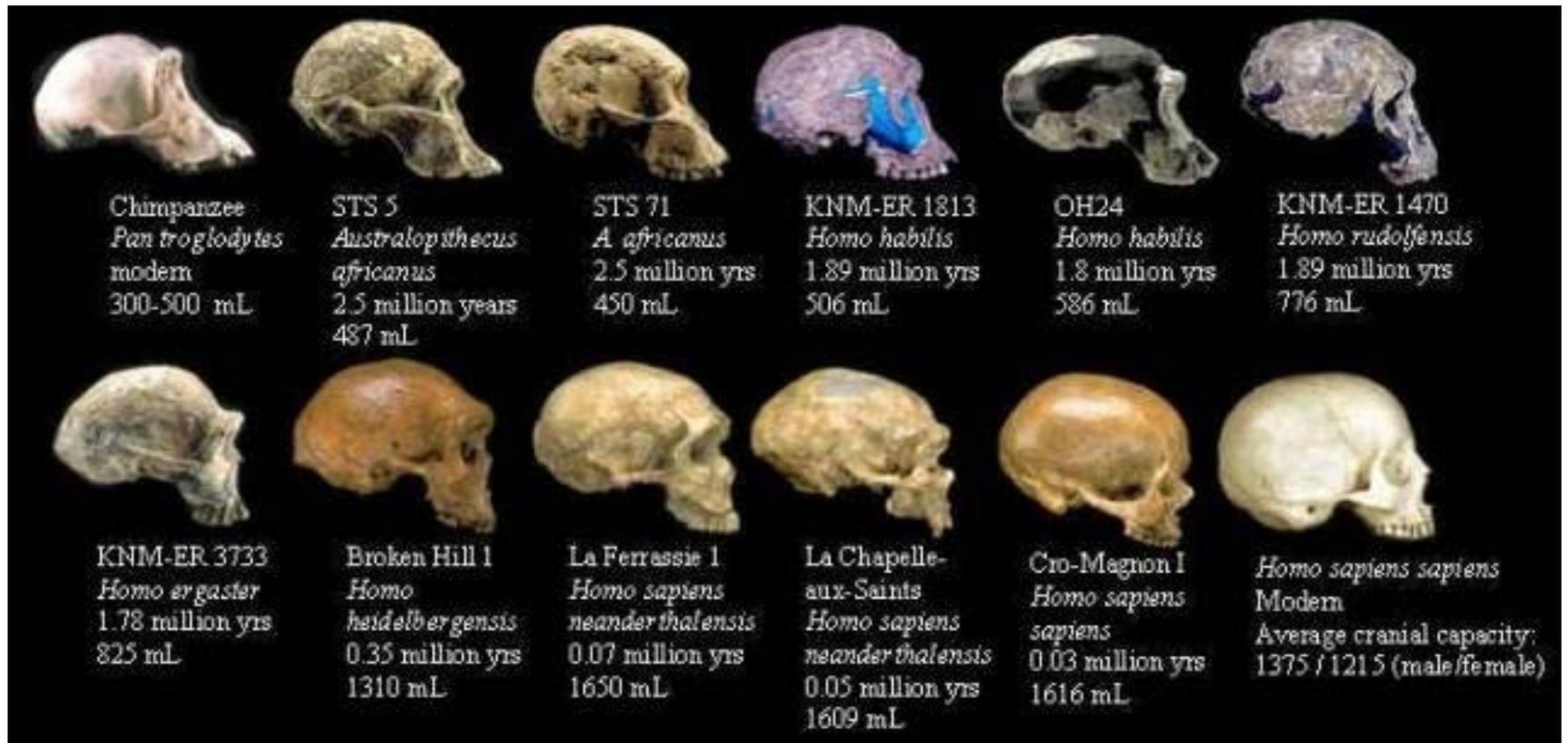
- Homologous embryonic structures reflect that the developmental programs of vertebrates are variations on a similar plan that existed in their last common ancestor
- “ They share common ancestor”
- มีบรรพบุรุษร่วมกัน
- “ Coming from similar origin”
- มาจากต้นกำเนิดเดียวกัน

# Fossil record

- **Fossils** are the preserved remains of previously living organisms or their traces, dating from the distant past. The fossil record is not, alas, complete or unbroken: most organisms never fossilize, and even the organisms that do fossilize are rarely found by humans. Nonetheless, the fossils that humans have collected offer unique insights into evolution over long timescales.

# Fossil record

- First, fossils are often contained in rocks that build up in layers called **strata**. The strata provide a sort of timeline, with layers near the top being newer and layers near the bottom being older.
- Fossils document the **existence of now-extinct species**, showing that different organisms have lived on Earth during **different periods of the planet's history**. They can also help scientists reconstruct the evolutionary histories of present-day species.



## Fossil of skull of apes and hominid

***Equus***

Recent



***Pliohippus***

Late Miocene



***Merychippus***

Middle Miocene



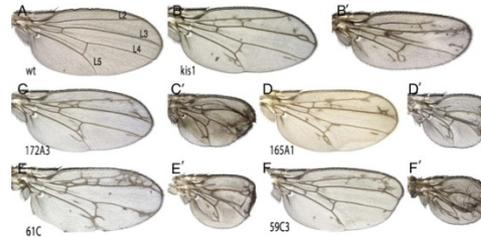
***Mesohippus***

Late Eocene



# Human evolution

- Natural selection theory by Charles R. Darwin
- การเปลี่ยนแปลงทางกายภาพ **Phenotype**
- **Mosaic Selection**



# How human evolved :

## The Evolutionary Path to Apes

- The story of human evolution begins around **65 million years ago**, with the explosive radiation of a group of small, arboreal mammals called the Archonta.
- These primarily **insectivorous mammals** had **large eyes** and were most likely **nocturnal** (active at night). Their radiation gave rise to different types of mammals, including bats, tree shrews, and primates, the order of mammals that contains humans.

# The Earliest Primates

- two distinct features that allowed them to succeed in the arboreal, insect-eating environment:
- **Grasping fingers** and toes : grasping hands and feet that let them grip limbs, hang from branches, seize food, and, in some primates, use tools.
- **Binocular vision** : the eyes of primates are shifted forward to the front of the face. This produces overlapping binocular vision that lets the brain **judge distance precisely**—important to an animal moving through the trees.



Bibocular enhance depth perception

# The Earliest Primates

- Other mammals have binocular vision, but **only primates have both binocular vision and grasping hands**, making them particularly well adapted to their environment.
- **dentition** began to change from the shearing, triangular-shaped **molars** specialized for insect eating to the more flattened, square-shaped molars and rodent like incisors specialized for plant eating.

