

Assessment Project SB5: Guess Who Came To Dinner!

You and your family are sitting down to Sunday dinner with your good friend, Charles Darwin, when, all of a sudden, the doorbell rings. The scientist on the research page arrive at your door and ask to come in and join you. But you only have limited seating, so you choose 6 guests. The rest are invited back next week. Amidst the fun and festivities, a heated debate about the theory of evolution ensues. Topics come up, such as:

- natural selection
- the fossil record
- genetic diversity and natural selection

Theories (as well as, maybe, a few punches) are flying left and right. Lucky for you, you have your tape recorder close at hand, because your Honors Biology teacher would never believe this in a million years!

1. Create a seating chart for the table, including you and your family members. Add a "cast of characters" section in which you very briefly summarize the important theory or contribution of each of the guests to the development of evolutionary theory as well as the years in which the individual lived.
2. Write an account of the dinner in which you describe conversation around the table, between people sitting next to each, and across from each other (including your brother or sister asking to "pass the peas please!"). Be sure to have each character, as well as your family members, contribute to the conversation. The conversation must support the position of the speaking scientists based on your research from step 1. Feel free to add humor! The paper must be typed, 3-5 pages in length (but you can go longer, if you are having fun).
3. Towards the end of dinner, there's a knock at the door. You answer and in barges an uninvited, and very unexpected, guest (someone from any time in history, including the present). Who is this guest? And what jaw-dropping pronouncement do they make to the dinner party?

This task and assessment supports SB5.

Research the Guests

Scientist	Contribution to Science	Feelings on Evolution*
Aristotle		
Charles Lyell		
Jean Baptiste Lamarck		
Ernst Mayr		

Theodosius Dobzhansky		
James Hutton		
Thomas Malthus		
Gregor Mendel		
Carolus Linnaeus		

*if there is no information available on feeling towards evolution then predict there stance based on their scientific contribution

Read and Conclude

The question of origins has always fascinated the human mind. From the earliest times, the existence of life has mostly been attributed to supernatural intervention. However, naturalistic models of origins based on logic and philosophy can be traced to about the fifth century BC in Greece. Plato (428-348 BC) and Aristotle (384-322 BC) were the philosophers that probably had the greatest impact on western thought. Their idealistic view of striving for perfection laid the foundations for a naturalistic view of origins.

Plato's idealistic views had a profound effect on biology. To him, the structure and form of organisms could be understood from their function which in turn was designed to achieve ultimate goodness and harmony imposed by an external creator.

Aristotle, the father of biology, expanded this idea to include the development of organisms and the origins of groups of organisms. To Aristotle, the adult form represented the final goal or purpose, and the changes occurring during embryological development represented a striving towards the purpose and is dictated by the purpose.

Aristotle used this idea to develop a "scale of nature," in which he arranged the natural world on a ladder commencing with inanimate matter to plants, invertebrates, and vertebrates. Among the vertebrates, he placed the fish at the lowest rung of the ladder and humans on the highest rung. This "scale of nature" represents a progression from the most imperfect to the most perfect.

The concepts developed by the Greek philosophers retained their influence well into the 18th century and were nurtured by prominent thinkers such as Goethe (1749-1832), who believed that the origin of each level of organism was based on a fundamental primitive plan—an archetype—from which the more complex features and organisms developed.

Although these naturalistic models of origins have existed for many centuries, only since the work of Charles Darwin (1809-1882) has biological evolution become socially accepted. The ideas propagated by Darwin were totally in conflict with the Christian worldview of his time. The Biblical account of Genesis was considered by Church authorities to be the only correct version of origins and the age of the earth was measured by the number of generations since Adam. In contrast, the Darwinian concept of evolution required millions of years for the gradual change of form and structure required for the transition of one species into another.

The conflict between Christianity and Darwinism centered largely on time and fixity of species. Ironically, Aristotle believed in the fixity of species, and Augustine (AD 345-430) had incorporated this concept into Christian thought. The European worldview in Darwin's time was that God had created unchangeable fixed species in the not-too-distant past.

Thomas Malthus lived from 1766 to 1834. In 1798, he published the *Principle of Population* where he made the observations that the human race would be likely to overproduce if the population size was not kept under control.

Malthus then focused his studies on the human race. His calculations and theories produced an idea that the human population would increase geometrically while the food supply and natural resources would only increase arithmetically. This is a potential explanation for the predicted poverty and famine. He concluded that as more offspring are born, a more competitive nature would arise. As more offspring come into the population, fewer resources will be available for the population. This has the potential for competition between organisms for survival due to lack of resources. This competitive nature would be necessary for survival of individuals within a large population size unable to be supported by the environment. He believed that this uncontrollable population size would eventually be the cause of famine and poverty among humans. His reasoning behind this idea was divine intervention. He believed that this would be the punishment for man if he became too lazy.

Malthus' *Principle of Population* caused Darwin to rethink many issues while coming up with his theory of natural selection. Malthus' work made Darwin realize the importance of overpopulation and how it was necessary to have variability in different populations. Darwin also used Malthus' ideas to use competition as well as the survival in numbers idea to come up with his full idea of natural selection.

