Genus *Homo* – Pleistocene Hominin Evolution

Assignment	Specimens will be placed throughout the lab at Stations 1–7. Your task is to examine the specimens at each station and answer the pertinent questions on the *Homo* Lab Worksheet. Consider from which geologic time period the fossils are derived. How are the specimens classified? What are the family, tribe, genus, and species categories for each specimen? Examine the morphology of the specimens. Do you see characteristics that would support the inclusion of the specimen into specific taxa?

The main objective of today's lab is to gain a basic understanding of the features that characterize the different members of the genus *Homo*. You will learn to identify the traits that changed on the hominin skull during the transition from *Homo erectus* to anatomically modern *Homo sapiens*.

Station 1) *Homo erectus*

Homo erectus appears in the fossil record in the lower Pleistocene, during the latter part of the hominin radiation. There are fragmentary cranial and postcranial remains found in Africa that are thought to be *Homo erectus* and date to around 1.9 mya (Conroy & Pontzer, 2012). However, the best dated *Homo erectus* fossil material in Africa is a cranium known as KNM ER-3733 that dates to at least 1.7 mya (Lepre & Kent, 2010). Most researchers include these early African fossils in the species *Homo erectus*. However some anthropologists, think that these remains belong to a different species, *Homo ergaster*. This is a convention that this manual will not follow; we will consider all of these fossils to be *Homo erectus*.

Although there is debate surrounding the precise ancestor of *Homo erectus,* there is agreement that *Homo erectus* evolved from an earlier hominin within the hominin radiation of Africa. It is important to note that as *Homo erectus* arose the australopithecines were either gone or disappearing from the fossil record, (although *Au. sediba* may require this to be reconsidered). Nevertheless, it is important to note that during this time period *Paranthropus* and early *Homo* species still existed in Africa. Hence *Homo erectus* appears at a time in which multiple hominin species existed in Africa. This hominin sympatry (multiple species in the same geographic space and time) eventually ended as *Paranthropus* and early *Homo* species disappeared while *Homo erectus* contiued and thrived.

Significantly, *Homo erectus* is the first documented hominin species whose populations were able to spread outside of Africa and exploit non-equatorial and non-tropical habitats. Current dating has *Homo erectus* at the Dmanisi site in the Republic of Georgia around 1.8 mya (Garcia et al., 2010) and in southeast Asia (Java) between 1.8–1.6 mya ago (Conroy & Pontzer, 2012).

The temporal duration of *Homo erectus* differs by geographic region and by the different fossil specimens that are included in the species. In Africa, populations of *Homo erectus* continue beyond 1 million years ago while in Asia, *Homo erectus* may have continued until between 200,000–300,000 years ago and perhaps even later in Indonesia. There is evidence from the site of Ngandong, (Java) that the species persisted in Indonesia until at least 100,000 years ago and possibly as late as 53,000 to 27,000. Whether or not *Homo erectus* was present in Western Europe is debated. It is clear that hominins did reach the Caucasus at the Dmanisi site as early as 1.8 mya. This site has yielded crania and mandibular remains that have been attributed to *Homo erectus* or *Homo ergaster*. However,

other fossil specimens from Europe have a much younger date. Sima del Elefente and Gran Dolina Atapuerca, Spain are dated to 1.2 mya and 800,000 years ago respectively and are often thought to be a species distinct from *Homo erectus*.[1]

Homo erectus is a distinctive hominin, rather than being a slight variation of earlier hominins. It displays major anatomical shifts with a significant increase in body and brain size, along with hindlimb elongation. Additionally, *Homo erectus* may have modified the digestive system by reducing the length of the gut as an adaptation to increased amounts of meat in the diet.

This station displays several *Homo erectus* specimens ranging from:

- an early African fossil (KNM–ER 3733 from Kenya, which is dated to 1.7 mya)
- an early specimen from the Republic of Georgia (Dmanisi) that is dated to 1.8–1.7 mya
- an early Indonesian fossil (Sangiran 17 from Java and dated to between 1.7–1.0 mya)
- a Chinese fossil (Zhoutoudian reconstruction that is dated to between 780,000–300,000 years ago)
- a late Indonesian fossil (Ngandong from Java dated to 53,000–27,000 years ago)
- an immature individual (the 8–11 year old Nariokotome boy from Kenya that dates to 1.6 mya)

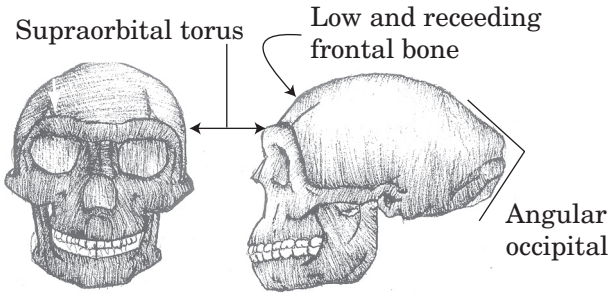
The first objective of this lab is to establish your understanding of the basic set of traits that are used to define the taxon *Homo erectus*. These traits should be seen in all these specimens and should be used to recognize them as a group. However, it is important that you realize that there is variation between the individuals who make up any species. Thus, some of the traits used to define *Homo erectus* will be clear on some skulls, but less so on others. Note how these individuals vary from one another and recognize that these specimens are derived from different continents and represent a time period of more than a million years. Examine the cranial materials at this station, select one adult individual from the group to measure and record the metric data necessary for the *Homo* Lab Table on pages 221–222 and answer the Station 1 questions on the Worksheet.

[1]The Atapuerca material has been proposed to represent *Homo heidelbergensis* or *Homo antecessor*

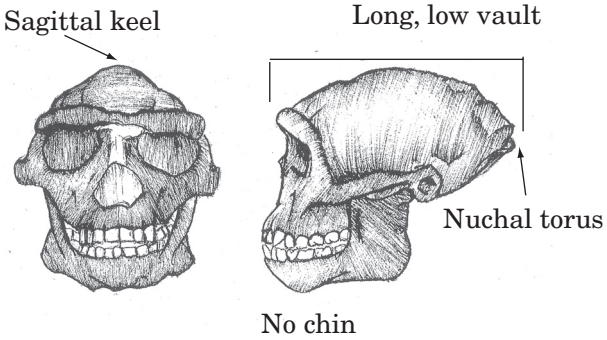
Cranial Characteristics of *Homo erectus*

1. Cranial capacity greater than *Australopithecus* but less than *Homo sapiens* 750–1225 cc, mean = 900 cc, EQ 3.3–4.0 (McHenry, 1994)
2. Long, low cranial vault with thick cranial walls (nearly twice as thick as modern humans)
3. Face is short but massive, nasal aperture projecting forward relative to the lateral facial regions (not a dished or concave face), the lower part of the face protrudes (prognathism)
4. Large supraorbital torus (usually in the form of a bar) and supraorbital sulcus
5. Frontal bone low and receding
6. Postorbital constriction greater than *Homo sapiens* but less than *Australopithecus*
7. Variable development of a sagittal keel along midline
8. Angular occipital with occipital (nuchal) torus
9. Broad base cranium with the maximum breadth of the skull low on the temporal bone (about the level of the external auditory meatus of the ear). This produces a pentagon shaped skull when viewed from behind (not bell shaped).
10. Basicranium moderately flexed
11. Tooth size is smaller than *Australopithecus* (reduced megadonty) but greater than *Homo sapiens*
12. No chin

