

# EXPLORATIONS: AN OPEN INVITATION TO BIOLOGICAL ANTHROPOLOGY, 2ND EDITION

BETH SHOOK, PH.D.; LARA BRAFF, PH.D.; KATIE NELSON, PH.D.; AND KELSIE AGUILERA, M.A.

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# Chapter 12: Modern *Homo sapiens*

Keith Chan, Ph.D., Grossmont-Cuyamaca Community College District and MiraCosta College

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## Learning Objectives

- Identify the skeletal and behavioral traits that represent modern *Homo sapiens*.
- Critically evaluate different types of evidence for the origin of our species in Africa and our expansion around the world.
- Understand how the human lifestyle changed when people transitioned from foraging to agriculture.
- Hypothesize how human evolutionary trends may continue into the future.

The walls of a pink limestone cave in the hillside of Jebel Irhoud jutted out of the otherwise barren landscape of the Moroccan desert (Figure 12.1). Miners had excavated the cave in the 1960s, revealing some fossils. In 2007, a re-excavation of the site became a momentous occasion for science. A fossil cranium unearched by a team of researchers was barely visible to the untrained eye. Just the fossil’s robust brows were peering out of the rock. This research team from the Max Planck Institute for Evolutionary Anthropology was the latest to explore the ancient human presence in this part of North Africa after a find by miners in 1960. Excavating near the first discovery, the researchers wanted to learn more about how *Homo sapiens* lived far from East Africa, where we thought our species originated.



Figure 12.1: The excavation of an exposed cave at Jebel Irhoud, Morocco, where hominin fossils were found in the 1960s and in 2007. Dating showed that they could represent the earliest-known modern *Homo sapiens*. Credit: View looking south of the Jebel Irhoud (Morocco) site by Shannon McPherron, MPI EVA Leipzig, is under a CC BY-SA 2.0 License.

The scientists were surprised when they analyzed the cranium, named Irhoud 10, and other fossils. Statistical comparisons with other human crania concluded that the Irhoud face shapes were typical of recent modern humans while the braincases matched ancient modern humans. Based on the

findings of other scientists, the team expected these modern *Homo sapiens* fossils to be around 200,000 years old. Instead, dating revealed that the cranium had been buried for around 315,000 years.

Together, the modern-looking facial dimensions and the older date reshaped the interpretation of our species: modern *Homo sapiens*. Some key evolutionary changes from the archaic *Homo sapiens* (described in Chapter 11) to our species today happened 100,000 years earlier than we had thought and across the vast African continent rather than concentrated in its eastern region.

This revelation in the study of modern *Homo sapiens* is just one of the latest in this continually advancing area of biological anthropology. Researchers today are still discovering amazing fossils and ingenious ways to collect data and test hypotheses about our past. Through the collective work of many scientists, we are building an overall theory of modern human origins. In this chapter, we will first cover the skeletal changes from archaic *Homo sapiens* to modern *Homo sapiens*. Next, we will track how modern *Homo sapiens* expanded around the world. Lastly, we will cover the development of agriculture and how it changed human culture.

## Defining Modernity

What defines modern *Homo sapiens* when compared to archaic *Homo sapiens*? Modern humans, like you and me, have a set of derived traits that are not seen in archaic humans or any other hominin. As with other transitions in hominin evolution, such as increasing brain size and bipedal ability, modern traits do not appear fully formed or all at once. In other words, the first modern *Homo sapiens* was not just born one day from archaic parents. The traits common to modern *Homo sapiens* appeared in a **mosaic** manner: gradually and out of sync with one another. There are two areas to consider when tracking the complex evolution of modern human traits. One is the physical change in the skeleton. The other is behavior inferred from the size and shape of the cranium and material culture evidence.

### Skeletal Traits

The skeleton of modern *Homo sapiens* is less robust than that of archaic *Homo sapiens*. In other words, the modern skeleton is **gracile**, meaning that the structures are thinner and smoother. Differences related to gracility in the cranium are seen in the braincase, the face, and the mandible. There are also broad differences in the rest of the skeleton.

#### Cranial Traits

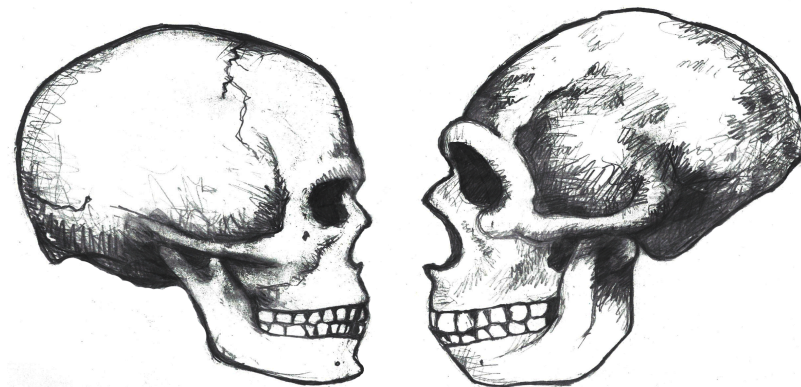


Figure 12.2: Comparison between modern (left) and archaic (right) *Homo sapiens* skulls. Note the overall gracility of the modern skull, as well as the globular braincase. Credit: Modern human and Neanderthal original to *Explorations: An Open Invitation to Biological Anthropology* by Mary Nelson is under a CC BY-NC 4.0 License.

Several elements of the braincase differ between modern and archaic *Homo sapiens*. Overall, the shape is much rounder, or more **globular**, on a modern skull (Lieberman, McBratney, and Krovitz 2002; Neubauer, Hublin, and Gunz 2018; Pearson 2008; Figure 12.2). You can feel the globularity of your own modern human skull. Feel the height of your forehead with the palm of your hand. Viewed from the side, the tall vertical



forehead of a modern *Homo sapiens* stands out when compared to the sloping archaic version. This is because the frontal lobe of the modern human brain is larger than the one in archaic humans, and the skull has to accommodate the expansion. The vertical forehead reduces a trait that is common to all other hominins: the brow ridge or **supraorbital torus**. The parietal lobes of the brain and the matching parietal bones on either side of the skull both bulge outward more in modern humans. At the back of the skull, the archaic occipital bun is no longer present. Instead, the occipital region of the modern human cranium has a derived tall and smooth curve, again reflecting the globular brain inside.

The trend of shrinking face size across hominins reaches its extreme with our species as well. The facial bones of a modern *Homo sapiens* are extremely gracile compared to all other hominins (Lieberman, McBratney, and Krovitz 2002). Continuing a trend in hominin evolution, technological innovations kept reducing the importance of teeth in reproductive success (Lucas 2007). As natural selection favored smaller and smaller teeth, the surrounding bone holding these teeth also shrank.

Related to smaller teeth, the mandible is also gracile in modern humans when compared to archaic humans and other hominins. Interestingly, our mandibles have pulled back so far from the prognathism of earlier hominins that we gained an extra structure at the most anterior point, called the **mental eminence**. You know this structure as the chin. At the skeletal level, it resembles an upside-down “T” at the centerline of the mandible (Pearson 2008). Looking back at archaic humans, you will see that they all lack a chin. Instead, their mandibles curve straight back without a forward point. What is the chin for and how did it develop? Flora Gröning and colleagues (2011) found evidence of the chin’s importance by simulating physical forces on computer models of different mandible shapes. Their results showed that the chin acts as structural support to withstand strain on the otherwise gracile mandible.

### Postcranial Gracility

The rest of the modern human skeleton is also more gracile than its archaic counterpart. The differences are clear when comparing a modern *Homo sapiens* with a cold-adapted Neanderthal (Sawyer and Maley 2005), but the trends are still present when comparing modern and archaic humans within Africa (Pearson 2000). Overall, a modern *Homo sapiens* postcranial skeleton has thinner cortical bone, smoother features, and more slender shapes when compared to archaic *Homo sapiens* (Figure 12.3). Comparing whole skeletons, modern humans have longer limb proportions relative to the length and width of the torso, giving us lankier outlines.

Why is our skeleton so gracile compared to those of other hominins? Natural selection can drive the gracilization of skeletons in several ways (Lieberman 2015). A slender frame is adapted for the efficient long-distance running ability that started with *Homo erectus*. Furthermore, slenderness is a genetic adaptation for cooling an active body in hotter climates, which aligns with the ample evidence that Africa was the home continent of our species.

### Behavioral Modernity

Aside from physical differences in the skeleton, researchers have also uncovered evidence of behavioral changes associated with increased cultural complexity from archaic to modern humans. How did cultural complexity develop? Two investigations into this question are archaeology and the analysis of reconstructed brains.

Archaeology tells us much about the behavioral complexity of past humans by interpreting the significance of material culture. In terms of advanced culture, items created with an artistic flair, or as decoration, speak of abstract thought processes (Figure 12.4). The demonstration of difficult artistic techniques and technological complexity hints at social learning and cooperation as well. According to paleoanthropologist John Shea (2011), one way to track the complexity of past

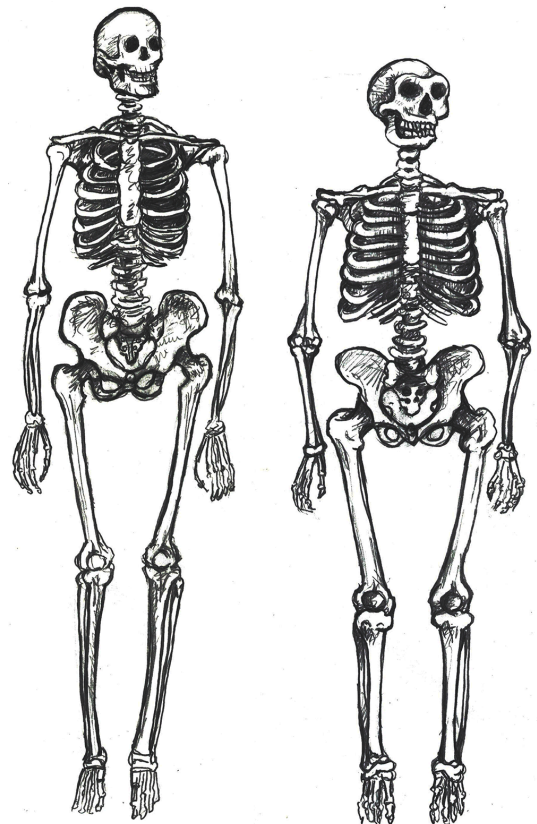


Figure 12.3: Anterior views of modern (left) and archaic (right) *Homo sapiens* skeletons. The modern human has an overall gracile appearance at this scale as well. Credit: Modern and archaic *Homo sapiens* skeletons (Figure 12.3) original to *Explorations: An Open Invitation to Biological Anthropology* by Mary Nelson is under a CC BY-NC 4.0 License.

behavior through artifacts is by measuring the variety of tools found together. The more types of tools constructed with different techniques and for different purposes, the more modern the behavior. Researchers are still working on an archaeological way to measure cultural complexity that is useful across time and place.

