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ORIGINAL SCIENTIFIC ARTICLE

Archaeology and Human Evolution

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Abstract Archaeology is the study of human behavior through material culture, the things we rely on for survival. Behavioral change was likely a driving factor in the evolution of our species, and archaeology therefore plays a central role in understanding human origins from the beginning of the known archaeological record some 2.5 million years ago. From its origins to subsequent diversification, the material record of human behavioral innovation provides an essential learning tool for understanding human behavioral diversity and also serves as a gateway to critical thinking in education.

Keywords Archaeology · Human evolution · Teaching

What is Archaeology?

Archaeology is a sub-discipline of anthropology, which is the study of people, particularly human biological and behavioral variation in the present, as well as the past. More specifically, archaeology is the reconstruction of ancient behavior from the things people left behind. When combined with the study of the biological changes that the human lineage has undergone over the last several million years, archaeology provides an important part of our understanding of the evolutionary success of modern humans, *Homo sapiens*.

The job of an archaeologist can be a difficult one. Archaeologists study peoples' *material culture*, the things that are made, modified, or used by humans or our ancestors (generally referred to as *hominins*). The study of material culture includes examining *artifacts*, portable items such as baskets or hammers, and *features*, which are non-portable things such as buildings or fireplaces. Equally important to the archaeologist are contextual clues that are often learned only through painstakingly careful excavation. These clues include the location of the found artifacts (inside a temple, a grave, or a trash pile?) and their association with other artifacts (are hammers always found with an anvil?) or environment (do the associated animals suggest humans were living in subarctic tundra or a heavily forested valley?). Imagine the difficulty encountered if someone were to reconstruct your life, likes, dislikes, and habits from the things that you own, and you begin to get a sense of what archaeology is about. Throw out half or more of those things made of perishable materials (cloth, wood, etc.), jumble them up with your neighbor's possessions and those of their great-great-great-great grandchildren and you begin to get a clearer sense of the task at hand.

How, then, do archaeologists know what they think they know? Like geology, archaeology is a historical science. As we cannot observe the past directly, archaeologists approach it by setting up analogous conditions through experimentation and observation. For example, what if

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you wanted to know how stone tools were made? To answer this question, some archaeologists have conducted a series of practical learning experiments in which they make the tools themselves, thereby understanding the process of manufacturing stone implements from beginning to end (Whittaker 1994). Likewise, how do archaeologists determine if the bones found at a site are the result of hominin dinners versus those left behind by other animals? Archaeologists have conducted controlled experiments in which bones are fed to hyenas and other animals in captivity and in the wild, carefully studying the remains for traces to distinguish the marks made by these and other animals from those made by humans (Lyman 1994).

Consider archaeologists interested in learning what early campsites looked like. To address this, scientists have studied from an archaeological perspective living groups of hunter–gatherers groups recently operating in Australia, southern Africa, and elsewhere, providing a comparative baseline of what to expect (Yellen 1977). Indeed, this spirit of comparison is in many ways at the root of prehistoric archaeology. It wasn't until contact with the stone tool-equipped populations in the New World that Renaissance Europeans (living in an agrarian society with metal tools) recognized that the strangely shaped stones they had attributed to lightning strikes or fairies were in fact stone tools from their own forgotten hunting and gathering past (Daniel 1962, 1967).

What is the Relevance of Archaeology to Human Evolution?

The archaeological record provides a unique, long-term view of the evolution of human behavior. The study of human evolution includes an examination of the physical, genetic, and behavioral variation of the hominin lineage since we diverged from other apes some seven million years ago or more. Although the shape of fossilized bones does record major changes in hominin behavior (such as habitually upright posture), it is not until about 2.5 million years ago with the first appearance of the archaeological record that we have abundant evidence for a more complete range of early human behaviors. Whereas morphological changes are the outcome of selective pressures acting on several generations, artifacts can record snapshots of the past, such as the time it took to make a stone tool, butcher an animal carcass, and transport meat back to friends and family.

In addition to providing a potentially different time perspective on the past, the relatively abundant archaeological traces from about 2.5 million years onward signal our increasing reliance on material culture as a key element of human survival and socialization (Table 1). Unlike most other animals, humans have long relied extensively on material items for basic survival needs (e.g., tools for hunting and cutting), as we lack, for example, the claws or sharp canine teeth of most carnivores. In addition to a complex knowledge of animal behavior and plant properties, human hunting and gathering involves bows, arrows, traps, digging sticks, and other items of material culture. Indeed, the earliest archaeological traces suggest hominins used tools to gain access to food and that natural selection may have favored those hominin groups with ready access to meat, marrow, and other food items more readily obtainable with tools.

