Unit 21 · Human Evolution

STUDY NOTES

WHAT NEB'S GRADE 11 EXAM ASKS

- **CDC's grid (2077):** Evolutionary Biology (Units 18–21 together): 9 of 75 marks; in one group with Faunal Diversity, Units 22–26 (28 marks)
- **The paper:** 11 MCQs × 1 · 8 short × 5 · 3 long × 8; 3 hours; 1 mark per expected point
- **CDC's model paper:** MCQ: the nearest ancestor of modern man, from four *Homo* names
- **MCQ (1 mark)**
  - epoch of the first primate-like mammals (Paleocene)
  - what tells Platyrrhini from Catarrhini (dentition)
  - a mark of New World monkeys (prehensile tail)
  - a prosimian (lemur)
  - dental formula of Catarrhini
- **Short (5 marks, in parts)**
  - Platyrrhini vs Catarrhini: nose, teeth
  - apes and man: two likenesses, two differences
  - *Dryopithecus*, *Ramapithecus*: what their fossils mean
  - *Australopithecus*: features, importance
  - Neanderthal vs Cro-Magnon
  - *H. habilis* vs *H. erectus*
  - the line from *Dryopithecus* to *Homo sapiens sapiens*

Key terms

Primates: order of mammals with lemurs, monkeys, apes, humans; grasping hands, forward-facing eyes.

Hominoids (Hominoidea): apes and humans; no tail.

Hominins: humans and extinct close relatives that walked upright on two legs.

Bipedalism: walking on two legs; frees the hands.

Prehensile tail: grips branches like a fifth hand (spider, howler monkeys).

Opposable: can meet the other fingers and grip (thumb = **pollex**; big toe = **hallux**).

Dental formula: teeth in **one half** of upper jaw over one half of lower: incisors, canines, premolars, molars; total = 2 × (upper + lower).

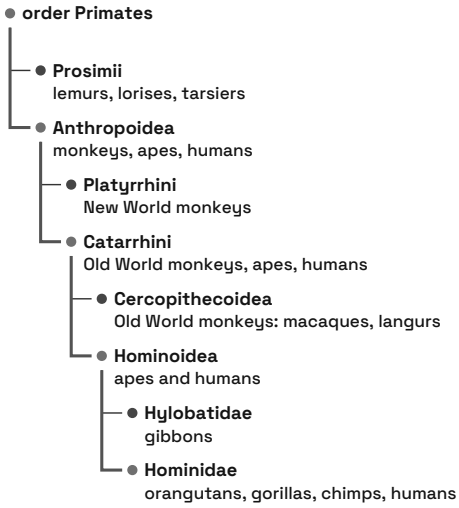
Diastema: gap in the opposite jaw for a large canine (apes).

Foramen magnum: hole for the spinal cord in the skull.

Cranial capacity: volume of the braincase (cc).

Origin and classification of primates

- shrew-like, insect-eating **placental (eutherian) mammals** in the **Cretaceous**
- first primate-like mammals: **Paleocene** (after 66 million years ago); first true primates: early **Eocene**, ~56 million years ago
- **Prosimii** ("before monkeys"): small, night-active tree-dwellers, long snouts
  - lemurs (Madagascar)
  - tarsiers
  - lorises (slow loris)
- **Anthropoidea** ("human-like"): monkeys, apes, humans; larger brains, flat faces
  - **Platyrrhini**: New World monkeys
  - **Catarrhini**: Old World monkeys, apes, humans
    - **Cercopithecoidea**: Old World monkeys (macaques, langurs, baboons)
    - **Hominoidea** (Miocene): **Hylobatidae** (gibbons) and **Hominidae** (orangutans, gorillas, chimpanzees and bonobos, humans)
- tree shrews: not primates (order Scandentia); old **Pongidae** for great apes → now in **Hominidae** with humans (DNA)
- **Huxley**, *Evidence as to Man's Place in Nature* (**1863**): humans closer to African apes than apes to monkeys
- **Darwin**, *The Descent of Man* (**1871**): common ancestor; humans arose in **Africa**



Classification of the primates: humans are in the Hominidae with the great apes.

Platyrrhini vs Catarrhini

Platyrrhini (New World)	Catarrhini (Old World)
broad, flat nose; nostrils wide apart, **sideways**	narrow nose; nostrils close, **downwards**
small to medium	medium to large
long tail; **prehensile** in some	never prehensile; some almost none
thumb not fully opposable	thumb opposable in most
36 teeth: 2.1.3.3 / 2.1.3.3	**32 teeth**: 2.1.2.3 / 2.1.2.3
no sitting pads	hard sitting pads (ischial callosities)
arboreal only	arboreal or terrestrial
Mexico, Central and South America	Africa and Asia
spider monkey, marmoset, capuchin, howler	rhesus macaque, langur, baboon, proboscis monkey

- marmosets: 32 teeth (two molars)
- $2 \times (8 + 8) = 32$
- Nepal's monkeys all **Old World**: rhesus macaque, Assamese macaque, gray langurs