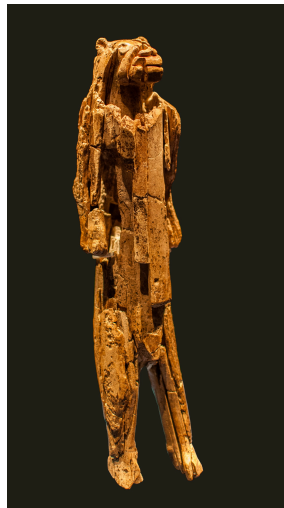


Figure 12.4: Carved ivory figure called “the Lion-Man of the Hohlenstein-Stadel.” It dates to the Aurignacian culture, between 35 and 40 kya. Credit: Loewenmensch1 by Dagmar Hollmann is under a CC BY-SA 3.0 License.

The interpretation of brain anatomy is another promising approach to studying the evolution of human behavior. When looking at investigations on this topic in modern *Homo sapiens* brains, researchers found a weak association between brain size and test-measured intelligence (Pietschnig et al. 2015). Additionally, they found no association between intelligence and biological sex. These findings mean that there are more significant factors that affect tested intelligence than just brain size. Since the sheer size of the brain is not useful for weighing intelligence within a species, paleoanthropologists are instead investigating the differences in certain brain structures. The differences in organization between modern *Homo sapiens* brains and archaic *Homo sapiens* brains may reflect different cognitive priorities that account for modern human culture. As with the archaeological approach, new discoveries will refine what we know about the human brain and apply that knowledge to studying the distant past.

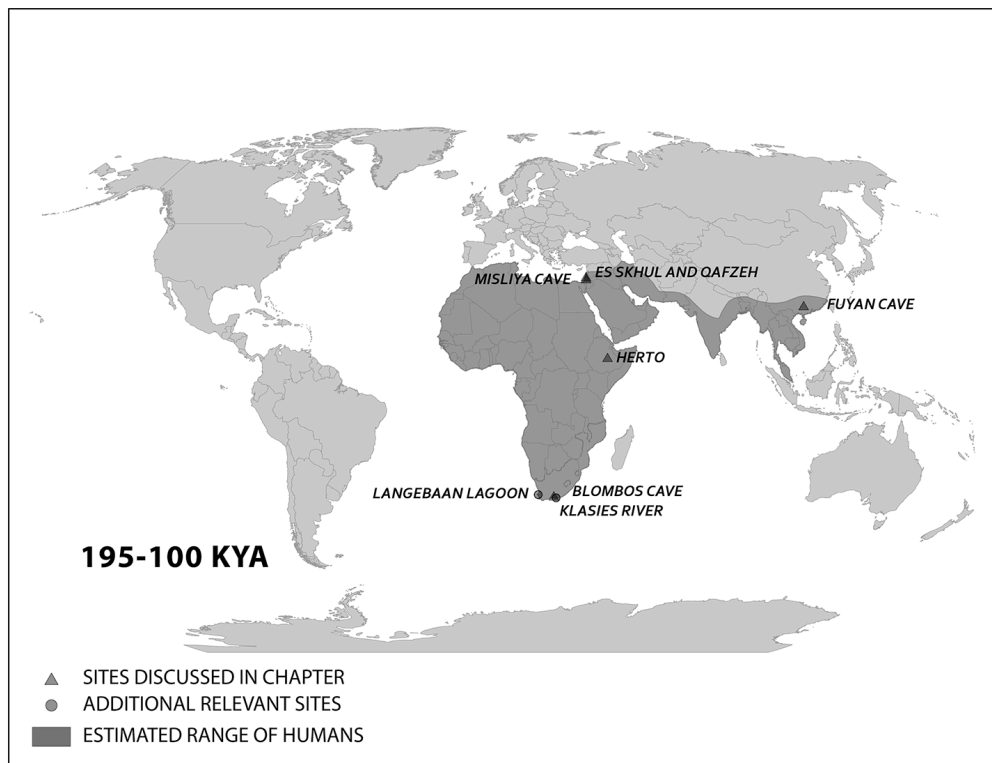
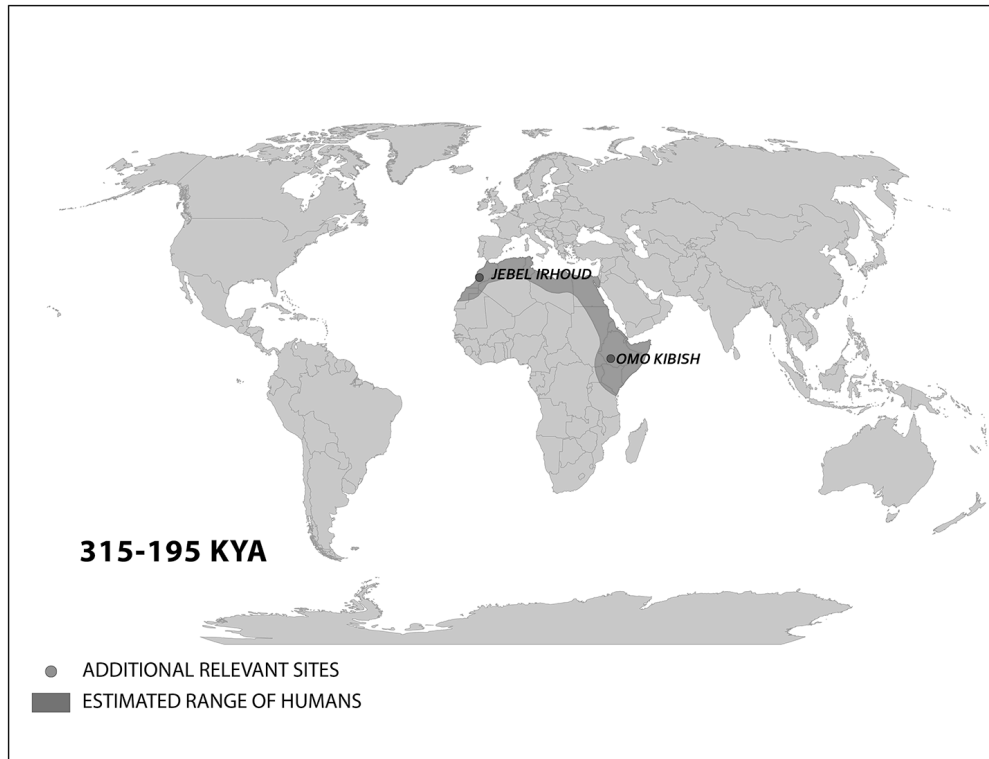
Taken together, the cognitive abilities in modern humans may have translated into an adept use of tools to enhance survival. Researchers Patrick Roberts and Brian A. Stewart (2018) call this concept the **generalist-specialist niche**: our species is an expert at living in a wide array of environments, with populations culturally specializing in their own particular surroundings. The next section tracks how far around the world these skeletal and behavioral traits have taken us.

## First Africa, Then the World

What enabled modern *Homo sapiens* to expand its range further in 300,000 years than *Homo erectus* did in 1.5 million years? The key is the set of derived biological traits from the last section. The gracile frame and neurological anatomy allowed modern humans to survive and even flourish in the vastly different environments they encountered. Based on multiple types of evidence, the source of all of these modern humans was Africa. Instead of originating from just one location, evidence shows that modern *Homo sapiens* evolution occurred in a complex gene flow network across Africa, a concept called **African multiregionalism** (Scerri et al. 2018).

This section traces the origin of modern *Homo sapiens* and the massive expansion of our species across all of the continents (except Antarctica) by 12,000 years ago. While modern *Homo sapiens* first shared geography with archaic humans, modern humans eventually spread into lands where no

human had gone before. Figure 12.5 shows the broad routes that our species took expanding around the world. I encourage you to make your own timeline with the dates in this part to see the overall trends.



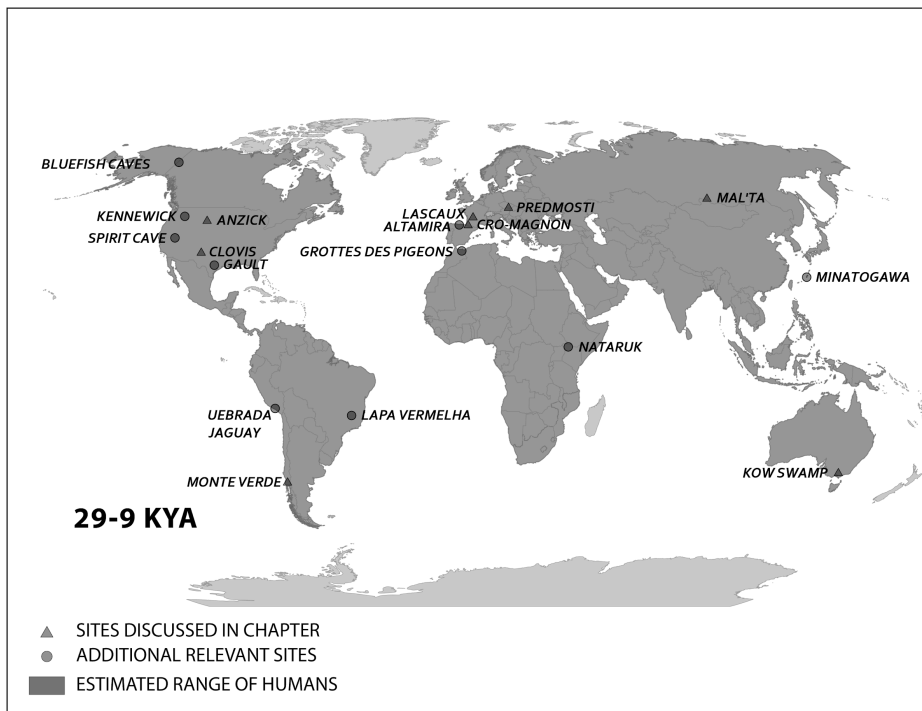
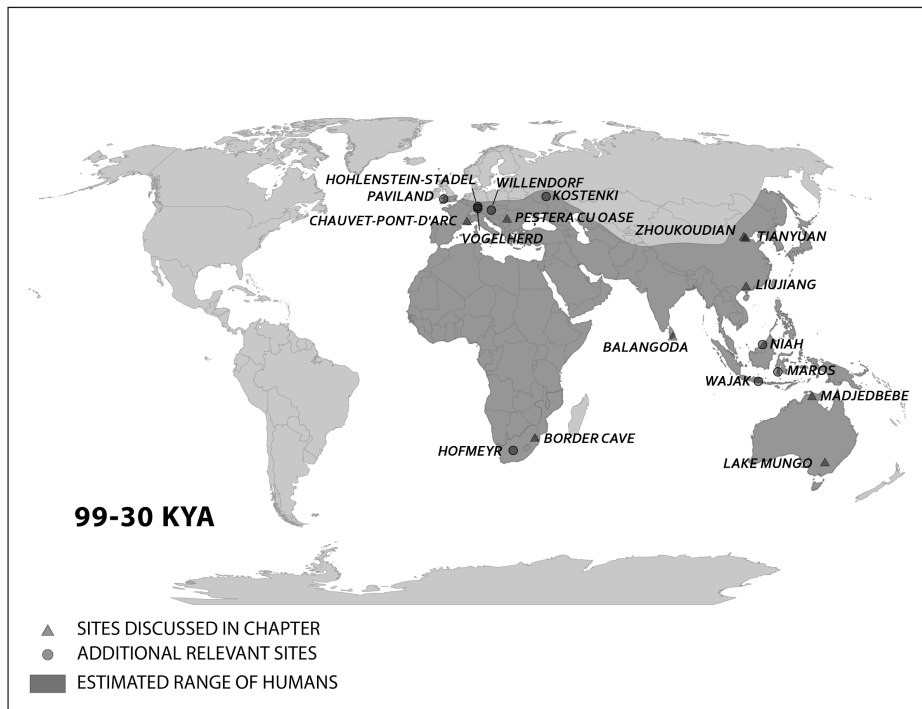


Figure 12.5a-d: Four maps depicting the estimated range of modern Homo sapiens through time. The shaded area is based on geographical connections across known sites. Note the growth in the area starting in Africa and the oftentimes-coastal routes that populations followed. Credit: Four maps depicting the estimated range of modern Homo sapiens through time original to Explorations: An Open Invitation to Biological Anthropology by Elyssa Ebding at GeoPlace, California State University, Chico is under a CC BY-NC 4.0 License.