To date, the earliest archaeological traces are stone tools from sediments that are approximately 2.5 million years old and are found at Gona, Ethiopia (Semaw 2000; Stout et al. 2005). All human groups as well as many other primate populations, such as chimpanzees, use tools composed of organic materials such as wood that rarely preserve more than a few years (McGrew 1992), unlike stone, which is a very durable material. But some chimpanzee groups use stone to make and use crude tools for nut-cracking (Mercader et al. 2007), and bone tools presumably made by *Paranthropus robustus* show signs of being used for digging into termite mounds (Backwell and d'Errico 2001). As these examples show, the earliest stone artifacts likely underestimate the true age of tool use and perhaps reliance upon tools by hominins, as there may have been a time lag between when stone tools were being made and when we can detect them in the record. The Gona artifacts show that by 2.5 million years ago, some hominins had learned to consistently select high quality rocks from local streambeds, fracture these stones using cobbles as hammerstones in order to produce sharp-edged splinters called "*flakes*," and to use these flakes as knives for removing skin or meat from animal carcasses (Fig. 1). Much like the marks on a kitchen cutting board, the direct evidence for this occurs on the bones themselves in the form of distinct cutmarks, as well as unique patterning of bone breakage distinctive of hominins determined through experimentation (Lyman 1994; Fig. 2).

The advent and routine use of stone tools likely had a profound effect in broadening the range of food types available to our omnivorous primate ancestors. The identity of the crafters of the earliest stone tools is unknown (thus earliest tools are termed "Oldowan" after Olduvai Gorge, Tanzania; see Table 1). Anatomical evidence suggests that a number of species on the landscape around 2.5 million years ago, including *Homo habilis*, *Australopithecus garhi*, *Paranthropus aethiopicus*, and *Paranthropus boisei*, could have made them (Tocheri et al. 2008). Later members of the genus *Homo* (such as *Homo erectus* by 1.6 million years ago) show anatomical changes that suggest a meat-rich diet and resulting larger brain, reduced gut size, and changes in tooth morphology, whereas *P. boisei* became extinct (Aiello

Table 1 Key Paleolithic industries, shown in stratigraphic order

	Approximate age range	Location	Hominins who made it	Defining characteristics and behaviors	Key sites
Upper Paleolithic/ Later Stone Age	40,000 years ago to present	Africa, Eurasia, Australia, and North and South America	*Homo sapiens*	The sole unifying characteristic of Upper Paleolithic (UP) and Later Stone Age (LSA) industries may be their diversity. The term UP was traditionally applied to Eurasia and LSA to Africa, but during the same period, artifacts first appear in Australia and the Americas. Many UP/LSA industries show stone tool-making traditions of manufacturing blades (flakes twice as long as wide) or microliths, small barbs used to tip arrows. Others are characterized by sophisticated stone spear points for hunting (e.g., Clovis points), whereas some regions show only simple methods of stone flaking. These sites are often characterized by artworks in various forms, evidence for the manufacture of clothing and other items from fibers, burials, boats, fishing, and in some sites, the use of clay to manufacture pots or other items	Abri Pataud, France; Elands Bay Cave, South Africa; Lindenmeier, USA
Middle Paleolithic/ Middle Stone Age	250,000–40,000 years ago	Africa, Eurasia	*Homo sapiens*, Neanderthals	Levallois (or prepared core) technology, hafting, spear points. The Middle Paleolithic (MP) is a general term applied to sites in Eurasia, whereas the term Mousterian may be used to refer to artifacts (particularly scrapers for hide- and wood-working) made by western European Neanderthals. MP sites in Israel and other areas in the eastern Mediterranean were made by Neanderthals and *Homo sapiens*. The Middle Stone Age (MSA) is restricted to Africa, made by hominins that included *H. sapiens* and includes early evidence for bead manufacture, bone tools, and the long distance movement of material, perhaps by exchange. Burials are found at both MP and MSA sites	Tabun, Israel; Combe Grenal, France; Blombos Cave, South Africa
Acheulian/ Early Stone Age	1.6 million to 200,000 years ago	Africa, parts of Europe and Asia as far east as India	*Homo erectus*, *Homo heidelbergensis*	Manufacture of large stone-cutting tools including the hand axe, controlled used of fire, dispersal from Africa	Boxgrove, UK; Olorgesailie, Kenya
Oldowan/ Early Stone Age	2.5–1.5 million years ago	Africa and perhaps southern Eurasia	Possibly members of the genera *Homo*, *Australopithecus*, and *Paranthropus*	Earliest stone tools, primarily cores and flakes, the latter in particular used to process meat, plants, and wood	Olduvai Gorge, Tanzania; Koobi Fora, Kenya

