

LEARNING GUIDE 2: EVOLUTION: DEFINITION AND CHARLES DARWIN

Subject Code: Biology 1: Fundamentals of Biology 1

Learning Guide Code: 2.0 (Evolution)

Lesson Code: 2.1 (Evolution: Definition and Charles Darwin)

Time Frame: 30 minutes



MATERIALS NEEDED

To complete this module, you need the following:

1. Pen and paper
2. Computer/Internet-ready Gadgets (Smartphones, Tablets, etc.)
3. Biology: A Global Approach by Campbell et. al., (2015)
4. Stable internet connection



TARGET

After completing this module, you are expected to:

- Define evolution.
- Explain how Charles Darwin became the lightning rod for a revolutionary view of life.
- Trace the intellectual context of Charles Darwin's ideas; and
- Distinguish between Darwin and Lamarck's Theory of Evolution.



HOOK

Before we delve on the actual discussion of evolution, fill out the first two parts of the K-W-L chart found below. Write what you know about EVOLUTION and what you want to know further. At the end of this module, go back to this chart and finish filling it out by writing what you learned.

BIOLOGY CLASS

K - W - L CHART

TODAY'S TOPIC

What I Know:

What I Want to Know:

What I Learned:

NAME: _____

CLASS: _____

DATE: _____

TEACHER: _____



What is evolution?

In the year 1859, a book entitled, “On the Origin of Species” was published and was sold out immediately. We might think, what could be the content of the book that interested the readers? Well, it might be something novel or something that might hold truth or something that might be naturally interesting, or a combination of them all. We will know the answer to that question as we go along this module.

The central theme of the said book revolves around evolution. It is defined by Charles Darwin, the author, as “descent with modification”. According to him, all life forms are related as present-day species are descendants of ancestral species that existed many years ago. We might ask again, how come that the organisms we observe today differ so much from their ancestors? This is where evolution comes into action. It is the process that has been operating in the past and that brought about the changes and modifications we observe in the present-day species. More specifically, **evolution** can be defined as a change in genetic composition of a population from generation to generation (Campbell, 2015). To understand this specific definition of evolution, watch this short video:



What is Evolution?

<https://www.youtube.com/watch?v=GhHOjC4oxh8>

Campbell (2015) also proposed two different ways of viewing evolution: (1) **evolution as a pattern** and (2) **evolution as a process**. The pattern of evolutionary changes is evident in the observations, findings, and facts presented by many different disciplines such as biology, geology, physics, and chemistry. These facts were established out of carefully designed experiments and data gathered from careful observations. Evolution as a process refers to the mechanisms that brought about these observed patterns.

Now that we have defined evolution, let us get to know more about the persons who worked on that theory. Even before Charles Darwin was born, there were already existing beliefs about Earth and life. There were also several prominent scientists who imparted their own perspectives on looking at species and the world they live in. They are the following:

Aristotle, Scala Naturae

- believed that species are fixed and unchanging.
- proposed that all life forms could be arranged on a ladder or scale with the lowest forms found below and the highest forms found above (Scala Naturae). Just like the rungs of the ladder, each species occupy a specific rung.
- For example, animals are above plants and humans are above animals. In this context we imagine therefore that the lowest species in the ladder are the plants and above that are the animals and above that again are humans.

The Old Testament, Creation Account

- Species were intelligently designed by God and so they are perfect.

James Hutton, Gradualistic Concept

- Geologic changes occur through a slow, continuous process rather than abrupt ones.

Thomas Malthus, Essay on the Principle of Population

- concerned about the increasing human population during the Industrial Revolution
- Human population increase geometrically (2, 4, 8, 16) while food production could increase only arithmetically (1, 2, 3, 4).
- The food supply could not keep up with the increasing number of population. As a result, some would survive and many would not.

Still many other scientists became known while Darwin was growing up. They are:

Georges Cuvier, Theory of Catastrophes

- studied fossils found in strata of sedimentary rocks
- Upper strata of sedimentary rocks contain younger fossils, while lower strata contain older ones.
- Boundaries between strata are proofs of natural catastrophic events that happened in the past.
- Only after the occurrences of these catastrophic events are the boundaries inhabited by new species.

