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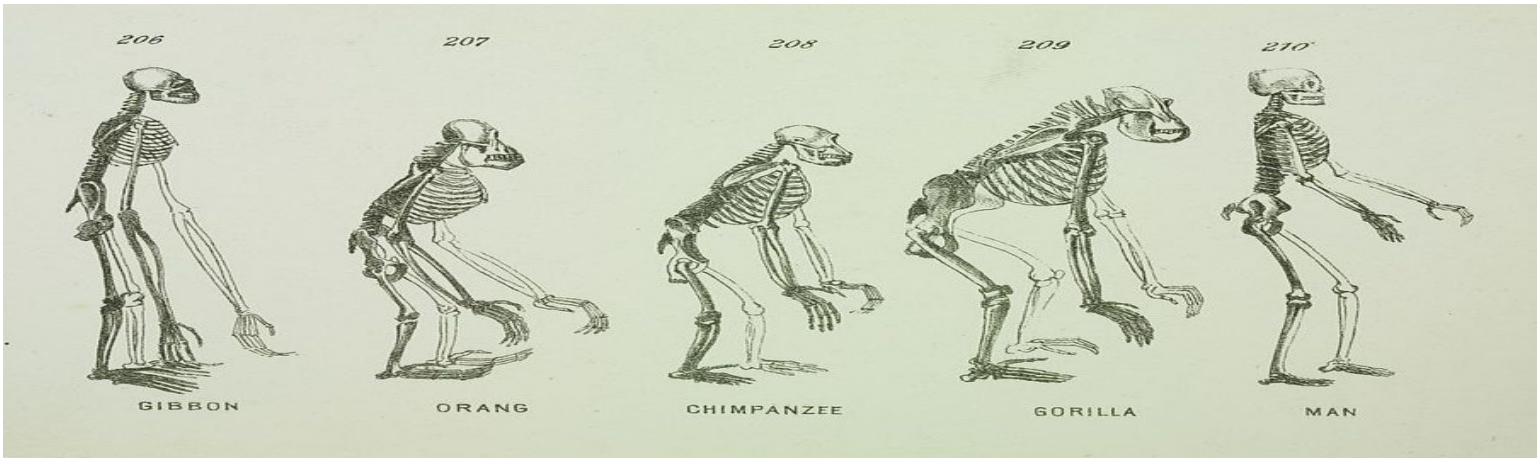

Evidence for Evolution: Analogous and Homologous Structures

fossil record, homologous structure, analogous structure, vestigial structure, evolution

Evolution Unit

We are able to prove evolution in many ways. When they look at every level of living systems, biologists see the mark of past and present changes. A large part of Darwin's book, *On the Origin of Species*, found patterns in the world around us that make sense with evolution. Since the time of Darwin, what we know about this subject has become clearer and broader. **Evolution** is when living things change over time to help them live long enough to reproduce. This causes groups of living things to change because the parents pass on what helped them live to their children.

Fossils

Fossils give strong signs that livings things from the past are not the same as those found today. This is because they show the changes from evolution. Scientists figure out the age of these remains. They sort them all over the world to decide when the life forms lived in terms of each other. The **fossil record** is made up of all the fossils that have been found to tell a story of the past and show how living things have changed over millions of years.

Fossil records with a lot of detail have been found for groups of species that have changed over time, such as whales and some horses. The record of horses in North America is quite rich. Many have what are called transition fossils. These show parts of the body that are in between earlier and later forms. The record goes back to a dog-like ancestor some 55 million years ago. These then gave rise to the first horse-like kinds of animals 55 to 42 million years ago in the genus *Eohippus*. This group of remains shows the change in the body that came from drying over time that changed the land from a forest to a large space with a lot of grass. Fossils that followed show the change over time of teeth shapes and how the leg and foot are built. They also show a move to a habit of eating grass with changes for running from animals that may eat them. This happened with a kind of *Mesohippus* found from 40 to 30 million years ago. More

recent ones showed gains in size, such as those of *Hipparion.* This was around from about 23 to 2 million years ago. The record shows several changes in the line of horses over time. It is now only one genus, *Equus*. It has several species.