The Paleolithic (from the Greek, roughly meaning "early stone age") archaeological record is often subdivided into categories that reflect major differences in hominin behavior that accumulate over time or occur between different areas. Traditionally, these categories are defined on the basis of stone tool technologies (or "industries") because of the abundance of this artifact type, and most industries were created before the advent of radiometric dating. More recent studies emphasize the complexity of hominin behavior, and thus this table is intended as a guideline only, and in particular, it simplifies the related issue of hominin taxonomy

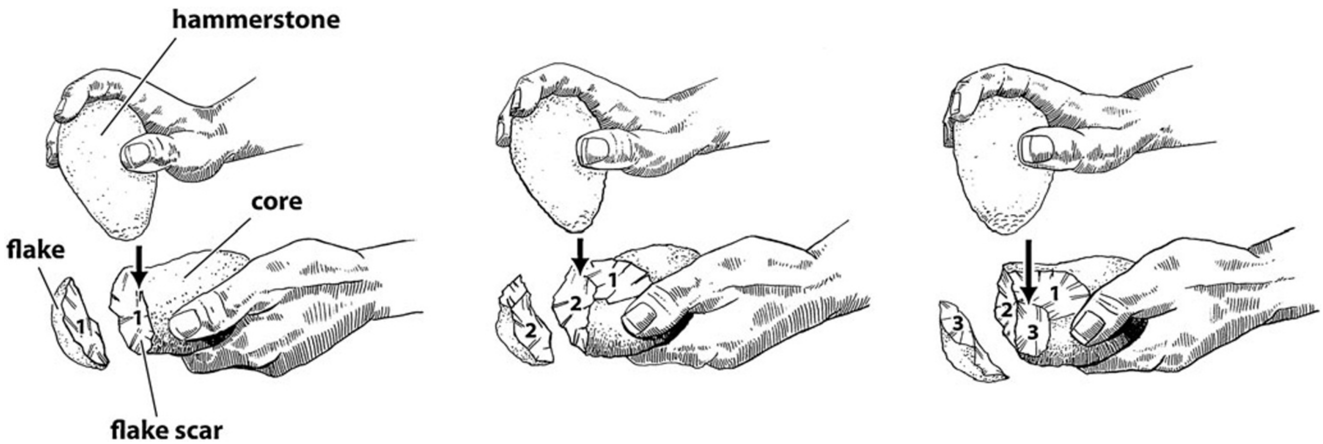

Fig. 1 Schematic illustration of how the earliest stone tools were made, striking sharp-edged flakes from a lava cobble by direct freehand percussion using a hammerstone. Shown is a sequence of three flake removals; note that the core from which the flakes are struck is rotated each time a flake is removed. Flaking is a controlled action requiring the correct combination of angles on the core, hand–eye coordination to strike a small spot, and use of the required force to remove the flake. Figure redrawn by Christopher Coleman from Schick and Toth (1993)

and Wheeler 1995), suggesting perhaps that more regular access to meat was a trait that characterized our genus. Whatever the long-term consequences, the changes in early hominin diet brought about by tool use was probably at first incremental. Early hominins were likely often in stiff competition with carnivores, and a major debate concerns the extent to which early hominins were passive scavengers or active hunters. In rare instances, as at approximately 1.8-million-year-old sites at places such as Olduvai Gorge, Tanzania, cutmarks are *overlain* by carnivore toothmarks, which by their placement must have been produced after the cutmarks. This demonstrates that in some instances, hominins had first access (Potts 1988).

Fossils found at early archaeological sites also show changes in the types of food hominins acquired and the distances they were transported. Early hominins such as *H. habilis* were probably often out-competed by carnivores, rarely acquired meat, and when they did, likely consumed it a short distance from the kill site (Faith et al. 2009). But by 50,000 years ago and probably much earlier, hominins were acquiring a diverse range of animals and transporting selected pieces with the most meat or nutritional value to home bases (Assefa 2006). Increasingly diverse wild game and careful selection of nutritionally rich elements may signal better hunting and has at least two more important implications. First, greater hunting skill combined with increased human population size had the consequence of putting substantial stress on local animal species, many of which underwent local population depletions or extinctions, at which point human hunters switched to different species, often with similar disastrous results on these other animal populations (Kuhn and Stiner 2001). Evidenced by this example, human impact on the environment is a very ancient story. A second important feature of food selection (particularly large game) and its transport to a home base or camp is that the transportation of the food, and its delayed consumption, provides the context for sharing amongst a larger group and thus the formation of the complex social obligations. It may also contribute to the sexual division of labor and changes in life history patterns that include extended periods of learning and paternal provisioning of young that are among the foundations of human society (Bird and O'Connell 2006; Hawkes et al. 1991, 1998; Isaac 1978).

