

## INSTRUCTOR INFORMATION

### Scientific Terms for Students to learn

Hominid- *group consisting of all modern and extinct humans and great apes (including gorillas, chimpanzees, and orangutans) and all their immediate ancestors.*

Evolution- *change in the heritable characteristics of biological populations over successive generations*

Natural selection- *differential survival and reproduction of individuals due to differences in phenotype*

Skull- *bony structure that forms the head in vertebrates*

Process- *projections on bones, often serving as attachment points for muscle*

Canine- *relatively long, pointed teeth, often called fangs, for folding and tearing apart food*

Incisor- *front teeth for shearing or cutting food during chewing*

Pre-molar- *teeth between Canine and Molar teeth ful-filling both functions*

Molar- *large, flat teeth at the back of the mouth used primarily to grind food*

Dental formula- *characteristic arrangement, kind, and number of teeth of a given species at a given age*

Phylogeny- *a branching diagram or "tree" showing the evolutionary relationships among species*

Ancestral character- *a character or trait inherited from a common ancestor*

Derived character- *a character or trait that arose in the most recent common ancestor*

### General Background

*Spinosaurus, a fearsome dinosaur and one of the largest carnivores ever to walk the Earth, was first discovered by humans in 1912. As is the norm in paleontology, the evidence consisted of just a few bones, but by using the right clues, scientists are often able to correctly infer the size and shape of many other bones in the skeleton, revising and making changes as new pieces of the puzzle are discovered. Sadly, the chance to study these fossils was lost in 1915 when Allied bombing of Munich destroyed the only fossils of Spinosaurus at the time. All that remained were detailed notes and sketches of the remains. Taking inspiration from this story (and many like it), students will place themselves in the shoes of paleoanthropologists as they construct an evolutionary history of the primate order, and our own family, Hominidae (the Great Apes). Approximately 25-30 million years ago, the tailless apes diverge from monkeys. 4 million years ago, human ancestors diverged from other apes, notably our cousin, the chimpanzee, which diverged from the same ancestral ape at the same time. While we still share many common features with our closest cousins, including a large brain case, forward-facing eyes, and grasping hands, humans evolved to cope with a new habitat forming in Africa: the savanna. Straight, forward facing legs were used to walk long distances in these grasslands, while hands were left free to develop tool use.*

*Comparisons in specific features of primate skulls yield an evolutionary history. The sloping of the forehead seen in gorillas and chimpanzees was also shared by early human ancestors, and gradually became more vertical as the brain case increased to accommodate this critical organ. Likewise, the chin recedes backwards in apes and early hominids, but points forward in modern humans.*

*Facial protrusion is a measure of how far the snout sticks out from the face. Brow ridge describes how large the protrusion of the forehead is. In other apes, both of these are very large, while almost absent in modern humans.*

*In hominid teeth, more distant ape relatives have large canines. However, in all apes, including humans, the number of incisors (front teeth, 4), canines (“vampire” teeth, 2), premolars (4) and molars (6) are the same: 4-2-4-6 on each jaw. This ratio is called a dental formula and is very important in determining diets.*

*The hole through which the spinal cord connects to the brain is called the foramen (4-ã-men) magnum. In gorillas and chimpanzees, this hole is towards the rear of the skull. In bipedal hominid, it is directly under the skull, perfect for walking upright.*

*A phylogeny is an evolutionary tree that branches organisms based on ancestral, derived characteristics. For example, monkeys form a separate branch, or clade, because they all have a shared, ancestral characteristic: a tail. Features of hominid skulls can be used to produce a morphological phylogeny. Students are challenged to find these ancestral characteristics to identify different skulls.*

*In addition to the evidence found in ancestral anatomical characteristics, both in the fossil record and in extant species, relationships are also documented through genetic testing, the study of embryos, and the location of different organisms throughout the world (biogeography).*

*The science of studying early hominids is called paleoanthropology.*

## **Skull Key Identification and Information**

**A**

*Gorilla gorilla*

The last common ancestor between gorillas and humans, a small gibbon-like ape, lived somewhere between 5 and 7 millions years ago. Despite the large canine teeth, gorillas are strict vegetarians. The skull has a smaller brain case than the others in proportion to the rest of its skull. A large crest on the top of the skull, called a sagittal crest, makes the head appear larger. The snout protrudes sharply, as does the brow. The teeth exist in a dental pattern of 4-2-4-6, (4 incisors, 2 canines, 4 premolars, and 6 molars) which is consistent among all the primates and provides structural evidence of relatedness among the apes.

**B**

*Pan troglodytes*

Chimpanzees are the closest living relatives of our own species, *Homo sapiens*. They slowly diverged into separate species as forests gave way to savanna, creating new habitat for early hominids. Chimpanzees retain a smaller sagittal crest, extended brow and the protruding snout of the gorilla, but the canines are significantly smaller, while the brain case is somewhat larger (more spherical) in relation to the rest of the skull. Chimpanzees are highly intelligent and omnivorous, eating both animals and plants.

C	<p><i>Homo habilis</i></p> <p>2.4-1.4 million years ago, the first human ancestor confirmed to use tools appeared on the scene. The tool was little more than a sharpened rock called a “hand ax”, but based on uniform notches preserved in bones of prey animals, served to butcher meat. It also maintains huge significance as the first in an increasingly complex set of tools used by the <i>Homo</i> genus. Slight less ape-like than the earlier <i>Australopithecus</i>, this human ancestor still had a somewhat protruding (prognathic) snout with smaller canines. The sagittal crest, which disappeared with <i>Australopithecus</i>, remains gone. It’s brow was heavy, but not as prominent as that scene in gorillas and chimps.</p>
D	<p><i>Australopithecus afarensis</i> remains one of the earliest confirmed human ancestors. Although they may have resembled chimpanzees in their looks, this species was confirmed as bipedal, losing grasping feet in favor of the current model humans still have today. They lived approximately 3.88-2.9 million years ago and were omnivorous, and presumably lived in both trees and on the ground. They have the distinction of being the first fossil hominid discovered, a female named “Lucy”. The sagittal crest is gone, and the braincase is slightly larger in relation to the rest of the skull than seen in chimps and gorillas. The snout protrudes slightly, and the brow remains pronounced.</p>
E	<p><i>Homo erectus</i></p> <p>Emerging as the first human-sized hominid between 1.89 million years until just 143,000 years ago, <i>Homo erectus</i> had long legs and shorter arms, allowing it to move easily on two legs. It was the first hominid confirmed to leave the continent of Africa, and may have used fire to stay warm and cook food. The brow remained heavy, but the protrusion of the snout is gone, and the braincase is larger in size when compared to the face. In terms of its time on Earth, <i>Homo erectus</i> was among the most successful of the group; they were here 9 times longer than modern humans!</p>
F	<p><i>Homo neanderthalensis</i></p> <p>Appearing 400,000 years ago, the Neanderthals lived in cold regions of Europe. As such, the nose is large to accommodate humidifying cold air, warming it as it enters the body. Despite a protruding brow, the braincase was as large, and in some cases larger, than those of modern humans. They are also the first human ancestors confirmed to bury their dead.</p>