## Modern *Homo sapiens* Biology and Culture in Africa

We start with the ample fossil evidence supporting the theory that modern humans originated in Africa during the Middle Pleistocene, having evolved from African archaic *Homo sapiens*. The earliest dated fossils considered to be modern actually have a mosaic of archaic and modern traits, showing the complex changes from one type to the other. Experts have various names for these transitional fossils, such as **Early Modern *Homo sapiens*** or **Early Anatomically Modern Humans**. However they are labeled, the presence of some modern traits means that they illustrate the origin of the modern type. Three particularly informative sites with fossils of the earliest modern *Homo sapiens* are Jebel Irhoud, Omo, and Herto.



Figure 12.6: Composite rendering of the Jebel Irhoud hominin based on micro-CT scans of multiple fossils from the site. The facial structure is within the modern human range, while the braincase is between the archaic and modern shapes. Credit: A composite reconstruction of the earliest known *Homo sapiens* fossils from Jebel Irhoud (Morocco) based on micro computed tomographic scans by Philipp Gunz, MPI EVA Leipzig, is under a CC BY-SA 2.0 License.

Recall from the start of the chapter that the most recent finds at Jebel Irhoud are now the oldest dated fossils that exhibit some facial traits of modern *Homo sapiens*. Besides Irhoud 10, the cranium that was dated to 315,000 years ago (Hublin et al. 2017; Richter et al. 2017), there were other fossils found in the same deposit that we now know are from the same time period. In total there are at least five individuals, representing life stages from childhood to adulthood. These fossils form an image of high variation in skeletal traits. For example, the skull named Irhoud 1 has a primitive brow ridge, while Irhoud 2 and Irhoud 10 do not (Figure 12.6). The braincases are lower than what is seen in the modern humans of today but higher than in archaic *Homo sapiens*. The teeth also have a mix of archaic and modern traits that defy clear categorization into either group.

Research separated by nearly four decades uncovered fossils and artifacts from the Kibish Formation in the Lower Omo Valley in Ethiopia. These Omo Kibish hominins were represented by braincases and fragmented postcranial bones of three individuals found kilometers apart, dating back to around 233,000 years ago (Day 1969; McDougall, Brown, and Fleagle 2005; Vidal et al. 2022). One interesting finding was the variation in braincase size between the two more-complete specimens: while the individual named Omo I had a more globular dome, Omo II had an archaic-style long and low cranium.

Also in Ethiopia, a team led by Tim White (2003) excavated numerous fossils at Herto. There were fossilized crania of two adults and a child, along with fragments of more individuals. The dates ranged between 160,000 and 154,000 years ago. The skeletal traits and stone-tool assemblage were both intermediate between the archaic and modern types. Features reminiscent of modern humans included a tall braincase

and thinner zygomatic (cheek) bones than those of archaic humans (Figure 12.7). Still, some archaic traits persisted in the Herto fossils, such as the supraorbital tori. Statistical analysis by other research teams concluded that at least some cranial measurements fit just within the modern human range (McCarthy and Lucas 2014), favoring categorization with our own species.



Figure 12.7: This model of the Herto cranium showing its mosaic of archaic and modern traits. Credit: *Homo sapiens* idaltu BOU-VP-16/1 Herto Cranium by ©BoneClones is used by permission and available here under a CC BY-NC 4.0 License.



The timeline of material culture suggests a long period of relying on similar tools before a noticeable diversification of artifacts types. Researchers label the time of stable technology shared with archaic types the **Middle Stone Age**, while the subsequent time of diversification in material culture is called the **Later Stone Age**.

In the Middle Stone Age, the sites of Jebel Irhoud, Omo, and Herto all bore tools of the same flaked style as archaic assemblages, even though they were separated by almost 150,000 years. The consistency in technology may be evidence that behavioral modernity was not so developed. No clear signs of art dating back this far have been found either. Other hypotheses not related to behavioral modernity could explain these observations. The tool set may have been suitable for thriving in Africa without further innovation. Maybe works of art from that time were made with media that deteriorated or perhaps such art was removed by later humans.

Evidence of what *Homo sapiens* did in Africa from the end of the Middle Stone Age to the Later Stone Age is concentrated in South African cave sites that reveal the complexity of human behavior at the time. For example, Blombos Cave, located along the present shore of the Cape of Africa facing the Indian Ocean, is notable for having a wide variety of artifacts. The material culture shows that toolmaking and artistry were more complex than previously thought for the Middle Stone Age. In a layer dated to 100,000 years ago, researchers found two intact ochre-processing kits made of abalone shells and grinding stones (Henshilwood et al. 2011). Marine snail shell beads from 75,000 years ago were also excavated (Figure 12.8; d’Errico et al. 2005). Together, the evidence shows that the Middle Stone Age occupation at Blombos Cave incorporated resources from a variety of local environments into their culture, from caves (ochre), open land (animal bones and fat), and the sea (abalone and snail shells). This complexity shows a deep knowledge of the region’s resources and their use—not just for survival but also for symbolic purposes.

On the eastern coast of South Africa, Border Cave shows new African cultural developments at the start of the Later Stone Age. Paola Villa and colleagues (2012) identified several changes in technology around 43,000 years ago. Stone-tool production transitioned from a slower process to one that was faster and made many **microliths**, small and precise stone tools. Changes in decorations were also found across the Later Stone Age transition. Beads were made from a new resource: fragments of ostrich eggs shaped into circular forms resembling present-day breakfast cereal O’s (d’Errico et al. 2012). These beads show a higher level of altering one’s own surroundings and a move from the natural to the abstract in terms of design.

### Summary of Modern *H. sapiens* in Africa

The combined fossil evidence paints a picture of diversity in geography and traits. Instead of evolving in just East Africa, the Jebel Irhoud find revealed that early modern *Homo sapiens* had a wide range across Middle Pleistocene Africa. Supporting this explanation, fossils have different mosaics of archaic and modern traits in different places and even within the same area. The high level of diversity from just these fossils shows that the modern traits took separate paths toward the set we have today. The connections were convoluted, involving fluctuating gene flow among small groups of regional nomadic foragers across a large continent over a long time.

African culture experienced a long constant phase called the Middle Stone Age until a faster burst of change produced innovation and new styles. The change was not one moment but rather an escalation in development. Later Stone Age culture introduced elements seen across many regions, including the construction of composite tools and even the use of strung decorations such as beads. These developments appear in the Later Stone Age of other regions, such as Europe. Based on the early date of the African artifacts, Later Stone Age culture may have originated in Africa and passed from person to person and region to region, with people adapting the general technique to their local resources and viewing the meaning in their own way.

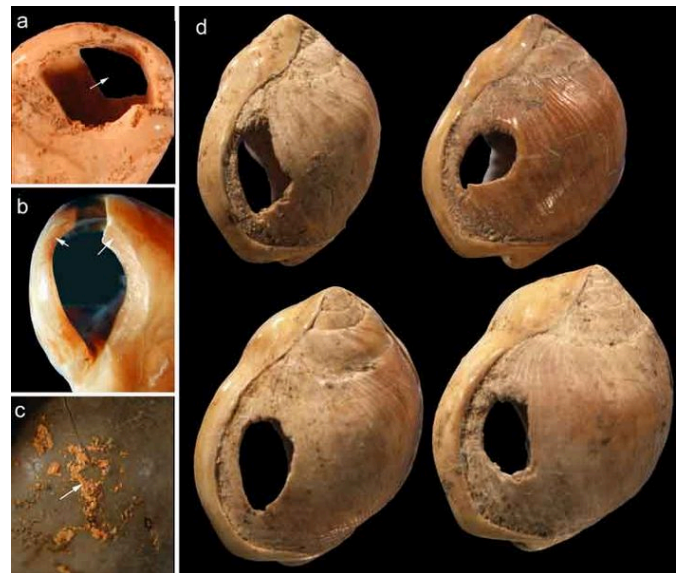


Figure 12.8: Examples of the perforated shell beads found in Blombos Cave, South Africa: (a) view of carved hole seen from the inside; (b) arrows indicate worn surfaces due to repetitive contact with other objects, such as with other beads or a connecting string; (c) traces of ochre; and (d) four shell beads showing a consistent pattern of perforation. Credit: BBC-shell-beads by Chenshilwood (Chris Henshilwood and Francesco d’Errico) at English Wikipedia is under a CC BY-SA 3.0 License.



## Expansion into the Middle East and Asia

While modern *Homo sapiens* lived across Africa, some members eventually left the continent. These pioneers could have used two connections to the Middle East or West Asia. From North Africa, they could have crossed the Sinai Peninsula and moved north to the **Levant**, or eastern Mediterranean. Finds in that region show an early modern human presence. Other finds support the **Southern Dispersal model**, with a crossing from East Africa to the southern Arabian Peninsula through the Straits of Bab-el-Mandeb. It is tempting to think of one momentous event in which people stepped off Africa and into the Middle East, never to look back. In reality, there were likely multiple waves of movement producing gene flow back and forth across these regions as the overall range pushed east. The expanding modern human population could have thrived by using resources along the southern coast of the Arabian Peninsula to South Asia, with side routes moving north along rivers. The maximum range of the species then grew across Asia.

### Modern Homo sapiens in the Middle East

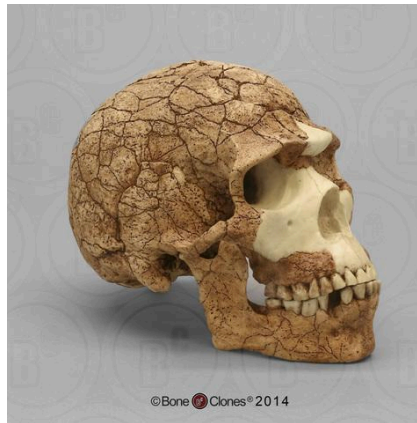


Figure 12.9: This Skhul V cranium model shows the sharp browridges. The contour of a marked occipital bun is barely visible from this angle. Credit: Homo sapiens Skull Skhul 5 by ©BoneClones is used by permission and available here under a CC BY-NC 4.0 License.