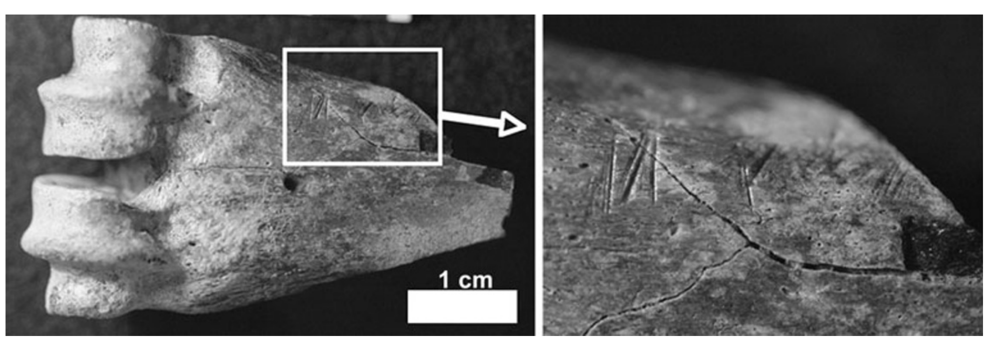

Fig. 2 Cutmarked antelope lower leg bone from site FwJj14A, Kenya, approximately 1.5 million years old. Photograph by B. Pobiner

Archaeologists who study hominin diets often focus on bones, meat, and hunting not because this is an accurate reflection of what hominins ate or how they spent their time as perhaps perpetuated by Ardey (1976) but rather because bones preserve well compared to other elements of the diet. This preservational bias is important to recognize, as plants for example comprise from 20 to 70 percent of the diet of recent human foraging groups except for those living in arctic or subarctic conditions (Kelly 1995; Marlowe 2005). Our understanding of the non-meat components of the diet largely hinges on newly developed methods for their recovery and the chance discovery of sites with conditions of exceptional preservation. One exciting new technique focuses on dental calculus (what dentists refer to as plaque) on fossil teeth, whose incremental accumulation serves as a hard, protective coating for starch grains and other microscopic plant components that can be recovered with careful sampling (Henry and Piperno 2008). Organic materials are also preserved under circumstances whereby the artifacts are burned or buried under waterlogged conditions. For example, seeds and fruits have been recovered from the Neanderthal levels at Kebara Cave, Israel (Lev et al. 2005) about 55,000 years ago. At the open-air site of Gesher Benot Ya'aqov, also in Israel, nutshell fragments and the anvils and hammerstones used to crack them were recovered from lakeshore sediments dated to more than 780,000 years old (Goren-Inbar et al. 2002).

The use of stone tools to crack nuts at Gesher Benot Ya'aqov is an important reminder not only of the importance of tools used by hominins but also of their diversity in form, function, and material. As for bones, the focus on stones by those who study the archaeology of human evolution is largely due to their preservation. There are some important general patterns among the stone tool record of the last 2.5 million years (Table 1). First, in general, stone tool complexity increases through time. Even the earliest pieces recognized as stone tools demonstrate mastery of the necessary complex relations between hand–eye coordination, motor skills, and an understanding of the raw material properties involved in the production of sharp-edged splinters or flakes that were used with little subsequent modification. Later tool forms, such as the Clovis spear points used by hunters some 13,000 years ago in what is today the United States, show numerous technically demanding flake removals that essentially “sculpt” carefully shaped pieces (Fig. 3a). These points were in turn hafted through an equally complex process of applying resin or binding to join to the stone tip to a carefully shaped wooden pole, or shaft (Frison 2004).

Necessity is the mother of all invention. Like the evidence for changes in diet, the increasingly complex stone tools suggest the need for hominins to acquire different sorts of food, or to acquire food more frequently,

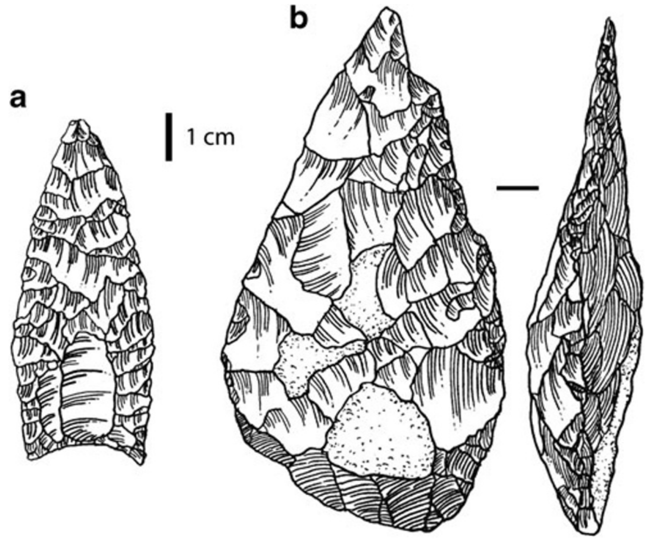

Fig. 3 Stone tools. **a** Clovis point, Dent Site, Colorado, approximately 13,000 years old (after Whittaker [1994]). **b** Front and side views of an Acheulian hand axe, Refuf Pass, Egypt, approximately 350,000 years old (after Coles and Higgs [1969]). Both artifacts redrawn by Christopher Coleman

