Evolution of Humankind

Studying human evolution involves understanding genetic, physical and behavioural differences and similarities between humans and other species. It is widely known that humans are mammals and belong to the Primate order.

A Common Ancestor

Evidence that primates have a common ancestor:

- **Biogeographical evidence:** all wild primates are found in regions that were part of the southern continent Gondwanaland. Latest research indicates that primates originated 85 million years ago and, as continental drift broke up the supercontinent occurred 180-200 mya, it probably had an important role in the geographical subdivisions of primates
  - Old World Primates are found in Sub-Saharan Africa and South-East Asia
  - New World Primates are found in South and Central America
- Most primates today are arboreal (live in trees). This suggests that they evolved from a common ancestor with this characteristic. Primates have characteristics that are suitable adaptations to an arboreal lifestyle:
  - Kept the clavicle or collar-bone, which is an important part of the shoulder joint: it stabilises the shoulder, allowing the primate to support its weight by hanging from its arms alone
  - Long, slender limbs that can rotate freely at the shoulders and hips which assists movement in the trees
  - Mobile, opposable thumbs, which allow the primate to effectively hold on to branches. This is only found in Old World monkeys, apes and humans. New World primates often have a prehensile tail.
- **Other characteristics shared by primates:**
  - Enlarged and complex brain relative to body size
  - Flattened face and reduced snout with a reduced sense of smell. This could be because primates rely on vision as opposed to smell
  - Forward-facing eyes, with overlapping fields of vision to give stereoscopic vision
  - Flat-nailed digits as opposed to claws or hooves. This could allow for more sensitive manipulation
  - Low and rounded cusps on molar and premolar teeth
  - Complex social behaviour, usually having only one offspring at a time and extended care for the young
- **Genetic evidence for a common ancestor:**
  - Large percentage of DNA is shared – humans share 98.5% of DNA with chimpanzees and 93% with rhesus monkeys
The Connection between Humans and Chimpanzees

Approximately 98.5% of the DNA in chimpanzees and humans is identical, making chimpanzees the closest living biological relatives of humans. However, humans did not evolve from chimpanzees; rather, both species evolved from a common ancestor thought to have existed about 6 million years ago.

Human features not found in African Apes:

While humans share many features with African Apes, there are some important features that are unique to humans:

- **Humans are bipedal** (walk on two legs) all the time
  - This was our most important adaptation
- **Humans have a large, highly developed brain**, which gives us unique behavioural qualities, such as:
  - The making of tools
  - the next major evolutionary step
  - Using and controlling fire
  - Development of a complex language based on sentences
- **Humans are omnivorous** (eat both meat and vegetables)
  - Allows humans to survive in various habitats
- **Humans have reduced body hair**

Bipedalism

The region of Africa in which early hominids lived was a heavily forested area. Climate change led to Africa drying up and their habitat changed to a savannah. The early hominids would have had to move across open land to find food and they were probably already well-adapted for bipedalism: their free arms could be used to climb trees and reach for fruit. Bipedalism would be a good way of moving across open land.

Bipedalism gave these early hominids a crucial advantage for survival: they could live in both forested areas and on open savannahs

**How to determine if a fossil was bipedal:**

Palaeontologists can determine whether or not a fossil was bipedal by looking for the following:

- The **foramen magnum** is further forward; the skull is balanced on a vertical spine
- The spine has an **S-shape**; allows upright posture to be maintained
- A **shorter, broader pelvis**; distributes weight effectively in an upright position
- The **femur is angled inwards**; knees are kept directly under the body, better distributing weight
- The big toe is **in line** with the other toes; this assists bipedal walking
- A **foot arch**; helps absorb shock while walking
Advantages of Bipedalism:

- Hominins could see further over the savannah grasses
  - Improved detection of predators and location of food
  - Could be a disadvantage by making them more visible to predators
- Allowed hominins to have completely free arms, enabling them to:
  - Gather food and carry it to safety
  - Efficiently make and use tools
  - Hold and carry tools for defence and hunting
  - Use hands for social interaction, communication and defence
  - Carry offspring while on migration
- Help hominins stay cool in midday sun
  - Less of body exposed directly to sun
  - Head at higher level, where the air is cooler
- Provided an energy efficient way of moving across the growing savannah