Charles Lyell, Uniformitarian Proposal

- agreed to Hutton on how geologic changes occur and these changes are still occurring today just like how it occurred in the past.
- also they occur in the same rate

For now just be familiar with these people. As we go over the discussion of Charles Darwin's life, try to decipher how they influenced Darwin when he was crafting his theory of evolution by natural selection.

Who is Charles Darwin?

Charles Darwin (1809-1882) was born in Shrewsbury, Shropshire, England. Even as a child, the young Darwin exhibited innate interest in nature. His typical activities include fishing, hunting, riding, and collecting insects. Growing up, his father saw his interest and did not agree with it. He saw no future in being a naturalist so he sent Darwin to Edinburgh Medical School. In medical school, Darwin showed lack of interest in his studies and fright when exposed to surgeries, as during those times the use of anesthesia was not yet practiced. Additionally, the sight of blood brings discomfort to him. Because of these, he quit medical school and entered Christ's College in Cambridge to study Theology. There he was supposed to be honed to become a parson, but then again, the mainstream education bored him. On the contrary, his love for the natural sciences grew even more.



At Cambridge, he was mentored by John Henslow, a botany professor. After graduation, he was recommended by Henslow to Captain Robert Fitzroy as a ship companion in his five-year travel aboard the HMS beagle. The two gentlemen clicked immediately as they were almost of the same age and social status, and they share some common interests too. During the entire trip, Darwin was collecting plant and animal species. In fact, most of his time was spent ashore, keenly observing organisms and noting how various animals are adapted to the environment they live. He also noticed resemblances between South American animals and between fossils and extant species. During the course of their trip, Fitzroy gave him Lyell's book on the Principles of Geology. Darwin read and studied it despite being tormented by seasickness.

One day, when they were in Chile, he was able to experience a geologic change right in front of him. The earthquake lifted the rocks under to several feet upward. There he found fossils and he concluded that similar events happened in the past that also resulted to many rocks being uprooted. From this experience and from his reading on Lyell's work, he concluded that the traditional view of Earth as young (existing for a couple thousands of years) is incorrect.

Among the places they stopped over, Galapagos Islands fascinated him more than any other. In these group of islands he



saw mockingbirds that have slightly different characteristics. He also noticed that although some organisms living there look like those found in mainland South America, others were entirely unique to the islands. He hypothesized that the organisms from South America might have reached the islands through events like flooding and eventually diversified there.

After the voyage, Darwin began reevaluating his observations and this was the birth of his revolutionary theory. He came to realize that **adaptations**, or the inherited characteristics of organisms that give them advantage on survival and reproduction, are connected to the origin of new

species. He thought that explaining adaptations thoroughly is key to the development of his theory of evolution. The mechanism he proposed as to how evolution works is through **natural selection**, which says that there are some individuals in a population with inherited traits which would give them a better chance to survive and reproduce.

By the early 1840's, Darwin was already able to identify his main points while he was writing his essay on descent with modification. However, publishing the essay was still a remote option as he was afraid his deviant thoughts would cause turmoil to what was popularly known by naturalists that time. He also thought that gathering more evidences should be prioritized if he wants his theory to be very credible. By the mid-1850's he shared his thoughts with close friends including Lyell, who urged him to publish his essay as soon as possible before anyone arrives at the same idea.



In June 1858, Lyell's words came true. Darwin received a manuscript from a novice naturalist, Alfred Russel Wallace. Wallace asked Darwin to assess his writing and forward it to Lyell if it has any potential to be published. Darwin read his ideas on the manuscript of Wallace. Some words he used were even there. On July 1, 1858. Wallace and his colleague, Hooker, forwarded Wallace's manuscript to the Linnaean Society of London. Along with that is an eighteen-page paper consisting of Lyell and Hooker's letter of introduction explaining the extraordinary circumstances between the two naturalists and excerpts from Darwin and Wallace's papers. The Linnaean Society of London decided to publish their essays at the same time. The paper came out with Darwin as the lead author.