or in greater abundance, perhaps as a result of the effects of increased population pressure. This complexity in tool design may also be evidence of increased skill or intelligence, but is more likely a signal of the greater reliance of humans on technology for survival. As we are today dependent on the ability to control our food resources and buffer our risk of food shortages through large-scale food production, harvesting, storage, and distribution, along with the use of refrigeration and chemical preservatives, so too, albeit in a different way, did our hominin ancestors begin to gain increasing control over their food resources.

Hominin ingenuity can been seen in the broadly similar patterns of technological development across much of the globe, with comparable solutions independently developed to solve what were likely common problems of subsistence or survival. For example, by about 1.5 million years ago, hominins developed Acheulian handaxes (Table 1), thin teardrop-shaped implements that probably served as a tool for cutting and chopping and as a source for other sharp-edged flakes: a Swiss Army knife of the Paleolithic (Fig. 3b). Similar tools were used throughout Africa and Eurasia for well over a million years, and the available data suggest the possibility that this tool form was independently reinvented by multiple hominin species (Clark and Riel-Salvatore 2006). And from at least 100,000 years ago, similar methods of producing flakes and the use of flake tools as spear points characterize diverse hominin populations during the Middle Paleolithic and Middle Stone Age (Table 1), including both Neanderthals in Eurasia and early *H. sapiens* in Africa (Shea 2006).

Importantly, many items of material culture were probably invented in parallel not only by geographically distinct populations but probably also by different species. The archaeological record reveals in many instances strikingly similar behavioral patterns among physically distinct groups of hominins. To continue the comparison between Neanderthals and *H. sapiens* initiated above, there are no measurable differences in hunting ability or animal prey acquired by these two types of hominin among the well-preserved food remains found in caves across Eurasia, from Roc de Combe in France (Grayson and Delpech 2008) to Ortvale Klde in the Republic of Georgia (Adler et al. 2006).

This leads to the obvious question of what led to the evolutionary success of our species. Unlike the case for most of the last several million years, *H. sapiens* is the only extant hominin species and has been so for at least the last 10,000 years. Part of the answer to our evolutionary success may be biological, such as high birth rates or climate-specific adaptations (Finlayson 2004; Zubrow 1989). However, as archaeologists, we are particularly interested in social factors that may have led to our evolutionary success, such as differences in the division of labor (Kuhn and Stiner 2006) or communication, particularly in the sharing of information between individuals, among groups, and across generations.

Although language doesn't fossilize and the earliest writing dates to “only” about 5,500 years ago (and outside this review), there is good archaeological evidence to suggest that by at least 40,000 years ago, some populations of *H. sapiens* began using material culture to convey important information in ways not previously seen or used by other hominin species. Beads, a broad term used here to describe a non-utilitarian group of objects for personal adornment, provide one important example. Small seashells, some with naturally occurring holes, others with deliberate perforations, and many with wear traces suggesting being suspended on string, occur on Upper Paleolithic and Later Stone Age (Table 1) sites in the Mediterranean and in South Africa. They date from perhaps as far back as 80,000 years ago and are abundant by 30,000 years ago (Bouzouggar et al. 2007; White 2003). Artifacts from areas further from the coast such as parts of eastern Africa show beads were made from land snail shell fragments (Assefa et al. 2008). Ostrich eggshells were also used to make beads, whereby fragments were carefully broken and ground into disk-shaped beads by about 40,000 years ago (Ambrose 1998; Fig. 4).

Perhaps some of the most striking examples come from Upper Paleolithic Aurignacian sites in Europe (Table 1). Aurignacian sites are characterized by a distinct suite of artifacts (such as long flakes called blades and antler projectile points) and, at perhaps 35,000 years ago, are associated with the earliest populations of *H. sapiens* in Europe (Bailey et al. 2009). Aurignacian people used teeth, with holes carefully drilled or with grooves incised to aid their suspension, as parts of necklaces or perhaps sewn onto clothing. Importantly, although these teeth are from a variety of animals, they belong to completely different sorts of animals than those being hunted. For example, the beads from Castanet and Brassempouy in France were composed of the drilled teeth of fox, red deer, wolf, and even rarely, humans, whereas reindeer, horse, and various bovids dominate the food refuse at these Aurignacian sites (White 2007). These teeth clearly had significant meaning to their wearers, and the presence of similar pierced teeth at numerous Aurignacian sites suggests that knowledge of their significance was probably shared among a fairly wide audience of friends, relatives, and other members of the extended population.