Geographically, the Middle East is the ideal place for the African modern *Homo sapiens* population to inhabit upon expanding out of their home continent. In the Eastern Mediterranean coast of the Levant, there is a wealth of skeletal and material culture linked to modern *Homo sapiens*. Recent discoveries from Saudi Arabia further add to our view of human life just beyond Africa.

The Caves of Mount Carmel in present-day Israel have preserved skeletal remains and artifacts of modern *Homo sapiens*, the first-known group living outside Africa. The skeletal presence at Misliya Cave is represented by just part of the left upper jaw of one individual, but it is notable for being dated to a very early time, between 194,000 and 177,000 years ago (Hershkovitz et al. 2018). Later, from 120,000 to 90,000 years ago, fossils of multiple individuals across life stages were found in the caves of Es-Skhul and Qafzeh (Shea and Bar-Yosef 2005). The skeletons had many modern *Homo sapiens* traits, such as globular crania and more gracile postcranial bones when compared to Neanderthals. Still, there were some archaic traits. For example, the adult male Skhul V also possessed what researchers Daniel Lieberman, Osbjorn Pearson, and Kenneth Mowbray (2000) called marked or clear occipital bunning. Also, compared to later modern humans, the Mount Carmel people were more robust. Skhul V had a particularly impressive brow ridge that was short in height but sharply juttred forward above the eyes (Figure 12.9). The high level of preservation is due to the intentional burial of some of these people. Besides skeletal material, there are signs of artistic or symbolic behavior. For example, the adult male Skhul V had a boar's jaw on his chest. Similarly, Qafzeh 11, a juvenile with healed cranial trauma, had an impressive deer antler rack placed over his torso (Figure 12.10; Coqueugniot et al. 2014). Perforated seashells colored with **ochre**, mineral-based pigment, were also found in Qafzeh (Bar-Yosef Mayer, Vandermeersch, and Bar-Yosef 2009).

One remaining question is, what happened to the modern humans of the Levant after 90,000 years ago? Another site attributed to our species did not appear in the region until 47,000 years ago. Competition with Neanderthals may have accounted for the disappearance of modern human occupation since the Neanderthal presence in the Levant lasted longer than the dates of the early modern *Homo sapiens*. John Shea and Ofer Bar-Yosef (2005) hypothesized that the Mount Carmel modern humans were an initial expansion from Africa that failed. Perhaps they could not succeed due to competition with the Neanderthals who had been there longer and had both cultural and biological adaptations to that environment.

### Modern Homo sapiens of China

A long history of paleoanthropology in China has found ample evidence of modern human presence. Four notable sites are the caves at Fuyan, Liujiang, Tianyuan, and Zhoukoudian. In the distant past, these caves would have been at least seasonal shelters that unintentionally preserved evidence of human presence for modern researchers to discover.

At Fuyan Cave in Southern China, paleoanthropologists found 47 adult teeth associated with cave formations dated to between 120,000 and 80,000 years ago (Liu et al. 2015). It is currently the oldest-known modern human site in China, though other researchers question the validity of the date range (Michel et al. 2016). The teeth have the small size and gracile features of modern *Homo sapiens* dentition.

The fossil Liujiang (or Liukiang) hominin (67,000 years ago) has derived traits that classified it as a modern *Homo sapiens*, though primitive archaic traits were also present. In the skull, which was found nearly complete, the Liujiang hominin had a taller forehead than archaic *Homo sapiens* but also had an enlarged occipital region (Figure 12.11; Brown 1999; Wu et al. 2008). Other parts of the skeleton also had a mix of modern and archaic traits: for example, the femur fragments suggested a slender length but with thick bone walls (Woo 1959).

Another Chinese site to describe here is the one that has been studied the longest. In the Zhoukoudian Cave system (Figure 12.12), where *Homo erectus* and archaic *Homo sapiens* have also been found, there were three crania of modern *Homo sapiens*. These crania, which date to between 34,000 and 10,000 years ago, were all more globular than those of archaic humans but still lower and longer than those of later modern humans (Brown 1999; Harvati 2009). When compared to one another, the crania showed significant differences from one another. Comparison of cranial measurements to other populations past and present found no connection with modern East Asians, again showing that human variation was very different from what we see today.



Figure 12.10 This cast of the Qafzeh 11 burial shows the antler's placement over the upper torso. The forearm bones appear to overlap the antler. Credit: Moulage de la sépulture de l'individu "Qafzeh 11" (avec ramure de cervidé), homme de Néandertal (Collections du Muséum national d'histoire naturelle de Paris, France) by Eunostos has been modified (cropped and color modified) and is under a CC BY-SA 4.0 License.



Figure 12.11: The Liujiang cranium shows the tall forehead and overall gracile appearance typical of modern *Homo sapiens*. Credit: Liujiang cave skull-a. Homo Sapiens 68,000 Years Old (Taken at the David H. Koch Hall of Human Origins, Smithsonian Natural History Museum) by Ryan Somma has been modified (color modified) and is under a CC BY-SA 2.0 License.



Figure 12.12: The entrance to the Upper Cave of the Zhoukoudian complex, where crania of three ancient modern humans were found. Credit: Zhoukoudian Upper Cave by Mutt is under a CC BY-SA 4.0 License.

### Summary of Modern *H. sapiens* in the Middle East and Asia

As in Africa, the finds of the Middle East have shown that humans were biologically diverse and had complex relationships with their environment. Work in the Levant showed an initial expansion north from the Sinai Peninsula that did not last. Away from the Levant, expansion continued. Local resources were used to make lithics and decorative items.

The early Asian presence of modern *Homo sapiens* was complex and varied as befitting the massive continent. What the evidence shows is that people adapted to a wide array of environments that were far removed from Africa. From the Levant to China, humans with modern anatomy used caves that preserved signs of their presence. Faunal and floral remains found in these shelters speak to the flexibility of the human omnivorous diet as local wildlife and foliage became nourishment. Decorative items, often found as burial goods in planned graves, show a flourishing cultural life.

Eventually, modern humans at the southeastern fringe of the geographical range of the species found their way southeast until some became the first humans in Australia.

### Crossing to Australia

Expansion of the first modern human Asians, still following the coast, eventually entered an area that researchers call **Sunda** before continuing on to modern Australia. Sunda was a landmass made up of the modern-day Malay Peninsula, Sumatra, Java, and Borneo. Lowered sea levels connected these places with land bridges, making them easier to traverse. Proceeding past Sunda meant navigating **Wallacea**, the archipelago that includes the Indonesian islands east of Borneo. In the distant past, there were many **megafauna**, large animals that migrating humans would have used for food and materials (such as utilizing animals' hides and bones). Further southeast was another landmass called **Sahul**, which included New Guinea and Australia as one contiguous continent. Based on fossil evidence, this land had never seen hominins or any other primates before modern *Homo sapiens* arrived. Sites along this path offer clues about how our species handled the new environment to live successfully as foragers.

The skeletal remains at Lake Mungo, land traditionally owned by Mutthi Mutthi, Ngiamppaa, and Paakantji peoples, are the oldest known in the continent. The now-dry lake was one of a series located along the southern coast of Australia in New South Wales, far from where the first people entered from the north (Barbetti and Allen 1972; Bowler et al. 1970). Two individuals dating to around 40,000 years ago show signs of artistic and symbolic behavior, including intentional burial. The bones of Lake Mungo 1 (LM1), an adult female, were crushed repeatedly, colored with red ochre, and cremated (Bowler et al. 1970). Lake Mungo 3 (LM3), a tall, older male with a gracile cranium but robust postcranial bones, had his fingers interlocked over his pelvic region (Brown 2000).

Kow Swamp, within traditional Yorta Yorta land also in southern Australia, contained human crania that looked distinctly different from the ones at Lake Mungo (Durband 2014; Thorne and Macumber 1972). The crania,



Figure 12.13: Replica of the Kow Swamp 1 cranium. The shape of the braincase could be due to artificial cranial modification. A competing hypothesis is that it reflects the primitive shape of *Homo erectus*. Credit: Kow Swamp1-Homo sapiens by Ryan Somma from Occoquan, USA, under a CC BY-SA 2.0 License has been modified (background cleaned and color modified) and is available here under a CC BY-NC 4.0 License.



dated between 9,000 and 20,000 years ago, had extremely robust brow ridges and thick bone walls, but these were paired with globular features on the braincase (Figure 12.13).

While no fossil humans have been found at the Madjedbebe rock shelter in the North Territory of Australia, more than 10,000 artifacts found there show both behavioral modernity and variability (Clarkson et al. 2017). They include a diverse array of stone tools and different shades of ochre for rock art, including mica-based reflective pigment (similar to glitter). These impressive artifacts are as far back as 56,000 years old, providing the date for the earliest-known presence of humans in Australia.

### Summary of Modern *H. sapiens* in Australia

The overall view of the first modern humans in Australia from a biological perspective shows a high amount of skeletal diversity. This is similar to the trends seen earlier in Africa, the Middle East, and East Asia. The earliest-known arrivals brought with them a multifaceted suite of cultural practices as seen in their material culture.

## From the Levant to Europe

The first modern human expansion into Europe occurred after other members of our species settled East Asia and Australia. As the evidence from the Levant suggests, modern human movement to Europe may have been hampered by the presence of Neanderthals. Another obstacle was that the colder climate was incompatible with the biology of African modern *Homo sapiens*, which was adapted for exposure to high temperature and ultraviolet radiation. Still, by 40,000 years ago, modern *Homo sapiens* had a detectable presence. This time was also the start of the Later Stone Age or **Upper Paleolithic**, when there was an expansion in cultural complexity. There is a wealth of evidence from this region due to a Western bias in research, the proximity of these findings to Western scientific institutions, and the desire of Western scientists to explore their own past. This section will cover key evidence of early modern human life in Europe, and the typologies used to view cultural changes in this region.



Figure 12.14: This side view of the Oase 2 cranium shows the reduced brow ridges but also occipital bunning that is a sign that modern *Homo sapiens* interbred with Neanderthals. Credit: Oase 2 by James Di Loreto & Donald H. Hurlbert, Smithsonian [exhibit: Human Evolution Evidence, Human Fossils] has been modified (sharpened) and is used for educational and non-commercial purposes as outlined by the Smithsonian.

In Romania, the site of Peștera cu Oase (Cave of Bones) had the oldest-known remains of modern *Homo sapiens* in Europe, dated to around 40,000 years ago (Trinkaus et al. 2003a). Among the bones and teeth of many animals were the fragmented cranium of one person and the mandible of another (the two bones did not fit each other). Both bones have modern human traits similar to the fossils from the Middle East, but they also had Neanderthal traits. Oase 1, the mandible, had a mental eminence but also extremely large molars (Trinkaus et al. 2003b). This mandible has yielded DNA that surprisingly is equally similar to DNA from present-day Europeans and Asians (Fu et al. 2015). This means that Oase 1 was not the direct ancestor of modern Europeans. The Oase 2 cranium has the derived traits of reduced brow ridges along with archaic wide zygomatic cheekbones and an occipital bun (Figure 12.14; Rougier et al. 2007).