Darwin was not the first naturalist to propose that species changed over time into new species—that life, as we would say now, evolves. In the eighteenth century, Buffon and other naturalists began to introduce the idea that life might not have been fixed since creation. By the end of the 1700s, paleontologists had swelled the fossil collections of Europe, offering a picture of the past at odds with an unchanging natural world. And in 1801, a French naturalist named Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck took a great conceptual step and proposed a full-blown theory of evolution.

Lamarck started his scientific career as a botanist, but in 1793 he became one of the founding professors of the *Musee National d'Histoire Naturelle* as an expert on invertebrates. His work on classifying worms, spiders, mollusks, and other boneless creatures was far ahead of his time.

Lamarck was struck by the similarities of many of the animals he studied, and was impressed too by the burgeoning fossil record. It led him to argue that life was not fixed. When environments changed, organisms had to change their behavior to survive. If they began to use an organ more than they had in the past, it would increase in its lifetime. If a giraffe stretched its neck for leaves, for example, a "nervous fluid" would flow into its neck and make it longer. Its offspring would inherit the longer neck, and continued stretching would make it longer still over several generations. Meanwhile organs that organisms stopped using would shrink.

The leading biological scientist of the mid 18th century was the Swedish botanist Karl von Linné (Carolus Linnaeus in Latin). His 180 books are filled with precise descriptions of nature, but he did little analysis or interpretation. This is to be expected since Linnaeus apparently believed that he was just revealing the unchanging order of life created by God. The goal of documenting change in nature would not have made sense to him. Late in his life, however, he was troubled by the fact that plant hybrids could be created by cross pollination. These were varieties that had not existed before. Linnaeus stopped short of concluding that these plants had evolved.

Despite his limiting research bias, Linnaeus was a first class scientist. His most important contribution to science was his logical classification system for all living things which he proposed in his book *Systema Naturae*, first published in 1735. In this and subsequent works, he described plants and animals on the basis of physical appearance and method of reproduction. He classified them relative to each other according to the degree of their similarities. He used a binomial nomenclature in naming them. That is to say, organisms were given two Latin names--genus and species. Each genus could have many related species. Each genus was also part of larger categories of living things. This Linnaean system of classification is today the basis for naming and describing organisms in all fields of biology.

A careful examination of European geological deposits in the early 19th century led the English lawyer and geologist, Charles Lyell, to conclude that Cuvier's catastrophism theory was wrong. He believed that there primarily have been slower, progressive changes. In his three volume *Principles of Geology* (1830-1833), Lyell documented the fact that the earth must be very old and that it has been subject to the same sort of natural processes in the past that operate today in shaping the land. These forces include erosion, earthquakes, glacial movements, volcanoes, and even the decomposition of plants and animals.

Ironically, one great unsolved problem in Darwin's master work, *On the Origin of Species*, was just that: How and why do species originate? Darwin and his later followers were faced with a seeming paradox. They described evolution as a continuous, gradual change over time, but species are distinct from each other, suggesting that some process has created a discontinuity, or gap, between them.

Credit for doing the most to crack this puzzle goes to Ernst Mayr, perhaps the greatest evolutionary scientist of the twentieth century. Along with Theodosius Dobzhansky, George Gaylord Simpson, and others, Mayr achieved the "modern synthesis" in the 1930s and 1940s that integrated Mendel's theory of heredity with Darwin's theory of evolution and natural selection

Born in 1904 in Germany, Mayr trained as a medical student but realized he had a greater passion for studying birds and biology. Emigrating to the United States, he became a curator at the American Museum of Natural History, working on bird classification while formulating his key ideas about evolution. In 1942 he published his most important work, *Systematics and the Origin of Species*. Mayr moved to Harvard University in 1953 and served as director of the school's Museum of Comparative Zoology from 1961 to 1970. Since then, he has published a number of books and chapters and received the prestigious Japan Prize for Biology in 1983.

In his landmark 1942 book, Mayr proposed that Darwin's theory of natural selection could explain all of evolution, including why genes evolve at the molecular level. On the stubborn question of how species originate, Mayr proposed that when a population of organisms becomes separated from the main group by time or geography, they eventually evolve different traits and can no longer interbreed.

It's this isolation or separation that creates new species, said Mayr. The traits that evolve during the period of isolation are called "isolating mechanisms," and they discourage the two populations from interbreeding.

Moreover, Mayr declared that the development of many new species is what leads to evolutionary progress. "Without speciation, there would be no diversification of the organic world, no adaptive radiation, and very little evolutionary progress. The species, then, is the keystone of evolution."

Lyell provided conclusive evidence for the theory of uniformitarianism, which had been developed originally by the late 18th century Scottish geologist, James Hutton. This held that the natural forces now changing the shape of the earth's surface have been operating in the past much the same way. In other words, the present is the key to understanding the past.

This revolutionary idea was instrumental in leading Charles Darwin to his understanding of biological evolution in the 1830's. However, it was not until the late 19th century that most educated people in the Western world finally rejected the theory of catastrophism in favor of uniformitarianism.

Today, we know that our planet has been shaped by occasional catastrophic events, such as bombardment of large meteors, in addition to the comparatively slower natural processes suggested by uniformitarianism. All of these events have potentially affected the rate and direction of biological evolution.