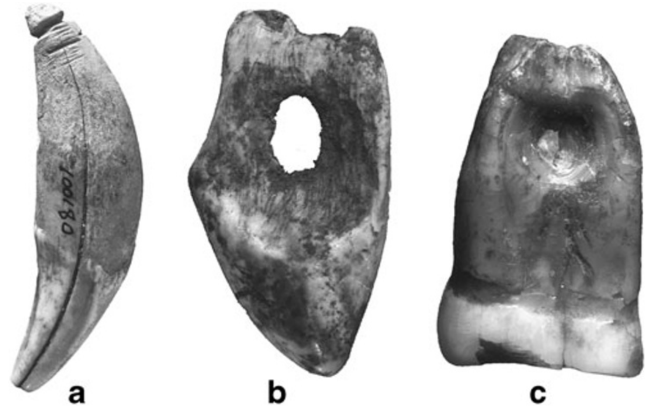

Fig. 4 Modified teeth from French Aurignacian sites (not to scale): (**a**) wolf canine, (**b**) deer vestigial canine, and (**c**) human molar. Images courtesy of Randall White

The precise meaning of beads and other items of ancient material culture to those who made and used them are obscure to archaeologists today. Of course, we lack anyone to inform us of the sort of cultural context necessary to interpret these artifacts. Wedding rings provide a good example. Those of us living in the United States, Canada, and the United Kingdom (for example) recognize that a person wearing a ring on the fourth finger of the left hand is probably married. Rings are not universally exchanged at marriage, and when done so, the choice of hand or finger may vary cross-culturally. Although this tradition may derive from early beliefs about the presence of a vein in the fourth digit leading to the heart, the choice is arbitrary. From the perspective of the archaeologist, there is nothing about the physical characteristics of (most) wedding rings that would link them to marriage, rather it is the understanding of their meaning shared by members of a culture or community that lends them significance. The early beads found in the archaeological record could possibly be important objects that—like wedding rings—likely carried substantial cultural information, and may have been a key element of socialization and signifying to other humans within or outside of immediate groups. The difficulty of interpreting the meaning of things in the absence of social context is hilariously explored in the David Macaulay (1979) classic for all ages, *Motel of the Mysteries*, which provides an essential cautionary tale for anyone interested in the deep past.

Whatever their specific meaning, the appearance and abundance of beads and other uses of other forms of symbolism after about 40,000 years ago demonstrate the increasing use of material objects as expressions of group and/or individual identity. Since at least at one site in Russia, Kostenki, perforated shells (presumably made into jewelry) come from at least 500 km away (Anikovich et al. 2007), it's likely that by this time, trade within and between groups had become more prevalent. Sustaining these social networks would have necessitated increasing frequent and complex forms of communication—perhaps a precursor to today's cell phone and Blackberry-reliant cultures.

How Do You Teach the Archaeology of Human Evolution?

Archaeology is an integral part of paleoanthropology, the multidisciplinary approach to the study of human evolution. Archaeology provides the long-term perspective of human behavioral change and is the necessary complement to other approaches that emphasize biological change. The archaeological record is considerably richer than that of the human fossil record. Few sites preserve fossil hominins, but many contain archaeological "visiting cards" (Isaac 1981) that record their passage across the ancient landscape: stone tools, food, and living debris and other elements that open an important window into past human behavior.

The teaching of archaeology and human evolution can be achieved through a number of approaches. Establishing the key concepts can be done by first stressing the importance of thinking about "things" and the way that we use them. Archaeology is a fairly tactile thing, and there can be little replacement for actually seeing, or better yet, handling ancient artifacts or accurate facsimiles. These are available in many museums, online websites, or from commercially available firms, some of which are listed in the Appendix. A visit to a local museum, historical society, university or college, and/or an interaction with a professional archaeologist (every state has one, and you can find them here: http://www.rpanet.org/) can be a memorable, fun, inspiring, and educational experience (Eldredge 2009). Museums often have programs for school groups and educator guides to some exhibitions available to enhance a museum visit experience. Also consider working with your local school or public librarian to gather books, articles, and archival materials on archaeology and human evolution. Suggestions for creating your own on-site experience are listed in the Appendix.

Why Is Teaching Archaeology Useful, and How Does it Relate to Other Curriculum Topics?

