**C. FOSSIL EVIDENCE.** **Fossils** are the remains or traces of organisms that once lived. Scientists who study fossils are called **paleontologists.** The study of fossils in the earth provides evidence to support the idea that life changed over time from simple to complex. Fossil distribution shows that life began in the sea and then moved to land. It also provides evidence for the time of origin (beginning) of various forms of life. Fossils also help scientists understand how climates and land surfaces have changed. It is through fossil evidence that we know that organisms existed over three billion years ago. Using the process of **radioactive dating** scientists can determine the age of Earth's rocks and its fossils.

Many fossils are found in sedimentary rock. In sedimentary rock, where the crust of the earth is undisturbed, the oldest rock layers are located beneath the younger layers. **Sedimentary rock** is formed from layers of slowly deposited sediments. Sediments, such as rock particles, silt, and mud, are usually deposited by water. After a long period of time and a great amount of heat and pressure, sediments harden into rock forming visible layers. In undisturbed layers the oldest layer is at the bottom layer and the youngest layer is at the top. Skeletons, imprints, shells, bones and other animal and plant remains became trapped in the sediment layers. When the sediment hardened, the remains of plants and animals became fossils. Fossils found in lower rock layers are assumed to be older than fossils found in upper layers. Generally, fossils found in upper layers look like those in the lower layers but are more complex in form. This suggests a relationship between modern forms and older forms (Figure 26-2).

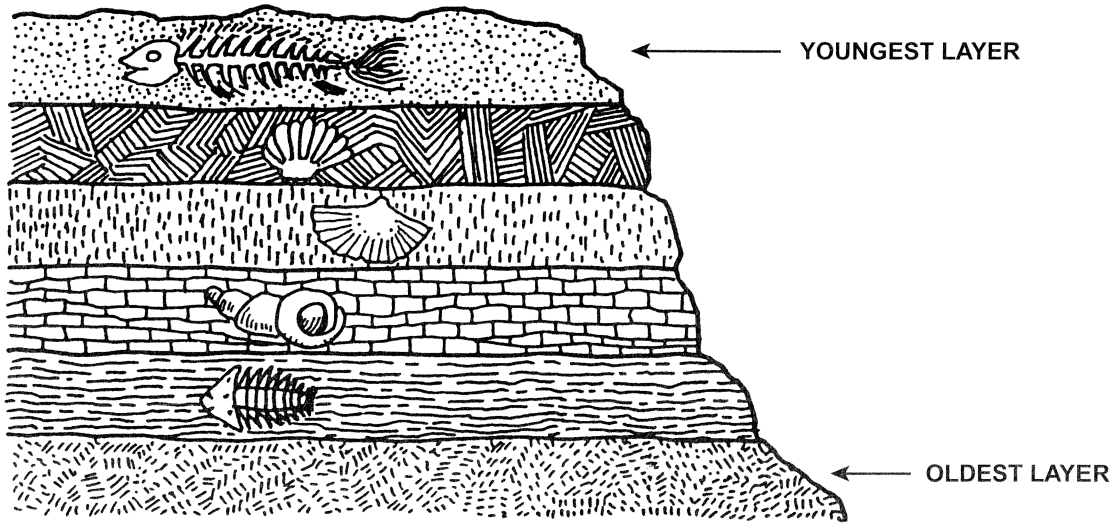



FIGURE 26-2. FOSSILS IN UNDISTURBED ROCK LAYERS.

Organisms can become fossils **(fossilization)** in a number of different ways. Whole organisms have been discovered preserved in tar, ice, and in **amber,** which is a yellowish-brown sap secreted by pine trees. By this method the entire body of an organism is preserved after death. Ancient insects have been found perfectly preserved in amber.

The soft parts of organisms usually decay but the hard parts, such as bones and teeth, may form molds or casts. A **mold** is an indentation in rock shaped like an organism. A **cast** is formed when the decayed organism forms a mold, and the mold becomes filled with a different substance.

Name _____ Class _____ Date _____

Organisms may also be preserved by petrification. During **petrification (or petrifaction)** the tissues of the organism are slowly replaced by minerals that preserve the original form of the organism. **Imprints**, such as dinosaur footprints, occur when a print is made in a soft sediment such as mud. The mud later turns into rock. Imprints of ancient ferns have been found in coal.