Apes and man

Alike

- **no tail**
- **large brains**, good memory
- dental formula **2.1.2.3**, 32 teeth
- flat nails, opposable thumb, fingerprints
- sounds, gestures, **facial expressions**
- menstrual cycle in females
- ABO blood groups; DNA differs ~**1.2%** (chimpanzee)
- vermiform appendix; apes 48 chromosomes, humans 46 (two fused → our chromosome 2)
- → **cousins**, a common ancestor; not descended from any living ape

Apes	Man
posture partly erect	fully erect
all fours (knuckle-walking) or swing	**bipedal**
arms longer than legs	legs longer than arms
big toe **opposable**	big toe in line; thumb opposable
foot flat, no arch	foot **arched**
spine **one curve** (C)	spine **four curves** (S)
pelvis long, narrow	short, **bowl-shaped**
foramen magnum towards back	under middle of skull
prominent brow ridges, low forehead	small brow ridges, high forehead
face, jaws project	face flat
no chin	prominent **chin**
large canines, **diastema**	small canines, no diastema
~300–550 cc	~1,350–1,450 cc
mainly plant-eaters	omnivores
simple tools; no speech	complex tools; speech, writing

Changes from ape-like ancestors to humans

- **bipedalism**, hands freed
- big toe in line, grip lost
- **upright posture**: lower back curve, bowl-shaped pelvis
- **larger brain**: ~400 → ~1,350 cc
- smaller brow ridges, canines, incisors; shorter face
- a **chin**
- upright walking came **first** (Laetoli footprints, 3.66 million years: chimp-sized brains)

Position of modern man

Rank	Name
Kingdom	Animalia
Phylum	Chordata
Subphylum	Vertebrata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo* (man)
Species	*sapiens* (wise)
Subspecies	*sapiens*

Evolution of modern man: eight stages

- a simplified line; really a **bush**: many branches died out, several kinds lived at once

1. *Dryopithecus* **and** *Proconsul* (Miocene apes)

- *Proconsul*: East Africa, **20–17 million years**; skull by **Mary Leakey**, Rusinga Island, Lake Victoria, 1948 (once *D. africanus*)
- *Dryopithecus*: Europe, 12–9 million years; France 1856
- **no tail**; monkey-like body, on all fours along branches
- forests; soft **fruit**, leaves
- ape-like teeth, large canines; brain ~170 cc
- arms ≈ legs
- near the **common ancestor of apes and humans**; not a direct human ancestor

2. *Ramapithecus*

- **Siwalik hills**, India; **G. Edward Lewis**, 1932; 12–8 million years
- **Nepal**: upper molar, Tinau Khola near Butwal (1983), ~9 million years
- **small canines**, large flat **molars**, **thick enamel** (hard seeds, nuts); jaw seemed curved
- once "first human ancestor"
- **1982**: *Sivapithecus* face (Pilbeam, Pakistan) like an **orangutan's** → now part of *Sivapithecus*, orangutan line
- proteins, DNA: humans and African apes split only **6–7 million years ago**
- old books' "gap" to *Australopithecus*: filled since 2000

3. *Australopithecus* (southern ape)

- **Raymond Dart**, Taung child, South Africa, named **1925** (*A. africanus*); foramen magnum under skull
- eastern and southern Africa, **4.2–2 million years ago**
- *A. afarensis* (3.9–2.9): **Lucy**, 3.2 million years, 40% skeleton, **Donald Johanson**, Hadar, Ethiopia, **1974**; Laetoli footprints
- *A. africanus* (3.3–2.1), South Africa
- features:
  - **upright, two legs** (human-like pelvis, knee); still climbed
  - brain **~450 cc**; projecting face, brow ridges, **no chin**
  - **small canines**, large molars
  - mostly **plant food**, some insects, meat
  - males ~1.4 m, females ~1.15 m
- robust kind (*A. robustus*) → *Paranthropus*: side branch, died ~1 million years ago
- ancestor of *Homo*: likeliest *A. afarensis* or close (debated)

4. *Homo habilis* (handy man, tool maker)

- **Louis and Mary Leakey**, **Olduvai Gorge**, Tanzania, 1960–63; named 1964 (Leakey, Tobias, Napier)
- East and South Africa, **2.4–1.4 million years ago**
- ~1–1.35 m, long arms, upright
- brain **500–800 cc** (~610)
- smaller face, teeth
- **Oldowan** stone tools: pebbles with sharp edge; meat, marrow
- **omnivorous** (meat much scavenged)
- earliest well-known *Homo*

5. *Homo erectus* (upright man)

- **1.9 million** to ~110,000 years ago; **first to leave Africa** (Georgia, China, Indonesia)
- 1.45–1.85 m; long legs, walking and running
- brain 600 → 1,100 cc, **~900 cc**
- long low thick skull, heavy **brow ridges**, sloping forehead, projecting jaws, **no chin**
- **Acheulean hand axe** (from 1.76 million years)
- much **meat**; hunted large animals
- probably **controlled fire** (~1 million years, South Africa)
- **Java man** (*Pithecanthropus erectus* → *H. erectus erectus*)
  - **Eugène Dubois**, Trinil, Java, 1891; named 1894
  - skullcap, thigh bone; ~900 cc; upright
- **Peking man** (*Sinanthropus pekinensis* → *H. erectus pekinensis*)
  - **Zhoukoudian** caves near Beijing; tooth 1927 (Davidson Black); skullcap 1929 (**Pei Wenzhong**)
  - **Mayr** (1950) put Java and Peking in one species
  - ~40 individuals, **750,000–400,000 years**; 850–1,200 cc; fossils lost 1941
- **Heidelberg man** (*Homo heidelbergensis*)
  - **jaw**, Mauer near Heidelberg, **1907**; heavy, no chin, human-like teeth; **~600,000 years**
  - Europe and Africa, 700,000–200,000; ~1,250 cc
  - ancestor of **Neanderthals** (perhaps of *H. sapiens*)