Because archaeology is inherently multidisciplinary, you can use archaeological content to teach about chemistry, physics, biology, earth science, history, social studies, art, and other topics. Archaeology can be a good way to teach about more abstract principles: for instance, using radiocarbon dating to teach about isotopes in chemistry or physics. Also, climate change is a popular current topic; archaeologists often try to understand how human populations adapted to climate change in the past, giving us perspective on current human interactions with the planet. Archaeological inquiry is based on objects and evidence, so it can be used to teach about the process of science in general. It can also be used to teach critical thinking skills, problem solving, and citizenship; it enhances group and cooperative learning; and it is an excellent way to promote cultural awareness and sensitivity. For prehistoric cultures (those that lived before the advent of writing), examining archaeological material is often the only way we can begin to understand how people in the deep past lived. Capitalize on student interest in forensics TV shows and inherent desire to solve mysteries, and teach archaeology! In short, archaeology and human evolution can be gateways to broader training in critical thinking and a liberal arts and sciences education.

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Appendix

Resource Guide to Teaching Human Evolution and Archaeology

This guide aims to aid educators in teaching human evolution from an archaeological perspective. Lesson plans and reference materials are provided.

Books

Burke H, Smith C (2007) Archaeology to Delight and Instruct: Active Learning in the University Classroom. Walnut Creek, CA: Left Coast Press. This innovative book presents novel ways of teaching archaeological concepts to students in college or university. Twenty experienced instructors provide exercises comprised of role-playing, simulations, performance, games, and activities. Simply put, this is a great way to breathe life into your archaeology lectures. *One world archaeology series, no. 49; 288 p.*

Gosden C (2003) Prehistory: A Very Short Introduction. Oxford: Oxford University Press. Probably the most engaging resource available, this is considerably briefer than most on the subject of prehistory. This introduction spans the entire archaeological record prior to the advent of writing. *Very short introductions series, no. 96; 131 p.*

Klein RG (2009) The Human Career: Human Biological and Cultural Origins. Chicago: The University of Chicago Press. Perhaps the most comprehensive published source of information on the archaeology of human evolution, this dense text is the standard against which all others are measured. It is used in undergraduate and graduate courses across the United States. *Third edition, 989 p.*

Morell V (1995) Ancestral Passions: The Leakey Family and the Quest for Humankind's Beginnings. New York: Simon & Schuster. No study of the archaeology of human evolution would be complete without mention of the Leakey family. Morell examines in her biography the family famous for discovering important fossil discoveries that have helped to shape the understanding of human origins. *638 p., illustrated.*

Osterweis Selig R, London MR, Kaupp PA (2004) Anthropology Explored: The Best of Smithsonian AnthroNotes. Washington, DC: Smithsonian Books. *AnthroNotes* is required reading. Published twice a year, this free resource is aimed towards educators and is published by the Smithsonian Institution's National Museum of Natural History. Some of the best articles published prior to 2004 have been collected in this book, including those on human evolution, archaeology, and art, among others. (Not included in this volume yet available online, the Spring 2010 issue (vol. 31, no. 1) of *AnthroNotes* is a special issue on human origins.) *Second edition, 348 p., contains illustrations and maps.*

Schick KD, Toth NP (1993) Making Silent Stones Speak: Human Evolution and the Dawn of Technology. New York: Simon & Schuster. This tome provides a beautifully illustrated and clearly written first-hand account of the earliest archaeological traces based mostly on the authors' own experimental fieldwork. *351 p., illustrated.*

White R (2003) Prehistoric Art: The Symbolic Journey of Humankind. New York: Harry N Abrams. A comprehensive overview, this volume provides a superbly illustrated coverage of Paleolithic art. With 226 full-color illustrations that are great visual aids to a lecture, this book covers the history of global excavations, the art, and the peoples who made it, and the interpretations of the symbols. *239 p., illustrations and maps included.*

Wood BA (2005) Human Evolution: A Very Short Introduction. Oxford: Oxford University Press: This small, affordable, and very handy book covers the history of paleoanthropology and sets the stage for evolutionary research, covering fossil evidence for human evolution, genetics, biology, paleoclimatology, and geochronology. *Very short introductions series, no. 142; 131 p., illustrations and maps included.*

Encyclopedias

Delson E, Tattersall I, Van Couvering J, Brooks AS (2000) Encyclopedia of Human Evolution and Prehistory. New York: Garland Publications. Perhaps the most authoritative source on human evolution, this standard in the field contains more than 800 alphabetical entries written by 54 internationally recognized scholars. Facts and theories are clearly described and supported by illustrations and diagrams. A summary of major subjects is presented, as well as a detailed list of articles by topic. This is geared toward advanced levels but provides detailed explanations and examples of teaching topics. *Second edition, Garland reference library of the humanities series, no. 1845; 753 p., illustrated.*