## Review Questions

1. What is a fossil? _____

_____

2. Describe the formation of sedimentary rock. _____

_____

_____

_____

3. In undisturbed layers of rock the oldest rock is found at the _____.

4. Name three ways that fossils are formed. _____

_____

**D. SKELETAL EVIDENCE. Comparative anatomy** is the science that studies the structures (anatomy) of plants and animals. When scientists compare skeletal structures of different vertebrates they see a similar basic structure. This observation shows that organisms with similar bone structures may have evolved from a common ancestor population. Organs or structural parts that seem to have a common evolutionary origin are referred to as **homologous structures.** For example, the wing of a bat, the flipper of a whale, and a human arm are homologous structures (Figure 26-3). Although homologous structures are similar in structure they *do not always* have the same function.

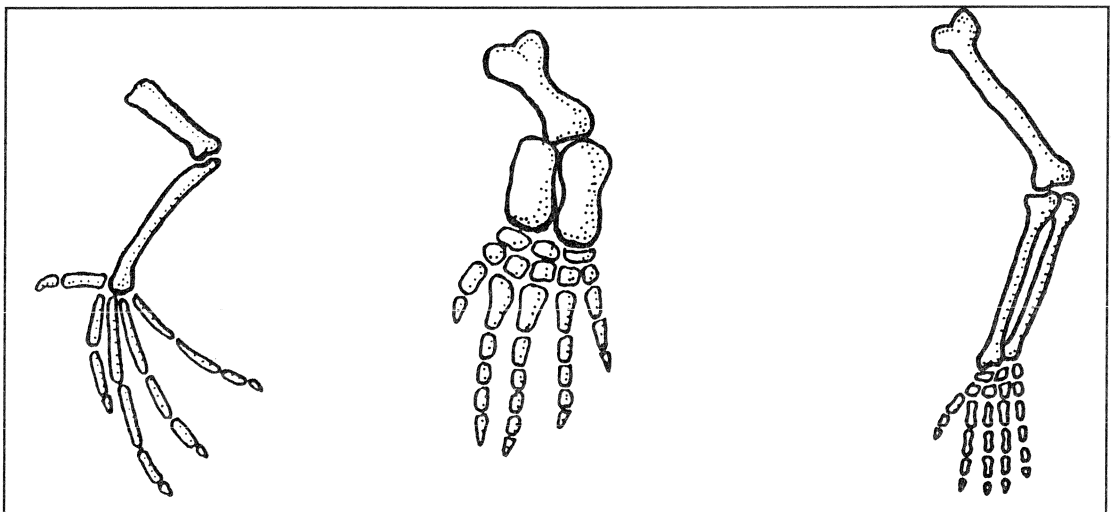



FIGURE 26-3. HOMOLOGOUS STRUCTURES.

Name_____ Class_____ Date_____

## Review Questions

1. What is comparative anatomy. _____

_____

2. Organs or structural parts that appear to have a common evolutionary origin are called _____ structures. These structures are similar in _____ but are not always similar in _____

**E. VESTIGIAL STRUCTURES. Vestigial structures** are parts of an animal's body that are not used. These structures look like structures that are fully developed and used by other animals. The human appendix is an example of a vestigial structure. Scientists think that perhaps some human ancestors used their appendix and, as evolution continued, humans stopped using this organ. Other vestigial structures are human ear muscles and the leg bones of the python and porpoise. These structures provide further evidence of changing structure and function.

## Review Questions

1. List three vestigial structures. _____

_____

2. Vestigial structures are defined as _____

_____

**F. COMPARING CELL STRUCTURE.** Cells and cell organelles are basically alike from one group of organisms to another. For example, all cells have a nucleus, cell membrane, cytoplasm, ribosomes, mitochondria, chromosomes, and various other organelles. In terms of evolution, this is evidence that different kinds of living things *may* share a common origin.

