Student Name: _____

4th Grade Science
Distance Learning Packet
Week 4

Directions:

Daily Directions

1. Read each passage.
2. Complete the following comprehension questions.
3. Students should complete approximately 5-6 pages per day.

Note- The work increases difficulty throughout the week.

Contact Information:

Teacher Contact Information

School Contact Information

What Can Fossils Tell Us About Earth's History?

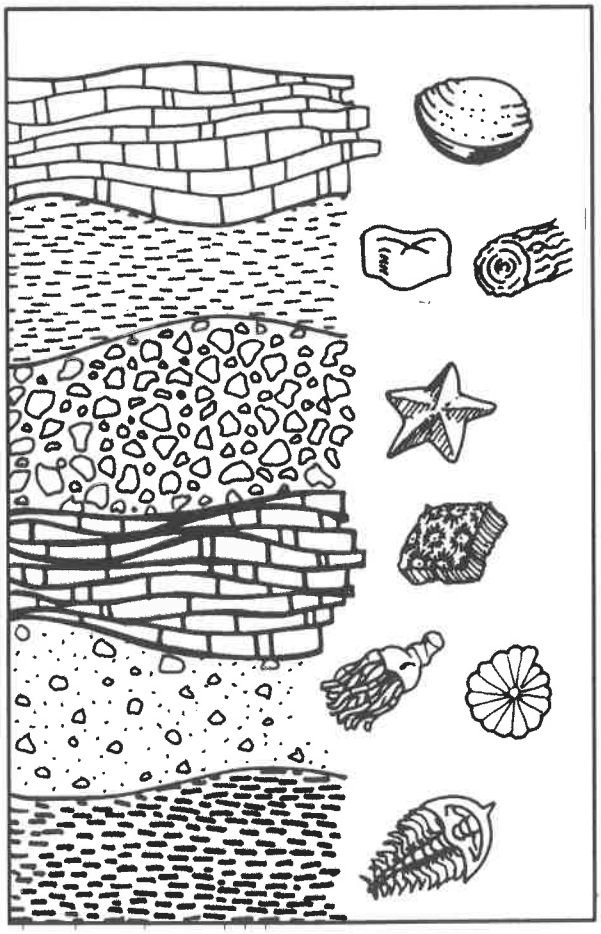
Understanding Rock Layers

Some scientists learn about Earth's past by studying Earth's rocks. Such scientists are called geologists. By studying the different layers in rocks, called strata, geologists can figure out the order of events in Earth's history.

The layers of rock exposed in a cliff or road cut are not all the same age. The oldest layers are usually the ones on the bottom. The youngest layers are usually the ones on top. Some of these rock layers may contain fossils. A fossil is the remains of a plant or animal from long ago. Fossils can tell scientists a lot about the age of rocks. They also reveal a lot about how living things and the climate have changed over time.

Studying Fossils

Scientists who study fossils are called paleontologists. Paleontologists mainly find fossils in sedimentary rocks. Living things usually decay or are eaten when they die. But sometimes they are buried quickly by sediment. The sediment helps preserve them. The hard parts of animals, like teeth or bones, are more likely to become fossils. But sometimes whole organisms are preserved. Animal footprints can be preserved, too. Animal footprint fossils are called trace fossils. A trace fossil provides evidence of an animal's movement. However, it doesn't contain any part of the actual animal.