Disadvantages of Bipedalism:

- The backbone suffers a lot of stress
- Shoulder blade no longer functions as a shock-absorber
- Reshaped pelvis narrows birth canal
  - Children are born small and helpless
Development of Modern Humans

Evidence for the development and evolution of humankind can come from:

- **Palaeontologists**: study fossils, look for hominid development: signs of bipedalism and increase in skull size
- **Anthropologists**: study humans, human remains and human artefacts, look at development of cultures and lifestyles of human ancestors
- **Archaeologists**: study human artefacts and human remains, look at human history

Human evolution does not follow a single, tidy chain. Instead, it resembles a tree with off-shoots, many branches and dead ends. Current thinking suggests that humans originated in Africa.

**Tribe Homini**

It is important to know some of the species of human ancestors and approximately how long ago they lived. Refer to this diagram for the examples you should know:
Australopithecines (4 mya – 2 mya)

Hundreds of Australopithecus fossils from various species have been found at several sites in South and East Africa. The fact that these fossils are found only in Africa suggests that humankind’s ancestors originated there.

*Australopithecus afarensis* (3.6 – 3 mya)

- Afarensis was a wide-spread species and is best represented by Lucy, the 3.2 million year old Ethiopian fossil discovered in 1973, which is 40 percent complete
  - Lucy has many ape-like features but the fossil shows that *Afarensis* was definitely bipedal. This is shown especially by the femur and pelvis. However, the skeleton also indicates that tree-climbing was still important
- The Laetoli footprints (3.7 mya) are also attributed to this species. The footprints were found in volcanic ash in Tanzania in 1976 and were formed by two adults and a child. They show that these hominids were habitually bipedal, as there are no knuckle impressions and did not have the mobile big toe of apes.

*Australopithecus africanus* (3 – 2 mya)

- The “southern ape of Africa” is best represented by:
  - The Taung Child, discovered in lime works in Taung, in the North West Province of South Africa and given its name by Professor Raymond Dart in 1924
    - Well-preserved child’s skull and endocranial cast of the brain
    - Dart believed that the skull showed both ape-like and human characteristics and was probably an intermediate species between *Homo* species and *Australopithecus afarensis*
      - Human-like teeth
      - Absence of large canines
      - Large (in proportion to body size) brain
    - The later discovery of Mrs Ples (discovered in 1947 by Doctor Robert Broom at the Sterkfontein Caves), an adult of the same species, supported Dart’s ideas
      - *Australopithecus africanus* is endemic to South Africa; no remains of the species have been found anywhere else.

Features of *Australopithecus africanus* that show evolution towards *Homo* species:

- Larger brain than *Afarensis*
- Upright and fully bipedal – shown by position of foramen magnum
- Human-like teeth – no large canines
- Rounded dental arch
- Studies of teeth indicate a large consumption of meat, probably scavenged
- Larger body than *Afarensis*
- May have been the first to make tools:
  - Oldest stone tools at least 2.7 million years old, same age as *Africanus*
**Australopithecus species (‘Little Foot’) – (4.1 – 3.3 mya)**

This almost complete fossil is one of the most important hominid discoveries ever made. It is not known if it is a separate species to *Afarensis*. It was discovered in 1994 in the Sterkfontein Caves by Ron Clark.

It has been confirmed to have been mostly bipedal, though it could still climb trees. Complete hominid fossils are extremely rare.

**Australopithecus sediba** (1.9 – 1.7 mya)

- Known from two partial skeletons found in Malapa Fossil Site in the Cradle of Humankind
  - One young male
  - One adult female
  - Long arms, strong hands and brow ridge are all consistent with australopithecine traits
  - It has some possible *Homo* traits too:
    - Just over 1.2m tall
    - Long legs and human-like pelvis
      - Suggests it was first ancestor to walk with a striding gait
      - Small teeth and modern nose
      - Uneven left and right halves of brain
Homo (2.2 mya → )

Humans belong to the genus Homo, which was different enough to the australopithecines to be classified as a new genus. The various Homo species are our most direct ancestors.