Dating to around 26,000 years ago, Předmostí near Přerov in the Czech Republic was a site where people buried over 30 individuals along with many artifacts. Eighteen individuals were found in one mass burial area, a few covered by the scapulae of woolly mammoths (Germonpré, Lázničková-Galetová, and Sablin 2012). The Předmostí crania were more globular than those of archaic humans but tended to be longer and lower than in later modern humans (Figure 12.15; Velemínská et al. 2008). The height of the face was in line with modern residents of Central Europe. There was also skeletal evidence of dog domestication, such as the presence of dog skulls with shorter snouts than in wild wolves (Germonpré,

Lázničková-Galetová, and Sablin et al. 2012). In total, Předmostí could have been a settlement dependent on mammoths for subsistence and the artificial selection of early domesticated dogs.



Figure 12.15: This illustration is based upon one of the surviving photographic negatives since the original fossil was lost in World War II. The modern human chin is prominent, as is an archaic occipital bun. Credit: Předmostí 9 by J. Matiegka (1862–1941) has been modified (sharpened) and is in the public domain.

The sequence of modern *Homo sapiens* technological change in the Later Stone Age has been thoroughly dated and labeled by researchers working in Europe. Among them, the Gravettian tradition of 33,000 years to 21,000 years ago is associated with most of the known curvy female figurines, often assumed to be “Venus” figures. Hunting technology also advanced in this time with the first known boomerang, **atlatl** (spear thrower), and archery. The Magdalenian tradition spread from 17,000 to 12,000 years ago. This culture further expanded on fine bone tool work, including barbed spearheads and fishhooks (Figure 12.16).

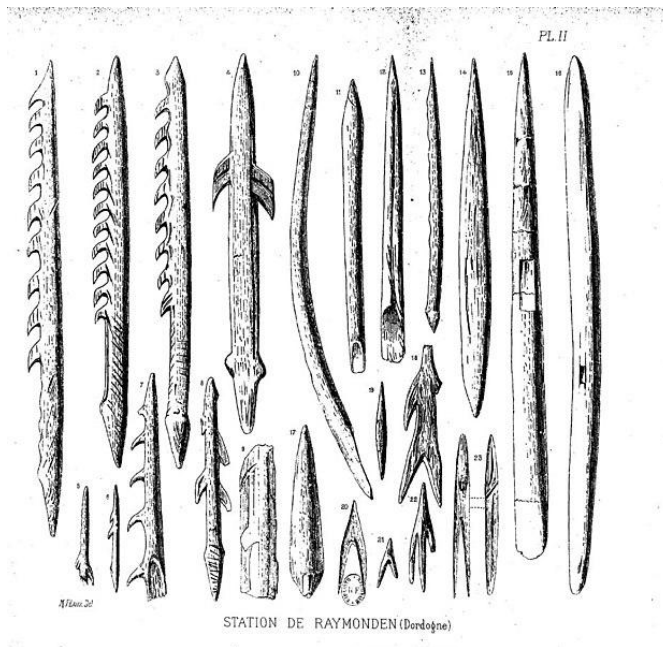


Figure 12.16: This drawing from 1891 shows an array of Magdalenian-style barbed points found in the burial of a reindeer hunter. They were carved from antler. Credit: La station quaternaire de Raymonden (...) Hardy Michel bpt6k5567846s (2) by M. Féauxis, original by Michel Hardy (1891), is in the public domain.

Among the many European sites dating to the Later Stone Age, the famous cave art sites deserve mention. Chauvet-Pont-d’Arc Cave in southern France dates to separate Aurignacian occupations 31,000 years ago and 26,000 years ago. Over a hundred art pieces representing 13 animal species are preserved, from commonly depicted deer and horses to rarer rhinos and owls. Another French cave with art is Lascaux, which is several thousand years younger at 17,000 years ago in the Magdalenian period. At this site, there are over 6,000 painted figures on the walls and ceiling (Figure 12.17). Scaffolding and lighting must have been used to make the paintings on the walls and ceiling deep in the cave. Overall, visiting Lascaux as a contemporary must have been an awesome experience: trekking deeper in the cave lit only by torches giving glimpses of animals all around as mysterious sounds echoed through the galleries.

### Summary of Modern *H. sapiens* in Europe

Study of Europe in the Upper Paleolithic gives a more detailed view of the general pattern of biological and cultural change linked with the arrival of modern *Homo sapiens*. The modern humans experienced a rapidly changing culture that went through waves of complexity and refinement. Skeletally, the increasing globularity of the cranium and the gracility of the rest of the skeleton continued, though with unique regional traits, too. The cave art sites showed a deeper exploration of creativity though the exact meaning is unclear. With survival dependent on the surrounding ecology, painting the figures may have connected people to important and impressive wildlife at both a physical and spiritual level. Both reverence for animals and the use of caves for an enhanced sensory experience are common to cultures past and present.



Figure 12.17: Photograph of just one surface with cave art at Lascaux Cave. The most prominent piece here is the Second Bull, found in a chamber called the Hall of Bulls. Smaller cattle and horses are also visible. Credit: Lascaux cave (document 108435) Prehistoric Sites and Decorated Caves of the Vézère Valley (France) by Francesco Bandarin, © UNESCO, has been modified (color modified) and is under a CC BY-SA 3.0 License.

### Peopling of the Americas

By 25,000 years ago, our species was the only member of *Homo* left on Earth. Gone were the Neanderthals, Denisovans, *Homo naledi*, and *Homo floresiensis*. The range of modern *Homo sapiens* kept expanding eastward into—using the name given to this area by Europeans much later—the Western Hemisphere. This section will address what we know about the peopling of the Americas, from the first entry to these continents to the rapid spread of Indigenous Americans across its varied environments.

While evidence points to an ancient land bridge called **Beringia** that allowed people to cross from what is now northeastern Siberia into modern-day Alaska, what people did to cross this land bridge is still being investigated. For most of the 20th century, the accepted theory was the **Ice-Free Corridor model**. It stated that northeast Asians (East Asians and Siberians) first expanded across Beringia inland through a passage between glaciers that opened into the western Great Plains of the United States, just east of the Rocky Mountains, around 13,000 years ago (Swisher et al. 2013). While life up north in the cold environment would have been harsh, migrating birds and an emerging forest might have provided sustenance as generations expanded through this land (Potter et al. 2018).

However, in recent decades, researchers have accumulated evidence against the Ice-Free Corridor model. Archaeologist K. R. Fladmark (1979) brought the alternate **Coastal Route model** into the archaeological spotlight; researcher Jon M. Erlandson has been at the forefront of compiling support for this theory (Erlandson et al. 2015). The new focus is the southern edge of the land bridge instead of its center: About 16,000 years ago, members of our species expanded along the coastline from northeast Asia, east through Beringia, and south down the Pacific Coast of North America while the inland was still sealed off by ice. The coast would have been free of ice at least part of the year, and many resources would have been found there, such as fish (e.g., salmon), mammals (e.g., whales, seals, and otters), and plants (e.g., seaweed).

### South through the Americas

When the first modern *Homo sapiens* reached the Western Hemisphere, the spread through the Americas was rapid. Multiple migration waves crossed from North to South America (Posth et al. 2018). Our species took advantage of the lack of hominin competition and the bountiful resources both along the coasts and inland. The Americas had their own wide array of megafauna, which included woolly mammoths (Figure 12.18), mastodons, camels, horses, ground sloths, giant tortoises, and—a favorite of researchers—a two-meter-tall beaver. The reason we cannot see these amazing animals today may be that resources gained from these fauna were crucial to the survival for people over 12,000 years ago (Araujo et al. 2017). Several sites are notable for what they add to our understanding of the distant past in the Americas, including interactions with megafauna and other elements of the environment.





Figure 12.18: Life-size reconstruction of a woolly mammoth at the Page Museum, part of the La Brea Tar Pits complex in Los Angeles, California. Outside of Africa, megafauna such as this went extinct around the time that humans entered their range. Credit: Woolly Mammoth (at La Brea Tar Pits & Museum) by Keith Chan is under a CC BY-NC 4.0 License.

away from the head (Figure 12.19). The stone points found at this site match those found as far as the Canadian border and northern Mexico, and from the west coast to the east coast of the United States. Fourteen Clovis sites also contained the remains of mammoths or mastodons, suggesting that hunting megafauna with these points was an important part of life for the Clovis people. After the spread of the Clovis style, it diversified into several regional styles, keeping some of the Clovis form but also developing their own unique touches.

### *Summary of Modern H. sapiens in the Americas*

Research in Native American origins found some surprising details, refining older models. Genetically, the migration can be considered one long period of movement with splits into regional populations. This finding matches the sudden appearance and diversification of the homegrown Clovis culture. A few thousand years after arrival into the hemisphere, people had already covered the Americas from north to south.

The peopling of the Americas also had a lot of elements in common with the prior spread of humans across Africa, Europe, Asia, and Australia. In all of these expansions, these pioneers explored new lands that tested their ability to adapt, both culturally and biologically. Besides stone-tool technology, the use of ochre as decoration was seen from South Africa to South America. The coasts and rivers were likely avenues in the movement of people, artifacts, and ideas, outlining the land masses while providing access to varied environments. The presence of megafauna aided human success, but this resource was eventually depleted in many parts of the world.

A 2019 discovery may allow researchers to improve theories about the peopling of the Americas. In White Sands National Park, New Mexico, 60 human footprints have been astonishingly dated to around 22,000 years ago (Bennett et al. 2021). This date and location do not match either the Ice-Free Corridor or Coastal Route models. Researchers are now working to verify the find and adjust previous models to account for the new evidence. This groundbreaking find is sparking new theories; it is another example of the fast pace of research performed on our past.

Monte Verde is a landmark site that shows that the human population had expanded down the whole vertical stretch of the Americas to Chile by 14,600 years ago, only a few thousand years after humans first entered the Western Hemisphere from Alaska. The site has been excavated by archaeologist Tom D. Dillehay and his team (2015). The remains of nine distinct edible species of seaweed at the site shows familiarity with coastal resources and relates to the Coastal Route model by showing a connection between the inland people and the sea.

Named after the town in New Mexico, the Clovis stone-tool style is the first example of a widespread culture across much of North America, between 13,400 and 12,700 years ago (Miller, Holliday, and Bright 2013). Clovis points were fluted with two small projections, one on each end of the base, facing



Figure 12.19: The Clovis point has a distinctive structure. It has a wide tip, and its base has two small projections. This example was carved from chert and found in north-central Ohio, dated to around 11,000 years ago. Credit: Clovis Point (15.2012.25) by the Smithsonian [Department of Anthropology; Cooper Hewitt, Smithsonian Design Museum] is used for educational and non-commercial purposes as outlined by the Smithsonian.

## The Big Picture: The Assimilation Hypothesis

How do researchers make sense of all of these modern *Homo sapiens* discoveries that cover over 300,000 years of time and stretch across every continent except Antarctica? How was modern *Homo sapiens* related to archaic *Homo sapiens*?