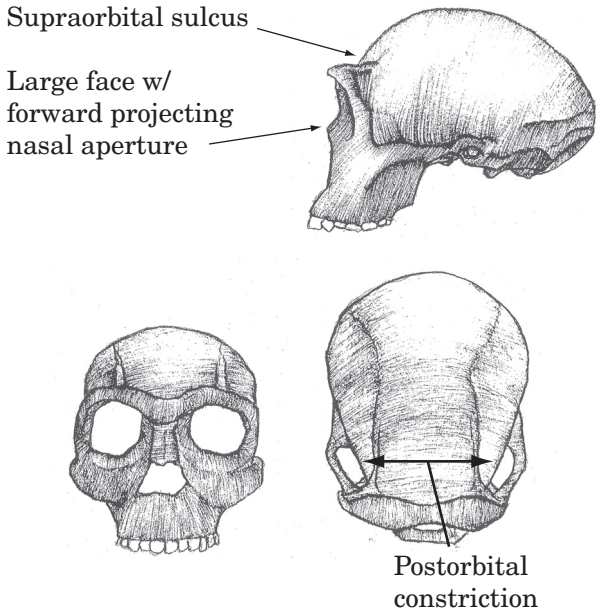
Figure 1



Homo erectus from China



Homo erectus from Java



Homo erectus from Africa

(redrawn by Jhosef Hern from Klein, 1999)

Postcranial Characteristics of *Homo erectus*

The body shape and proportions of *Homo erectus* are similar to modern humans (see Figure 16 on page 198 from the Plio–Pleistocene Hominin Lab). Based on the analysis of the *Homo erectus* boy (Nariokotome) skeleton, it is clear that *Homo erectus* had very human-like limb proportions. The most notable change from *Australopithecus* is an elongation of the hindlimb. This change increases stride length so that it is comparable to modern humans. Listed below are the most prominent post-cranial features of *Homo erectus*.

1. Increased stature and body mass – stature is estimated to range from 148-185 cm (4' 10" – 6'1") and body mass ranges from 46–68 kg (101–150 lbs) (Anton, 2003), EQ 3.3–4.0 (McHenry, 1994)
2. Barrel-shaped chest rather than funnel-shaped as seen in *Australopithecus* (see Figure 16 in the Plio–Pleistocene Hominins Lab)
3. Forelimb is shortened
4. Lower limb is elongated in length compared to body size
5. Thick cortical bone in the long bone shafts

Station 2) HOMININS OF THE MIDDLE PLEISTOCENE

Homo heidelbergensis or Pre-Modern humans

The hominin fossils from the middle Pleistocene may represent a fossil species or simply a transitional grade between *Homo erectus* and *Homo sapiens.* They have had numerous labels applied to them over the years: archaic *Homo sapiens,* archaic humans, pre-modern humans and even late *Homo erectus.* Paleoanthropologists agree that these fossils are not the same as modern humans, hence the term pre-modern human is a common label used today. This nomen is not a scientific species name, but rather it is a term that is applied to hominins that date between 600,000 to 200,000 years ago, with some researchers pushing the dates back to 800,000 years ago. Although interpretations vary, most paleoanthropologists agree that these pre-modern humans evolved from populations of *Homo erectus.* They are found in essentially the same geographic range as *Homo erectus*; however, they have a far greater exploitation of Europe. Many paleoanthropologists are classifying these hominins, particularly the African and European specimens, into a single species, *Homo heidelbergensis.*

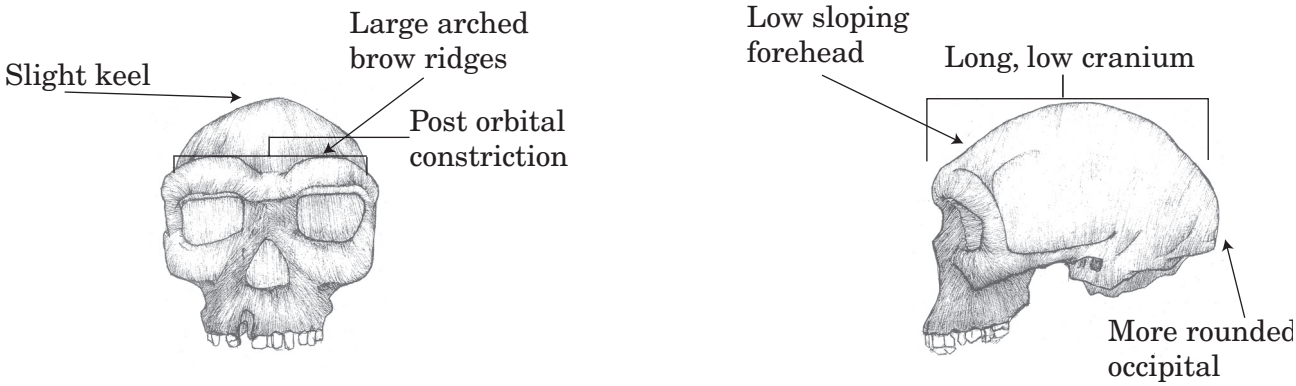
Table 1 – Pre-Modern human fossils often assigned to *Homo heidelbergensis*

African specimens	European specimens	Asian specimens
Kabwe cranium (Zambia), 300,000–125,000	Steinheim cranium (Germany), 250,000–300,000	Dali cranium (China), 180,000–230,000
	Sima de los Huesos – Atapuerca numerous specimens (Spain), 400,000–600,000	Jinniushan (China), 200,000–280,000
	Arago face and partial cranium (southern France), 320,000–470,000	
Bodo cranium (Ethiopia), 600,000	Mauer mandible (Germany), 500,000	

In their overall morphology, *Homo heidelbergensis* is similar to *Homo erectus*; the cranial vault is thick, with a low sloping forehead, long low skull and a large robust face with heavy browridges. However, these specimens differ from *Homo erectus* in important derived features such as increased brain size and somewhat modified cranium. As compared to *Homo erectus,* the cranium of *Homo heidelbergensis* is tall, more rounded with a higher point of maximum breadth and more rounded (less angular) occipital bone. Moreover, the browridge, while being quite large, is arched rather than having a straight bar shape as seen in *Homo erectus.* Thus, in some very subtle ways, *Homo heidelbergensis* is viewed as more derived towards modern *Homo sapiens* in their morphology.

A variety of fossils can be exhibited at this station (See Table 1). However, the most likely fossil will be a specimen known as Kabwe from Zambia, discovered in 1921 (See Figure 2). This specimen was found along with several femoral fragments, a tibia, sacrum, and two iliac fragments and can be considered to be an example of *Homo heidelbergensis* in Africa. The cranium has many traits that are similar to *Homo erectus* such as a large brow ridge, long low cranial vault, low and sloping frontal bone with a slight keel and some postorbital constriction. However it also has a very large brain size (1280 cc), a slightly more rounded cranial shape, and arched brow ridges that are features similar to that of modern humans.