# The Evolution of Prosimians

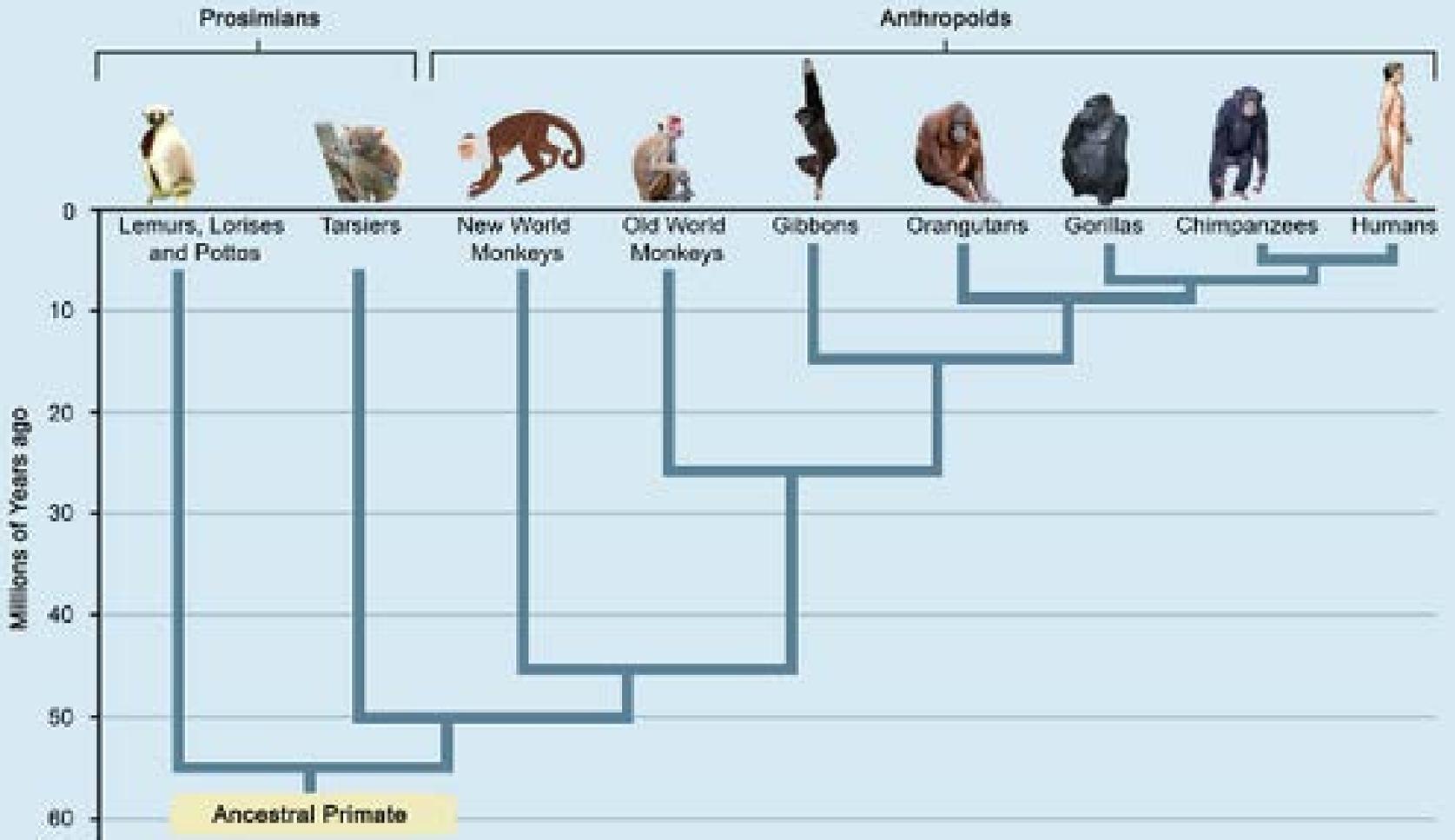
- About 40 million years ago, the earliest primates split into two groups: the prosimians and the anthropoids.
- The prosimians (“before monkeys”) looked something like a cross between a squirrel and a cat and were common in North America, Europe, Asia, and Africa. Only a few prosimians survive today, lemurs, lorries and tarsiers

# Origin of the Anthropoids

- The anthropoids, or **higher primates**, include monkeys, apes, and humans
- Anthropoids are almost all **diurnal**—that is, active during the day—feeding mainly on fruits and leaves. Evolution favored many changes in eye design, including **color vision**, that were adaptations to day-time foraging. An **expanded brain** governs the improved senses, with the brain case forming a larger portion of the head.

# Anthropoids

- the anthropoids tend to **care for their young** for prolonged periods, allowing for a long childhood of learning and brain development.
- The early anthropoids, now extinct, are thought to have evolved in Africa. Their direct descendants are a very successful group of primates, the monkeys.



# New World Monkeys.

- About 30 million years ago, some anthropoids migrated to South America, where they evolved in isolation. Their descendants, known as the New World monkeys, are easy to identify: all are arboreal, they have flat spreading noses, and many of them grasp objects with long prehensile tails

# New World Monkeys.

- Old World Monkeys. Around 25 million years ago, anthropoids that remained in Africa split into two lineages: one gave rise to the **Old World monkeys** and one gave rise to the **hominoids**
- Old World monkeys include **ground-dwelling** as well as arboreal species. None of the Old World monkeys have prehensile tails. Their nostrils are close together, their noses point downward, and some have toughened pads of skin for prolonged sitting



New world monkey



(a)



Old world monkey

(b)



**Hominids:** humans and their direct ancestors

# How ape evolved

- Apes have larger brains than monkeys, and they lack tails. With the exception of the gibbon, which is small, all living apes are larger than any monkey. Apes exhibit the most adaptable behavior of any mammal except human beings. Once wide-spread in Africa and Asia, apes are rare today, living in relatively small areas. No apes ever occurred in North or South America.

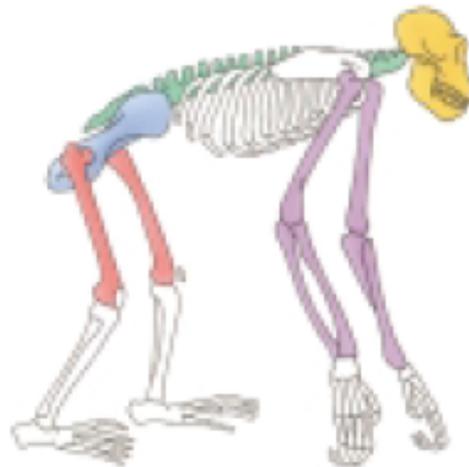
# The First Hominoid

- In 1932, a candidate fossil, an 8-million-year-old jaw with teeth, was unearthed in India. It was called. But this fossil close to Ourangutang **Ramapithecus**
- Much of the subsequent evolution of the hominoids reflected different approaches to **locomotion**. Hominids became **bipedal**, **walking up-right**, while the apes evolved knuckle-walking, supporting their weight on the back sides of their fingers

- Because humans walk on two legs, their vertebral column is more curved than an ape's, S curve
- The human pelvis has become broader and more bowl-shaped, with the bones curving forward to center the weight of the body over the legs.
- humans carry much of the body's weight on the lower limbs, which comprise 32 to 38% of the body's weight and are longer than the upper limbs;

### Chimpanzee

- Skull attaches posteriorly
- Spine slightly curved
- Arms longer than legs and also used for walking
- Long, narrow pelvis
- Femur angled out