The decision of the Linnaean Society of London bothered Darwin as he thought Wallace might find that unjustifiable. It turned out, however, that Wallace was more than willing to give the full credit of original theory conception to Darwin. In his exact words he said, "I shall always maintain it to be actually yours and yours only". Both of the authors recognized that they

were able to use Thomas Malthus's essay on Population as springboard to conceptualizing their ideas.

Today, when we think of evolution we can now link the idea with Charles Darwin and Alfred Russel Wallace as they independently formed similar theory. For visual learners, you can watch their story on the link below.



The Making of a Theory: Darwin, Wallace, and Natural Selection - HHMI BioInteractive Video:
<https://www.youtube.com/watch?v=XOiUZ3ycZwU>

Now that you got to know Charles Darwin a little better already, I would like to introduce you to Jean Baptiste de Lamarck. His theory of evolution was published at the same year Charles Darwin was born. Unlike Aristotle, Lamarck believed that species are changing and they came from preexisting species. Further, he claimed that species change or evolve because the environment required them to. There is a “need” to evolve as dictated by their environment. In summary, Lamarck’s points can be broken down into two main principles. First is the law of use and disuse and the second is the inheritance of acquired characteristics.

1. Use and Disuse

According to this principle, body parts that are used more frequently become stronger and more developed, while those that are not used frequently tend to weaken and may eventually deteriorate.

2. Inheritance of acquired characteristics

The traits acquired by an organism in its lifetime, through the use or disuse of its body parts, can be passed on to the next generation.

Incorporating these two principles, Lamarck came up with an explanation on how giraffes got their long necks. For him, giraffes had short necks before. As time went by, there was shortage of food as many giraffes have been grazing on the same field. However, the leaves of trees are still many and they can eat them. Some giraffes started stretching their necks to get the leaves high up on trees. This stretching caused their once short necks to become long and the trait was passed on to the next generation and still to the next ones. You can just imagine how giraffes could have very long necks after many generations.