Figure 2 – Kabwe



(redrawn by Jhosef Hern from Klein, 1999)

In Europe, *Homo heidelbergensis* can be distinguished by a further set of cranial features illustrated by the specimens from Arago in France and from Sima de los Huesos in Spain. These specimens are dated to 300,000–600,000 years ago. They represent a group of fossils that share most of the features seen in other middle Pleistocene hominins but they also exhibit a set of unique features that are thought to related them to the later in time Neandertals. Indeed, Stringer (2012) has suggested that Neandertal-like features in the Sima de los Huesos fossils would place these fossils in an early Neandertal grouping rather than *Homo heidelbergensis.*

The specialized cranial features that seem similar to features seen in Neandertals include the following:

1. larger average brain size, 1212 cm^3 (Campbell, Loy, and Cruz-Uribe, 2005)
2. rounded parietal bones (giving the cranium a barrel shape from posterior view)
3. development of an occipital bun (a rounded bony protrusion on the occipital bone in the region of the occipital torus)
4. development of midfacial prognathism produced by inflation of the maxillary bones
5. the presence of large noses
6. development of a retromolar gap (a space between the lower third molar and the ascending ramus of the mandible)

Do you think the Arago or Atapuerca Sima de los Huesos specimens exhibit traits similar to the younger Neandertals? Examine the cranial materials at this station, select one individual to measure and record the metric data necessary for the *Homo* Lab Table. Answer the Station 2 questions in the Worksheet.

Station 3) Neandertals – *Homo sapiens neanderthalensis* or *Homo neanderthalensis*

The informal term, Neandertal, refers to a population of fossil hominins found in Europe and the Middle East from approximately 150,000 to 27,000 years ago. There has been an ongoing and vigorous debate about the Neandertals and their relationship to modern humans. Many paleoanthropologists suggest that Neandertals and modern humans share common ancestry from *Homo heidelbergensis*. Neandertals are clearly closely related to modern humans but there is a debate as to their classification. Should they be classified into their own unique species (*Homo neanderthalensis*) or should they be considered a subspecies of *Homo sapiens* (*Homo sapiens neanderthalensis*)? There is recent genetic research (Green et al., 2010) that successfully extracted Neandertal DNA from fossil remains and compiled draft sequence of the Neandertal genome. Their research yielded evidence of interbreeding between non-African modern humans and Neandertals. They submit that their sample of European and Asian modern humans share between 1 to 4 percent of their genes with Neandertals. They would argue that this is evidence of interbreeding or gene flow between Neandertals and modern humans.

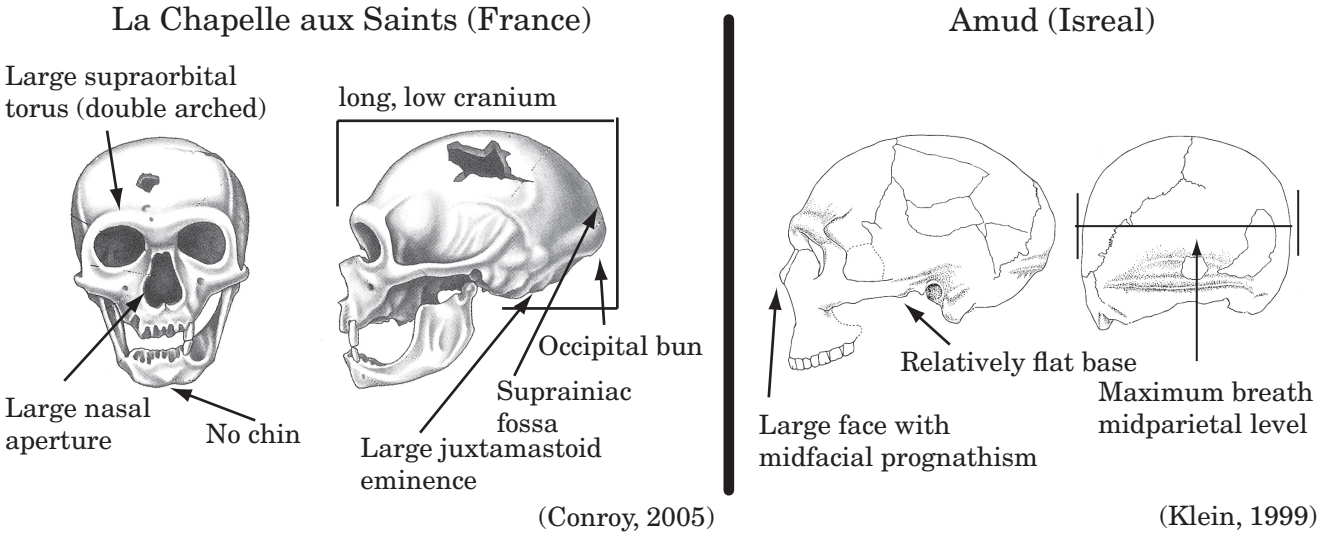
The development of the study of ancient DNA is bringing to light additional complications to the study of later Pleistocene hominin evolution. Reich and colleagues (2010) have analyzed DNA samples from a hominin phalange and molar tooth found in a Siberian Cave dated to 60–80,000 years ago (Meyer et al., 2012). The analysis suggests that these fossils and their DNA belonged to a hominin group that shared common ancestry with Neandertals. This group, which occupied parts of Asia, is called the Denisovans and is thought to have split from a common ancestor with the Neandertals. The research indicated that this group of hominins interbred with some modern humans, as a modern human Melanesian sample has been found to share 4–6 percent of their genetic code with Denisovans. It, therefore, appears that there were at least three populations of late Pleistocene hominins that were capable of some interbreeding although we do not see extensive patterns of gene flow. Unfortunately, we know very little about the Denisovans; we have DNA data from this group but we know next to nothing about their actual appearance since we have almost no fossil record of these hominins.

Conversely, the fossils we call Neandertal are a well-recognized group that appear to be a unique population with a distinctive morphology that is listed on the next page.

Cranial Characteristics of Neandertals

1. large cranial capacity, mean = 1498 cc (Ruff et.al.,1997), male range = 1524–1640 cc and female range = 1270–1425 cc (McKee, 2005), EQ = 4.78 (Ruff et.al., 1997)
2. long, low and wide cranial vault
3. cranial base is often relatively flat (often not highly flexed)
4. large face characterized by midfacial prognathism (inflated maxilla and big nose) and no canine fossa
5. large supraorbital torus often forming a double arch over the orbits (not a straight bar across the brow)
6. occipital bun (chignon) with a suprainiac fossa
7. maximum breadth – midparietal level
8. small mastoid but a large juxtamastoid eminence
9. chin usually absent
10. teeth size smaller than *Homo erectus* but larger than ours, molars with enlarged pulp chamber (taurodont) and a retromolar gap (gap between M3 and the anterior margin of the ascending ramus of the mandible)

Figure 3 – Neandertal Crania



Examine the Neandertal crania at this station and try to identify the Neandertal cranial features in these specimens. Compare the Neandertal specimens to that of the modern skull at this station. Do they look significantly different from us? Select one individual to measure and record the metric data necessary for the *Homo* Lab Table and answer the Station 3 questions in the Worksheet.