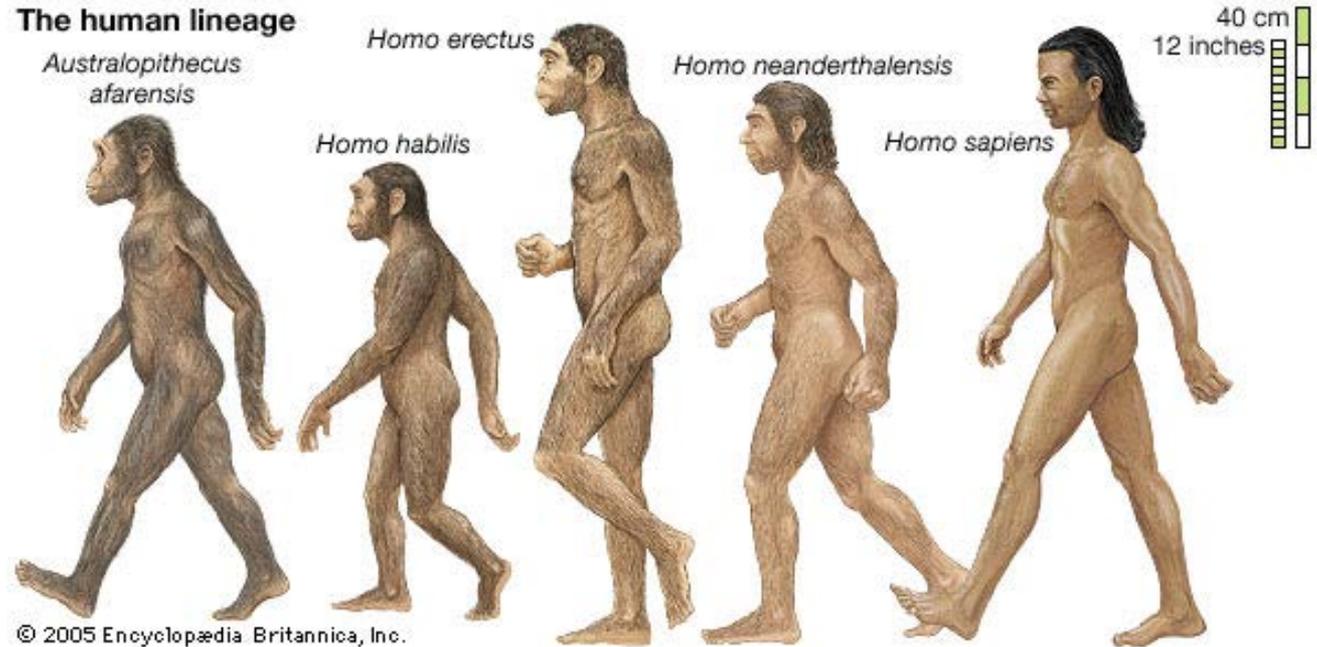
### Australopithecine

- Skull attaches inferiorly
- Spine S-shaped
- Arms shorter than legs and not used for walking
- Bowl-shaped pelvis
- Femur angled in

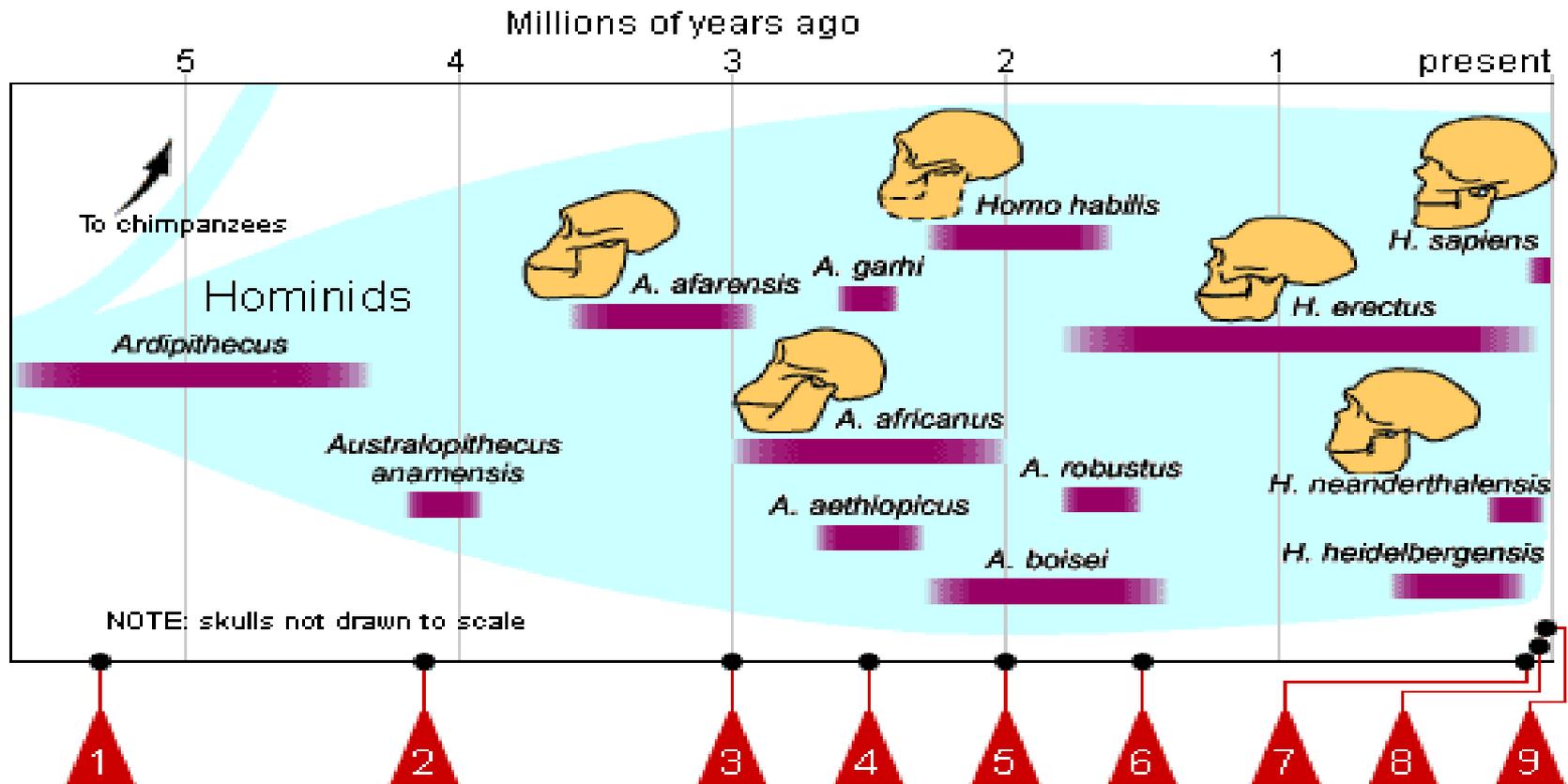


# Biological evolution

- Hominidae or Hominid What is it?
- Australopithecus



- There are two major groups of hominids: three to seven species of the genus *Homo*
- and seven species of the older, smaller-brained genus *Australopithecus*.



# Discovery of Australopithecus

- The first hominid was discovered in 1924 by Raymond Dart, an anatomy professor at Johannesburg in South Africa.
- Scientists now estimate Dart's skull to be 2.8 million years old. Dart called his find *Australopithecus africanus* (from the Latin *australo*, meaning “southern” and the Greek *pithecus*, meaning “ape”), the ape from the south of Africa.



*A. afarensis*

*A. africanus*



*A. robustus*

*A. boisei*

Nick-named “Lucy,” the skeleton was 40% complete and over 3 million years old. The skeleton and other similar fossils have been assigned the scientific name *Australopithecus afarensis* (from the Afar Desert). The shape of the pelvis indicated that Lucy was a female, and her leg bones **proved she walked upright.**



# Australopithecus



- **3.3-2.8** ล้านปีมาแล้ว ความสูง 120 **cm.** น้ำหนัก 18-23 กก.
- เดินตัวตรงได้ สมอง ประมาณ 400 **cc**
- มือเป็นอิสระ เกิดลักษณะวัฒนธรรมโอดูแวน (Olduvai) ยุคต้น
- had some ape-like features including relatively long arms and a strongly sloping face that juts out from underneath the braincase with a pronounced jaw



ape-like features of the cranium and the location of its discovery (a Limestone cave in South Africa)