Jones S, Martin RD, Pilbeam DR (1992) The Cambridge Encyclopedia of Human Evolution. Cambridge: Cambridge University Press. This encyclopedia covers a wide range of human evolution, including genetics, fossils, primatology, biology, ecology, and archaeology. Emphasis is on the biological diversity of modern people and fossil and genetic evidence for evolution. This is geared toward advanced education levels. Although now slightly dated, the writing is superb throughout. *Cambridge reference book series; 506 p., illustrations and maps included.*

Stringer C, Andrews P (2005) The Complete World of Human Evolution. London: Thames & Hudson. The full range of human evolution is explored in this well-written book, including the fossil, genetic, and archaeological evidence, as well as detailed chapters exploring how paleoanthropologists “know what they know.” Sites around the world are explored, including more recent ones in the Republic of Georgia, as well as genetic innovations, tool use, and art. Beautiful illustrations (including many specially commissioned for this volume), photographs, and diagrams help demonstrate key topics and provide a ready source of lecture aids. *240 p., illustrated.*

Organizations and Institutions

Archaeological Institute of America (www.archaeological.org). Publishers of *Archaeology* magazine, the AIA provides resources for hands-on learning of archaeology with lesson plans and examples for classroom learning, including shoebox digs and the mystery cemetery, the basics of archaeology, movies, bibliographies, and glossaries.

Mississippi Valley Archaeology Center at the University of Wisconsin, La Crosse (www.uwlax.edu/mvac). This center is involved in the researching, preserving, and teaching about the archaeological resources of the Upper Mississippi River area. The resources for educators include frequently asked questions, resource guides to the area's past peoples and technologies, a glossary, lesson plans (including in PowerPoint), and more.

National Academy of Sciences, Evolution Resources (http://nationalacademies.org/evolution). The National Academy of Sciences provides the fundamental definitions and defense of evolution from the premier association of American scientists. The Evolution Resources portal contains definitions, research reports, frequently asked questions, and more on issues pertaining to evolution and teaching evolution.

Science Netlinks (http://sciencenetlinks.com). The American Association for the Advancement of Science's *Science Netlinks* website provides lesson plans for K-12 science educators. We suggest the plans for grades 3–5: the *Artifacts* series; *Technology: Past, Present and Future*; for grades 6–8: *Environment, Technology, and Culture of the Chumash People*, *Learn to Think like an Archaeologist*, the *Collapse* series (about civilizations); and for grades 9–12: *Exploring Human History* and *The science of Mummies.*

Human Origins Program, Smithsonian Institution (http://humanorigins.si.edu/). The Department of Anthropology at the Smithsonian Institution National Museum of Natural History recently launched the website of its Human Origins Program, showcasing interactive resources on human evolution and paleoanthropology, asking "What does it mean to be human?" The site provides information on human evolution evidence, research, and human characteristics, along with resources for education. The site is a companion to the museum's new human origins exhibit. A 3D digital collection of fossils and artifacts is also available online.

Society for American Archaeology (www.saa.org). SAA provides many resources on teaching and discussing archaeology for educators at K-12, undergraduate, and graduate levels, including lesson plans. The "For the Public" section includes resource links and a frequently asked questions (FAQ) page with questions educators may receive from students. The "Resources" tab in this section features brochures for the public, including a factsheet on common myths in archaeology and more FAQs for students and teachers.

Directories

The American Association of Museums (www.aam-us.org). The AAM lists a directory of member museums, searchable by museum type, museum name, and state, among others. Search for "Natural History/Anthropology."

The National Association of State Archaeologists (www.uiowa.edu/~osa/nasa). The NASA provides a directory of state archaeologists for the United States and its territories.

Videos

NOVA: Becoming Human: Unearthing Our Earliest Ancestors (2009). PBS, WGBH Educational Foundation. This series explores human evolution through computer-generated animations and interviews with experts in the field. The three-part series includes Part 1: "First Steps," Part 2: "Birth of Humanity," and Part 3: "Last Human Standing." The companion website to the series, www.becominghuman.org, features an interactive documentary and resources. *Series producer, Graham Townsley, rated TV-PG, about 160 minutes per part.*

NOVA (www.pbs.org/wgbh/nova). NOVA television programming offers great documentaries on anthropology, archaeology, and human evolution. The "Teachers" section offers teacher's plans for many of their videos. We suggest videos in the "Anthropology" section, specifically, *Alien from Earth*, which explores the "hobbit" found in the Indonesian island of Flores. Many videos are available for viewing online.

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