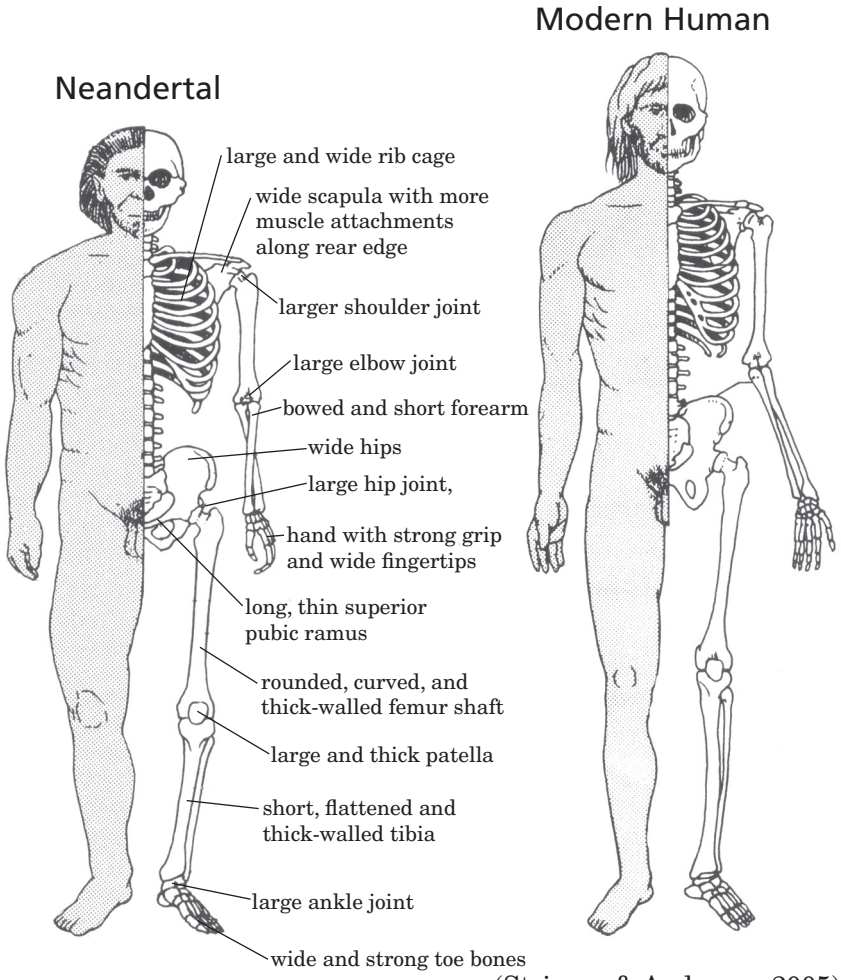
Station 4) Neandertal Postcrania

Postcranially, Neandertals seem to be built for strength and power. They exhibit a number of unique features, the most prominent being a shortening of the distal segments (radius and ulna in forelimb, tibia and fibula in hindlimb), large joint surfaces, and pronounced anterior posterior curvature of the femur and radius. The precise adaptive explanations for all these characteristics are not entirely understood. However, at least in part, they represent adaptations to the colder climates, which prevailed over the northern hemisphere during much of the Pleistocene.

Postcranial Characteristics of Neandertals

1. barrel-like chest cavity
2. scapula which is broad and usually with a dorsal sulcus along the lateral margin
3. large shoulder joint
4. radius and femur have a-p curvature
5. hand has a strong grip and wide fingertips
6. pelvis is characterized by a long narrow pubic ramus producing a wide pelvis
7. distal limb segments (forearm and tibia) shorten i.e. low crural and brachial indices
8. femur and tibia have large epiphyses (end joints) with robust, cortically thick shafts (although not as thick as *Homo erectus*)
9. large, thick patella (kneecap)

Figure 4



(Stringer & Andrews, 2005)

10. overall they were relatively short and robust people. Body mass ♂ mean = 75 kg (165 lbs), ♀ mean = 67.2 kg (147.8 lbs), (Rosenberg et al., 2006). Stature estimates = 1.5–1.7 meters (4'11"–5'7") (Conroy, 2005), ♂ = 169 cm (5'6.5"), ♀ = 160 cm (5'3") (Stringer & Gamble, 1993)

Examine the material at this station and identify the Neandertal traits in the postcranial bones. Additionally, spend some time comparing the Neandertal specimens to *Homo sapiens sapiens* and the older anatomically modern humans (AMH) postcranial material if present. Answer the questions for Station 4 in the *Homo* Lab Worksheet.

Station 5) *Homo floresiensis*

A remarkable discovery of hominin fossils, from the Indonesian island of Flores, introduced a new hominin species, *Homo floresiensis* (Brown et al., 2004). Archaeological material had long been known on this island but this type of hominin had never been encountered. The cave site known as Liang Bua cave has evidence of artifact yielding conglomerates that are dated to ~190,000 years ago (Westaway et al., 2009). The hominin fossils, which represent as many as 14 individuals, occupied the cave from ~95 – 74,000 to 17,000 years ago (Morwood et al., 2009). The majority of these fossils, including LB1, the partial skeleton, date to between ~18,000 to 16,000 years ago. LB1 is the specimen that has produced an extraordinary array of contrasting opinions about its nature. This specimen is a partial skeleton of a tiny adult female individual that was under 3 ½ feet tall (106 cm) and had a cranial capacity between 385-417 cm^3 (Brown et al., 2004), which is at the lower end of the australopithecine range. LB1 is the only complete cranium in the fossil collection and has caused a dilemma. Many scientists have been surprised and to some degree reluctant to accept that a hominin with a nearly ape-size brain would be capable of controlling fire, complex tool making and large animal hunting as the archeological record suggests.

Initially, it was suggested that *Homo floresiensis* was the descendant of *Homo erectus* that arrived on the island at least 800,000 years ago and subsequently dwarfed down in size through a process called insular dwarfing. In this evolutionary pattern, large animals that become stranded on an island subsequently reduce in size due to the effects of natural selection while small animals often increase in size. The island of Flores has fossil remains of a dwarfed elephant-like animal and remains of a large lizard (Komodo dragon), giant rat and a large carnivorous bird. It was argued that hominins were part of this island adaptation, that the large-bodied *Homo erectus* population reduced in size and thereby produced *Homo floresiensis*. The contrasting hypothesis, at this time, was that LB1 represents an individual that was suffering from some sort of pathological condition that resulted in dwarfism and microcephaly (a disorder that produces an abnormally small cranial capacity).

Aiello (2010) has reviewed an array of arguments on this fossil and has suggested that the pathology hypothesis has not been substantiated. Moreover, recent analyses have noted a variety of primitive characteristics in *Homo floresiensis*, such as long arm to leg proportions along with primitive features in the wrist and foot (Jungers et al., 2009a; Jungers et al., 2009b; Tocheri et al., 2007). She supports, along with a consensus of opinion of the discovery team, that *Homo floresiensis* may be the descendant of early *Homo* ancestors that reached the island. Aiello's conclusion is "that the evidence supports the hypothesis that *Homo floresiensis* is a late-surviving species of early *Homo* with its closest morphological affinities to early African pre-erectus/ergaster hominins" (Aiello, 2010, p.167). The test of time and additional fossil discoveries will, perhaps, be the only way to resolve this controversy.