# The Origins of Bipedalism : Hominid

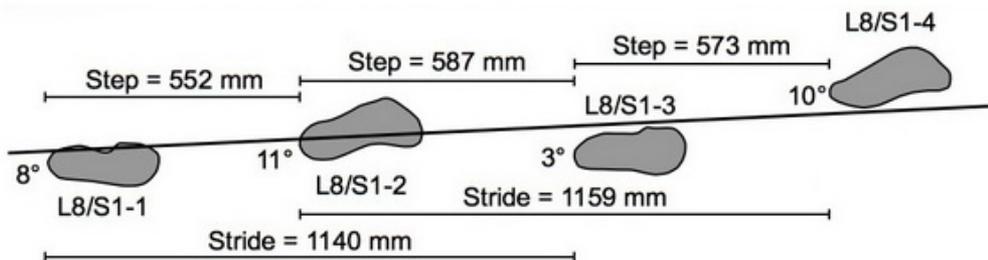
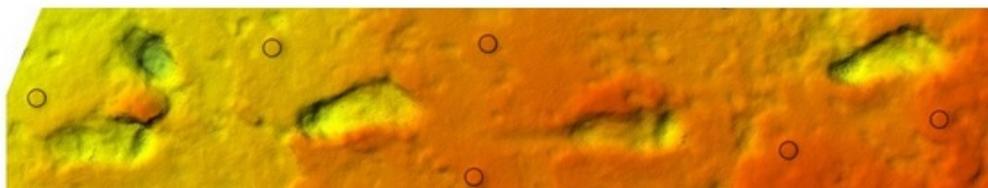
- A key element may have been bipedalism. **Bipedalism** seems to have evolved as our ancestors left dense forests for grass-lands and open woodland.
- bipedalism freed the forelimbs to manufacture and use tools, favoring the subsequent evolution of bigger brains.
- These fossils demonstrate that bipedalism extended back 4 million years ago; knee joints, pelvis, and leg bones all exhibit the hallmarks of an upright stance.

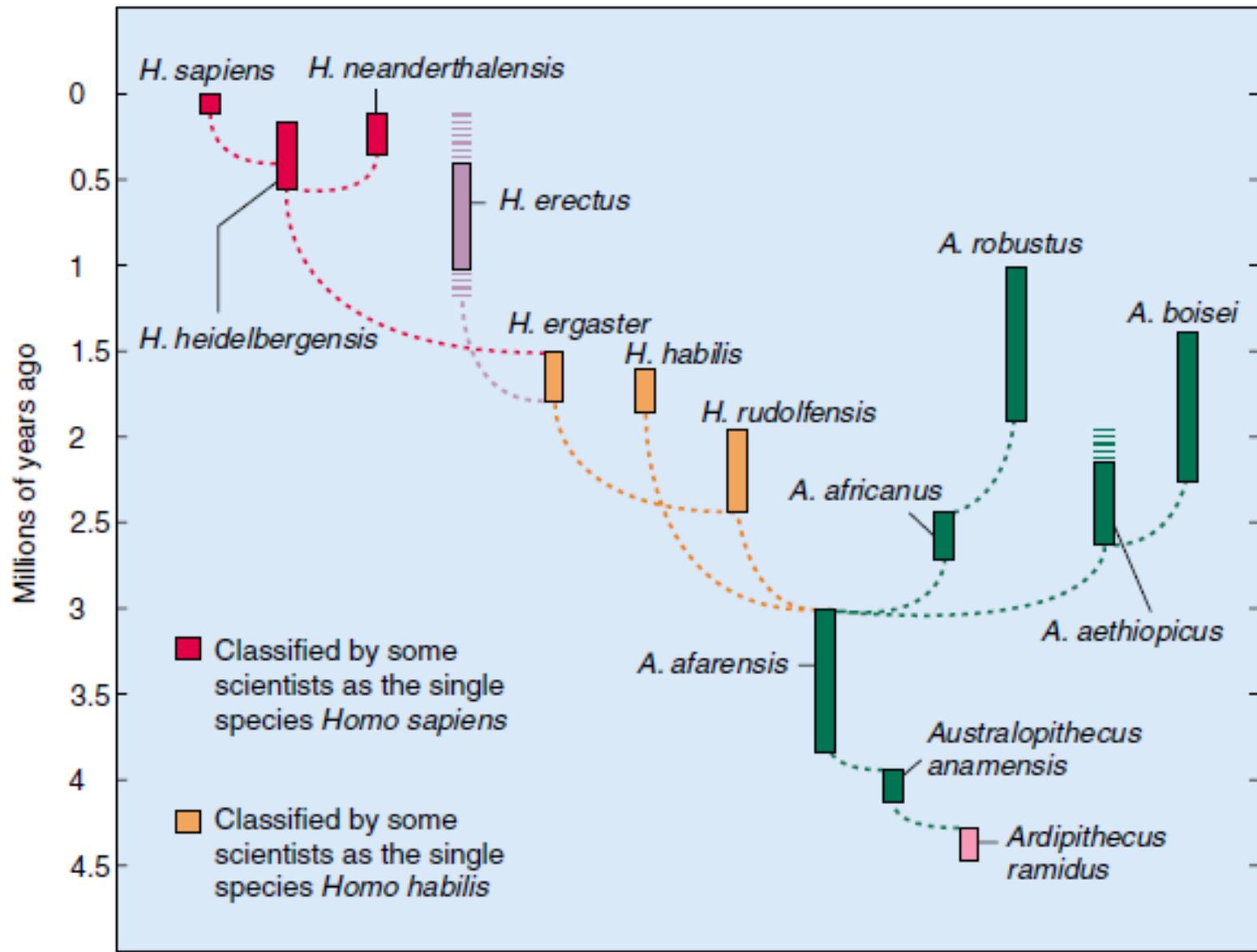
# Evidence from foot print fossil

- 69 hominid footprints found at Laetoli, East Africa and big toe did not splayed out to the side as in a monkey or ape—the footprints were clearly made by a hominid.



Low  High





# African Origin: Early Homo



FIGURE 23.11

Early *Homo*. This skull of a boy, who apparently died in early adolescence, is 1.6 million years old and has been assigned to the species *Homo ergaster* (a form of *Homo habilis* recognized by some as a separate species). Much larger than earlier hominids, he was about 1.5 meters in height and weighed approximately 47 kilograms.