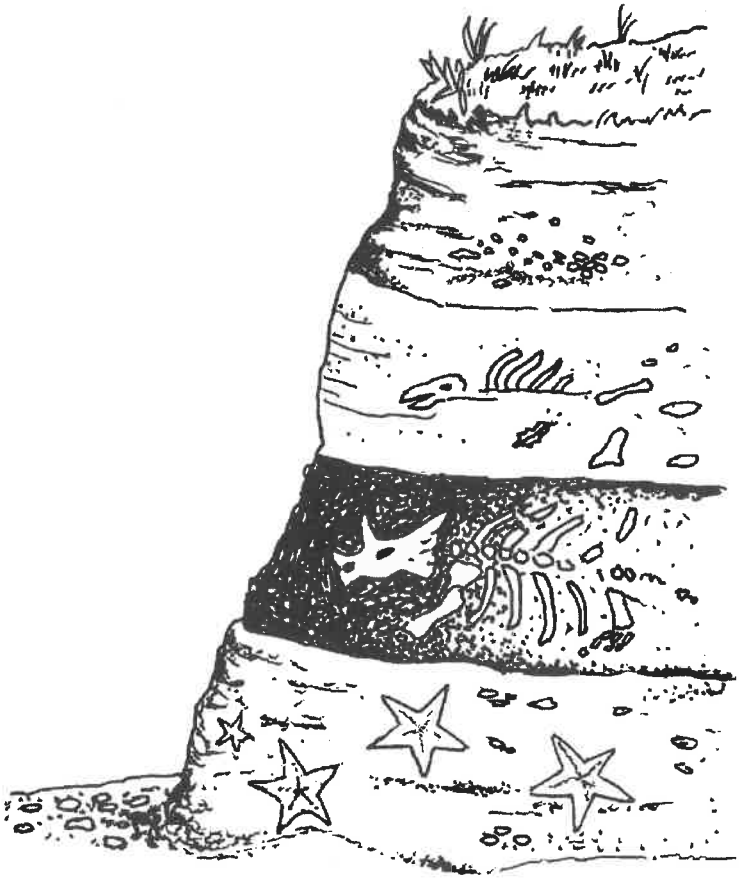


Remember that sedimentary rock is made up of layers and layers of deposited sediment. The fossils found on the bottom layers of a sedimentary rock are very different from the ones in the top layers. That is because the preserved organisms in the bottom layers lived a long time ago. As a result, a sedimentary rock with fossils is like a history book.

What Fossils Tell Us

Fossils can help scientists figure out how old a rock is. They also tell us about the history of living things. The types of fossils found in each layer change as you get higher up a rock. This is because different types of plants and animals lived during different time periods. The oldest layers sometimes contain fish and other sea life. The next layers may also contain fossils of amphibians, reptiles and small mammals. The youngest layers may include larger mammals, birds, and even humans. The layers give a picture of how living things have changed over time. Fossils reveal our geologic history.

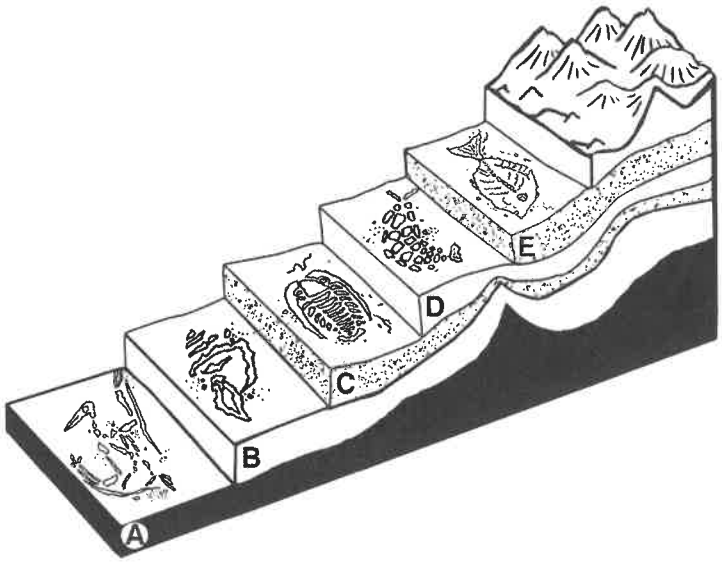
We can also learn about Earth's different environments through fossils. For example, a rock in a dry area might contain the fossils of animals or plants that live in the sea. These fossils tell you that the area used to be covered by water. If a fossil of a cool climate plant is found in a warm climate, the fossil tells you that the area used to be cool. The position of the fossil layers in rocks can also reveal evidence of earthquakes, volcanoes, and movement in Earth's crust.



Name _____ Date _____

What Can Fossils Tell Us About Earth's History?