This drawing is of species that show the history of the horse as it changed over time. The species shown are only four from a line with a lot of differences that has many branches, dead ends, and adaptations. One of the changes shown here is from a forest to a large open space of grass. This is shown in forms that are better for eating grasses and escaping from animals who may eat them by running. Przewalski's horse is one of a few living kinds of horses.

Anatomy

Another way to prove evolution is with structures in living things that share the same simple form. The bones in the limbs of a human, dog, bird, and whale all share the same general way they are built. What is alike comes from their beginning in the limbs of a shared ancestor. Over time, evolution led to changes in the shapes and sizes of these bones in different kinds of animals. They have, however, kept the same general form. This shows that they came from a shared past family member. These alike parts are called homologous structures. Some are present in living things that have no clear job at all and appear to be remaining parts from a past ancestor. Some snakes have bones in their pelvis even though they do not have legs. They came from reptiles that did have legs. **Vestigial structures** are parts left over in animals that do not have a clear job in the body. They come from a past ancestor that did use the body part at one time, but have not been lost because they do not hurt the animal’s ability to live. These are shown with wings on birds that cannot fly, though these wings may have other jobs.

These limbs look alike in how they are built. This picture shows that these living things share an ancestor.

Similarity of Form

Another sign of evolution is the coming together of form in living things that share similar living places. We can look at animals that are not related, such as the arctic fox and ptarmigan, a kind of bird, that both live in the Arctic. They both have white covers during winter to match with the snow and ice. This happens not because of shared ancestors. Indeed, one cover is of fur and the other of feathers. They happened instead because of needs that are alike, such as the use of not being seen by animals that want to eat them.

Two Measures of Similarity

Life forms that share parts of the body and genetic sequences are likely more closely related than those that do not. Body parts that are similar both in how they look and how they're related genetically are called

homologous structures. What they are stems from paths of changes over time that are alike. As shown in the next image, the bones in the wings of bats and birds, the arms of humans, and the front leg of a horse are these kinds of structures. Notice that the form is not just a single bone. Rather, it is a group of several bones put together in a way that is alike in each life form. They are alike even though the parts of the structure may have changed in shape and in size.

All the limbs share common bones, which are like the bones in the arms and fingers of people. However, in the bat wing, finger bones are long and separate. They form a base on which the wing's skin is stretched. In the bird wing, the finger bones are united together. In the horse leg, one of the bones is shorter and is united with the other bone. The hand bones are just one long thick bone, and the finger bones are just one long thick finger with a modified nail or hoof. In the whale flipper, the bones are very short and thick.

Bat and bird wings, the front leg of a horse, the flipper of a whale, and the arm of a human are homologous structures. This shows that bats, birds, horses, whales, and people have a shared past in how they changed over time.

Misleading Appearances

Some life forms may be very closely related, even though a small genetic change caused a major difference in what they look like. Chimpanzees and humans, which are shown in the next image, share 99 percent of their genes. However, they show major differences in how they look, such as how much the jaw sticks out in those that are grown. It is also shown in the lengths of our arms and legs.

However, unrelated life forms may be related in a far-off way yet appear very much alike. This is often because similar changes to alike conditions came about in both. This can be seen in the streamlined body shapes, the shapes of fins and other limbs, and the tails in fishes and whales, which are mammals. These are alike at the surface level because they are changes to moving about in the same living space, water. **Analogous structures** are different body parts in different animals that do similar jobs, like the wing of a bat and the wing of an insect. They are alike not because the animals are related, but because they evolved in a similar environment. For one, insects use wings to fly like bats and birds. We call them both wings because they have same job and have a similar form on the surface. The embryonic start of the two wings is quite different. The difference in the way that the wings came about in each case is a sign that insects and bats or birds do not share an ancestor that had a wing. The wing forms, shown in the next image, came about in each of the two lines on their own.