Distinctive features of early Homo:

- Larger brains (probably due to a better diet which included meat) enabled:
  - use of specialised tools
  - use and control of fire
  - development of language
- Human-like skull with:
  - less prominent brow ridges
  - flatter face
  - no skull ridge
  - human teeth (small molars and no large canines)
  - a rounded dental arch

We, as modern Homo sapiens are the only hominins along our evolutionary path left alive. However, there were others, such as:

- Homo habilis
- Homo erectus
- Homo neanderthalensis
- Archaic Homo Sapiens

Unlike the Australopithecines, fossils of some Homo species have been found in places outside Africa, such as China, Java and Europe.

Homo habilis (2.2 – 1.6 mya)

Australopithecus africanus probably gave rise to Homo habilis (the handy man), which is regarded as the first species of our genus. The first specimen was found in 1960 in Olduvai Gorge, Tanzania, by Mary and Louis Leakey.

H. habilis had a larger brain capacity than Africanus, and this enabled it to use its hands with more dexterity, allowing it to make simple stone tools. Such tools were found in Ethiopia; the oldest tools are known as the Oldowan tools and are 2.6 to 1.4 million years old. They are usually pebbles with some flakes removed to form a chopping tool.

It is probable that climate change reduced the range of plant-based food, meaning that Habilis would have used tools to scavenge meat from kills left by other predators. It is more likely that Habilis was a scavenger as it could not have competed with large predators.
**Homo erectus** (2 – 0.4 mya)

*Homo erectus* was the first human ancestor that can be identified as ‘near-human’ rather than ‘man-ape’. The best preserved *Homo* fossil is the full skeleton of the **Turkana Boy**, found in 1984 by Richard Leakey.

**Features of *Homo erectus* that show evolution towards *Homo sapiens***:

- Males as tall as modern humans (150-180cm)
- Powerful and graceful; perfectly adapted to bipedalism
- Adult brain approximately ¾ a modern human brain
- They made and used tools
  - Advanced tools called Acheulian (1.5 mya – 200 000 years ago)
  - Hand-axes and cleavers
  - Made *Erectus* an efficient hunter of small mammals
    - Able to live on diet of both meat and plants
- First species to use and control fire – about 1.5 mya
  - Anthropologists found 279 burnt bone fragments at the Cradle of Humankind
    - Analysis showed they had been burnt at a high temperature in a campfire, not a natural fire
  - Probably initially gathered from lightning fires

Fire can tell anthropologists a lot about the lifestyle of *Homo erectus* as it could have:

- Led to more social behaviour
  - Extended ‘daylight hours’ and warmth
- Encouraged conversation
- Given protection from predators
- Provided a wider range of food
  - Smoking, drying and cooking meat
- Been a sign of intelligence
  - Maintaining a fire requires forward thinking and planning
- Allowed *H. erectus* to migrate out of Africa to the colder climates of Europe and Asia

The use and control of fire shows a crucial change in human behaviour as it illustrates the ability to adjust the environment according to their needs.

**Archaic Homo sapiens** (600 000 – 200 000 years ago)

‘Archaic’ *Homo sapiens* refers to a variety of fossils found in Southern Africa, dating from between 600 000 to 200 000 years ago: the bridging period between *H. erectus* and modern *Homo sapiens*. They have more primitive facial features than modern *H. sapiens*. The fossil record of these archaic humans, which refined into modern humans, is more complete in Africa than anywhere else, pointing to Africa again as the origin of modern humans.
Anatomically modern *Homo sapiens* (200 000 years ago)

About 200 000 years ago, a new type of *H. sapiens* emerged in Africa. The earliest such fossils were found in Kibish, Ethiopia. Their existence as a separate species has been confirmed by:

- Mitochondrial DNA of females
- Palaeontological evidence (fossils)

Major changes in stone tools coincide with the appearance of modern humans. The hand-axe of *H. erectus* was replaced by the Middle Stone Age flake tool (200 000 to 35 000 years ago)

- They were smaller tools
  - side-scrapers and points designed for specific tasks, such as skinning animals
- The tools were sometimes attached to wooden handles (hafted) to make spears and knives

Spear hunting would have required group coordination and anthropologists suggest that this meant that humans would have developed complex group structures and language.