Use the diagram below to answer questions 1 and 2.



1. Which fossil is the oldest? How can you tell?

_____

2. Which fossil is the youngest? How can you tell?

_____

Fill in the blanks.

3. _____ are the different layers of rock.

4. A rock layer at the bottom of a road cut is _____ than one at the top.

5. Fossils are the _____ of living things.

6. Animal tracks preserved in rock are called _____ fossils.

7. Fossils may form when plants or animals are buried by

_____.

Name _____ Date _____

8. **Main Idea** What do fossils tell us about Earth's past?

_____

_____

9. **Vocabulary** What does it mean when an organism has been been preserved whole?

_____

_____

10. **Reading Skill: Compare and Contrast** How are geologists and paleontologists the same? How are they different?

_____

_____

11. **Critical Thinking: Infer** Suppose that a paleontologist finds a fossil of a crab. The fossil is located in a layer of a rock high on a mountain. What does this tell you about the rock layer?

_____

_____

12. **Inquiry Skill: Use Models** How could you make a model of a fossil?

_____

_____

_____

13. **Test Prep** Which of the following animal's remains would be found in the oldest rock layer?

A Eagle

B Dinosaur

C Kangaroo

D Elephant

What Are Renewable Resources?

A natural resource is a material found on Earth that can be used by people. Trees, soil, and minerals are a few natural resources. Some natural resources, such as oil, are nonrenewable.

A nonrenewable resource is one that cannot be replaced once it is used up or that takes thousands of years to be replaced.

A renewable resource is a natural resource that can be replaced or can renew itself. Air and water are renewable resources that all living things need.

Plants and Animals

Plants and animals are renewable resources. Animals get energy by eating plants or by eating other animals that eat plants.

Plants help clean and renew the air. Plants make their own food. As they do this, they take in a gas called carbon dioxide. They also let go of a gas called oxygen. Animals and plants both need oxygen from the air. Without plants, the animals would use up all the oxygen.

When old plants die, new plants often grow in their place naturally. People who farm help new plants grow. After a food crop is picked, a new crop can be planted.

Water as a Resource

All living things need water to live. But most of Earth's water is found in oceans. Most plants and animals cannot use this water. It has too much salt in it.

Only a small amount of Earth's water is fresh water. More than half of the fresh water is contained in glaciers and the polar ice caps. The rest is under the ground, in streams and lakes, inside plants and animals, or in the atmosphere. Only the water under the ground and in streams and lakes is available for drinking and washing.

The supply of fresh water is renewed through the water cycle. In this cycle, energy from the sun heats Earth's water. The heat changes the water into a gas called water vapor. The process in which liquid water changes to water vapor is called evaporation. When water evaporates, anything that is mixed with the water is left behind.

When water vapor cools, it forms tiny drops of liquid water. Condensation is the process in which water vapor turns back into liquid water. This happens all of the time, but when there is more condensation than evaporation, a cloud may form.

Clouds are made when drops of water form around small particles in the air. When the drops become too heavy, they fall from the clouds as rain, snow, sleet, or hail.

Water that falls to Earth is called precipitation. Precipitation returns fresh water to Earth. Some of it flows into the ground. The rest of it flows into oceans, lakes, and rivers. The water cycle repeats again and again.