6. Neanderthal man (*Homo neanderthalensis*)

- **Neander valley**, Germany, **1856**; **Fuhlrott**; named 1864 (or *H. sapiens neanderthalensis*)
- Europe, western and central Asia, **400,000–40,000 years ago**; ice-age cold
- **short, stocky**, 1.55–1.65 m
- brain **~1,450 cc**
- long **low** skull, heavy brow ridges, sloping forehead, big face and nose, **no chin**
- **Mousterian** tools; hunted mammoths, bison
- caves, **fire**, skin clothes

- **buried dead**, cared for the sick (Shanidar), ornaments
- died out ~40,000 years ago; **interbred** with modern humans: **1–2%** of non-Africans' DNA (**Pääbo**, genome 2010, Nobel 2022)

7. Cro-Magnon man (early modern humans of Europe, *Homo sapiens*)

- rock shelter, **Les Eyzies**, France, **1868**; **Louis Lartet**; ~28,000 years
- Europe ~45,000–10,000 years ago, late **Pleistocene**
- **tall**, 1.7–1.8 m
- **high rounded** skull, **vertical forehead**, small brow ridges, flat face, narrow nose, **prominent chin**
- brain ~**1,500 cc** (old man ~1,600)
- stone **blades**; bone, antler, **ivory**; spear-throwers, harpoons, **eyed needles**
- **hunter-gatherers**; no farming
- **art**: Lascaux (~17,000), Chauvet (30,000+)
- not extinct: ancestors of today's Europeans

8. Living modern man (*Homo sapiens sapiens*)

- arose in **Africa**: Jebel Irhoud, Morocco, ~**300,000 years**
- out of Africa **70,000–60,000 years ago** → Australia ~50,000, Europe ~45,000, Americas ≥20,000
- high, rounded, thin-boned skull; high forehead
- ~**1,350 cc** (1,350–1,450)
- small brow ridges, flat face, small teeth, **chin**
- spine with **four curves**
- since ~50,000 years: **cultural** evolution (tools, language, art)
- Bhimbetka rock paintings (Madhya Pradesh): 10,000+ years
- **farming** from 11,000–10,000 years ago (Fertile Crescent)
- **Denisovans**: Tibetan jaw ~160,000 years; Tibetans, Sherpas carry Denisovan *EPAS1* (high altitude)

H. habilis vs H. erectus

Homo habilis	Homo erectus
2.4–1.4 million years ago	1.9 million–110,000 years ago
Africa only	Africa, then Asia
1–1.35 m, long arms	1.45–1.85 m, modern proportions
~610 cc	~900 cc
Oldowan pebble tools	Acheulean hand axes
scavenged meat	hunted large animals
no fire	probably fire

Neanderthal vs Cro-Magnon

Neanderthal	Cro-Magnon
separate species (or subspecies)	*Homo sapiens*
400,000–40,000 years ago	from 45,000 years ago, Europe
short, stocky	tall, slender
long low skull; heavy brow ridges	high rounded skull; small brow ridges
no chin	prominent chin
~1,450 cc	~1,500 cc
Mousterian flake tools	blades; bone, ivory; needles
some burials, ornaments	rich cave art
side branch, died out	ancestors of Europeans

Newer finds

- **gap filling**: *Sahelanthropus* (Chad, ~7 million), *Orrorin* (Kenya, ~6), *Ardipithecus* (Ethiopia, ~4.4; grasping big toe) → human line began in **Africa**
- **many kinds at once**: ~50,000 years ago *H. sapiens*, Neanderthals, Denisovans, *H. floresiensis* (Flores, ~1 m), *H. luzonensis*
- **ancient DNA** (since 2010): interbred with Neanderthals, Denisovans

COMMON MISTAKES

✗ Humans evolved from chimpanzees
✓ **cousins**: a common ancestor ~6–7 million years ago.

✗ *Ramapithecus* was the first human ancestor
✓ an orangutan relative (*Sivapithecus*).

✗ Humans arose in Asia
✓ in **Africa**.

✗ Apes can't make tools
✓ chimpanzees make tools; only humans make tools to make tools, and talk.

✗ Australopithecines hunted with weapons; Peking man a cannibal
✓ bones killed by **leopards**, **hyenas**.

✗ Tree shrews are prosimians
✓ not primates (Scandentia).

✗ Big brain came first
✓ **upright walking** first.

✗ Cro-Magnon died out
✓ they are *Homo sapiens*, ancestors of Europeans.