The **Assimilation hypothesis** proposes that modern *Homo sapiens* evolved in Africa first and expanded out but also interbred with the archaic *Homo sapiens* they encountered outside Africa (Figure 12.20). This hypothesis is powerful since it explains why Africa has the oldest modern human fossils, why early modern humans found in Europe and Asia bear a resemblance to the regional archaics, and why traces of archaic DNA can be found in our genomes today (Dannemann and Racimo 2018; Reich et al. 2010; Reich et al. 2011; Slatkin and Racimo 2016; Smith et al. 2017; Wall and Yoshihara Caldeira Brandt 2016).

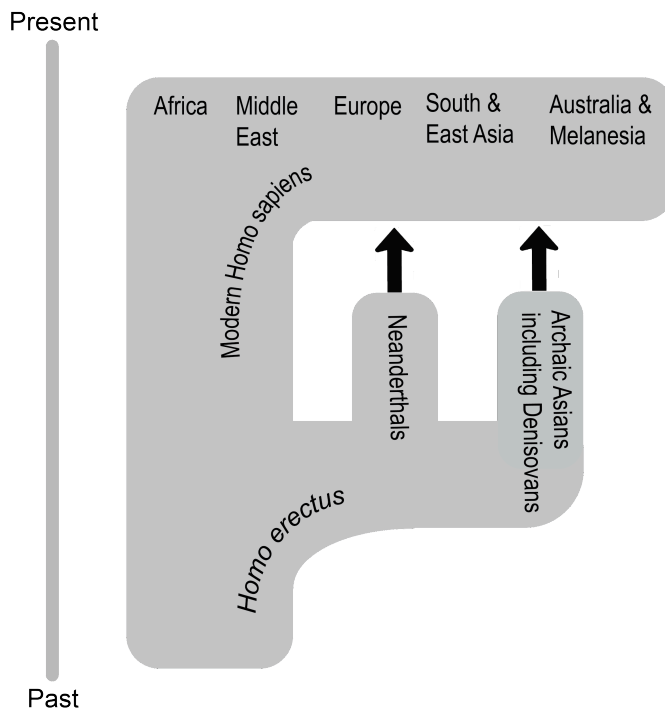


Figure 12.20: This diagram shows archaic humans, having evolved from *Homo erectus*, expanded from Africa and established the Neanderthal and Denisovan groups. In Africa, archaic humans evolved modern traits and expanded from the continent as well, interbreeding with two archaic groups across Europe and Asia. Credit: Assimilation Model (Figure 12.23)| original to Explorations: An Open Invitation to Biological Anthropology by Keith Chan and Katie Nelson is under a CC BY-NC 4.0 License.

While researchers have produced a model that satisfies the data, there are still a lot of questions for paleoanthropologists to answer regarding our origins. What were the patterns of migration in each part of the world? Why did the archaic humans go extinct? In what ways did archaic and modern humans interact? The definitive explanation of how our species started and what our ancestors did is still out there to be found. You are now in a great place to welcome the next discovery about our distant past—maybe you’ll even contribute to our understanding as well.

## The Chain Reaction of Agriculture

While it may be hard to imagine today, for most of our species’ existence we were nomadic: moving through the landscape without a singular home. Instead of a refrigerator or pantry stocked with food, we procured nutrition and other resources as needed based on what was available in the environment. Instead of collecting and displaying shelves of stuff, we kept our possessions small for mobility. This section gives an overview of how the foraging lifestyle enabled the expansion of our species and how the invention of a new way of life caused a chain reaction of cultural change.

## The Foraging Tradition

There are a variety of possible **subsistence strategies**, or methods of finding sustenance and resources. To understand our species is to understand the subsistence strategy of **foraging**, or the search for resources in the environment. While most (but not all) humans today live in cultures that practice **agriculture** (whereby we greatly shape the environment to mass produce what we need), we have spent far more time as nomadic foragers than as settled agriculturalists. As such, our traits have evolved to be primarily geared toward foraging. For instance, our efficient bipedalism allows persistence-hunting across long distances as well as movement from resource to resource.

How does human foraging, also known as hunting and gathering, work? Anthropologists have used all four fields to answer this question (see Ember n.d.). Typically, people formed **bands**, or kin-based groups of around 50 people or less (rarely over 100). A band’s organization would be **egalitarian**, with a flexible hierarchy based on an individual’s age, level of experience, and relationship with others. Everyone would have a general knowledge of the skills assigned to their gender roles, rather than specializing in different occupations. A band would be able to move from place to place in the environment, using knowledge of the area to forage (Figure 12.21). In varied environments—from savannas to tropical forests, deserts, coasts, and the Arctic circle—people found sustenance needed for survival. Our species’s omnivorousness and cultural abilities led us to excel in the generalist-specialist niche.



Figure 12.21: A present-day San man in Namibia demonstrates hunting using archery. Anthropologists study the San today to learn about the persistence of foraging as a viable lifestyle, while noting how these cultures have changed over time and how they interact with other groups. Credit: San hunter with bow and arrow by CharlesFred has been modified (color modified) and is under a CC BY-NC-SA 2.0 License.

Humans made extensive use of the foraging subsistence strategy, but this lifestyle did have limitations. The ease of foraging depended on the richness of the environment. Due to the lack of storage, resources had to be dependably found when needed. While a bountiful environment would require just a few hours of foraging a day and could lead to a focus on one location, the level and duration of labor increased greatly in poor or unreliable environments. Labor was also needed to process the acquired resources, which contributed to the foragers' daily schedule (Crittenden and Schnorr 2017).

The adaptations to foraging found in modern *Homo sapiens* may explain why our species became so successful both within Africa and in the rapid expansion around the world. Overcoming the limitations, each generation at the edge of our species's range would have found it beneficial to expand a little further, keeping contact with other bands but moving into unexplored territory where resources were more plentiful. The cumulative effect would have been the spread of modern *Homo sapiens* across continents and hemispheres.

## Why Agriculture?

After hundreds of thousands of years of foraging, some groups of people around 12,000 years ago started to practice agriculture. This transition, called the **Neolithic Revolution**, occurred at the start of the **Holocene** epoch. While the reasons for this global change are still being investigated, two likely co-occurring causes are a growing human population and natural global climate change.

Overcrowding could have affected the success of foraging in the environment, leading to the development of a more productive subsistence strategy (Cohen 1977). Foraging works best with low population densities since each band needs a lot of space to support itself. If too many people occupy the same environment, they deplete the area faster. The high population could exceed the **carrying capacity**, or number of people a location can reliably support. Reaching carrying capacity on a global level due to growing population and limited areas of expansion would have been an increasingly pressing issue after the expansion through the major continents by 14,600 years ago.

A changing global climate immediately preceded the transition to agriculture, so researchers have also explored a connection between the two events. Since the **Last Glacial Maximum** of 23,000 years ago, the Earth slowly warmed. Then, from 13,000 to 11,700 years ago, the temperature in most of the Northern Hemisphere dropped suddenly in a phenomenon called the **Younger Dryas**. Glaciers returned in Europe, Asia, and North America. In Mesopotamia, which includes the Levant, the climate changed from warm and humid to cool and dry. The change would have occurred over decades, disrupting the usual nomadic patterns and subsistence of foragers around the world. The disruption to foragers due to the temperature shift could have been a factor in spurring a transition to agriculture. Researchers Gregory K. Dow and colleagues (2009) believe that foraging bands would have clustered in the new resource-rich places where people started to direct their labor to farming the limited area. After the Younger Dryas ended, people expanded out of the clusters with their agricultural knowledge (Figure 12.22).

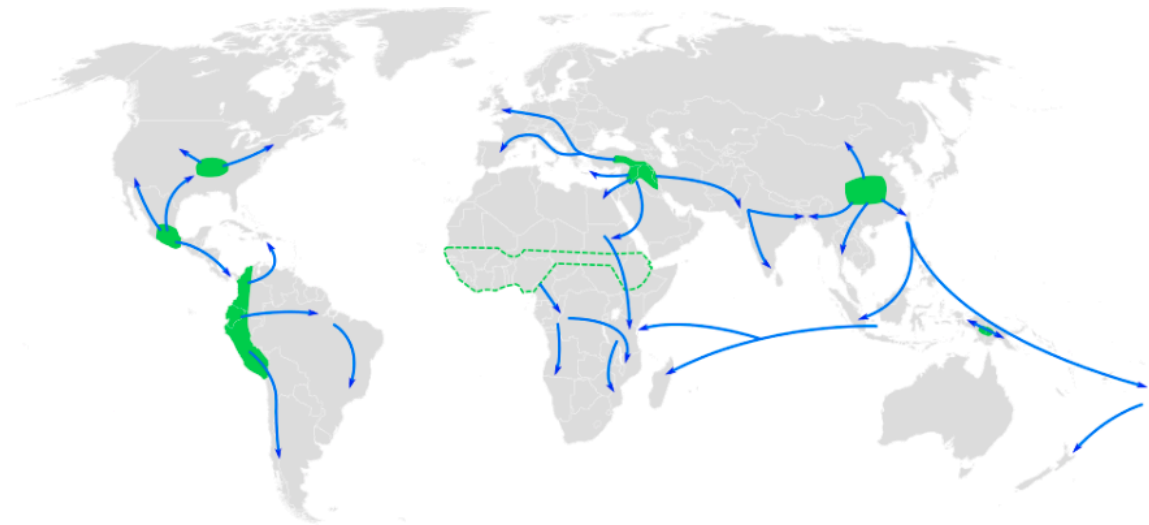


Figure 12.22: The map shows the areas where agriculture was independently invented around the world and where they spread. Blue arrows show the spread of agriculture from these zones to other regions. A full text description of this image is available. Credit: Centres of origin and spread of agriculture by Joe Roe is under a CC BY-SA 3.0 License.

The double threat of the limitation of human continental expansion and the sudden global climate change may have placed bands in peril as more populations outpaced their environment's carrying capacity. Not only had a growing population led to increased competition with other bands, but environments worldwide shifted to create more uncertainty. As people in different areas around the world faced this unpredictable situation, they became the independent inventors of agriculture.

