Lab 7
The Fossil Record for Human Evolution II:
Early and Middle Pleistocene *Homo*

INTRODUCTION

In this lab we will be looking at specimens of the genus *Homo* from the early and middle Pleistocene epoch, found across Africa and Eurasia.

Family Hominidae
Subfamily Homininae
Tribe Hominini

Species	Time span
Homo habilis	2.4 – 1.8 Ma
Homo rudolfensis	2.4 – 1.8 Ma
*Homo erectus (*in Africa & Georgia, aka *H. ergaster*)	1.9 – 0.9 Ma
Homo erectus (in Asia)	1.6 – ? Ma
Homo antecessor	1.2 – 0.8 Ka
Homo heidelbergensis	600-300 Ka
Homo naledi	335-236 Ka
Homo sapiens neanderthalensis	130-30 Ka
Homo sapiens sapiens	315 Ka - present

In the previous lab, you examined the fossils representing early members of the genus *Homo*, commonly attributed to the species *H. habilis* and *H. rudolfensis*. A later member of this genus, ***Homo erectus*** (or ***H. ergaster***, see below), appears to have first arisen in sub-Saharan Africa and then quickly dispersed into eastern Europe/western Asia (today the Republic of Georgia), south-eastern Asia (Indonesia), and east Asia (China). As with the *H. habilis/rudolfensis* debate, some researchers find the range of morphological variation within this material too great to represent a single species and therefore split it into two: an African form, ***Homo ergaster***, and an Asian form, retaining the name ***Homo erectus***. Others, however, argue that the range of variation simply reflects the morphological variation expected of a long-lasting (over 1.5 million years!) and a widely geographically dispersed species. Such researchers lump all of this material into *H. erectus* and do not use the *H. ergaster* designation.

Homo ergaster/erectus is the first hominin to exhibit modern-like body proportions and height. As mentioned above, it is also the first hominin to spread outside of Africa. *Homo ergaster/erectus* fossils are characterized by a long, low cranial vault, with cranial suprastructures such as sagittal keels and pronounced supraorbital tori.

Middle Pleistocene *Homo*, often referred to as “the Muddle in the Middle”, refers to fossils from across Africa and Eurasia that appear morphologically intermediate between *H. erectus/ergaster* on the ancestral side, and Neanderthals and/or modern humans on the more derived side. These specimens retain ancestral characteristics

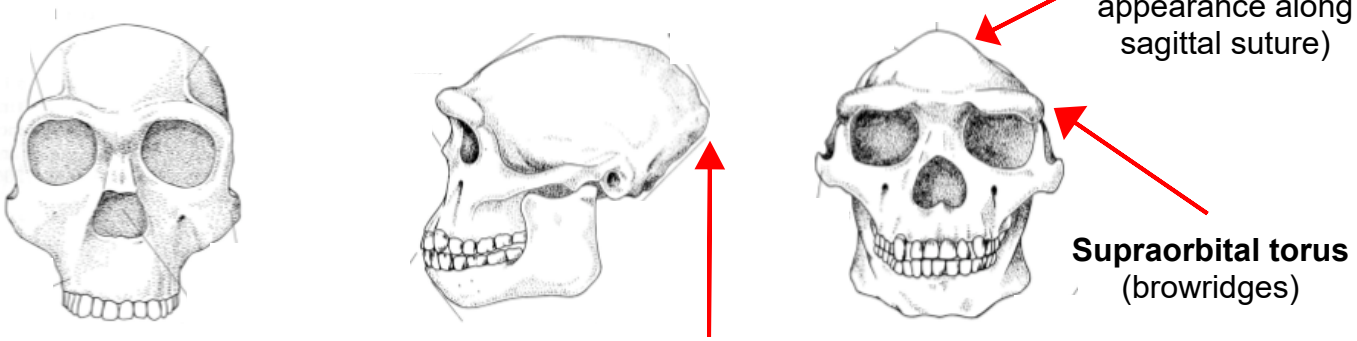
such as strong supraorbital tori, angled occipitals, and sloping foreheads (though not as low as in *H. erectus*), but exhibit brain sizes within the modern human range of variation.

