

Early Concepts of Evolution: Jean Baptiste Lamarck

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, molluscs, and other boneless creatures was far ahead of his time.

Change through use and disuse

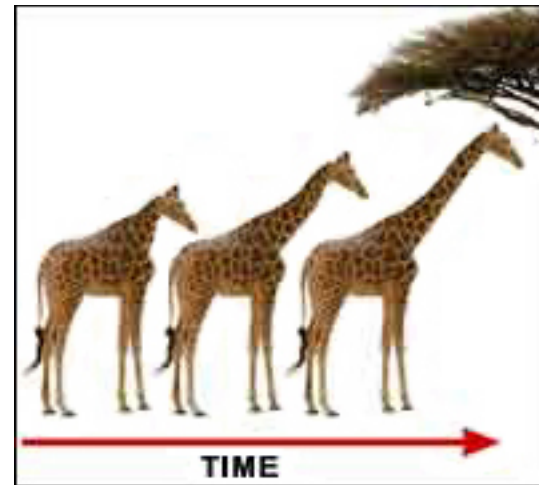
Lamarck was struck by the similarities of many of the animals he studied, and was impressed too by the burgeoning fossil record. It led him to argue that life was not fixed. When environments changed, organisms had to change their behavior to survive. If they began to use an organ more than they had 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.

Organisms driven to greater complexity

This sort of evolution, for which Lamarck is most famous today, was only one of two mechanisms he proposed. As organisms adapted to their surroundings, nature also drove them inexorably upward from simple forms to increasingly complex ones. Like Buffon, Lamarck believed that life had begun through spontaneous generation. But he claimed that new primitive life forms sprang up throughout the history of life; today's microbes were simply "the new kids on the block."

Evolution by natural processes

Lamarck was proposing that life took on its current form through natural processes, not through miraculous interventions. For British naturalists in particular, steeped as they were in natural theology, this was appalling. They believed that nature was a reflection of God's benevolent design. To them, it seemed Lamarck was claiming that it was the result of blind primal forces. Rejected by some on religious grounds and shunned by scientists like Cuvier for lack of deductive rigor in his arguments, Lamarck died in 1829 in poverty and obscurity. But the notion of evolution did not die with him. The French naturalist Geoffroy St. Hilaire would champion another version of evolutionary change in the 1820s, and the British writer Robert Chambers would author a best-selling argument for evolution in 1844: *Vestiges of a Natural Creation*. And in 1859, Charles Darwin would publish the *Origin of Species*. Lamarck, St. Hilaire, Chambers, and Darwin all had radically different ideas about how evolution operates, but only Darwin's still have scientific currency today.



Lamarck believed that the long necks of giraffes evolved as generations of giraffes reached for ever higher leaves.

Different from Darwin

Darwin relied on much the same evidence for evolution that Lamarck did (such as vestigial structures and artificial selection through breeding), but made completely different arguments from Lamarck. Darwin did not accept an arrow of complexity driving through the history of life. He argued that complexity evolved simply as a result of life adapting to its local conditions from one generation to the next, much as modern biologists see this process. But of course, Darwin's ideas weren't entirely modern either. For example, he tried on and eventually rejected several different ideas about heredity (including the inheritance of acquired characteristics, as championed by Lamarck) and never came to any satisfying conclusion about how traits were passed from parent to offspring. Lamarckian inheritance is an idea that today is known mainly from textbooks, where it is used to as a historical contrast for our modern understanding of genetic inheritance, which began with the rediscovery of Mendel's work in the late 1800s. Despite all he got wrong, Lamarck can be credited with envisioning evolutionary change for the first time.

Natural Selection: Charles Darwin & Alfred Russel Wallace

The genius of Darwin, the way in which he suddenly turned all of biology upside down in 1859 with the publication of the *Origin of Species*, can sometimes give the misleading impression that the theory of evolution sprang from his forehead fully formed without any precedent in scientific history. But as earlier chapters in this history have shown, the raw material for Darwin's theory had been

known for decades. Geologists and paleontologists had made a compelling case that life had been on Earth for a long time, that it had changed over that time, and that many species had become extinct. At the same time, embryologists and other naturalists studying living animals in the early 1800s had discovered, sometimes unwittingly, much of the best evidence for Darwin's theory.