## Agriculture around the World

Due to global changes to the human experience starting from 12,000 years ago, cultures with no knowledge of each other turned toward intensely farming their local resources (see Figure 12.22). The first farmers engaged in artificial selection of their domesticates to enhance useful traits over generations. The switch to agriculture took time and effort with no guarantee of success and constant challenges (e.g. fires, droughts, diseases, and pests). The regions with the most widespread impact in the face of these obstacles became the primary centers of agriculture (Figure 12.23; Fuller 2010):

- **Mesopotamia:** The Fertile Crescent from the Tigris and Euphrates rivers through the Levant was where bands started to domesticate plants and animals around 12,000 years ago. The connection between the development of agriculture and the Younger Dryas was especially strong here. Farmed crops included wheat, barley, peas, and lentils. This was also where cattle, pigs, sheep, and goats were domesticated.
- **South and East Asia:** Multiple regions across this land had varieties of rice, millet, and soybeans by 10,000 years ago. Pigs were farmed with no connection to Mesopotamia. Chickens were also originally from this region, bred for fighting first and food second.
- **New Guinea:** Agriculture started here 10,000 years ago. Bananas, sugarcane, and taro were native to this island. Sweet potatoes were brought back from voyages to South America around the year C.E. 1000. No known animal farming occurred here.
- **Mesoamerica:** Agriculture from Central Mexico to northern South America also occurred from 10,000 years ago; it was also only plant based. Maize was a crop bred from teosinte grass, which has become one of the global staples. Beans, squash, and avocados were also grown in this region.
- **The Andes:** Starting around 8,000 years ago, local domesticated plants started with squash but later included potatoes, tomatoes, beans, and quinoa. Maize was brought down from Mesoamerica. The main farm animals were llamas, alpacas, and guinea pigs.
- **Sub-Saharan Africa:** This region went through a change 5,000 years ago called the Bantu expansion. The Bantu agriculturalists were established in West Central Africa and then expanded south and east. Native varieties of rice, yams, millet, and sorghum were grown across this area. Cattle were also domesticated here.
- **Eastern North America:** This region was the last major independent agriculture center, from 4,000 years ago. Squash and sunflower are the



produce from this region that are most known today, though sumpweed and pitseed goosefoot were also farmed. Hunting was still the main source of animal products.



Figure 12.23: Rice farmers in the present day using draft cattle to prepare their field. Credit: Plowing muddy field using cattle by IRRRI Photos (International Rice Research Institute) has been modified (color modified) and is under a CC BY-NC-SA 2.0 License.

**sedentarism.** This led to new aspects of life that were uncommon among foragers: the construction of permanent shelters and agricultural infrastructure, such as fields and irrigation, plus the development of storage technology, such as pottery, to preserve extra resources in case of future instability.

The high productivity of successful agriculture sparked further changes (Smith 2009). Since successful agriculture produced a much-greater amount of food and other resources per unit of land compared to foraging, the population growth rate skyrocketed. The surplus of a bountiful harvest also provided insurance for harder times, reducing the risk of famine. Changes happened to society as well. With a few farming households producing enough food to feed many others, other people could focus on other tasks. So began specialization into different occupations such as craftspeople, traders, religious figures, and artists, spurring innovation in these areas as people could now devote time and effort toward specific skills. These interdependent people would settle an area together for convenience. The growth of these settlements led to **urbanization**, the founding of cities that became the foci of human interaction (Figure 12.24).

The formation of cities led to new issues that sparked the growth of further specializations, called **institutions**. These are cultural constructs that exist beyond the individual and have wide control over a population. Leadership of these cities became hierarchical with different levels of rank and control.

The stratification of society increased social inequality between those with more or less power over others. Under leadership, people built impressive **monumental architecture**, such as pyramids and palaces, that embodied the wealth and power of these early cities. Alliances could unite cities, forming the earliest states. In several regions of the world, state organization expanded into empires, wide-ranging political entities that covered a variety of cultures.

Urbanization brought new challenges as well. The concentration of sedentary peoples was ideal for infectious diseases to thrive since they could jump from person to person and even from livestock to person (Armelagos, Brown, and Turner 2005). While successful agriculture provided a

By 5,000 years ago, our species was well within the Neolithic Revolution. Agriculturalists spread to neighboring parts of the world with their domesticates, further expanding the use of this subsistence strategy. From this point, the human species changed from being primarily foragers to primarily agriculturalists with skilled control of their environments. The planet changed from mostly unaffected by human presence to being greatly transformed by humans. The revolution took millennia, but it was a true revolution as our species' lifestyle was dramatically reshaped.

## Cultural Effects of Agriculture

The worldwide adoption of agriculture altered the course of human culture and history forever. The core change in human culture due to agriculture is the move toward not moving: rather than live a nomadic lifestyle, farmers had to remain in one area to tend to their crops and livestock. The term for living bound to a certain location is



Figure 12.24: View of downtown San Diego taken by the author at a shopping complex during a break from jury duty. Here, people live amongst structures that facilitate commerce, government, tourism, and art. Credit: Downtown San Diego (October 13, 2016; Figure 12.28) original to Explorations: An Open Invitation to Biological Anthropology by Keith Chan is under a CC BY-NC 4.0 License.

large surplus of food to thwart famine, the food produced offered less diverse food sources than foragers' diets (Cohen and Armelagos 1984; Cohen and Crane-Kramer 2007). This shift in nutrition caused other diseases to flourish among those who adopted farming, such as dental cavities and malocclusion (the misalignment of teeth caused by soft, agricultural diets). The need to extract “wisdom teeth” or third molars seen in agricultural cultures today stems from this misalignment between the environment our ancestors adapted to and our lifestyles today.

As the new disease trends show, the adoption of agriculture and the ensuing cultural changes were not entirely positive. It is also important to note that this is not an absolutely linear progression of human culture from simple to complex. In many cases, empires have collapsed and, in some cases, cities dispersed to low-density bands that rejected institutions. However, a global trend has emerged since the adoption of agriculture, wherein population and social inequality have increased, leading to the massive and influential nation-states of today.

The rise of states in Europe has a direct impact on many of this book's topics. Science started as a European cultural practice by the upper class that became a standardized way to study the world. Education became an institution to provide a standardized path toward producing and gaining knowledge. The scientific study of human diversity, embroiled in the race concept that still haunts us today, was connected to the European slave trade and colonialism.



Figure 12.25: This combine harvester can collect and process grain at a massive scale. Our food now commonly comes from enormous farms located around the world. Credit: Combine CR9060 by Hertzprung is under a CC BY-SA 3.0 License.

Also starting in Europe, the Industrial Revolution of the 19th century turned cities into centers of mass manufacturing and spurred the rapid development of inventions (Figure 12.25). In the technologically interconnected world of today, human society has reached a new level of complexity with **globalization**. In this system, goods are mass-produced and consumed in different parts of the world, weakening the reliance on local farms and factories. The imbalanced relationship between consumers and producers of goods further increases economic inequality.

As states based on agriculture and industry keep exerting influence on humanity today, there are people, like the Hadzabe of Tanzania, who continue to live a lifestyle centered on foraging. Due to the overwhelming force that agricultural societies exert, foragers today have been marginalized to live in the least habitable parts of the world—the areas that are not conducive to farming, such as tropical rainforests,

deserts, and the Arctic (Headland et al. 1989). Foragers can no longer live in the abundant environments that humans would have enjoyed before the Neolithic Revolution. Interactions with agriculturalists are typically imbalanced, with trade and other exchanges heavily favoring the larger group. One of anthropology's important roles today is to intelligently and humanely manage equitable interactions between people of different backgrounds and levels of influence.

## Special Topic: Indigenous Land Management

Insight into the lives of past modern humans has evolved as researchers revise previous theories and establish new connections with Indigenous knowledge holders.

The outdated view of foraging held that people lived off of the land without leaving an impact on the environment. Accompanying this idea was anthropologist Marshall Sahlins's (1968) proposal that foragers were the “original affluent society” since they were meeting basic needs and achieving satisfaction with less work hours than agriculturalists and city-dwellers. This view countered an earlier idea that foragers were always on the brink of starvation. Sahlins's theory took hold in the public eye as an attractive counterpoint to our busy contemporary lives in which we strive to meet our endless wants.

A fruitful type of study involving researchers collaborating with Indigenous experts has found that foragers did not just live off the



land with minimal effort nor were they barely surviving in unchanging environments. Instead, they shaped the landscape to their needs using labor and strategies that were more subtle than what European colonizers and subsequent researchers were used to seeing. Research from two regions shows the latest developments in understanding Indigenous land management.

In British Columbia, Canada, the bridging of scientific and Indigenous perspectives has shown that the forests of the region are not untouched wilderness but, rather, have been crafted by Indigenous peoples thousands of years ago. Forest gardens adjacent to archaeological sites show higher plant diversity than unmanaged places even after 150 years (Armstrong et al. 2021). On the coast, 3,500-year-old archaeological sites are evidence of constructed clam gardens, according to Indigenous experts (Lepofsky et al. 2015). Another project, in consultation with Elders of the T'exelc (William Lakes First Nation) in British Columbia, introduced researchers to explanations of how forests were managed before the practice was disrupted by European colonialism (Copes-Gerbitz et al. 2021). Careful management of controlled fires reduced the density of the forest to favor plants such as raspberries and allow easier movement through the landscape.

Similarly, the study of landscapes in Australia, in consultation with Aboriginal Australians today, shows that areas previously considered wilderness by scientists were actually the result of controlling fauna and fires. The presence of grasslands with adjacent forests were purposely constructed to attract kangaroos for hunting (Gammage 2008). People also managed other animal and insect life, from emus to caterpillars. In Tasmania, a shift from productive grassland to wildfire-prone rainforest occurred after Aboriginal Australian land management was replaced by British colonial rule (Fletcher, Hall, and Alexander 2021). The site of Budj Bim of the Gunditjmarra people has archaeological features of **aquaculture**, or the farming of fish, that date back 6,600 years (McNiven et al. 2012; McNiven et al. 2015). These examples show that Indigenous knowledge of how to manipulate the environment may be invaluable at the state level, such as by creating an Aboriginal ranger program to guide modern land management.

## Conclusion

Modern *Homo sapiens* is the species that took the hominin lifestyle the furthest to become the only living member of that lineage. The largest factor that allowed us to persist while other hominins went extinct was likely our advanced ability to culturally adapt to a wide variety of environments. Our species, with its skeletal and behavioral traits, was well-suited to be generalist-specialists who successfully foraged across most of the world's environments. The biological basis of this adaptation was our reorganized brain that facilitated innovation in cultural adaptations and intelligence for leveraging our social ties and finding ways to acquire resources from the environment. As the brain's ability increased, it shaped the skull by reducing the evolutionary pressure to have large teeth and robust cranial bones to produce the modern *Homo sapiens* face.

Our ability to be generalist-specialists is seen in the geographical range that modern *Homo sapiens* covered in 300,000 years. In Africa, our species formed from multiregional gene flow that loosely connected archaic humans across the continent. People then expanded out to the rest of the continental Eurasia and even further to the Americas.

For most of our species's existence, foraging was the general subsistence strategy within which people specialized to culturally adapt to their local environment. With omnivorousness and mobility, people found ways to extract and process resources, shaping the environment in return. When resource uncertainty hit the species, people around the world focused on agriculture to have a firmer control of sustenance. The new strategy shifted human history toward exponential growth and innovation, leading to our high dependence on cultural adaptations today.

While a cohesive image of our species has formed in recent years, there is still much to learn about our past. The work of many driven researchers shows that there are amazing new discoveries made all the time that refine our knowledge of human evolution. Technological innovations such as DNA analysis enable scientists to approach lingering questions from new angles. The answers we get allow us to ask even more insightful questions that will lead us to the next revelation. Like the pink limestone strata at Jebel Irhoud, previous effort has taken us so far and you are now ready to see what the next layer of discovery holds.