Some Middle Pleistocene *Homo* fossils from western Eurasia appear to show incipient Neanderthal traits, such as **midfacial prognathism** and **retromolar space/gap**, leading some researchers to propose they were direct ancestors of Neanderthals, with the species name ***H. heidelbergensis*** (named after the Mauer mandible found near Heidelberg, Germany). The specimens from Africa do not exhibit Neanderthal-like traits, and so are often considered to be the direct ancestors of modern humans, referred to by some as ***H. rhodesiensis*** (named after the fossil cranium known as Kabwe, from what is today Zambia, but was called Northern Rhodesia in colonial times). However, this species-level separation also implies that Neanderthals and modern humans are different species (***H. neanderthalensis*** and ***H. sapiens***, respectively), which not all researchers agree with. Using the biological species concept, the extensive evidence of interbreeding between Neanderthals, modern humans, and another taxon called **Denisovans** would suggest these were all the same species, but different subspecies (***H. sapiens neanderthalensis*** and ***H. sapiens sapiens***).

Most recently, our understanding of the Middle Pleistocene *Homo* in Africa was further complicated by the discovery in South Africa of ***Homo naledi***, a hominin dated to 230-330 ka exhibiting a surprising mosaic of ancestral (e.g., brain and body size in the australopith range) and derived traits (e.g., more modern human-like cranial shape). While many researchers consider this taxon to be a different species, others consider it a late-surviving population of *H. erectus,* most similar to the Dmanisi specimens.

As a reminder, as you examine the fossil casts, look at the specific details your worksheet points out, as overall impressions can be misleading.

Figure 1. **Cranial superstructures**



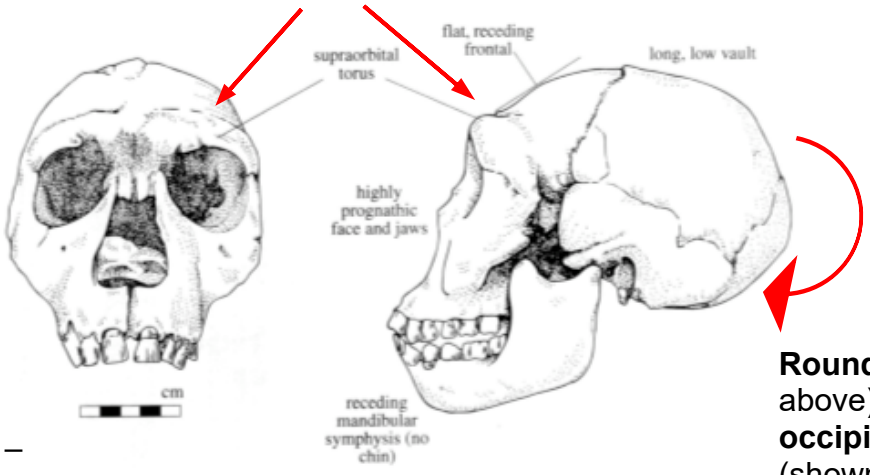
None
(flat, smooth vault)

Occipital torus
(thick ridge of bone at the back of the cranium)

Figure 2. Cranial traits in *H. erectus* in Africa vs. Asia

Supraorbital torus–
pronounced, double-arched

KNM-WT 15000,
"Nariokotome Boy",
Kenya



Rounded (shown above) vs. **angular occipital bone** (shown below)

