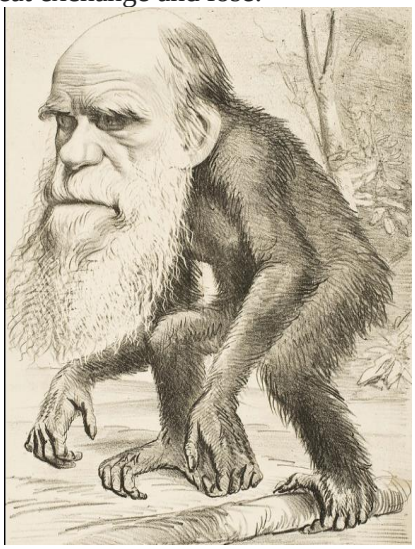
3.1 Enlightenment Scientists Transform Understanding of Earth's History and Human Origins
Background: Today we know that the Earth is over 4.5 billion years old. In 1589, a French religious dissenter named Bernard Palissy was convicted of heresy and imprisoned in the Bastille for arguing that fossils were the remnants of extinct species and an extended age of the Earth. In 1654, James Ussher, a Bishop of the Anglican (Protestant) Church, claimed that by using Biblical references he had calculated the age of the Earth as approximately 6,000 years. Ussher identified the first day of creation as October 23, 4004 BC. As recently as the 1890s, British scientist Lord Kelvin believed that the Earth was only 20 to 40 million years old based on his research on the thermodynamics of heat exchange and lose.

Two of the most influential European Enlightenment thinkers who transformed our understanding of the age of the Earth and the origin of species were Charles Lyell (1797-1875), a Scottish geologist and Charles Darwin (1809-1882), an English naturalist, who were close friends and colleagues. Darwin built on Lyell's studies on the age of the earth to support his explanation of the origin of new species through natural selection over long periods of time and Lyell helped arrange the publication of Darwin's ideas on natural selection and human evolution.


An 1871 caricature of Charles Darwin as part man and part ape (Wikipedia).

Lyell's best-known books, the three volumes of *Principles of Geology* (1830-1833), synthesized his own research on earthquakes, volcanoes, and the history of the Earth with the ideas of his pioneering predecessor James Hutton. This book is one of the first times the word evolution is used to describe changes in species. Lyell argued that the Earth's surface was shaped over unknown and uncalculable millennium by a process he called uniformitarianism, or gradual incremental change. By extending the history of the Earth in this way Lyell created a sufficient time frame for the evolution of living things to take place. Darwin believed the Earth had to be at least 300 million years old for the evolutionary processes he described to have taken place.

Lyell was very much a product of European Enlightenment thinking. His belief that the geological present held the key for understanding the past drew on a fundamental intellectual premise proposed by Scottish philosopher David Hume that "all inferences from experience suppose ... that the future will resemble the past."

Darwin developed his theory of evolution while traveling the world from 1831 to 1836 as the captain's gentleman-companion and a naturalist on the HMS Beagle. After returning to England he rethought his ideas for 25 years before finally publishing *The Origin of Species* in 1859.

Questions
1. Why is the basis for Lyell's believe people are capable of understanding the past?
2. What does Lyell believe about the impact of geologic change on living things?
3. What does Darwin propose about the role of natural laws?
4. What does Darwin believe explains the "production of higher animals"?
5. How are Lyell's and Darwin's ideas products of European Enlightenment thinking?
6. In your opinion, how has the work of Lyell and Darwin shape the way we think today?

(A) Charles Lyell, Principles of Geology (1830). "Although we are mere sojourners on the surface of the planet, chained to a mere point in space, enduring but for a moment of time, the human mind is not only enabled to number worlds beyond the unassisted ken of mortal eye, but to trace the events of indefinite ages before the creation of our race, and is not even withheld from penetrating into the dark secrets of the ocean, or the interior of the solid globe; free, like the spirit which the poet described as

animating the universe . . . Amidst the vicissitudes of the earth's surface, species cannot be immortal, but must perish, one after another, like the individuals which compose them. There is no possibility of escaping from this conclusion."

(B) Charles Darwin, The Origin of Species (1859). "It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us . . . Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved" (714).