Soil and Nutrients

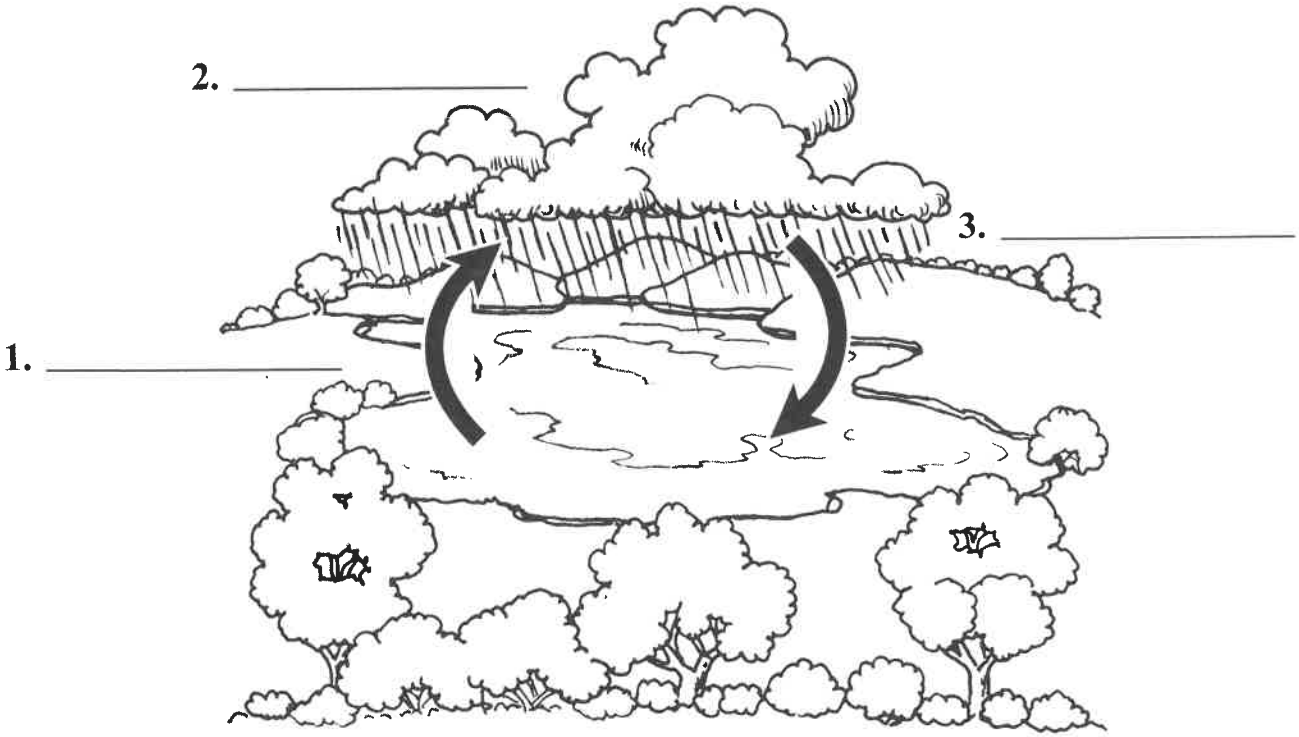
Soil is an important resource. Most plants need soil to grow. Soil gives the plants support and nutrients. If the soil used for growing crops is well cared for, it can be used again and again.

Some crops use a lot of nutrients as they grow. If a farmer plants the same crop in the same soil every year, it uses up some of the nutrients. Some crops help put nutrients back into the soil. Many farmers change the crops that they grow. One time they will grow a crop that uses up nutrients. The next time they will grow a crop that gives back those nutrients.

Name _____ Date _____

What Are Renewable Resources?

Fill in the blanks in the diagram below.



Write answers to the questions on the lines below.

4. How do plants help clean and renew air?

_____

_____

5. What is the water cycle?

_____

_____

6. Why do some farmers rotate their crops?

_____

_____

_____

Name _____ Date _____

7. **Main Idea** What is a renewable resource?

_____

_____

8. **Vocabulary** Use the term *evaporation* in a sentence about the water cycle.

_____

_____

9. **Reading Skill: Main Idea and Details** Explain why water is a renewable resource.

_____

_____

_____

10. **Critical Thinking: Evaluate** Someone says that plants are a more important natural resource than water. Do you agree or disagree? Give reasons for your answer.

_____

_____

_____

11. **Test Prep** One example of a natural resource that is renewable is

A oil.

B coal.

C fresh water.

D gold.

What Are Nonrenewable Resources?

People use energy every day. A small amount of energy comes from renewable resources. These resources include the sun, wind, moving water, and heat from inside Earth.

However, most of the energy used in the United States comes from nonrenewable resources called fossil fuels. A fossil fuel is made from the remains of ancient plants and animals. Fossil fuels are oil, natural gas, and coal. These fuels began forming on Earth more than 300 million years ago.