**Evidence of modern *Homo sapiens* in southern Africa:**

- **Klasies River Caves**: human remains from 115 000 years ago found in 2000
- **Border Caves, Kwa-Zulu Natal**: remains of an infant from 100 000 years ago
  - Found buried in a grave with shell ornaments and stains suggesting the body had been painted
  - Burial suggests than early humans were capable of abstract and symbolic thought
- **Blombos Cave**: chunks of engraved ochre 75 000 years old
  - Selected and ground to give a flat surface which was then engraved
  - Designs probably had some meaning to the community
  - Also found shell necklaces and sophisticated tools

**Anatomical features of *Homo sapiens* that show evolutionary process:**

Features that indicate evolution from archaic *H. sapiens* are:

- A more slender build
- A dome-shaped skull
  - Large, sharply rising forehead
  - Increased frontal lobe contains speech centre
- Small or usually absent eyebrow ridges
- A large brain
- A small, flattened face
  - Nose is smaller – implies less dependence on smell
- Smaller teeth in an arched lower jaw
- Eye teeth the same height as other teeth
- A prominent chin
  - Created a larger space under tongue, possibly allowing for development of language
Anthropologists believe that the use of complex tools, language and cooperative behaviour are all mutually-dependent. They would have promoted and required the larger brain found in modern *H. sapiens*.

**Out of Africa hypotheses**

**Out of Africa I:**

- The spread of *Homo erectus* from Africa to other parts of the world about 2 million years ago. One suggested reason is that *H. erectus* followed large predators in order to scavenge their kills
- Multiple events over many thousands of years
- Evidence is seen in *H. erectus* fossils and artefacts found in Africa, Asia and Indonesia
  - Java Man
  - Peking Man

**Out of Africa II:**

- The hypothesis that modern humans originated in Africa
  - First put forward in Darwin’s *Descent of Man* in the 19th century, but remained uncertain until the 1980s, when it was supported by:
    - Fossil evidence of ancient hominids
    - A study of present-day mitochondrial DNA
  - According the fossil and genetic evidence, archaic *H. sapiens* evolved into modern *H. sapiens* sometime between 200,000 and 100,000 years ago, solely in Africa
- Hypothesis proposes that about 60,000 years ago, modern human spread out of Africa to populate the world:
  - Being highly adaptable, they colonised the world very quickly
  - Completely replaced the last of the earlier hominids
    - *H. neanderthalensis* in Europe
    - *H. erectus* in Asia
- This hypothesis of a single origin of modern humans in Africa is accepted by most scientists because:
  - The oldest fossils of the species exist in Africa
  - Of indications of ancient symbolic thought
  - Research of mitochondrial DNA supports the idea
    - Greatest genetic diversity among Africans than any other population
      - This means that Africans are ‘older’ and other race groups are ‘younger’
      - This is the field of genetic anthropology
Genetic anthropology

Combines DNA and physical evidence to reveal the history of ancient human migration. DNA studies indicate that all humans share a female ancestor who lived in Africa about 140 000 years ago, and all men share a male ancestor who lived in Africa about 60 000 years ago.

It is possible to trace this as so-called ‘Adam and Eve’ genes are passed on, unchanged, from generation to generation. These can then be traced back to our ancestors.

Y-chromosome DNA and mitochondrial DNA:

One of the unaltered DNA pieces is carried from generation to generation by the Y-chromosome, passed from father to son. It does not mix with other DNA and can be used to trace paternal lineages of men.

Mitochondrial DNA is passed from mother to child, and can be used to trace the maternal lineage of all humans. It mutates about 20 times faster than other DNA, making it easier to follow patterns over time. The larger the number of differences between two individuals’ mtDNA, the further back their common ancestor is.

Testing of mtDNA shows that the Khoisan (!Kung) people in Southern Africa are far older than populations of humans outside Africa, and that the most recent common ancestor for humans dates back to between 150 000 and 200 000 years ago.