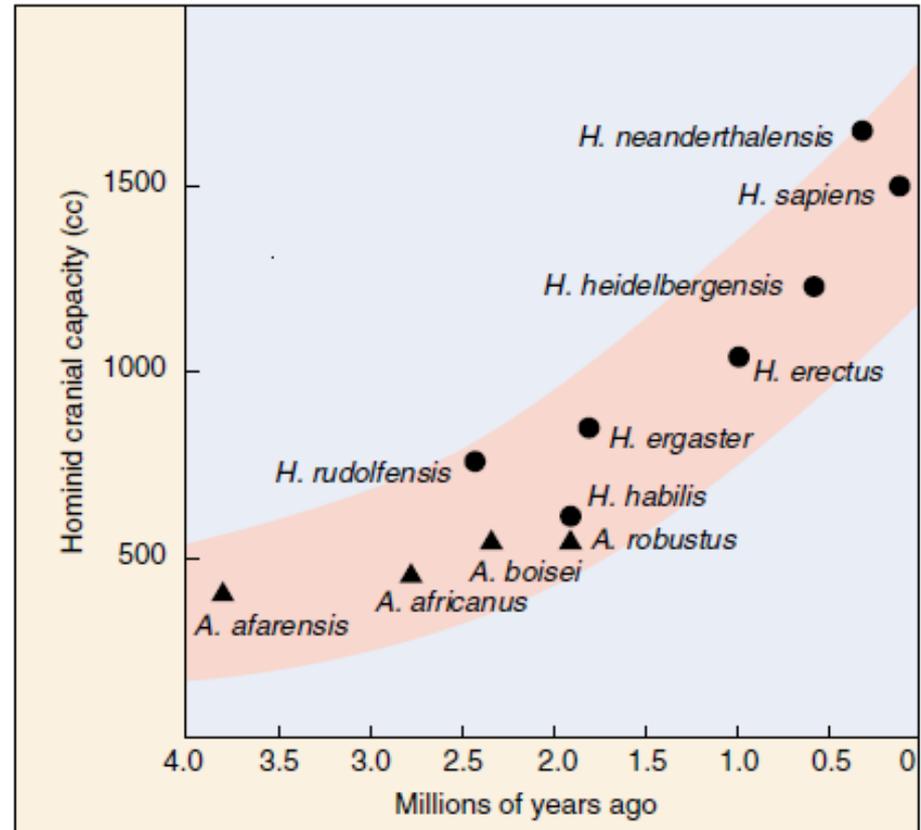
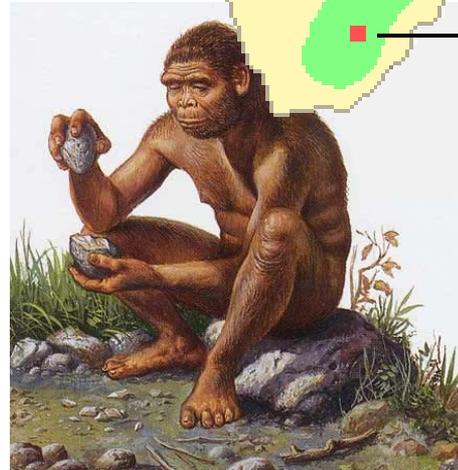
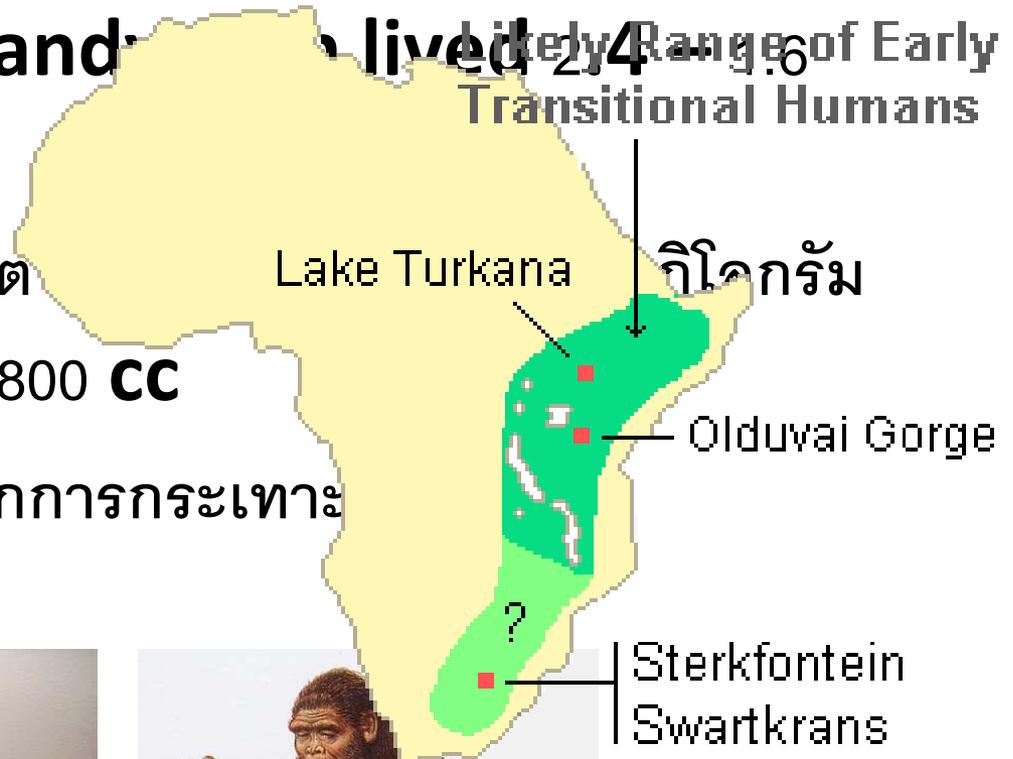


FIGURE 23.12

Brain size increased as hominids evolved. *Homo erectus* had a larger brain than early *Homo*, which in turn had larger brains than those of the australopithecines with which they shared East African grasslands. Maximum brain size (and apparently body size) was attained by *H. neanderthalensis*. Both brain and body size appear to have declined some 10% in recent millennia.

# *Homo habilis*

- Habilis means “handy” and lived 2.4–6 million years ago
- ความสูงประมาณ 4-6 ฟุต  
สมองเล็กประมาณ 680-800 CC
- เริ่มทำอาหารอย่างง่ายจากการกระแทะ



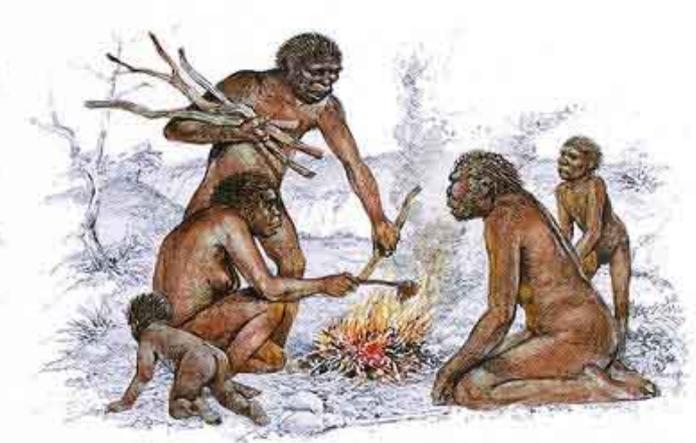
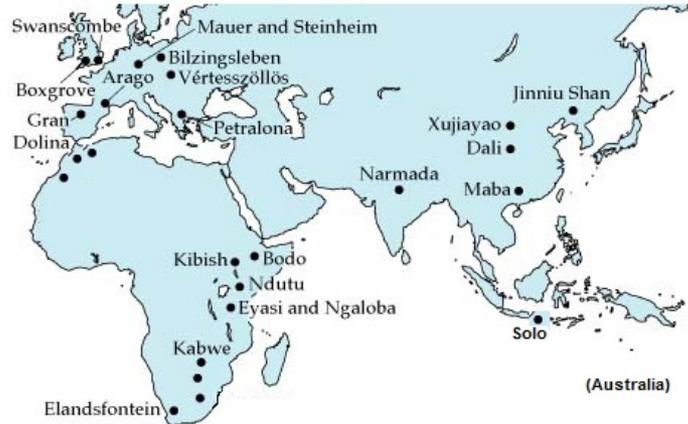
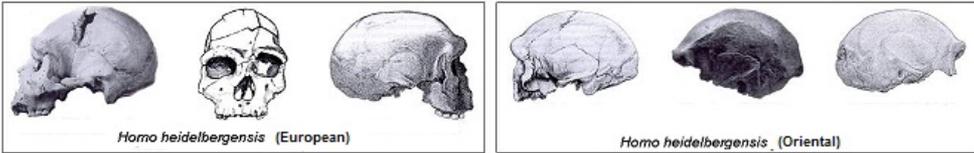
# *Homo erectus*

