Name ________________________________
Hour ____
Due Date ________________

**Earth’s Changing Surface – Chapter 4**
(You do not need your book)

Page 1 - Fossils Summary
Page 2 - Traces of Tracks
Page 3 - Finding the Relative Age of Rocks Summary.
Page 4 - Finding the Relative Age of Rocks.
Page 5 - The Grandest Canyon of All.
Page 6 - Finding Clues to Rock Layers. (Real World Lab)
Page 7 - Finding Clues to Rock layers continued.

**Grade Requirements:**
C complete pages 1,2,3,4
B complete pages 1,2,3,4,5 (complete but not accurate)
A complete pages 1,2,3,4,5,6,7 (complete and accurate)
Fossils are the preserved remains or traces of living things. Fossils provide evidence of how life has changed over time. Most fossils form when living things die and are buried by sediments. The sediments slowly harden into rock and preserve the shapes of the organisms. Scientists who study fossils are called paleontologists. They usually find fossils in sedimentary rock, the type of rock that is made of hardened sediment.

Most fossils form from animals or plants that once lived in or near quiet water such as swamps, lakes, or shallow seas. When an organism dies, generally only its hard parts leave fossils. Fossils found in rock include petrified fossils, molds and casts, carbon films, and trace fossils. Other fossils form when the remains of organisms are preserved in substances such as tar, amber, or ice.

Petrified fossils are fossils in which minerals replace all or part of an organism. The most common fossils are molds and casts. A mold is a hollow area in sediment in the shape of an organism or part of an organism. A mold forms when the hard part of an organism, such as a shell, is buried in sediment. Later, water carrying dissolved minerals may seep into the empty space of a mold. If the water deposits the minerals there, the result is a cast, a copy of the shape of an organism. Another type of fossil is a carbon film, an extremely thin coating of carbon on rock. Trace fossils provide evidence of the activities of ancient organisms. Fossil footprints, trails, and burrows are examples of trace fossils. Some processes preserve the remains of organisms with little or no change. Organisms can be preserved in tar, amber, or ice.

Paleontologists use the fossils they collect to determine what past life forms were like. Together, all the information that paleontologists have gathered about past life is called the fossil record. The fossil record provides evidence about the history of life on Earth. The fossil record also shows that groups of organisms have changed over time. It also reveals that fossils occur in a particular order, showing that life on Earth has evolved, or changed. Thus, the fossil record provides evidence to support the theory of evolution. A scientific theory is a well-tested concept that explains a wide range of observations. Evolution is the gradual change in living things over long periods of time. The fossil record shows that millions of types of organisms have evolved. Some have become extinct. A type of organism is extinct if it no longer exists and will never again exist.

Fossils provide evidence of Earth’s climate in the past. Paleontologists also use fossils to learn about past environments and changes in Earth’s surface.
Traces of Tracks

Paleontologists can learn a lot from trace fossils. The figure below shows fossil footprints. The larger prints were made by a dinosaur. The smaller prints were made at the same time by a small mammal. Can you infer what happened?

Answer the following questions on a separate sheet of paper.

1. What are trace fossils?
2. When these animals made the prints, was the soil moist or dry? Explain.
3. How did the prints become trace fossils?
4. From which direction did the dinosaur come? From which direction did the mammal come?
5. Did either animal change its speed? How can you tell?
6. What prints lead away from the meeting of these animals?
7. How do you interpret these trace fossils? Tell what happened.
The sediment that forms sedimentary rocks is deposited in flat layers. Over years, the sediment becomes deeply buried, hardens, and changes into sedimentary rock. At the same time, remains of organisms in the sediment may become fossils. These rock layers provide a record of Earth's geologic history.

The relative age of a rock is its age compared to the ages of other rocks. The absolute age of a rock is the number of years since the rock formed. It can be difficult to determine the absolute age of a rock. Geologists use the law of superposition to determine the relative ages of sedimentary rock layers. According to the law of superposition, in horizontal sedimentary rock layers the oldest is at the bottom. Each higher layer is younger than the layer below it.

There are other clues to the relative ages of rocks. Geologists find some of these clues by studying extrusions and intrusions of igneous rock and faults. Igneous rock forms when magma or lava hardens. Lava that hardens on the surface is called an extrusion. The rock layers below an extrusion are always older than the extrusion. Beneath the surface, magma may push into bodies of rock. There, the magma cools and hardens into a mass of igneous rock called an intrusion. An intrusion is always younger than the rock layers around and beneath it.