Station 6) Anatomically Modern *Homo sapiens*

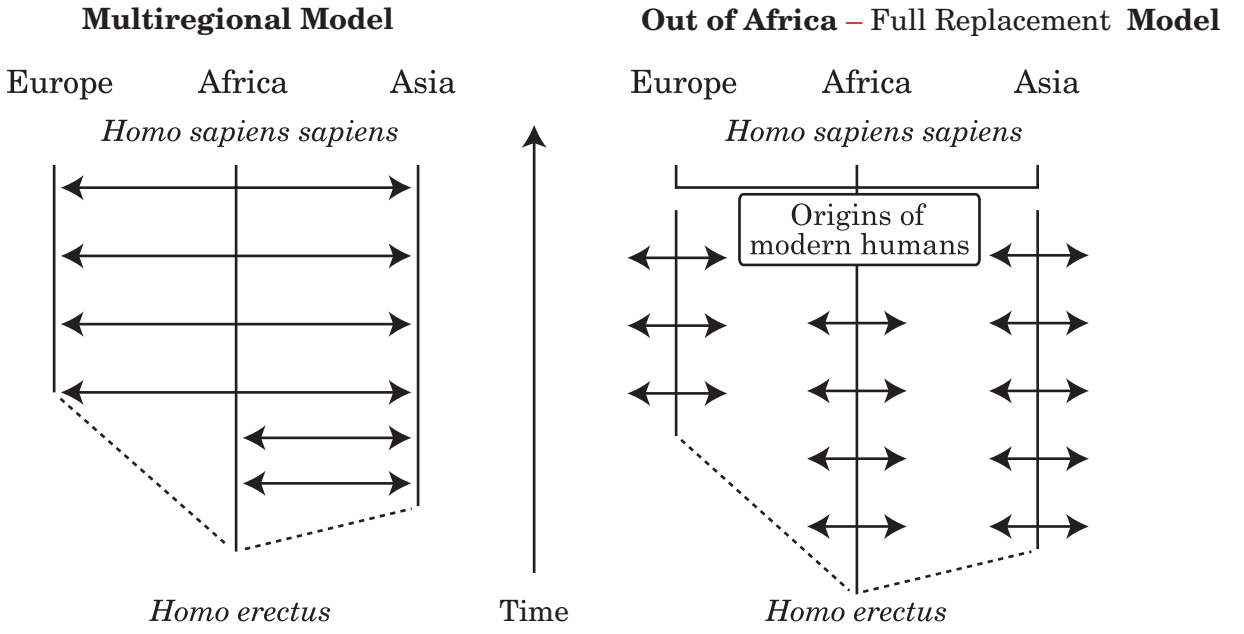
Modern Human Origins

At the center of the study of paleoanthropology are the questions of where, when and how did modern humans arise. There are basically two models that address these questions. The **Multiregional Model** suggests that there was an exodus from Africa by early *Homo erectus* in the Pleistocene with their populations migrating first into Asia and eventually into Europe. During this period of geographic expansion, the hominin populations maintained enough gene flow between populations in the various regions of the world to preserve species integrity. This widely dispersed hominin population evolved from early *Homo erectus* to *Homo heidelbergensis* and eventually into *Homo sapiens*

sapiens. This model would expect to find continuity of characteristics in each region of the world as this evolutionary transformation occurred. Genetic analysis should yield evidence of ancient relationships between living humans. It essentially suggests that the last time all of humanity shared a common localized population was 1.8 million years ago in Africa prior to the exodus. See the Multiregional Model in Figure 5 below.

The alternate model that is used to explain modern human origins is the **Single Origin/Full Replacement Model** that is sometimes referred to as the **Out of Africa Model**. This approach would also suggest that hominins exited Africa in the Pleistocene and occupied Asia and eventually Europe. However, this hypothesis suggests that gene flow was occurring within each region of the world but not extensively between the different regions. It further suggests that modern humans arose in Africa, perhaps 200,000 years ago and that a second exodus out of Africa occurred. This exodus was a migration of modern humans into Asia and Europe and a subsequent replacement of any resident archaic populations in those regions. This model would predict that modern humans should be found in Africa earlier than in other regions of the world and that we should not see continuity of traits from *Homo erectus* and *Homo heidelbergensis* to modern humans in each region of the world. One would also expect to see some overlap in resident archaic populations and the immigrant modern human populations. Moreover, the genetic evidence should demonstrate a relatively recent common ancestry for all living humans. See the Out of Africa – Full Replacement Model in Figure 5 below.

Figure 5



(modified from Lewin & Foley, 2004)

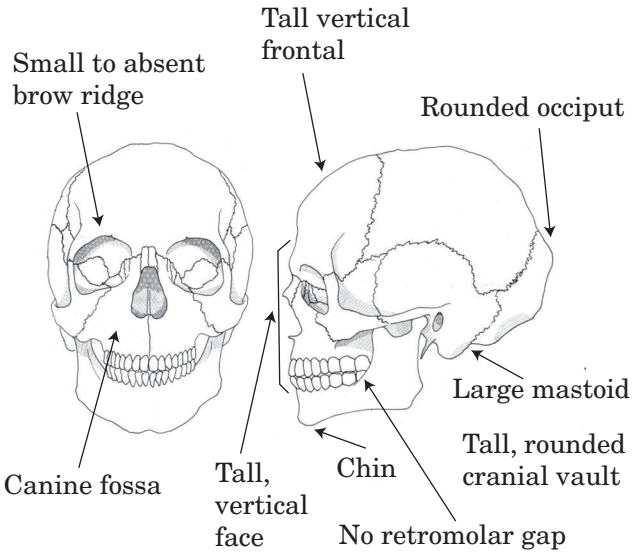
There currently is a middle ground between these models that will be referred to as the **Single Origin/Partial Replacement Model.** It is basically an Out of Africa Model, suggesting that modern humans arose in Africa and migrated to the other regions of the world. This model suggests that once modern humans arrive in Asia and Europe there was some gene exchange between immigrant modern humans and local archaic humans. This model still argues that most of our ancestry is African but it allows for some contribution of the more ancient local populations. This model would seem to have significant genetic support with the publication of DNA evidence of Neandertal/modern human interbreeding (Green et al., 2010).

Modern *Homo sapiens* (populations that are categorized in the Linnaean system as *Homo sapiens sapiens*) have many morphological changes that are tied to modifications of the cranial and facial anatomy of this population. The population is characterized by a very large brain that is contained in a tall, short, rounded skull vault with a short vertical face tucked under the cranium. When the Multiregional model was the dominant explanation for modern human origins, we thought that these people appeared around 35 to 40,000 years ago. However, by the 1980's, fossil discoveries revealed specimens that looked like modern humans but appeared to be much older than 35 to 40,000 years. These specimens were referred to as Anatomically Modern Humans (AMH), or nearly modern humans. The morphology of this group is essentially like modern humans albeit somewhat more robust. Basically they are a group of fossils that look very much like modern humans but they were far older than anyone expected modern looking fossil to be. If we include the AMH in our discussion of modern human origins, then the earliest of fossils that look like us appear in Africa around 195,000 years ago. These fossils include Omo (195,000), Herto (165,000), Klasies River Mouth Cave (125,000) and Border Cave(100,000). At 90,000, AMH fossils are found at two sites in the Middle East (Israel), Qafzeh, and Skhul Caves. Eventually, these modern human populations expand out of Africa: into Asia by 60,000, Australia by 50,000, Europe by 35 to 40,000 years ago and lastly, the New World. by at least 15,000 years ago.