- มนุษย์ผู้ยืนตรง มีชีวิตราว 1.6 ล้านปีที่ผ่านมา ลำตัวสูงใหญ่ ช่วงแขนสั้น เดินด้วย 2 เท้าอย่างมีประสิทธิภาพ
- สมองมีขนาด 750-1200 **CC** สร้างเครื่องมือจากหินอย่างง่าย และอยู่รวมกันเพื่อล่าสัตว์
- มีการทำภาชนะ และ เสื้อผ้าเครื่องนุ่งห่ม เริ่มใช้ไฟ
- **Most interesting of all, the shape of the skull interior suggests that *H. erectus* was able to talk.**

*H. habilis*

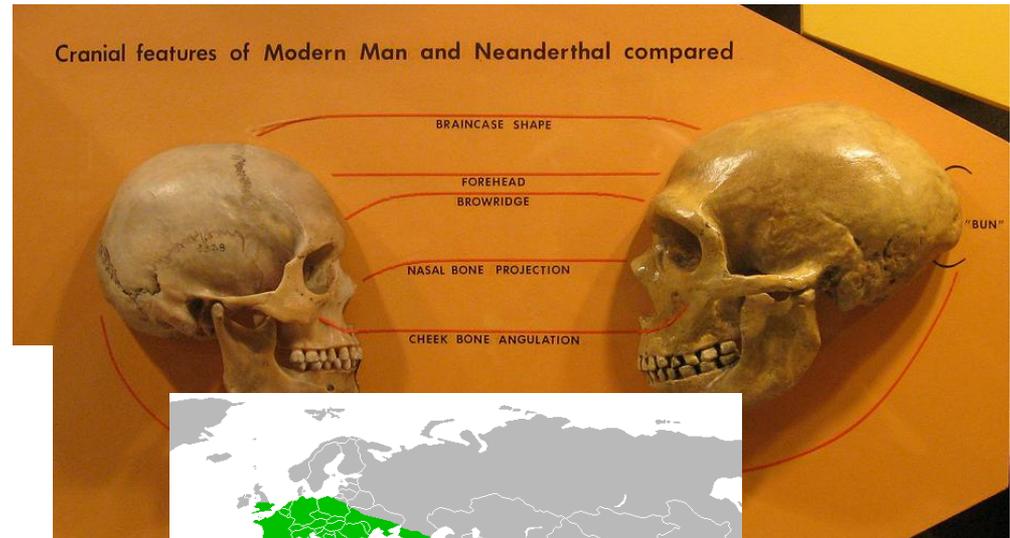


*H. erectus*



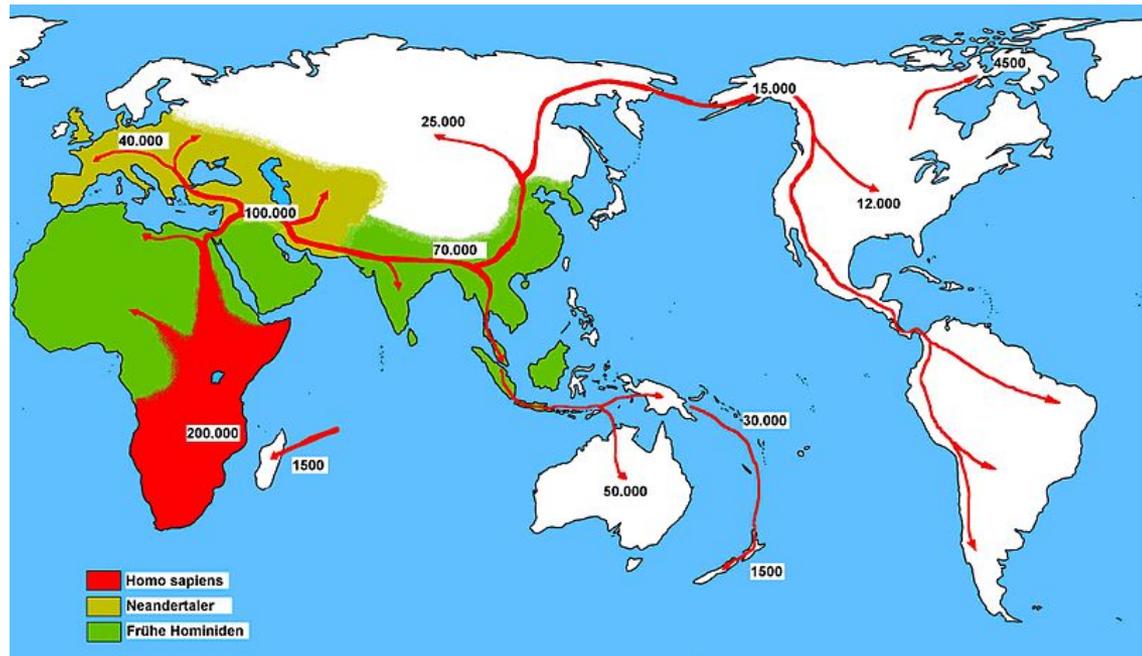
# *Homo sapien neanderthalensis*

- **Very close to current hominid, found during 300,000 – 27,000 previous years**
- **Extinction with curious, Found fossil during the period of time overlap with modern human**



# *Homo sapien sapien*

- 20,000 – 30,000 ปี เรียกว่า มนุษย์ โครมันยอง สูง 170 – 180 ซม.
- ขนาดสมองใกล้เคียงมนุษย์ปัจจุบัน สามารถใช้ชีวิตเพื่อเอาตัวรอด และ สร้างสรรค์งานศิลปะ