Supraorbital torus –
thick, bar-like

H. erectus from
Java, Indonesia

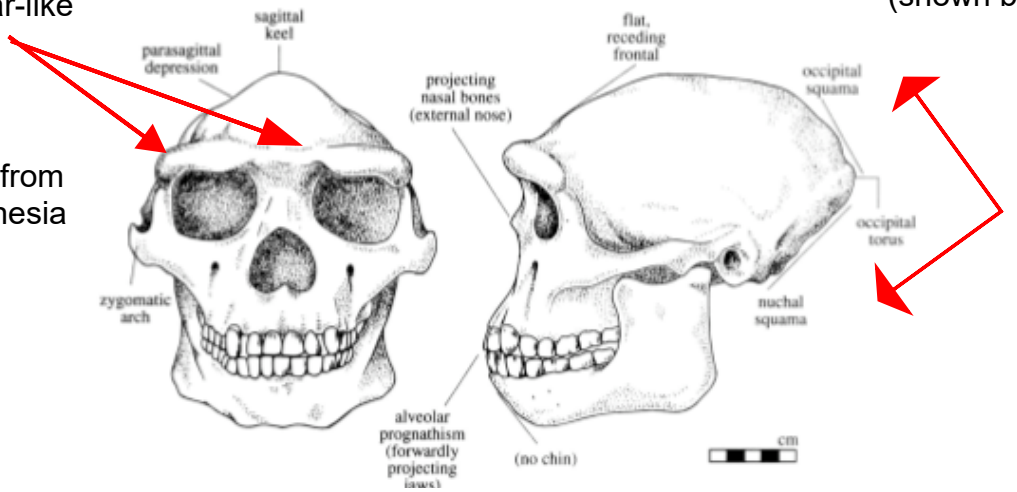
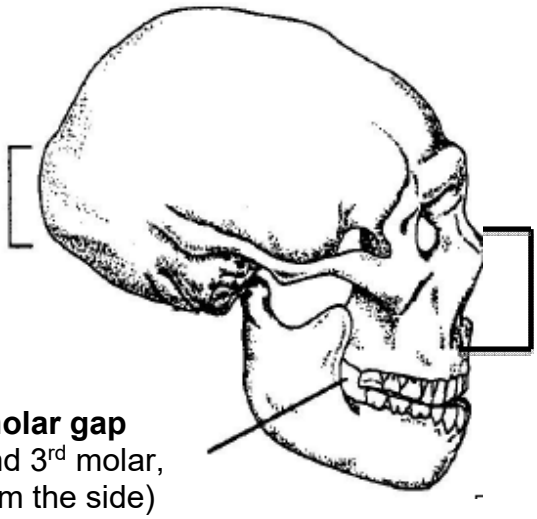


Figure 3. Classic Neandertal skull morphology

Occipital bun –
outward bulging of
occipital bone at
rear of skull



<u>Midfacial prognathism</u>
– nasal region and
cheeks are "puffed" out,
so the zygomatics slope
backwards

Retromolar gap
(gap behind 3rd molar,
visible from the side)

Station 1 - *Homo erectus* & *Homo ergaster*: cranial features

Compare *H. erectus* and *H. ergaster* skulls with that of a modern human.

- African *Homo erectus* (or *H. ergaster*) (KNM-WT 15000, dated to 1.6 Ma)
- Asian *Homo erectus* (Sangiran 17, dated to 1.3-1.0 Ma)
- Recent *Homo sapiens*

	KNM-WT 15000	**Sangiran 17**	***H. sapiens***
Brain size	880 cc's (~ 900 in adulthood)	1,029 cc's	1,350 cc's (average)
Skull shape (more elongated or more rounded)			
Thickness and shape of supraorbital tori (arched or bar-like), if present			
Is the lower face prognathic? (Y/N)			
Type of cranial superstructures, if any (Fig. 1)			
Occipital: angular or rounded? (Fig. 2)			

Question 1: Give at least two specific examples of shared derived traits that link African and Asian *H. erectus*. Does either African or Asian *Homo erectus* have any uniquely derived traits? Does African *H. erectus* share any derived traits with *H. sapiens* to the exclusion of Asian *H. erectus*, or vice versa?