## Review Questions

1. Name three cell organelles that are common to all cells. _____

_____

**G. COMPARING EMBRYOS.** Another evidence for evolution is the study of the embryonic development of different organisms. Comparisons of early stages of embryonic development show the possibility of common ancestry and evolutionary relationships. At early stages vertebrate embryos, for example, show gill slits, tails, and two-chambered hearts. Look closely at Figure 26-4. Do you see many differences among the embryos during their early embryo stages? Observe that as development continues the distinct traits of each species become more noticeable. The science that studies the structural similarities among vertebrate embryos is called **comparative embryology.**

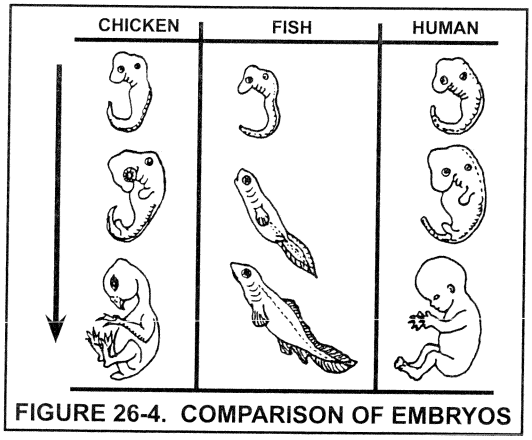


FIGURE 26-4. COMPARISON OF EMBRYOS

Name_____ Class_____ Date_____

## Review Questions

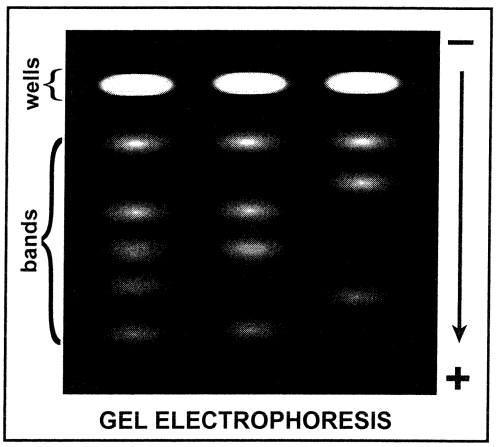
1. The developing organism is called an _____.
2. Name three vertebrate structures that are similar during early embryonic development.

_____

_____

**H. SIMILARITIES IN BIOCHEMISTRY.** Similarities in the **biochemistry** (body chemicals) of living things, such as DNA, hormones, and enzymes, show a close relationship among various forms of life. Organisms that are closely related, like the cat and the lion, have a greater similarity in their protein structure. Greater differences in cell biochemistry are thought to indicate a lesser evolutionary relationship.

**Gel Electrophoresis** is a complex laboratory technique that is used to analyze DNA, RNA, and proteins. A common use for this technique is DNA analysis. Complex mixtures of DNA are separated into different sized fragments by isolating the DNA to be tested and then treating it with enzymes called *restriction enzymes*. This produces small pieces that can be separated by electrophoresis. The DNA fragments are then placed in structures called *wells* at one end of a gelatinous material. In the electrophoresis chamber an electric current is applied to the gel creating an electric field inside the gel. Negatively charged DNA fragments move toward the positive pole of the chamber. Smaller fragments move faster and farther than larger ones causing separation by molecular fragment size forming a series of *bands* from one end of the gel to the other. These bands can be identified as specific fragments of DNA. Each individual has a unique banding pattern that can be used for identification purposes. Scientists also use this process to determine relationships among different organisms. They believe that organisms with similar banding patterns are more closely related than those with different banding patterns.



GEL ELECTROPHORESIS

## Review Questions

1. Organisms that are _____ related have a greater similarity in their protein structure.
2. Name two body chemicals that are similar in living things. _____

_____

**I. EXAMPLES OF EVOLUTION.** Scientists have discovered several complete series of fossil records that show gradual changes in animals through the ages. Two of the best examples of vertebrate evolution are those of the horse and the elephant (Figure 26-5).

The ancient ancestor of the horse, *Eohippus,* was about the size of a fox. It had four toes on its front feet and three toes on its hind feet. The horse gradually got bigger and the length of its feet increased. As time passed some of the toes disappeared until today the modern horse, *Equus,* is

one-toed. The middle toe is the one that remains but the horse retains tiny splints of two other toes. The skull grew longer and the teeth became flat-topped.

The ancestor of the present elephant was the size of a pig and had no tusks. Over time the size of the elephant's body and head increased tremendously. The two upper incisor teeth increased in size and length and gradually developed into tusks. The early trunk was much shorter than the trunk of today's elephant.