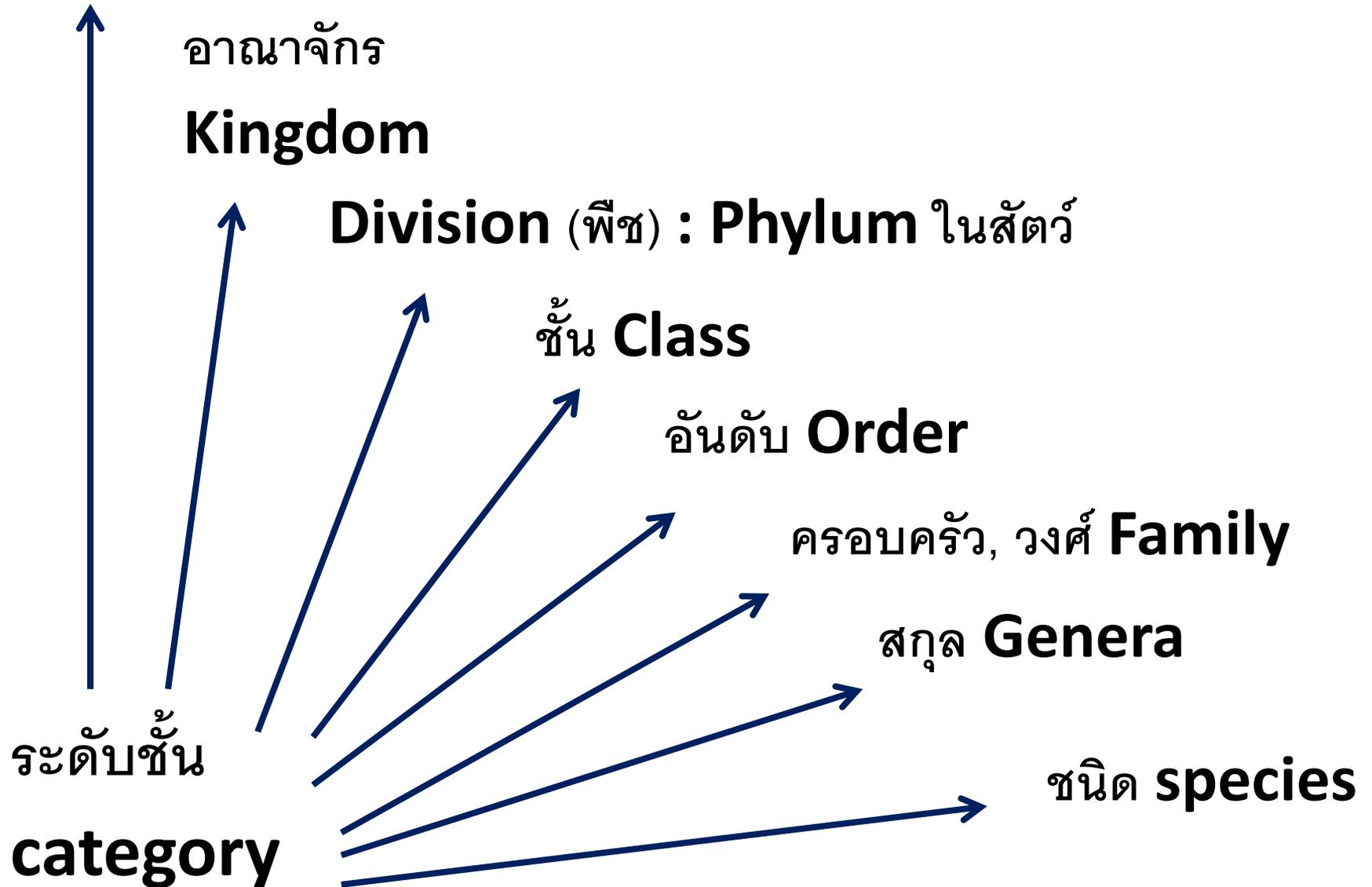
# **Taxonomy : ออนุกรมวิธาน**

- **Taxonomy comprise 2 words;**
- **Taxis = arrangement and nomos = rule**
- **Scope of Taxonomy is**
- **classification**
- **nomenclature**
- **identification**

# Classify of living thing

- **Classify and setting category organism by the similar phenotype** ลักษณะที่ปรากฏ
- **Arrangement as order**
- **Hierarchy.....**

# Domain



# Nomenclature

- **International acceptance**
- **permanent**
- **Each group as its own system**
- **Animal uses International code of zoological nomenclature (ICZN)**
- **For plant : International code of botanical nomenclature (ICBN)**

# Scientific name

- **binomial system of Nomenclature**
- **The first part is genus, uses capital letters at the first alphabet**
- **The second name is specific name or specific epithet**