Station 2 – Geographic and temporal variation in *H. erectus*

- African *Homo erectus* (or *H. ergaster*) (OH 9, dated to 1.4 Ma)
- African *Homo erectus* (or *H. ergaster*) (KNM-ER 3733, dated to 1.8 Ma)
- Asian *Homo erectus* (Zhoukoudian, dated to 780-400 Ka)
- Asian Homo erectus (Ngandong 7, dated to 250-70 Ka)

	OH 9	**KNM-ER 3733**	**Zhoukoudian**	**Ngandong**
Brain size	1,067 cc's	841 cc's	~1,000 cc's (average)	~1,200 cc's (average)
Skull shape (more elongated or more rounded)				
Thickness and shape of supraorbital tori (arched or bar-like)				
Type of cranial superstructures, if any (Fig. 1)				
Occipital: angular or rounded? (Fig. 2)				

Question 2: Looking at the data collected at Stations 1 and 2, are there any traits present in Asian *H. erectus* specimens that are absent in African *H. erectus* specimens, or vice versa? Do you think this justifies their separation into two different species (*H. erectus* in Asia and *H. ergaster* in Africa)? Why or why not?

Question 3: Looking at the data collected at Stations 1 and 2, do you observe any temporal trends (features changing over time) within the African or Asian *H. erectus* specimens?

Station 3 – Small-sized *H. erectus* and *H. naledi*

- African *H. erectus* (KNM-ER 42700, dated to 1.55 Ma)
- Georgian *H. erectus* (Dmanisi 2, dated to 1.77 Ma)
- Georgian *H. erectus* (Dmanisi 5, dated to 1.77 Ma)
- *Homo naledi* (DH 1, dated to 335-225 Ka)

	KNM-ER 42700	**Dmanisi 2**	**Dmanisi 5**	**DH 1**
Brain size	690-721 cc's	650 cc's	546 cc's	555 cc's
Skull shape (more elongated or more rounded)				
Widest point on the skull (when viewed from behind: low, middle, high)				
Is the lower face prognathic? (very/somewhat/no)				
Shape of supraorbital tori (arched or bar-like)				
Type of cranial superstructures, if any (Fig. 1)				
Occipital: angular or rounded? (Fig. 2)				

Question 4: Which traits are shared between the three *H. erectus* specimens and *H. naledi?* Are there some traits shared between Dmanisi and *H. naledi* to the exclusion of the Ileret specimen (KNM-ER 42700)? Are there some traits shared between KNM-ER 42700 and DH1?

Station 4: Middle Pleistocene *Homo*

- *Homo erectus* (Zhoukoudian, dated to 780-400 Ka)
- *Homo heidelbergensis* (Sima de los Huesos 5, dated to ~400 Ka)
- *Homo heidelbergensis* (Kabwe, dated to 300-125 Ka)
- Recent *Homo sapiens*

	H. erectus	Kabwe	Sima de los Huesos 5	*H. sapiens*
Brain size	~1,000 cc's (average)	1,280 cc's	1,125 cc's	~1,350 cc's (average)
Cranial shape (more rounded or more elongated)				
Thickness of supraorbital tori				
Is the occipital rounded or angular? (Fig. 2)				
Sagittal keel? (Fig. 1) Y/N				
Occipital torus (Fig. 1) or bun? (Fig. 3)				
Is the midface (nasal region) protruding? (Y/N, Fig. 3)	N/A			

Question 5: Which traits are shared between H. erectus and *H. heidelbergensis* (i.e., which ancestral traits can be observed in *H. heidelbergensis*) compared to *H. sapiens*? Which *H. heidelbergensis* traits are intermediate between *H. erectus* and *H. sapiens*?

Question 6: Midfacial prognathism and occipital buns are classic Neanderthal traits. Do any of the Middle Pleistocene hominins at this station exhibit any of these traits? What does this pattern suggest about the origins of Neanderthals?

Question 7: Based only on morphology, which specimen (except the modern human skull) is the most modern human-like? What morphological traits lead you to this conclusion?

Question 8: Based on what we know about the biogeography and chronology of modern human origins, do you think the specimen you selected is the most likely ancestor of modern humans among the fossils we have examined? Why or why not?