Pre-Darwinian ideas about evolution

It was Darwin's genius both to show how all this evidence favored the evolution of species from a common ancestor and to offer a plausible mechanism by which life might evolve. Lamarck and others had promoted evolutionary theories, but in order to explain just how life changed, they depended on speculation. Typically, they claimed that evolution was guided by some long-term trend. Lamarck, for example, thought that life strove over time to rise from simple single-celled forms to complex ones. Many German biologists conceived of life evolving according to predetermined rules, in the same way an embryo develops in the womb. But in the mid-1800s, Darwin and the British biologist Alfred Russel Wallace independently conceived of a natural, even observable, way for life to change: a process Darwin called natural selection.

The pressure of population growth

Interestingly, Darwin and Wallace found their inspiration in economics. An English parson named Thomas Malthus published a book in 1797 called *Essay on the Principle of Population* in which he warned his fellow Englishmen that most policies designed to help the poor were doomed because of the relentless pressure of population growth. A nation could easily double its population in a few decades, leading to famine and misery for all.

When Darwin and Wallace read Malthus, it occurred to both of them that animals and plants should also be experiencing the same population pressure. It should take very little time for the world to be knee-deep in beetles or earthworms. But the world is not overrun with them, or any other species, because they cannot reproduce to their full potential. Many die before they become adults. They are vulnerable to droughts and cold winters and other environmental assaults. And their food supply, like that of a nation, is not infinite. Individuals must compete, albeit unconsciously, for what little food there is.

Selection of traits

In this struggle for existence, survival and reproduction do not come down to pure chance. Darwin and Wallace both realized that if an animal has some trait that helps it to withstand the elements or to breed more successfully, it may leave more offspring behind than others. On average, the trait will become more common in the following generation, and the generation after that.

As Darwin wrestled with natural selection he spent a great deal of time with pigeon breeders, learning their methods. He found their work to be an analogy for evolution. A pigeon breeder selected individual birds to reproduce in order to produce a neck ruffle. Similarly, nature unconsciously "selects" individuals better suited to surviving their local conditions. Given enough time, Darwin and Wallace argued, natural selection might produce new types of body parts, from wings to eyes.

Darwin and Wallace develop similar theory

Darwin began formulating his theory of natural selection in the late 1830s but he went on working quietly on it for twenty years. He wanted to amass a wealth of evidence before publicly presenting his idea. During those years he corresponded briefly with Wallace, who was exploring the wildlife of South America and Asia. Wallace supplied Darwin with birds for his studies and decided to seek Darwin's help in publishing his own ideas on evolution. He sent Darwin his theory in 1858, which, to Darwin's shock, nearly replicated Darwin's own.

Charles Lyell and Joseph Dalton Hooker arranged for both Darwin's and Wallace's theories to be presented to a meeting of the Linnaean Society in 1858. Darwin had been working on a major book on evolution and used that to develop *On the Origins of Species*, which was published in 1859. Wallace, on the other hand, continued his travels and focused his study on the importance of biogeography.