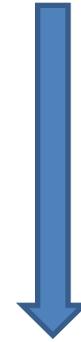
***Oryza sativa* Linn. indica**



**Genus**



**Species**



**Linnaeus who named it**

---

***Chanos chanos* Forsskal, 1775**

**genus species Person who named and  
time that it was named**

- ข้าว

**Domain Eukarya**

**Kingdom plantae**

**Division Anthrophyta**

**Class Liliopsida**

**Order Poales**

**Family Poaceae**

**Genus graminocae**

**specie**

**Genus """"""**

**Genus *Oryza***

***Species sativa* Linn.**

- คน

**Domain Eukarya**

**Kingdom Animalia**

**Division Chordata**

**Class Mammalia**

**Order Primate**

**Family Homonidae**

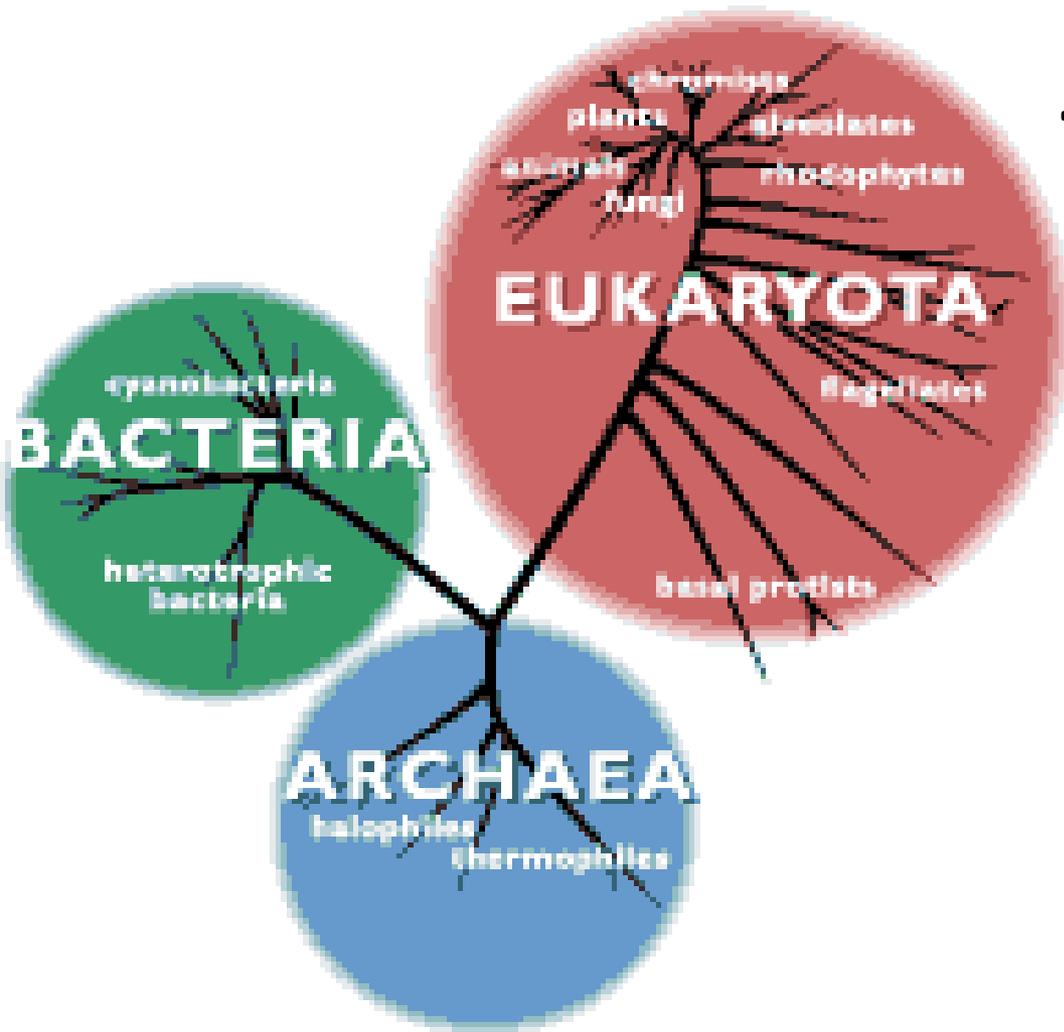
**Genus *Homo***

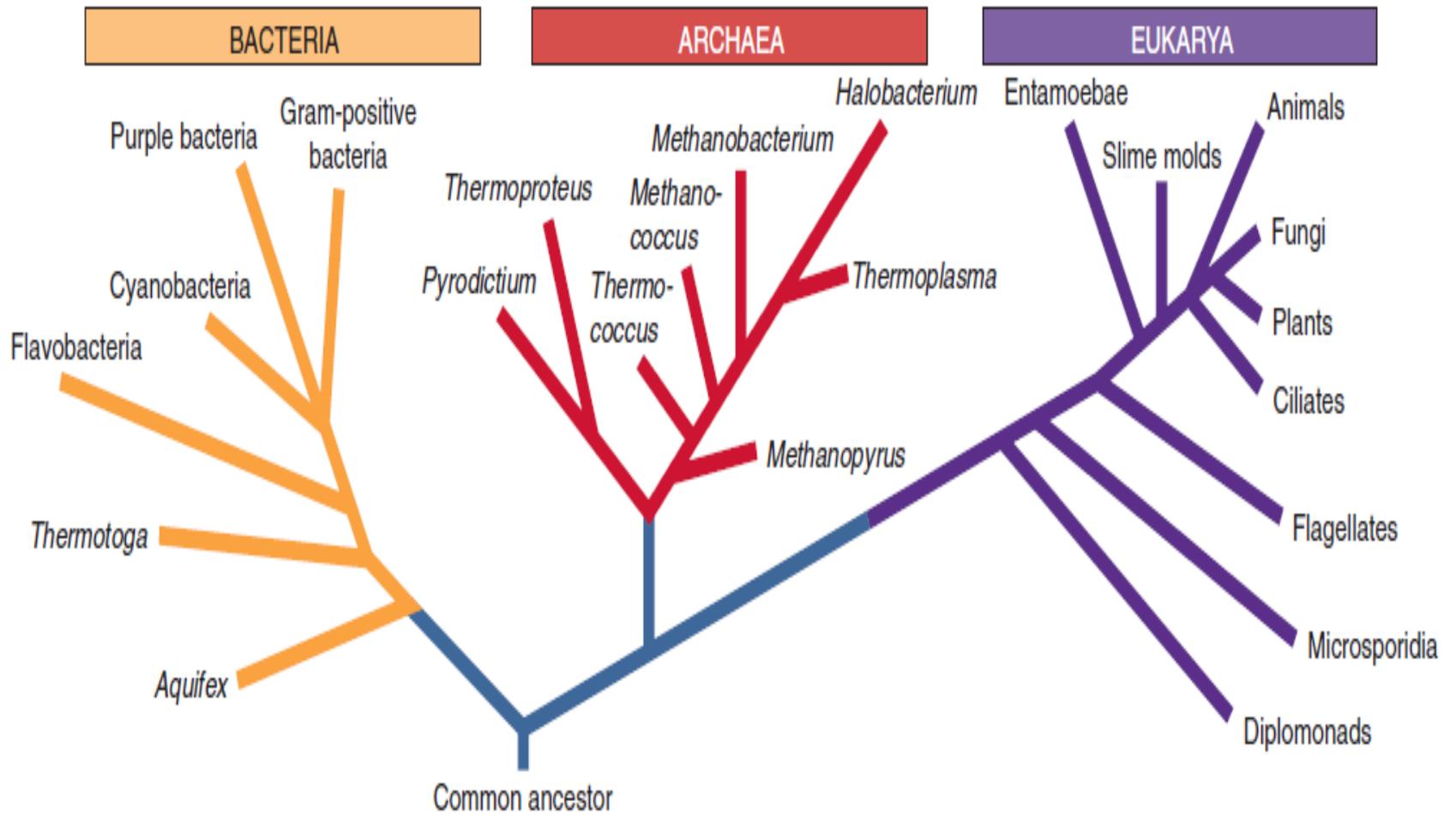
***Species sapiens* Linn.**

# Kingdom of living thing

# Domain

- Domain bacteria
- Domain Archea
- Domain Eukaryota





# 5 Kingdoms

**Plant kingdom**

**Protista Kingdom**

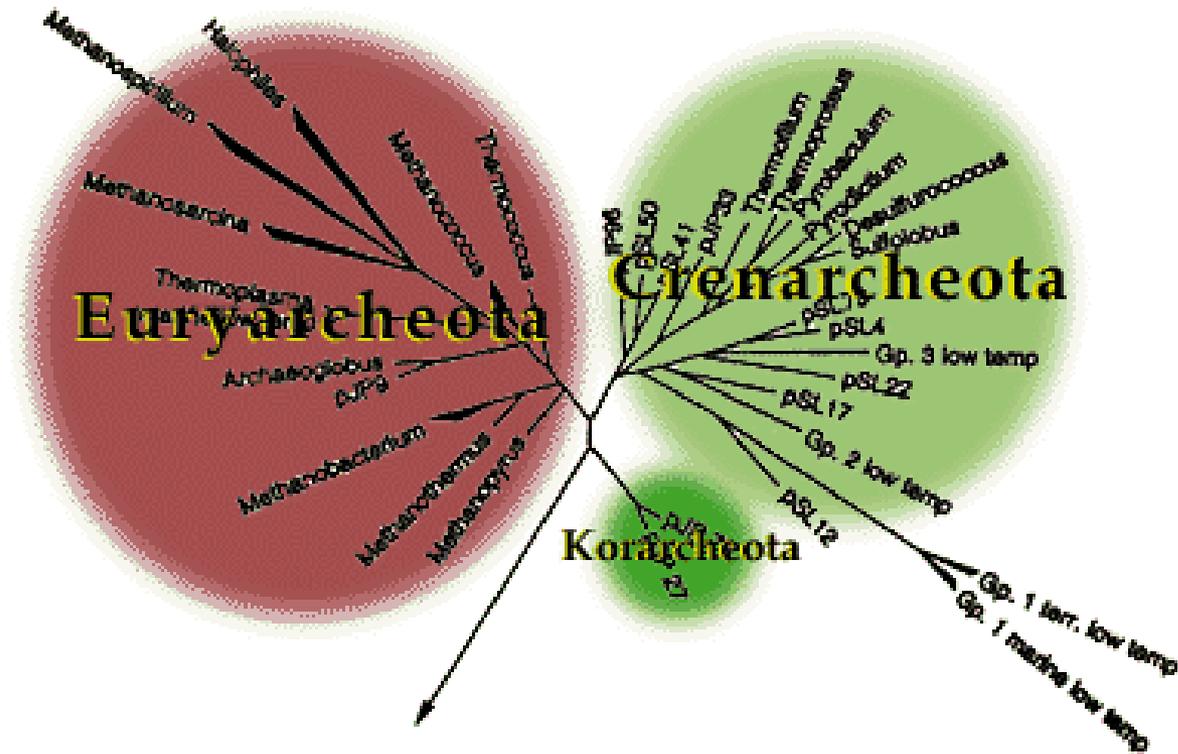
**Animal Kingdom**

**Monera Kingdom**

**Fungi kingdom**

# Domain Archaea

....."they aren't bacteria -- they're Archaea."



# Domain Archaea

- Archaeans include inhabitants of some of the most extreme environments on the planet.
- Some live near rift vents in the deep sea at temperatures well over 100 degrees Centigrade
- Others live in hot springs or in extremely alkaline or acid waters

# Domain Archaea

- They have been found thriving inside the digestive tracts of cows, termites, and marine life where they produce methane.
- They live in the anoxic muds of marshes and at the bottom of the ocean, and even thrive in petroleum deposits deep underground.

# Domain Archaea

- Archaeans may be the only organisms that can live in extreme habitats such as thermal vents or hypersaline water. They may be extremely abundant in environments that are hostile to all other life forms. However, archaeans are not restricted to extreme environments; new research is showing that archaeans are also quite abundant in the plankton of the open sea. Much is still to be learned about these microbes, but it is clear that the Archaea is a remarkably diverse and successful clade of organisms.

**Archaeal Phylogeny** : The phylogeny of archaeans is based on molecular sequences in their DNA. The analysis of these sequences reveals three distinct groups within the Archaea. The Euryarcheota are probably the best known, including many methane-producers and salt-loving archaeans. Crenarcheota include those species that live at the highest temperatures of any known living things, though a wide variety have recently been discovered growing in soil and water at more moderate temperatures. The Korarcheota are only known from their DNA sequences -- nothing more is known about them yet since they have only recently been discovered.