Cranial Characteristics of Modern Humans

1. tall rounded cranial vault with a large brain, mean = 1349 cc and EQ = 5.28, (Ruff, 1997)
2. small, vertical face with canine fossa
3. relatively vertical frontal bone (forehead)
4. brow ridge development is absent or relatively small
5. large mastoid process
6. highly flexed cranial base
7. gently rounded occiput (no torus or bun)
8. when viewed from behind the skull is widest near the top of the parietal region
9. chin
10. small teeth
11. no retromolar gap

Figure 6



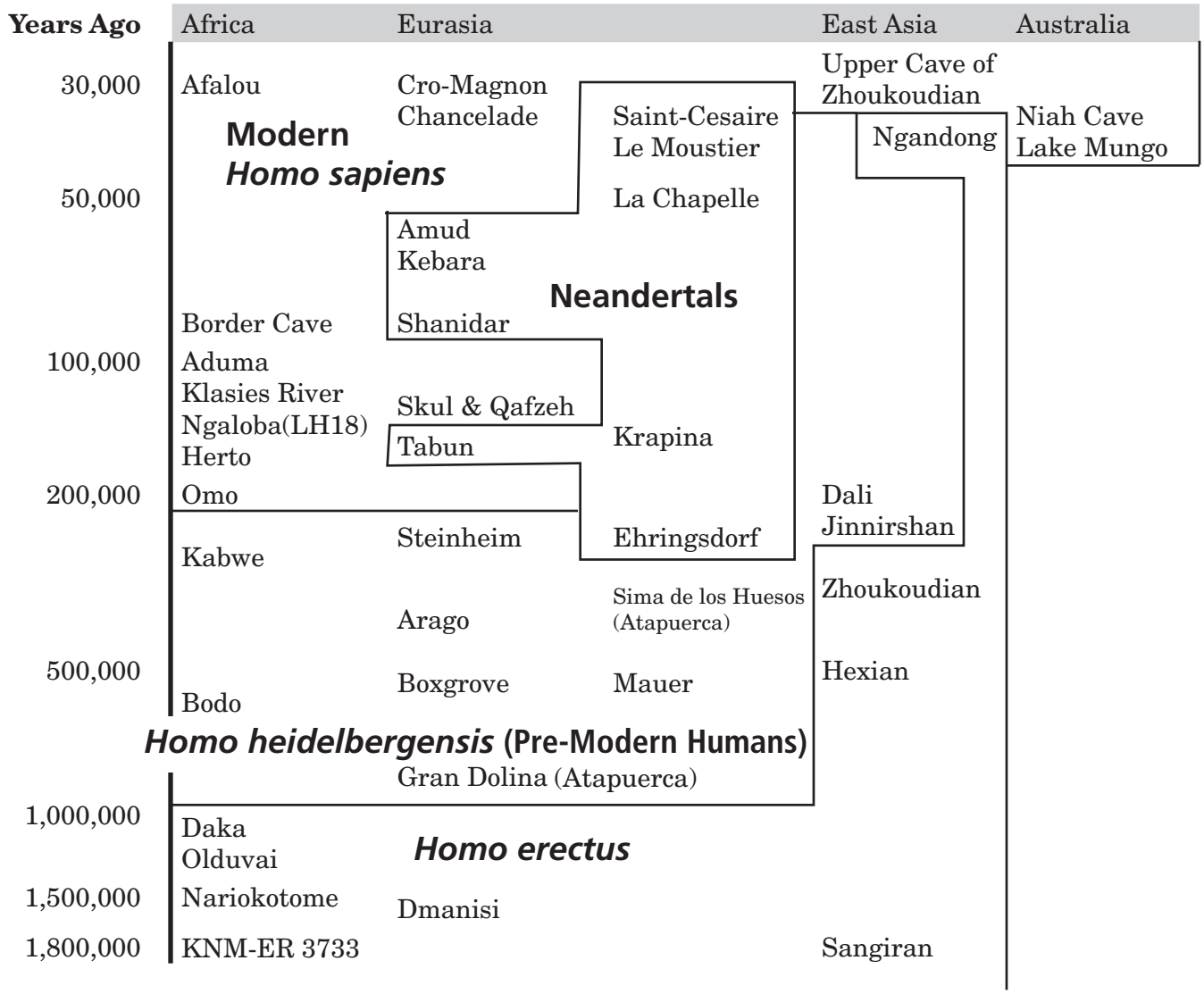
(drawn by Jhosef Hern)

Postcranial Characteristics of Modern Humans

1. generally less robust postcranial skeleton,
   mean body weight – ♂ = 58 kg (127.6 lbs), ♀ = 49 kg (107.8 lbs) (McHenry and Coffin, 2000)
   mean stature – ♂ = 175 cm (≈5'9"), ♀ = 161 cm (≈5'3") (McHenry and Coffin, 2000)
2. limb bones can vary from small and delicate to very large and robust, however, they are still significantly less robust than earlier people
3. scapula is characterized by a bisulcate or ventral sulcus on the lateral margin
4. thumb distal phalange 2/3 the length of the proximal phalanx
5. distal limb segments usually longer relative to the entire limb
6. cortical bone of the femur and tibia thinner than in earlier people

This station displays a variety of specimens thought to represent modern humans or nearly modern humans. One could examine any of the following fossils in order to understand the characteristics of nearly modern and fully modern humans. Omo, Herto, Border Cave (from Africa), Skhul/Qafzeh (from Israel) are generally referred to as AMH or nearly modern humans. Whereas Chancelade and Cro-Magnon (from France), Upper Cave of Zhoutoudian (from China) or Lake Mungo (from Australia) are generally referred to as modern humans or *Homo sapiens sapiens.* Examine the fossils at this station and identify the characteristics that define modern humans and the patterns displayed in the nearly modern human specimens. Do these fossils look like Neandertals? What features distinguish the nearly modern human specimens from the fully modern humans (*Homo sapiens sapiens*)? Select one individual to measure and record the metric data necessary for the *Homo* Lab Table then answer the questions for Station 5 in the *Homo* Lab Worksheet. The figure below is included for your reference regarding the dating, geographic location and the general categories that the hominins from today's lab are thought to belong.

Figure 7



(Modified from Conroy, 2005)

Station 7) Tools

At this station you will find sets of tools from the Lower Paleolithic (Oldowan and Acheulean), Middle Paleolithic (Mousterian), and Upper Paleolithic. Examine the different kinds of tools, looking for workmanship, difficulty of manufacture, aesthetics and so on. It is important that you understand the progression of tool making sophistication that accompanies hominin evolution.

Oldowan Tools

The earliest stone tools found in Africa (2.5 mya) are generally assigned to the Oldowan Tradition or Clark's (1977) "Mode 1." Technology consisted of the simple reduction of cores and the flakes produced from this activity (Schick, 1998). These are very simple implements that have been divided into several artifact types (Klein, 1989) which are described below.