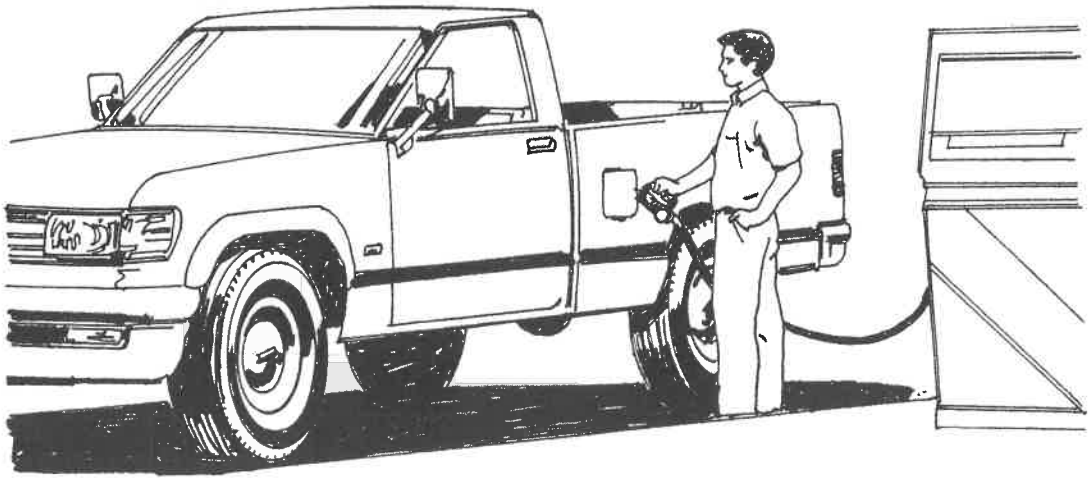
Coal

Coal is the most common fossil fuel on Earth. Coal is formed from ancient swamp plants. The energy stored in coal is used mainly to make electricity. It is also used for heating.

Oil and Natural Gas

Oil and natural gas are also fossil fuels. They are formed much like coal. But instead of swamp plants, they are made from animals and plants that lived in Earth's oceans. Over millions of years, heat and pressure changed the remains of these plants and animals into oil and natural gas.

Oil is used as fuel for cars and trucks. It is also used to make things like plastics, medicines, and cloth. Natural gas is used to heat many homes and businesses. It is also used to run some machines, such as stoves.



Oil is used to make gas, motor oil, and asphalt for roads.

Fossil Fuels—Pro and Con

As sources of energy, there are some advantages to using fossil fuels. They are fairly easy to get out of the ground. They are easy to move from place to place. They are often cheaper than other forms of energy. There are enough supplies now to meet people's needs for the present time.

There are also very serious problems with using fossil fuels. All fossil fuels are nonrenewable. Scientists have calculated that at the rate oil and natural gas are used today, supplies will very likely run out within 100 years.

Pollution is the adding of harmful materials to the air, water, and soil. Taking fossil fuels out of the ground pollutes water supplies. Taking fossil fuels from under the ocean can cause oil spills. The pollution resulting from the use of fossil fuels can never really be cleaned up.

Renewable energy sources will not run out, and they do not produce pollution. But they can cost a lot. Scientists are working to find ways to make renewable energy sources cheaper and easier to use.

Layers of Soil

Soil is made up of many things, including humus and tiny pieces of rock. The process of making soil takes a long time. In fact, the top inch of soil in some places started forming about 500 years ago.

Soil can be thought of as both a renewable and a nonrenewable resource. Nutrients lost from soil can be replaced. This means soil can be thought of as a renewable resource. But some soil is lost because of erosion. When this happens, it takes a long time to be replaced. That is why soil can be thought of as nonrenewable.

Rocks and Minerals

Living things need minerals to grow and stay healthy. Remember that rock is a solid material that is made up of one or more minerals. Rocks are always changing very slowly in the rock cycle. People mine minerals, such as iron and copper. Over time, these minerals will be replaced in the rock cycle. But the rock cycle is very slow. Plus, some minerals are rare, which means there are not a lot of them. That is why minerals are thought of as nonrenewable resources.

