

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Group: \_\_\_\_\_

## Dating Rocks


(Lexile 780L)

1 Canyons are like books. They tell the story of Earth's past. You just have to know how to read them. The Grand Canyon tells more than one billion years of the story! Look at the picture at right. You can see many layers. The Colorado River has cut through the rocks. Each layer has a different color. Matching layers are found at roughly the same height on both sides of the canyon. The oldest rocks are found in the bottom of the canyon. The newest rocks are found near the rim. The river has carved the canyon over the last 5-6 million years.



2 Sedimentary rock layers are called strata. Stratigraphy is the description and classification of strata. It is used to determine the relative ages of rocks. In the 1600s, Nicolas Steno was nicknamed "Strata" by his friends for his interest in rock layers. The principles he came up with are still used in stratigraphy today. The first principle tells us that older rocks are on the bottom. Younger rocks are on top. The next principle is that sediments are laid down horizontally. So layers that are at an angle must have moved after they were deposited. Another of Steno's principles is that sediments deposit over a wide area. Snow does not fall only on one street corner. In the same way, sediments are not limited to small areas. The same stratum can be seen in different locations. The last principle is that anything that cuts through strata has to have happened after the strata were deposited. All the strata of the Grand Canyon are older than the Colorado River's path through them.

3 Sometimes a stratum gives clues to a particular event. One such event is the extinction at the end of the Cretaceous period. Dinosaurs and many other life forms vanished in a short period of time. The speed and pattern of extinction gave rise to several theories. The composition of the stratum between the Cretaceous and Paleogene periods is unusual. This thin stratum is found all over the world. It is rich in iridium. Iridium is a metal that is very rare in the Earth's crust. But iridium is very common in asteroids. Scientists think a large asteroid containing large amounts of iridium hit the Earth. Iridium was then thrown into the atmosphere. Over time, iridium was deposited to form the stratum. Two other pieces of evidence support an asteroid impact. Other deposits have been found along the Gulf coast and the Caribbean. These are a sign of an ancient large tsunami. An impact crater has been found in the Yucatan peninsula of Mexico. Scientists think that the impact of the asteroid led to the extinctions.



## Reading Science

- 4 Stratigraphy can be combined with the fossil record. This allows scientists to figure out Earth's story around the world. William Smith was a British geologist in the 1800s. He first observed strata in coal mines. Smith noticed that strata were always present in the same order in each mine. He could identify each stratum in different places. This was possible because each stratum has a unique combination of plant and animal fossils. These fossil combinations are known as assemblages. Fossils in older strata were of simpler organisms than fossils in younger strata. Because of his observations, Smith added another principle to the ones written by Steno. He called this the principle of faunal succession. This tells us that each stratum contains a unique assemblage, or variety, of organisms. Also, assemblages are found in the same vertical order over large horizontal distances. If the same assemblage is found in a stratum in a distant location, both strata are assumed to have the same age.
- 5 What assemblage is found in the rocks below the iridium-rich stratum? It contains the fossils of many familiar dinosaurs, such as *Tyrannosaurus rex*. Some areas of continents were covered in shallow oceans. Fossils of ammonites, a relative of squid, are found. There are also fossils of marine reptiles such as the mosasaur. Mammal fossils were present. However, they were less common and small. Early mammals were often no larger than today's rats. Right above the iridium rich boundary layer, the number of different species found is much smaller. No dinosaur fossils exist. More mammals and birds gradually appear as the rocks move towards the surface from the iridium layer.
- 6 Stratigraphy can only tell us the order the strata formed in. Scientists can determine that one rock is older than another. Scientists cannot use strata to tell exactly how old the rock really is. But there is a way to determine how old rocks are. Radiometric dating is a process used to determine the actual age of rocks. The process uses radioactive decay. Naturally occurring radioactive elements decay. They change into non-radioactive end products through steps in a decay chain. Each radioactive element decays with a predictable rate. The amount of radioactive element is compared to the end product. This gives the date when the rock became solid.
- 7 Several different elements are used for radiometric dating. The decay chain of radioactive uranium decays ends with lead. The oldest rock on Earth is a crystal of zircon found on a sheep ranch in Australia. The crystal is tiny, about twice the thickness of human hair in each dimension. The decay of uranium was used to find its age. Scientists measured the amount of uranium and lead in the crystal. They found that it dates to about 4.4 billion years ago! This suggests that the Earth had a solid crust at that time. The oldest microscopic fossils date back to 3.4 billion years ago. The Earth's crust is constantly being recycled. Some scientists believe older fossils might have been lost to this recycling. Stratigraphy, combined with radiometric dating of Earth's rocks, tells a fascinating story of Earth's history. To figure out the true age of Earth itself, we have to look to space.
- 8 The age of the Earth itself cannot be found from Earth's rocks. Rocks are constantly recycled back into the mantle. They melt and become solid again. Scientists hypothesize that meteorites formed at the same time as Earth. Meteorites don't recycle their components. Therefore, the age of the meteorite will be the same as the age of its formation. Radiometric dating of meteorites dates them to about 4.5 billion years ago.



1 Which of the following statements is NOT true about the Grand Canyon?

- A The Grand Canyon is older than the rocks in its walls.
- B The oldest rocks in the canyon are found near the bottom.
- C The rock layers on both sides are in the same order.
- D The canyon is about 5-6 million years old.

2 Scientists observe several strata that are tilted at an angle. What most likely caused the tilting?

- A The strata were deposited at an angle.
- B Fossils were deposited within each stratum.
- C The strata were moved after they were deposited.
- D The strata were deposited in a small area.



3 Scientists believe that the boundary stratum between the Cretaceous and Paleogene was caused by an asteroid. What evidence is most consistent with this theory?

- A The stratum is found all over the world.
- B The stratum is thin.
- C The stratum contains iridium.
- D Few fossils are found in the stratum.

4 Which statement best summarizes the principle of faunal succession?

- A Different combinations of fossils are found in different strata.
- B Some fossils are found in multiple strata, other fossils only in one stratum.
- C Some strata contain marine fossils, while others contain fossils of terrestrial organisms.
- D Fossils in older strata are more primitive than fossils in more recent strata.



5 What evidence is most consistent with dinosaurs becoming extinct at the end of the Cretaceous era?

- A Mammal fossils are rare in the Cretaceous, and numerous in the Paleogene.
- B No dinosaur fossils are found above the Cretaceous Paleogene boundary.
- C The Cretaceous Paleogene boundary layer contains few or no fossils.
- D Dinosaur fossils are not found in the oldest rocks on Earth.

6 Radioactive uranium decays into lead. What relative amount of uranium and lead would you expect to find in the oldest rocks?

- A Very little uranium and very little lead.
- B A lot of uranium and very little lead.
- C Very little uranium and a lot of lead.
- D A lot of uranium and a lot of lead.