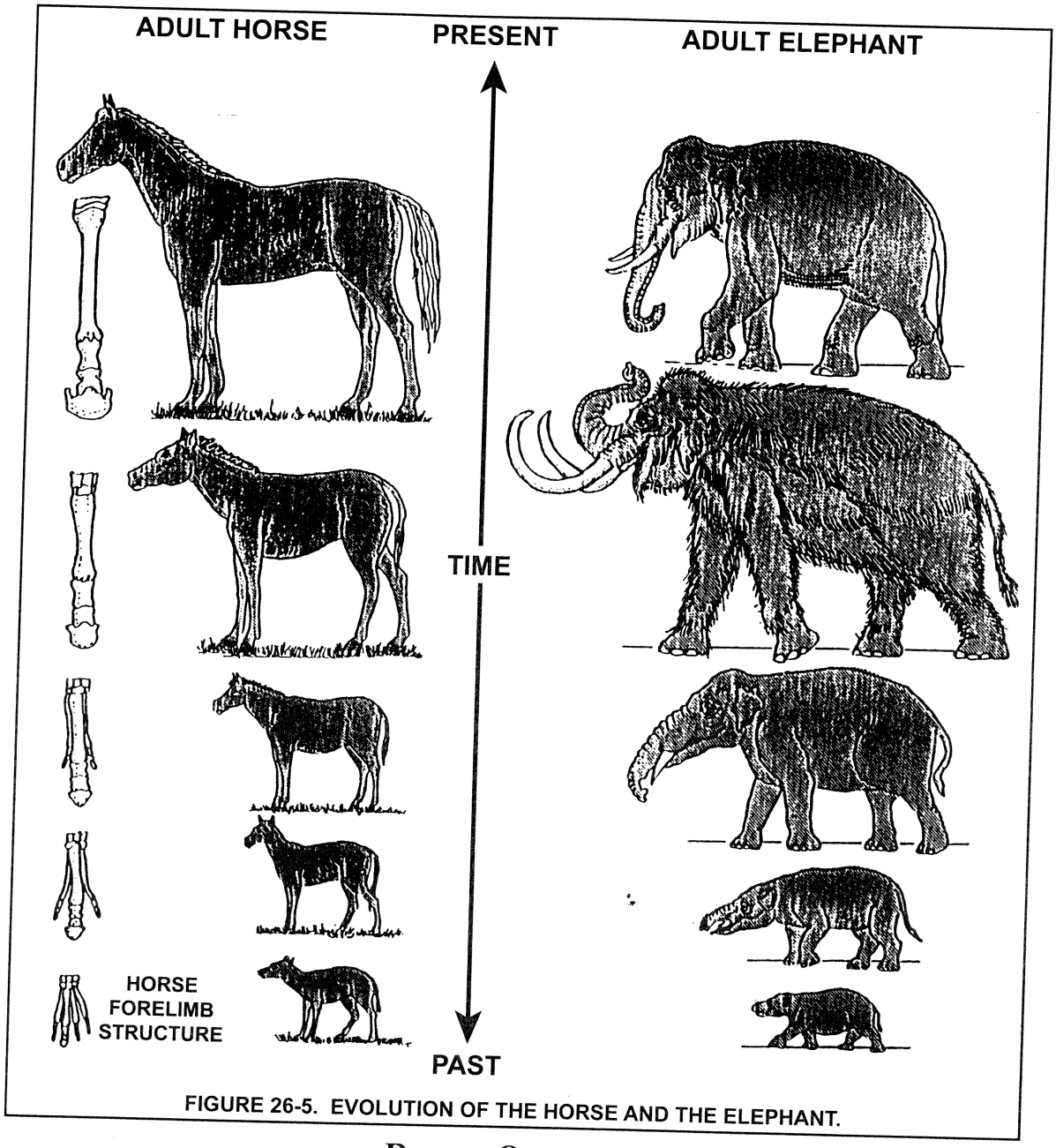



FIGURE 26-5. EVOLUTION OF THE HORSE AND THE ELEPHANT.

## Review Questions

1. Fossils of the _____ and the _____ show that animals have gradually changed through time.