Name _____ Date _____

What Are Nonrenewable Resources?

Write answers to the questions on the lines below.

1. What are fossil fuels?

_____

_____

2. How is coal used?

_____

_____

3. How were oil and natural gas formed?

_____

_____

_____

_____

4. What are some of the benefits of using fossil fuels?

_____

_____

_____

5. What are some drawbacks to using fossil fuels?

_____

_____

6. Why can rich soil be considered a nonrenewable resource?

_____

_____

Name _____ Date _____

7. **Main Idea** Why are minerals nonrenewable resources?

_____

_____

8. **Vocabulary** Explain the difference between oil and coal.

_____

_____

9. **Reading Skill: Compare and Contrast** Consider what you learned about renewable energy resources, like solar power. Compare solar power and natural gas. Explain the advantages and disadvantages of each.

_____

_____

_____

10. **Critical Thinking: Predict** What might happen when oil and natural gas run out?

_____

_____

_____

11. **Inquiry Skill: Hypothesize** What would happen if an area had increased erosion?

_____

_____

_____

12. **Test Prep** Which is a nonrenewable resource?

A plants

B water

C soil

D sunlight

Chapter 1
Earth's Features

Standards Covered: 4-ESS2-1, 4-ESS2-2, 4-ESS2-3, 4-ESS3-2

Essential Questions:

- What is the impact of natural processes in shaping the earth's surface?
- How do living things and plants contribute or lessen erosion?

Shaping the Earth's Surface

The Earth's surface (crust) is made of many different types of rocks and minerals. The processes which form the Earth's surface are constantly changing. Most of the processes are too slow to track with our eyes. A mountain can take millions of years to form. However, we can see the results all around us. Let us explore how some of these processes shape the planet.

Melting Glaciers

Glaciers are compressed layers of snow hardened into ice over a long period of time. Glaciers are located in the colder areas of the earth like Antarctica and Alaska. Although they make look still, glaciers move. Melting ice moves the glacier over land and sea. The movement of the glacier works a lot like erosion, carving landforms into the earth's surface. The glacier can form lakes, craters, and gorges. Since glaciers are a primary source of freshwater, glaciers form many freshwater lakes for people and animals to use. A downside to glacial melting is it can erode coastlines. Coastal erosion is harmful to the environment. It reduces the availability of habitat for many plants and animals. Accelerated melting and movement is a sign of global warming. Increased temperatures on earth lead to faster melting. The melting glaciers cause sea levels to rise, which leads to more coastal erosion and harm to wildlife.

Figure 1.1 Glaciers

Crystallization

Have you ever visited a cave? Did you notice the rock formations growing up from the floor of the cave and growing down from the ceiling? These are called **stalagmites** and **stalactites**. A process called **crystallization** forms them. Natural crystallization occurs under a variety of conditions. Temperature, water, and the type of mineral all contribute to crystallization. For a stalactite to form, water from the surface penetrates the ground. Caves, mainly made of limestone, contain a significant amount of materials like calcium. The water that penetrates the soil eventually makes its way to the top of the cave. By this point, the water has picked up some minerals along the way. Eventually, enough water accumulates on the ceiling, and gravity forces some of the water to fall to the cave floor. The residual water left on the cave ceiling contains minerals. Over time, these minerals start forming layers and eventually form a stalactite. Stalagmites are formed by the same process, except the water is dropping from the stalactite instead of the cave ceiling. It is why you usually see stalactites and stalagmites in pairs. Another way to think about minerals and crystallization is gemstones. Many types of quartz, such as amethyst, are formed from crystallization.