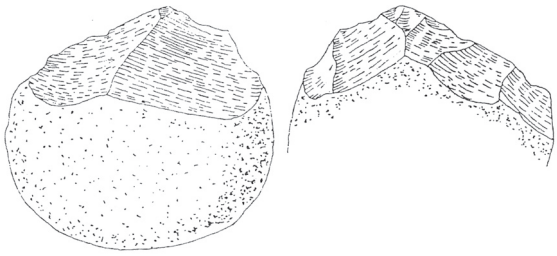
1. Manuports – stones that must have been carried to a site but were not modified by hominins
2. Hammerstones – battered rocks mainly used for striking flakes from cores
3. Cores – rocks that have had flakes removed (Today many archaeologists think cores were largely sources for flake production rather than actual tools themselves)
4. Flakes – the small chips of stones removed from the core, sometimes retouched

It is not clear what hominin made these implements although they are generally attributed to early *Homo*. Nonetheless, since there are several hominins existing at this time (*Australopithecus garhi, Australopithecus sediba, Paranthropus, Homo habilis, Homo rudolfensis*) there is no absolute way of attributing these tools to one specific hominin. Consequently, it is best to indicate that these implements were made by one or more of the hominins from this time period.

Acheulean Tools

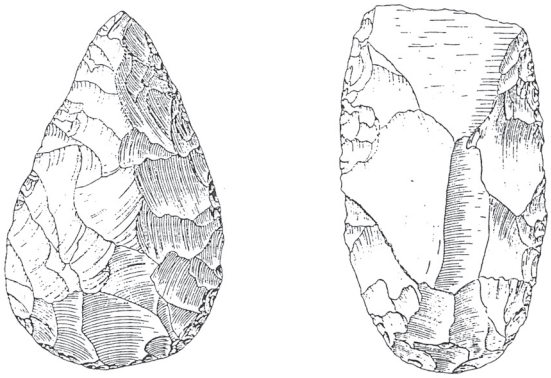
These tools, referred to as Mode 2 technology, are found in Africa and originated between 1.7 and 1.4 million years ago and probably developed out of the earlier Oldowan tool technology. The bifacial hand axe and the cleaver are the classic tool types found with this industry and often constitute a very high percentage of artifacts found at these sites. These core implements have had flakes removed from two sides of the core and the flaking extend to nearly the entire periphery of the core. The implements are cruder in the earlier phase of the tradition but become extremely well made and symmetrical in the later phases (200–300,000 years ago). These types of tools are extraordinary for their longevity of more than a million years. This type of tool inventory is found in Africa, Europe and western Asia and is typically associated with *Homo erectus* fossils. In Asia *Homo erectus* sites are not found with Acheulean tool industries (hand axe and cleavers) but rather with Mode 1 technologies of flaked cores and flakes.

Figure 8 –
Simple chopper tools found in the Oldowan Tool Industry



Unifacial chopper Bifacial chopper

Acheulean Tools



Bifacial hand ax Bifacial cleaver

(Klein, 1999)

The later Acheulean is found in association with *Homo heidelbergensis*. In the later Middle Pleistocene (200,000–300,000 years ago) a new manufacturing technique was developed (initially in Africa) called the prepared core technique (also called the Levallois technique). This technique involved shaping a core by removing many flakes from around the circumference of the core. Once the desired shape is produced, a final large circular or oval flake is removed from the top of the core (see Figure 9). The flake is then modified into a variety of tools such as a small hand axe.

Mousterian Tools

There is a gradual shift away from large hand axes to smaller flake tools made by the prepared core technique. These flake tool industries are called Mousterian, Middle Paleolithic, or Middle Stone Age and are considered Mode 3 technologies. This tool industry is associated with Neandertal hominins and some early modern humans. In this industry, a core would be shaped and then a desired flake would be removed (prepared core technique) and the flake made into a tool such as a side scraper or point or even a small handaxe. The point of the tool making operation is the production of a flake. This industry is known for flake tools and for the development of composite tools (implement made of a stone point and wooden shaft).

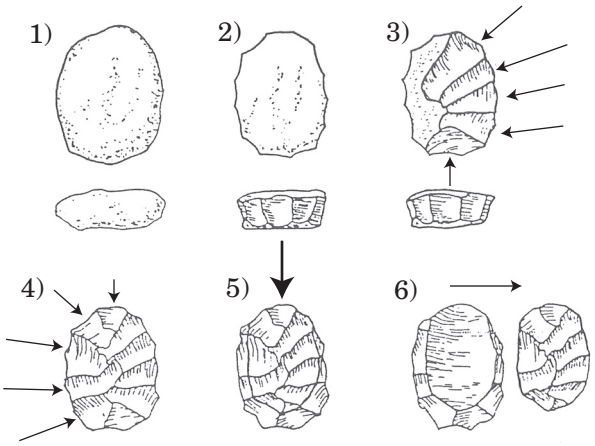
Upper Paleolithic Tools

These tools are Mode 4 technologies in Clark's system and were made by modern humans (*Homo sapiens sapiens*). They too were made from a prepared core technique but the typical implement is a blade. A blade is a flake that is at least twice as long as it is wide. This technique was a very efficient method for the production of numerous straight cutting edge surfaces. These blades could then be modified into a variety of tools, such as end scrapers, burins, and points, many of which were hafted to wood or bone. The industry is associated with magnificent stone blades, bone and antler tools, needles, engraved and carved artwork, and the first projectile device, the spear thrower or atlatl.

Complete the Tool Table on page 226 and answer the questions for Station 7 in the *Homo* Lab Sheet.

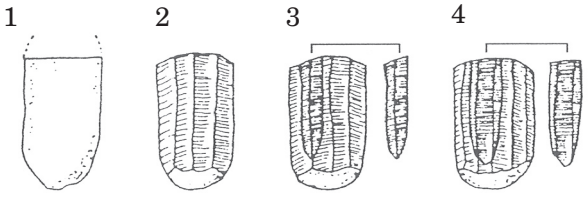
Figure 9

Mousterian Tools and the prepared core technique



Stages in the manufacture of a Levallois core.
1) Original stone or core; 2) core is rounded by removing flakes around the edges; 3) flakes are struck off the surface until the core has the desired shape; 4) core preparation is complete 5) a final hammer blow removes a large flake; 6) the flake will be further modified and used as a preferred tool such as hand axe or scraper.

Upper Paleolithic Tools and the production of a blade



Stages in the manufacture of a prismatic blade core.

1) Blade core;
2) blade core is fully prepared;
3) a blade is struck off the core;
4) blades continue to be struck off the core.

(Klein, 1999)

Paleoanthropologist _____ Date _____

Before you begin, I would urge you to tear out these worksheets thereby allowing you to answer the questions for each station while keeping the manual open to the pages with relevent information.

Homo Lab Worksheet

In the table below you will record a series of measurements and observations on four skulls: one *Homo erectus*, one *Homo heidelbergensis*, one Neandertal, and one modern *Homo sapiens*. The measurements will be very familiar to you now. You are welcomed to utilize the *Homo sapiens* and *Homo erectus* data that you have collected at earlier labs for this assignment. You will also calculate a series of indices that are used to describe the shape of the cranium and face, and then respond to the questions for each station.