More clues come from the study of faults. A fault is a break in Earth's crust. A fault is always younger than the rock it cuts through. The surface where new rock layers meet a much older rock surface beneath them is called an unconformity. An unconformity is a gap in the geologic record. An unconformity shows where some rock layers have been lost because of erosion.

To date rock layers, geologists first give a relative age to a layer of rock at one location and then give the same age to matching layers at other locations. Certain fossils, called index fossils, help geologists match rock layers. To be useful as an index fossil, a fossil must be widely distributed and represent a type of organism that existed only briefly. Index fossils are useful because they tell the relative ages of the rock layers in which they occur. Geologists use particular types of organisms, such as trilobites, as index fossils. Trilobites were a group of hard-shelled animals that evolved in shallow seas more than 500 million years ago. They later became extinct. Trilobite fossils have been found in many different places.
Finding the Relative Age of Rocks

Understanding Main Ideas

Use the figure below to answer questions 1–4. Write your answers on a separate sheet of paper.

1. What is the youngest rock layer on the figure? Explain.
2. Is the extrusion older or younger than rock layer B? Explain.
3. Is the fault older or younger than rock layer A? Explain.
4. How could a geologist use the fossil in rock layer B to date a rock layer in another location?

Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

5. fault  a. the number of years since a rock formed
6. extrusion  b. a break or crack along which rocks move
7. unconformity  c. the way to determine relative ages of rocks
8. relative age  d. a hardened layer of magma
9. law of superposition  e. the age of a rock compared with the age of other rocks
10. intrusion  f. fossils used to determine the relative ages of rock layers
11. absolute age  g. a place where an eroded surface is in contact with a newer rock layer
12. index fossil  h. a hardened layer of lava
The Grandest Canyon of All

How did the Grand Canyon form? It formed through the processes that build up and wear down the surface of Earth. The figures below show how this majestic landscape came to be.

A Several sedimentary rock layers form over ancient rock.

B Forces within Earth cause large faults, and layers of the sedimentary rock shift.

C Weathering and erosion wear down the whole area.

D More sedimentary rock layers form over the old, eroded surface.

E Finally, the Colorado River flows over the surface and cuts down through the layers of rock, forming the Grand Canyon.

Answer the following questions on a separate sheet of paper.

1. How do sedimentary rock layers form?
2. What happened to the sedimentary rock layers that first formed over the ancient rock?
3. Where in this sequence of events is the formation of an unconformity?
4. How did the Grand Canyon itself form?
5. Which is older, the Grand Canyon or the rock layers now exposed on the canyon walls? Explain your reasoning.
Finding Clues to Rock Layers

Fossil clues give geologists a good idea of what life on Earth was like millions or even billions of years ago.

♦ Problem

How can you use fossils and geologic features to interpret the relative ages of rock layers?

♦ Skills Focus

interpreting data, drawing conclusions

♦ Procedure

1. Study the rock layers at Sites 1 and 2. Write down the similarities and differences between the layers at the two sites.

2. List the kinds of fossils that are found in each rock layer of Sites 1 and 2.

♦ Analyze and Conclude

Write your answers in the spaces provided.

♦ Site 1

1. What “fossils clues” in layers A and B indicate the kind of environment that existed when these rock layers were formed? How did the environment change in layer D?

______________________________________________________________________________

______________________________________________________________________________
2. Which layer is the oldest? How do you know?
______________________________________________________________________________
______________________________________________________________________________

3. Which of the layers formed most recently? How do you know?
______________________________________________________________________________
______________________________________________________________________________

4. Why are there no fossils in layers C and E?
______________________________________________________________________________
______________________________________________________________________________

5. What kind of fossils occurred in layer F?
______________________________________________________________________________
______________________________________________________________________________

◆ Site 2
6. Which layer at Site 1 might have formed at the same time as layer W at Site 2?
______________________________________________________________________________

7. What clues show an unconformity or gap in the horizontal rock layers? Which rock layers are missing? What might have happened to these rock layers?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

8. Which is older, intrusion V or layer Y? How do you know?
______________________________________________________________________________

9. Think About It Working as a geologist, you find a rock containing fossils.
What information would you need in order to determine this rock’s age relative to one of the rock layers at Site 1?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

◆ More to Explore
Draw a sketch similar to Site 2 and include a fault that cuts across the intrusion. Have a partner then identify the relative age of the fault, the intrusion, and the layers cut by the fault.