Figure 1.2 Stalactites and Stalagmites

Erosion

When the Earth's surface decreases, this process is **erosion**. Erosion has many causes. Wind, water, plants, and human activity causes erosion. Erosion happens either very quickly or very slowly. The Grand Canyon is a perfect example of erosion. It took millions of years for erosion by the Colorado River to form the Grand Canyon. Erosion has both positive and negative effects on the environment. Erosion creates new and beautiful landforms. However, too much erosion harms coastlines. Louisiana has a major coastal erosion problem. The coast of Louisiana loses a football field of coast each day. One of largest contributors to coastal erosion is **levees**. Levees block the flow of water from the Mississippi. Although they help with river flooding, they cause more soil loss. The river can't rebuild the soil deposits.

Figure 1.3 Grand Canyon

Weathering

When a rock is worn away or dissolved, the process is called **weathering**. The weather makes the earth's crust change. Changes are caused by water, air, or temperature. Water can change rocks several ways. Some minerals change into something different around water. They dissolve and interact with other minerals. This is a chemical change in the rock.

Water also breaks rock into smaller pieces. This is a physical change in the rock. It can happen quickly. When a tidal wave or tsunami strikes, it rapidly strikes the land. It can cause pieces of rocks to break off and wash away. Earthquakes and volcanoes cause rapid physical changes, too.

Figure 1.4 Weathered Rock Formation

Weathering happens slowly, too. Water can ear down surfaces over time. Ice can melt and refreeze in crevices. The expansion of the ice when it freezes causes rock to crack. Mountains can be worn down over time. Wind is one method landforms are weathered. Exposure to wind slowly erodes soil over time. Remember, weathering is different from erosion. Weathering breaks down the rock enough so erosion can occur.

Vegetation

As plants grow in the soil, vegetation affects erosion. Vegetation is the plants which grow in an area. Vegetation slows erosion. When plants die, they decay and become part of the soil. More soil means less erosion. The roots of the plants absorb water. It prevents too much water from washing away soil. Plants and their roots hold down the soil and prevent it from being washed away. Forests are very important in slowing erosion. The trees make the soil stable. On land areas which slope, trees make the difference in the amount of soil eroded. However, some tree roots get so big they affect the soil negatively. They break up the soil if the roots make it to the surface. These roots can lead to more erosion. Overall, when vegetation in an area decreases, erosion increases. It also slows the movement of rocks. If a logging company cuts down all the trees on a hill, the soil will quickly erode. Vegetation is important in protecting the land.

Figure 1.5 Vegetation

Science Journal

Objective: To learn about local vegetation in your area.

Notes: Draw or take pictures of different vegetation in your yard or a park.

Data: Record how you think this vegetation helps prevent erosion.

Summary: Share your findings with the class.

Living Things

Figure 1.6 Beaver dam

Animals and people cause erosion. Living things are "biotic." It means they affect the environment around them. Animals are constantly interacting with the environment. Beavers are an example of one animal which affects the earth's surface. They chew down trees to make dams in rivers. The dams change the flow and direction of the water. The loss of trees affects erosion. Louisiana faced severe erosion because of the **nutria**. Nutria are large rodants that look similar to beavers and also live on land and in water. Nutria came to Louisiana during the 1930s. Their fur was prized. They escaped to the wetlands. They ate the roots of many types of vegetation. This caused flooding and erosion. Louisiana had to take steps to reduce the nutria population. Another animal affecting erosion is the groundhog. Groundhogs dig tunnels under the earth. They burrow through roots as well. The groundhog tunnels destabilizes the soil. These are just some of the ways animals cause erosion.

Human activities like mining and logging also change the Earth's surface. These types of human activities are large contributors to erosion. Natural disasters are another cause of erosion. Tornadoes, hurricanes, and heavy rains from storms erode soil and destroy vegetation. Although humans don't cause natural disasters, they can build structures to lessen erosion. **Barrier islands** and **levees** can both lessen flooding. Barrier islands are islands which prevent coastal flooding and erosion. Protecting these islands makes coastlines safer. Living in Louisiana, you are probably familiar with levees. A levee is an embankment made naturally or manmade. Levees are both helpful and harmful. Levees can prevent flooding, but they can harm the environment. When levees fail, the destruction is worse. Hurricane Katrina's storm surge broke through New Orleans' levees. It caused severe flooding and loss of life. Engineers are always searching ways to improve levees to prevent flooding and erosion.

