SOME QUESTIONS AND ANSWERS ABOUT TEACHING HUMAN EVOLUTION

by Alison S. Brooks

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How do we know a fossil is a human ancestor and not just an ape?

Humans have some special characteristics that are not shared by apes. One of the earliest characteristics that differentiates even very early human fossils from apes is bipedalism, walking on two legs instead of four. This creates so many differences in the shape of the pelvis, legs, backbone and even the skull that we can recognize bipedalism in a fossil even when we don't have foot or leg bones. Another characteristic that appears in very early human ancestors is the lack of a large projecting canine toothÙ human canines are blunt and project little if at all. The large human brain develops later in human evolution, after 2 million years ago.

How come apes are still apes while humans evolved?

We have very few fossils of African apes from the last 5 million years when humans were evolving, so we do not know what the African apes of that time looked like. We do have fossils of Asian apes that show that they too were evolving. Some of them (e.g. *Gigantopithecus)* became very large, lived more on the ground than in the trees, and developed smaller, less projecting canine teeth. The last of these giant forms lived about 300,000 years ago. We do not know why we find so few fossils of African apes from the last 5 million years (one of the only chimpanzee fossils was found recently in Kenya, near Lake Baringo); perhaps they lived more in dense forests in Central and West Africa that have not been explored for fossils.

Do other animals evolve?

Yes, for example, a close relative of elephants which lived as recently as 5 million years ago had two sets of tusks, two each in their lower AND upper jaws. Even the recent (last 100,000 years) ancestors of today's mammals were often larger and had very different horns, antlers or tusks.

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Where did the ape-like creatures from which humans evolved come from?

This is actually a debated issue because only a few fossils in Africa have been found from between 9 and 5 million years ago. The first apes probably evolved in Africa about 25-30 million years ago from generalized 'higher primate' ancestors, that is tree-dwelling animals with forward-facing eyes, flat grinding molar teeth somewhat like ours, and projecting canine teeth, as well as other features in the ear and elsewhere that are shared with us, the apes, and the monkeys. They spread from Africa to Europe and Asia by about 17-15 million years ago but continued to develop in Africa. (Before this, Africa was an island, separated from the northern continents by a narrow sea called the Tethys, so tree-dwelling primates could not get across from Africa.)

Is human evolution finished?

Humans have actually changed biologically in just the last 15,000 years. Since we invented agriculture and ate softer foods such as porridge, bread, milk and cooked stews, our teeth have become smaller, our muscles are weaker, and our skeletons are less robust. We have also spread to new lands (North and South America, the Arctic) and developed many physical differences in response to the different climates we encountered. We are also developing resistance to many diseases that did not exist in humans before agriculture, such as influenza. Evolution happens when some individuals, who were born with a disease resistance or an ability to withstand a particular stress such as cold winters or low sunlight or crowding survive, and have lots of offspring while others who are not so fortunate have few or no offspring. Even with modern medicine and cultural responses to environmental challenges, there is no reason to think that we will not continue to respond biologically to environmental change.

At what stage did different races evolve?

Whenever a group of humans or animals is isolated from the rest of the species, they may develop characteristics by chance that are not shared with the larger species groups. Some of these characteristics may prove beneficial in the particular environment occupied by the small group. Over time the new characteristics come to dominate the small group, as individuals with those characteristics live longer and have more offspring. The genetic and archaeological evidence suggests that modern humans (*Homo sapiens sapiens)* evolved in Africa before 200,000 years ago. (The oldest fossils of our species known currently are from the Omo Valley, close to the Kenya-Ethiopia border). They appear to have spread out of Africa between 60 and 40,000 years ago. So the modern "racial differences" especially those characteristics of people living in climates with low levels of sunlight such as very pale skin, hair and eyes, or the cold adaptations in body shape seen in modern Arctic inhabitants have to have developed after this time.

Are people in some continents more brainy than others?

It has been very hard even to define differences in human "braininess," let alone to study the extent to which they are determined by biology as opposed to the environment. Even the "intelligence" measured by typical IQ tests consists of many different abilities that reside in different areas of the brain—spatial visualization, verbal ability, logical or mathematical reasoning, etc., while many types of "intelligence" that are highly valued by our various cultures (e.g. social intelligence, physical coordination and movement) are not measured by these tests at all but may contribute more to a child's future success. When environmental factors (e.g. better nutrition, early education, more visual stimulation, absence of debilitating diseases) are considered, it does not appear that any one continent or even any one people are "brainier" than anyone else.

What caused species that were evolving progressively to become extinct?

There are several reasons why a species may go extinct, many of which are forcing extinctions today all over the world. One is that the environment to which the species is adapted may change so that its characteristics are no longer advantageous or useful. For example, Europe used to have many species of apes, but when the climate began to cool down about 5 million years ago, the types of year-round fruit-bearing forests that apes do well in began to disappear, and so did the apes. A second is that a new competitor is introduced into the species environment that may eat the same foods or nest in the same places but feed or reproduce more successfully or more rapidly. The result is that the newcomer gradually crowds out the older resi-

dents, and the original resident species goes extinct. For example English sparrows and pigeons are now found all over the world, and many local sparrow-like or pigeon-like birds are going extinct. The third possibility is the arrival of a new predator, who may consume eggs, young or adults of an existing species in new ways, until the existing species numbers are reduced to extinction. This is what happened when dogs were introduced to Australia, or when new types of snakes arrived in the islands of the Pacific. Humans are now causing extinctions for all three reasons: changing environments (by deforestation, for example), bringing in competitors (such as cattle) and preying more and more successfully on other species, due to improved hunting and fishing technologies.

If evolution is real, shouldn't we be born apelike and become human as we grow up?

Actually we do something very much like this before we are born. At a very early stage of development, human embryos and chimpanzee embryos are much more similar than the adults are. At one stage, both species' embryos even have a tail, which disappears gradually before we are born.

Is evolution real?

The evidence for evolution is overwhelming. Not only do we have fossil evidence for the ancestral stages of many living animals and plants, but we also have new genetic evidence that underlines the basic unity of all life. (For example, we share about half of our genetic material with a banana! and 98% with a chimpanzee). In addition, we are increasingly able to identify the chain of actual chance "mistakes" or mutations in the genetic material (DNA) that change the activity of each gene and result, for example, in lighter skin, or hairlessness, a longer face or lack of a tail. These chance mistakes are simple (e.g., substitution of one chemical for another on a long chain, or reversal of a small segment of the chain), yet can result in major changes in the body, especially when they affect an important stage in the development of the organism from a single cell or fertilized egg.

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