## Special Topic: The Future of Humanity

A common question stemming from understanding human evolution is: What will the genetic and biological traits of our species be hundreds of thousands of years in the future? When faced with this question, people tend to think of directional selection. Maybe our braincases will be even larger, resembling the large-headed and small-bodied aliens of science fiction (Figure 12.26). Or, our hands could be specialized for interacting with our touch-based technology with less risk of repetitive injury. These ideas do not stand up to scrutiny. Since natural selection is based on adaptations that increase reproductive success, any directional change must be due to a higher rate of producing successful offspring compared to other alleles. Larger brains and more agile fingers would be convenient to possess, but they do not translate into an increase in the underlying allele frequencies.



Figure 12.26: Will we evolve toward even more globular brains? Actually, this trend is not likely to continue for our species. Credit: Hypothetical image of future human evolution (Figure 12.30) original to Explorations: An Open Invitation to Biological Anthropology by Mary Nelson is under a CC BY-NC 4.0 License.

Scientists are hesitant to professionally speculate on the unknowable, and we will never know what is in store for our species one thousand or one million years from now, but there are two trends in human evolution that may carry on into the future: increased genetic variation and a reduction in regional differences.

Rather than a directional change, genetic variation in our species could expand. Our technology can protect us from extreme environments and pathogens, even if our biological traits are not tuned to handle these stressors. The rapid pace of technological advancement means that biological adaptations will become less and less relevant to reproductive success, so nonbeneficial genetic traits will be more likely to remain in the gene pool. Biological anthropologist Jay T. Stock (2008) views environmental stress as needing to defeat two layers of protection before affecting our genetics. The first layer is our cultural adaptations. Our technology and knowledge can reduce pressure on one's genotype to be "just right" to pass to the next generation. The second defense is our flexible physiology, such as our acclimatory responses. Only stressors not handled by these powerful responses would then cause natural selection on our alleles. These shields are already substantial, and cultural adaptations will only keep increasing in strength.

The increasing ability to travel far from one's home region means that there will be a mixing of genetic variation on a global level in the future of our species. In recent centuries, gene flow of people around the world has increased, creating admixture in populations that had been separated for tens of thousands of years. For skin color, this means that populations all around the world could exhibit the whole range of skin colors, rather than the current pattern of decreasing melanin pigment farther from the equator. The same trend of intermixing would apply to all other traits, such as blood types. While our genetics will become more varied, the variation will be more intermixed instead of regionally isolated.

Our distant descendants will not likely be dextrous ultraintellectuals; more likely, they will be a highly variable and mobile species supported by novel cultural adaptations that make up for any inherited biological limitations. Technology may even enable the editing of DNA directly, changing these trends. With the uncertainty of our future, these are just the best-educated guesses for now. Our future is open and will be shaped little by little by the environment, our actions, and the actions of our descendants.

## Hominin Species Summary

<b>Hominin</b>	Modern <i>Homo sapiens</i>
<b>Dates</b>	315,000 years ago to present
<b>Region(s)</b>	Starting in Africa, then expanding around the world
<b>Famous discoveries</b>	Cro-Magnon individuals, discovered 1868 in Dordogne, France. Otzi the Ice Man, discovered 1991 in the Alps between Austria and Italy. Kennewick man, discovered 1996 in Washington state.
<b>Brain size</b>	1400 cc average
<b>Dentition</b>	Extremely small with short cusps.
<b>Cranial features</b>	An extremely globular brain case and gracile features throughout the cranium. The mandibular symphysis forms a chin at the anterior-most point.
<b>Postcranial features</b>	Gracile skeleton adapted for efficient bipedal locomotion at the expense of the muscular strength of most other large primates.
<b>Culture</b>	Extremely extensive and varied culture with many spoken and written languages. Art is ubiquitous. Technology is broad in complexity and impact on the environment.
<b>Other</b>	The only living hominin. Chimpanzees and bonobos are the closest living relatives.

## Review Questions

- What are the skeletal and behavioral traits that define modern *Homo sapiens*? What are the evolutionary explanations for its presence?
- What are some creative ways that researchers have learned about the past by studying fossils and artifacts?
- How do the discoveries mentioned in “First Africa, Then the World” fit the Assimilation model?
- What is foraging? What adaptations do we have for this subsistence strategy? Could you train to be a skilled forager?
- What are aspects of your life that come from dependence on agriculture and its cultural effects? Where did the ingredients of your favorite foods originate from?

## Key Terms

**African multiregionalism:** The idea that modern *Homo sapiens* evolved as a complex web of small regional populations with sporadic gene flow among them.

**Agriculture:** The mass production of resources through farming and domestication.

**Aquaculture:** The farming of fish using techniques such as trapping, channels, and artificial ponds.

**Assimilation hypothesis:** Current theory of modern human origins stating that the species evolved first in Africa and interbred with archaic humans of Europe and Asia.

**Atlatl:** A handheld spear thrower that increased the force of thrown projectiles.

**Band:** A small group of people living together as foragers.

**Beringia:** Ancient landmass that connected Siberia and Alaska. The ancestors of Indigenous Americans would have crossed this area to reach the Americas.

**Carrying capacity:** The amount of organisms that an environment can reliably support.

**Coastal Route model:** Theory that the first Paleoindians crossed to the Americas by following the southern coast of Beringia.

**Early Modern *Homo sapiens*, Early Anatomically Modern Human:** Terms used to refer to transitional fossils between archaic and modern *Homo sapiens* that have a mosaic of traits. Humans like ourselves, who mostly lack archaic traits, are referred to as Late Modern *Homo sapiens* and simply Anatomically Modern Humans.

**Egalitarian:** Human organization without strict ranks. Foraging societies tend to be more egalitarian than those based on other subsistence strategies.

**Foraging:** Lifestyle consisting of frequent movement through the landscape and acquiring resources with minimal storage capacity.

**Generalist-specialist niche:** The ability to survive in a variety of environments by developing local expertise. Evolution toward this niche may have been what allowed modern *Homo sapiens* to expand past the geographical range of other human species.

**Globalization:** A recent increase in the interconnectedness and interdependence of people that is facilitated with long-distance networks.

**Globular:** Having a rounded appearance. Increased globularity of the braincase is a trait of modern *Homo sapiens*.

**Gracile:** Having a smooth and slender quality; the opposite of robust.

**Holocene:** The epoch of the Cenozoic Era starting around 12,000 years ago and lasting arguably through the present.

**Ice-Free Corridor model:** Theory that the first Native Americans crossed to the Americas through a passage between glaciers.

**Institutions:** Long-lasting and influential cultural constructs. Examples include government, organized religion, academia, and the economy.

**Last Glacial Maximum:** The time 23,000 years ago when the most recent ice age was the most intense.

**Later Stone Age:** Time period following the Middle Stone Age with a diversification in tool types, starting around 50,000 years ago.

**Levant:** The eastern coast of the Mediterranean. The site of early modern human expansion from Africa and later one of the centers of agriculture.

**Megafauna:** Large ancient animals that may have been hunted to extinction by people around the world.

**Mental eminence:** The chin on the mandible of modern *H. sapiens*. One of the defining traits of our species.

**Microlith:** Small stone tool found in the Later Stone Age; also called a bladelet.

**Middle Stone Age:** Time period known for Mousterian lithics that connects African archaic to modern *Homo sapiens*.

**Monumental architecture:** Large and labor-intensive constructions that signify the power of the elite in a sedentary society. A common type is the pyramid, a raised crafted structure topped with a point or platform.

**Mosaic:** Composed from a mix or composite of traits.

**Neolithic Revolution:** Time of rapid change to human cultures due to the invention of agriculture, starting around 12,000 years ago.

**Ochre:** Iron-based mineral pigment that can be a variety of yellows, reds, and browns. Used by modern human cultures worldwide since at least 80,000 years ago.

**Sahul:** Ancient landmass connecting New Guinea and Australia.

**Sedentarism:** Lifestyle based on having a stable home area; the opposite of nomadism.

**Southern Dispersal model:** Theory that modern *H. sapiens* expanded from East Africa by crossing the Red Sea and following the coast east across Asia.

**Subsistence strategy:** The method an organism uses to find nourishment and other resources.

**Sunda:** Ancient Asian landmass that incorporated modern Southeast Asia.

**Supraorbital torus:** The bony brow ridge across the top of the eye orbits on many hominin crania.

**Upper Paleolithic:** Time period considered synonymous with the Later Stone Age.

**Urbanization:** The increase of population density as people settled together in cities.

**Wallacea:** Archipelago southeast of Sunda with different biodiversity than Asia.

**Younger Dryas:** The rapid change in global climate—notably a cooling of the Northern Hemisphere—13,000 years ago.

## About the Author



### Keith Chan, Ph.D.

Grossmont-Cuyamaca Community College District and MiraCosta College, drkeithchan@gmail.com, Dr. Keith Chan is an instructor of anthropology at Grossmont-Cuyamaca Community College District and MiraCosta College in San Diego County. He reached this step of his anthropological path after many memorable experiences across the country and the hemisphere. He earned a bachelor's degree in anthropology from the University of California, Berkeley, in 2001. As a graduate student at the University of Missouri, he traveled to Perú with teams of students to study skeletons in the archaeological record to understand the lives of ancient Andeans. He completed his dissertation and earned a Ph.D. in 2011. Inspired by many educators in his journey, Dr. Chan turned his career toward teaching anthropology and helping students understand and appreciate humanity.

## For Further Exploration

### Websites

First-person virtual tour of Lascaux cave with annotated cave art: Ministère de la Culture and Musée d'Archéologie Nationale. "Visit the cave" Lascaux website.

Online anthropology magazine articles related to paleoanthropology and human evolution: SAPIENS. "Evolution." *SAPIENS* website.

Various presentations of information about hominin evolution: Smithsonian Institution. "What does it mean to be human?" *Smithsonian National Museum of Natural History* website.

Magazine-style articles on archaeology and paleoanthropology: ThoughtCo. "Archaeology." ThoughtCo. Website.

Database of comparisons across hominins and primates: University of California, San Diego. "MOCA Domains." *Center for Academic Research & Training in Anthropogeny* website.

### Books

Engaging book that covers human-made changes to the environment with industrialization and globalization: Kolbert, Elizabeth. 2014. *The Sixth Extinction: An Unnatural History*. New York: Bloomsbury.

Overview of what human life was like among the environmental shifts of the Ice Age: Woodward, Jamie. 2014. *The Ice Age: A Very Short Introduction*. Oxford: OUP Press.

### Articles

Recent review paper about the current state of paleoanthropology research: Stringer, C. 2016. "The Origin and Evolution of *Homo sapiens*." *Philosophical Transactions of the Royal Society B* 371 (1698).

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Amazing magazine article that synthesizes hominin evolution and why it is important to study this subject: Wheelwright, Jeff. 2015. "Days of Dysevolution." *Discover* 36 (4): 33–39.

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### Documentaries

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PBS NOVA special featuring the footprints found in White Sands National Park: Falk, Bella, dir. 2016. *Ice Age Footprints*. Boston: Windfall Films. <https://www.pbs.org/wgbh/nova/video/ice-age-footprints/>.

PBS NOVA special about how modern humans evolved adaptations to different environments. Shows how present-day people live around the world: Thompson, Niobe, dir. 2016. *Great Human Odyssey*. Edmonton: Clearwater Documentary. <http://www.pbs.org/wgbh/nova/evolution/great-human-odyssey.html>.



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