Lab 8
The Fossil Record for Human Evolution III: Middle and Late Pleistocene *Homo*

INTRODUCTION

In this lab we will be looking at specimens from the latter stages of *Homo* evolution, comparing them to each other, as well as to earlier fossils (*H. heidelbergensis*) and recent modern human specimens.

As you observed in the previous lab, some Middle Pleistocene *Homo* fossils from western Eurasia appear to show incipient Neanderthal traits, such as **midfacial prognathism** with posteriorly sloping zygomatics, and **retromolar space/gap**, leading some researchers to propose they were direct ancestors of Neanderthals, with the species name ***H. heidelbergensis***. 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***, However, this species-level separation of middle Pleistocene hominins 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***). In this lab, we use the term Neanderthal and anatomically modern human, respectively.

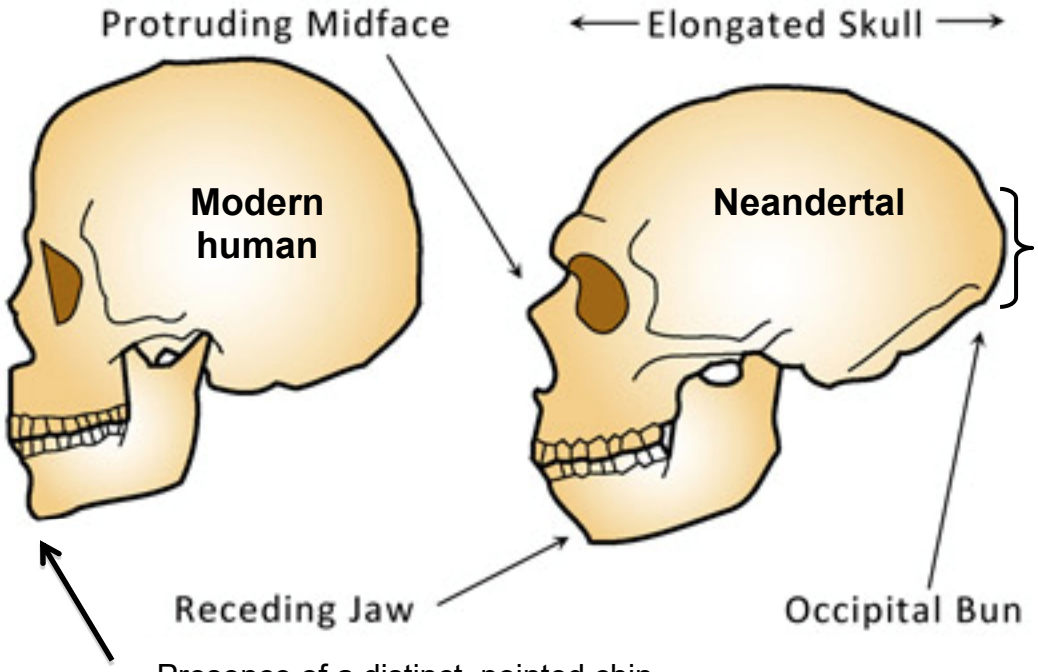
Fossils considered to belong to anatomically modern humans, including us, are characterized by having more vertical frontal bones and more rounded occipital bones, resulting in a more globular, rounded appearance of the cranium overall. Derived features of the skull include a **canine fossa** (a large depression behind the root of the canine, on the anterior surface of the maxilla, below the inner edge of the orbit) and an anteriorly projecting chin, or **mental eminence**. Early anatomically modern humans often retain some ancestral traits, such as pronounced browridges, and are generally are more **robust** (have thicker, stronger bones) than recent modern human populations. It appears that modern human skeletal morphology became more **gracile** (with thinner, more delicate bones) in the recent past, likely reflecting increasingly advanced technology and means of cultural adaptations at our disposal.

As a reminder, as you examine the fossil casts, look at the specific details your worksheet points out, as overall impressions can be misleading. Keep in mind that in many cases we have only a single specimen, and we don't know how variable the individuals in that species might have been. Our own species is quite variable.