Homo Lab Table

	Homo erectus	*Homo heidelbergensis*	Neandertal	modern *Homo sapiens*
Lower Facial Depth (Basion - Alveolare Length)				
Upper Facial Depth (Nasion-Basion Length)				
Facial Prognathism Index $\frac{\text{Lower Facial Depth} \times 100}{\text{Upper Facial Depth}}$				
Upper Facial Height (alveolare-nasion)				
Cranial Length (glabella-opisthocranion)				
Cranial Breadth (max. breadth on the parietals) (euryon to euryon)				
Cranial Facial Index $\frac{\text{Upper Facial Height} \times 100}{\text{(Cranial Length + Cranial Breadth)}}$				
Bizygomatic Breadth (zygion to zygion)				
Minimum Frontal Breadth (frontotemporal - frontotemporal)				
Postorbital Constriction Index $\frac{\text{Minimum Frontal Breadth} \times 100}{\text{Bizygomatic Breadth}}$				
Postorbital Constriction (absent, slight, moderate, extensive)				

(continue)	*Homo erectus*	*Homo heidelbergensis*	Neandertal	modern *Homo sapiens*
Size and shape of the face (dished-shape, large & prognathous, inflated maxilla, canine fossa present?)				
The frontal bone shape (sloping, vertical)				
Supraorbital torus (absent, slight, moderate, large)				
Describe the occipital bone (angular, occipital bun, vertical)				
As viewed from the back, where is the skull broadest?				
Is there a chin present?				
Is there a retromolar gap?				

Station 1

1 a. Locate and identify six features in the adult specimens at this station that are characteristic of the species *Homo erectus*.

i. _____ ii. _____

iii. _____ iv. _____

v. _____ vi. _____

b. As you know from reading the *Homo erectus* section of this lab, the specimens at this station range geographically from Africa to East Asia and temporally from 1.7 mya to perhaps 50–30,000 years ago. As you went about answering the first question at this station, you were in essence listing the shared characteristics of the species *Homo erectus*. Nonetheless, these fossils comprise a very broad group of specimens both temporally and geographically. While these specimens have much in common, some researchers would suggest that they also possess unique traits. List one unique trait for each of the adult specimens at this station.

KNM-ER 3733 _____

Sangiran 17 _____

Ngandong _____

Dmanisi _____

Zhoukoudian _____

Station 2

2 a. Observe Kabwe and list two *erectus*-like characteristics that can be seen.

i. _____ ii. _____

b. List two derived (changed) features that can be seen in this specimen.

i. _____ ii. _____

c. Do you see any evidence of pathology in the Kabwe specimen? _____ yes / no?

If so, what type of pathology? _____

d. Look at the specimen from Europe (See Table 1 on page 210. Does this specimen have Neandertal-like traits? Neandertal characteristics are listed in the manual under the discussion for Station 3 and are also discussed in the European *Homo heidelbergensis* text at Station 2. List any Neandertal-like traits you see on this specimen.

i. _____

ii. _____ iii. _____

e. Do you see any cut marks (made by stone tools) on the Bodo specimen? _____ yes / no?

f. Where are these marks located? _____

g. What type of behaviors might be associated with these cut marks? _____

_____

Station 3

3 a. Compare the Neandertal crania at this station to the crania of modern humans. How does the Neandertal cranium differ from the modern human cranium? In other words, identify the defining cranial characteristics of Neandertals.

i. _____ ii. _____

iii. _____ iv. _____

v. _____ vi. _____

b. What is the geographical range of Neandertals? _____

c. Do you think that Neandertals should be classified as *Homo neanderthalensis* or *Homo sapiens neaderthalensis*? _____

d. Based on your answer to question 3c., do you think modern humans and Neandertals could interbreed? _____ yes / no?

e. How does the scientific name you selected for your answer to 3 c. (*Homo neanderthalensis* or *Homo sapiens neandertalensis*) indicate if these populations could interbreed?

_____

_____

_____

Station 4

4 a. Compare these Neandertal limb bones to those of a modern human. In what ways do the Neandertal skeletal elements differ?

i. _____ ii. _____

iii. _____ iv. _____

b. Based on the morphological appearance of these bones, what do you think the Neandertal body type might have been: tall and slender or short and stocky?

_____

c. The chapter on human variation and adaptation in your textbook discusses Bergmann's and Allen's rules regarding body size, proportion and climate.

i. What is Bergmann's rule? _____

ii. What is Allen's rule? _____

iii. Can these rules be applied to Neandertals? Explain. _____

_____

_____

d. In addition to modern specimens and Neandertal fossil casts, this station also displays casts of postcranial remains from Skhul (thought to be an AMH specimen). Are these AMH specimens similar to Neandertal or modern humans?

_____

Support your conclusion with characteristics. i. _____

ii. _____ iii. _____

Station 5

5 a. Examine the cranium at this station. Do you see any traits that are similar between *Homo florensiensis* and early *Homo,* if so, list two.

i. _____ ii. _____

b. Do you see any traits that are similar between *Homo florensiensis* and *Homo erectus,* if so, list two.

i. _____ ii. _____

Station 6

6 a. Which specimen(s) look nearly (almost) modern to you? _____

b. What features make the specimen(s) identified in 6a "nearly (almost) modern" rather than "fully modern"?

i. _____ ii. _____

c. Does the Herto specimen look fully modern to you? ..... yes / no

d. List features that support your assessment. i. _____

ii. _____ iii. _____

e. Chancelade is the type of human that is often called Cro-Magnon man. How would you classify this cranium using the Linnaean species name?

_____

Review Questions

Answer these questions after you have completed stations 1 through 6. These questions will require you to synthesize information from stations 1 through 6. You must consider the morphological observations you have made, as well as the measurements and indices that you have recorded and calculated.

1. Do you think that all the *Homo erectus* specimens that you have studied today should share a single species category? In other words, are they all *Homo erectus* or should the early African fossils be called *Homo ergaster*?

_____

Why? _____

_____

2. Would you label the specimens at Station 2 as late *Homo erectus*, *Homo heidelbergensis* or archaic *Homo sapiens*?

_____

Why? _____

_____

3. Should Neandertal be placed in the species *Homo sapiens*? _____

Why? _____

_____

4. Do you think that Neandertals contributed to the modern human gene pool? yes / no ?

5. Your answer to the above question reflects your alignment with one of the models that explains the orgins of modern humans. Which model does it reflect?

_____

6. For all the specimens in today's lab name the

   a. family _____ b. tribe _____ c. genus _____

Station 7

Tool Table

Tool Type	Oldowan	Acheulean	Mousterian	Upper Paleolithic
Are the cores a resource or the tool itself?				
Describe the cores				
Are the implements symmetrical? (no, somewhat, highly)				
Is there any sign of retouching on the flakes? (none, slight, extensive)				
Relative to the overall size of the artifact, is there much cutting edge surface on these tools?				

7 a. What kinds of hominins are found in sites where Oldowan tools are found?

_____

b. What kind of hominin made Early Acheulean tools? _____

c. What are the diagnostic tools of the Acheulean tool industry? _____

_____

d. What tool industry is associated with the Neandertal? _____

e. What stone tool manufacturing technique did the Neandertals use? _____

f. How are Upper Paleolithic blades different from Mousterian points? _____

g. Is there any strikingly different artifact type associated with modern humans, if so what?

_____

_____