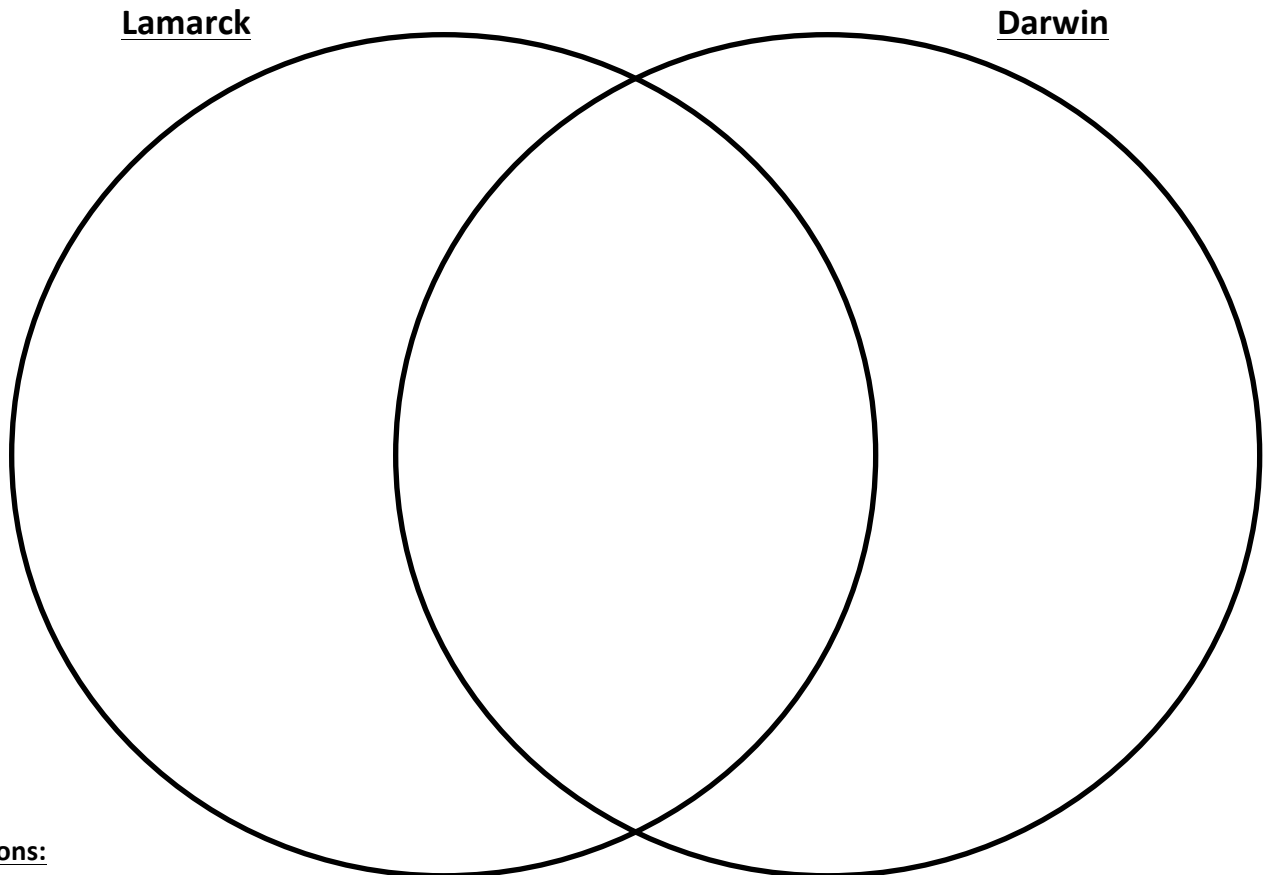
The book was not only a best seller but also one of the most influential scientific books of all time. Yet it took time for its full argument to take hold. Within a few decades, most scientists accepted that evolution and the descent of species from common ancestors were real. But natural selection had a harder time finding acceptance. In the late 1800s many scientists who called themselves Darwinists actually preferred a Lamarckian explanation for the way life changed over time. It would take the discovery of genes and mutations in the twentieth century to make natural selection not just attractive as an explanation, but unavoidable.

(Adapted from evolution.berkley.edu, 2014)

Name: _____ Period: _____

Lamarck vs Darwin: Dueling Ideas of Evolution

Read the article about Lamarck and Darwin's theories of evolution. The article is posted under Unit 5! In the space provided below, create a Venn diagram to demonstrate the similarities and differences between the two theories of evolution. Then answer the questions below with **COMPLETE THOROUGH AND THOUGHTFUL** sentences.



Questions:

1. In one sentence, thoroughly describe Lamarck's theory of evolution.

2. In one sentence, thoroughly describe Darwin's theory of evolution.

3. Why was Lamarck ultimately incorrect in his theory of evolution?

4. What about Darwin's newer theory proved to be correct compared to Lamarck's?