Figure 1. Comparison of modern human and Neandertal traits

Protruding (or "puffy") midfacial region (around cheeks and nasal opening) vs. flat midfacial region

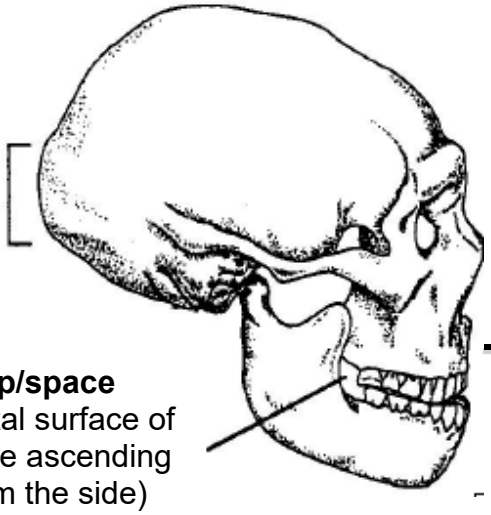
Elongated cranium with a low, receding frontal bone vs. shorter, rounder cranium with vertical frontal



Presence of a distinct, pointed chin vs. receding symphysis with no chin

Figure 2. Classic Neandertal skull morphology

Occipital bun outward bulging of occipital bone at rear of skull



Midfacial prognathism nasal region and cheeks are "puffed" out, so zygomatics slope backwards

Retromolar gap/space (gap behind the distal surface of the 3rd molar and the ascending ramus, visible from the side)

Station 1

- *Homo heidelbergensis* (Sima de los Huesos 5, Spain, dated to ~400 Ka)
- Neandertal (La Ferrassie 1, France, dated to 70-50 ka)
- Fossil anatomically modern human (Skhul V, Israel, dated to 90 ka)
- Recent anatomically modern human

	Sima de los Huesos 5	La Ferrassie	Skhul V	Recent *H. sapiens*
Shape of the cranium (more rounded or more elongated)				
Thickness of brow ridges (describe in relative terms)				
Is the midface protruding? (Y/N; Figs. 1&2)				
Is the frontal bone vertical, or low and sloping?				
Is the occipital angular or rounded?				
Is there an occipital bun? (Fig. 2)				
Brain size	1,125 cc's	1,641 cc's	1,520 cc's	1,400 cc's

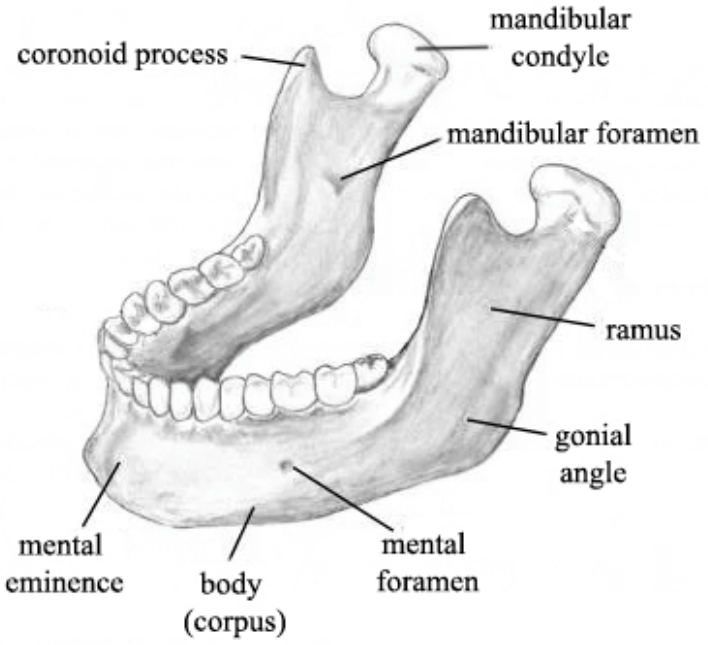
Question 1: Describe the suite of morphological features that characterize the cranium of a Neandertal.