NAVIGATE

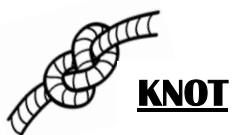
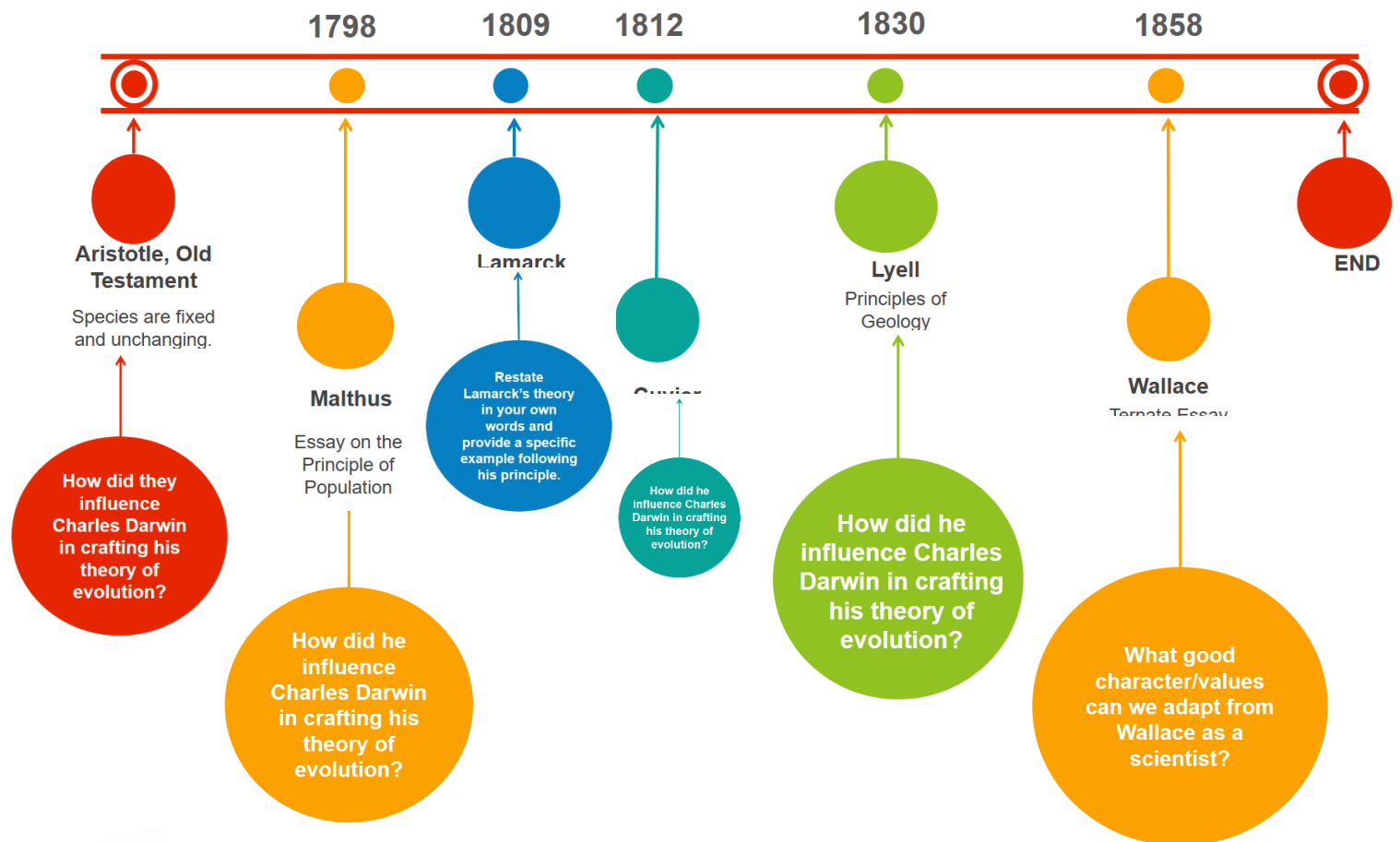
*Note: This is a **GRADED** assessment.*

How did Charles Darwin become the lightning rod for a revolutionary view of life? Limit your answer in five to ten sentences only and be guided by the rubric provided below.

Rubric:

| Score | Dimensions |
|-------|---|
| 5 | Ideas are well-explained with very strong and clear support; transitions are used appropriately contributing to the logical ordering of thoughts; there are no grammar errors |
| 4 | Ideas are explained in a very understandable manner with clear support; thoughts flow logically; there are less than five grammar errors. |
| 3 | Ideas are a bit vague but an attempt to explain them is evident; thoughts are slightly disorganized; there are at most 7 grammar errors. |
| 2 | Ideas seem to be irrelevant and unclear. There is a grammar error in almost every line. |
| 0 | No effort was exerted to answer the question. |

Trace the intellectual context of Charles Darwin's ideas by answering the questions in the timeline below. The space provided here may not be enough to fit your answers. Feel free to attach a separate sheet when needed.



Charles Darwin became famous because of his theory of evolution by means of natural selection. Contrary to popular knowledge, this theory was independently arrived at by a naturalist in the name of Alfred Russel Wallace. Their theory proposes that the mechanism involved for evolution to occur is through natural selection, where some individuals in a population inherit traits from their parents that may be advantageous to them in the long-run. Those traits that fit the demands of the environment organisms are in and that confer them advantage are called adaptations. Over time, these more adapted individuals will tend to have a higher survival and reproductive success. Because of the reproduction of these better adapted individuals, these adaptations can be acquired by the succeeding generations thereby effecting change in the population. While formulating the theory, Charles Darwin was influenced by many other professionals like Charles Lyell, Georges Cuvier, and Thomas Malthus.

Jean Baptiste de Lamarck, among any other who tried to discuss evolution in the past, is very well known today because of his proposed theory of evolution. His principles include the use and disuse of body parts and the inheritance of acquired characteristics.

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