Question 2: What features differentiate La Ferrassie 1 from Skhul V? What features do they share? Which shared traits are ancestral (primitive), and which are derived?

Station 2: Mandibular morphology

- *Homo heidelbergensis* (Mauer, Germany, dated to ~400 Ka)
- *Homo heidelbergensis* (Sima de los Huesos 5, Spain, dated to ~400 Ka)
- Neandertal (Krapina J, Croatia, dated to ~125 Ka);
- fossil anatomically modern human (Skhul V, Israel, dated to 90 Ka);
- recent modern human

Figure 3. Anatomical features of the mandible



	Mauer	Sima de los Huesos 5	Krapina J	Skhul V	Recent *H. sapiens*
Is there a chin (mental eminence; Fig. 3)?					
Is there a retromolar gap (when viewed from the side; Figs 1 and 2)?					
Height of mandibular condyle relative to coronoid process (Fig. 3)					
Is the mandibular foramen under second premolar (P4) or first molar (M1; Fig. 3)?					

Question 3: Which mandibular traits characterize Neanderthals compared to anatomically modern humans?

Question 4: Which traits are different and which are shared between *H. heidelbergensis* specimens and Neanderthals? What does that suggest about the evolutionary relationship of those two taxa?

Question 5: Based on what you observed in Stations 1 and 2, why do you think Skhul V is considered to be a member of *Homo sapiens* and not a Neanderthal? Discuss specific features.

Station 3: Brain size variation in *Homo*

- Homo habilis, KNM-ER 1813, 510 cc's (East Turkana, Kenya, 1.9 Ma)
- Homo erectus, KNM-ER 42700, ~700 cc's (Ileret, Kenya, 1.5 Ma)
- *Homo floresiensis*, LB 1, 417 cc's (Liang Bua Cave, Indonesia, 100-60 Ka)
- *Homo naledi*, DH 1, 555 cc's (Rising Star Cave, South Africa, 335-236 Ka)
- Recent *Homo sapiens* with microcephaly, ~500 cc's

Question 6: Compare the crania of Liang Bua 1 and recent modern human with microcephaly. How are they similar? How are they different?

Question 7: There is a debate among researchers whether the Liang Bua specimens are recent modern humans affected by microcephaly, or if they are descendants of *Homo erectus* that got smaller in the well-known process known as insular (island) dwarfism. However, others have argued that a likelier explanation is that Liang Bua hominins are dwarfed descendants of an even earlier *Homo* migration (e.g., descended from fossils like *Homo habilis*). Based on your observations here and what we've discussed in class, which of these scenarios seems most likely to you? Explain your reasoning.

Question 8: When they were first discovered, paleoanthropologists mistakenly thought the Liang Bua fossils were dated to 18 Ka instead of 100 Ka. Many paleoanthropologists thought the *H. naledi* fossils were > 1 Ma old when they were first found, but instead they are dated to 300-250 Ka. Discuss how these different dates would affect our ideas about taxonomy and possibly evolutionary relationships (phylogeny) between these fossils and the other fossils discussed this semester. Write down a summary of what you discuss with your group.

Station 4. Cranial variation in anatomically modern humans

- Skhul V, Israel, dated to ~90 Ka
- Cro-Magnon 1, France, dated to ~30 Ka
- Wajak, Indonesia, dated to ~37-28.5 Ka
- Multiple recent modern human specimens

Question 7. All of the crania at this station belong to our species, *Homo sapiens (sapiens).* Which derived characteristics (see Fig. 1) justify this designation?

Question 8. What ancestral traits can still be observed in some of these specimens? Are some more robust and/or larger than others? What does this tell us about recent human evolution?

Question 9. Examine the cranial variation represented at this station, in just a few members of our species. What cautionary note would you draw from this when it comes to interpreting variation in the fossil record, especially with temporally and geographically widely distributed taxa, as being either within or between species?