Time to Investigate

Get small bowl or container. A shallow bowl or container works best. Fill it halfway with sand. First, blow on the sand. What happens to the sand after you do that? Record your findings. During the second part of the investigation, take a bottle of water and pour it over the sand gently. Don't use the whole bottle, and move it around as you pour it. What are the results of pouring water over the sand? What is your breath and the water imitating? Write down your findings.

Practice 1: Shaping the Earth's Surface

1. The process of crystallization forms
   - **A** glacier lakes.
   - **B** stalagmites.
   - **C** mountains.
   - **D** craters.

2. What was mainly responsible for forming the Grand Canyon?
   - **A** water
   - **B** wind
   - **C** fire
   - **D** soil

3. Which of the following does not contribute to weathering?
   - **A** dissolving minerals
   - **B** wind
   - **C** water
   - **D** vegetation

4. What is the effect of climate change on glaciers?
   - **A** It changes the water content.
   - **B** It causes the glaciers to melt faster.
   - **C** It makes the glaciers larger.
   - **D** It makes the glaciers unable to melt.

Mapping Earth's Features

Maps and Earth's Surface

The earth's surface is constantly changing. **Maps** are a great way to see these changes. When you look at maps, you can see a coastline change or the growth of a mountain range. Maps make it easier to compare these changes. Another use for maps is predicting future events. For example, looking at maps of tectonic plates can help predict earthquakes. Below are examples of maps showing land and water features.

The map below looks at the land loss due to coastal erosion.

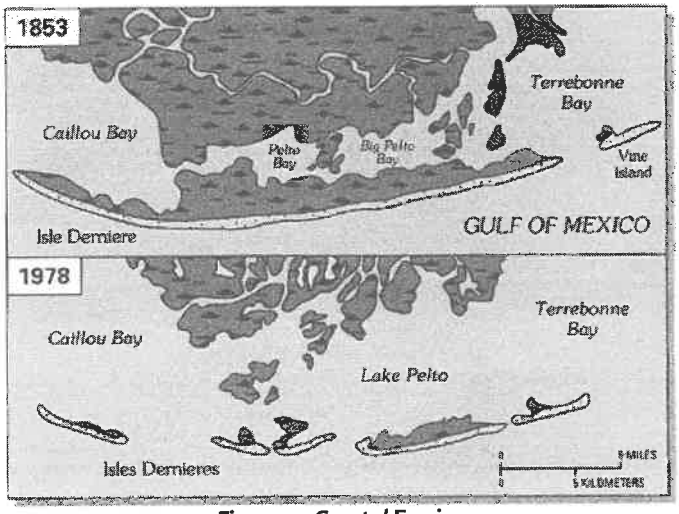


Figure 1.7 Coastal Erosion

Figure 1.8 shows the boundary of an oceanic trench and how they form. You can see each layer of the trench and how they connect together.

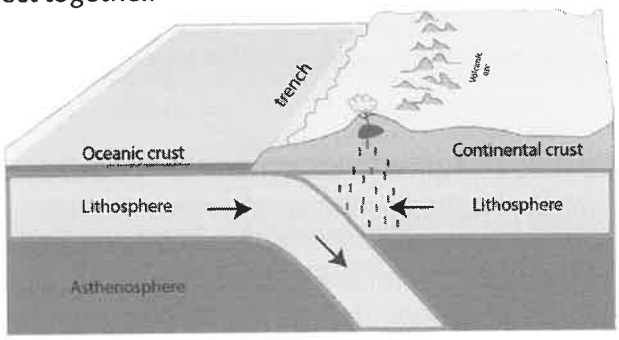


Figure 1.8 Formation of Oceanic Trench

A physical map shows you where landforms are located. The map on the following page looks at mountains and other US landforms. You can also see the natural boundaries created by the mountains. The phyisical features of the mountain, like height, can change because of earthquakes and volcanic eruptions. How do you think the mountains in the US formed?

Figure 1.9 Landform map

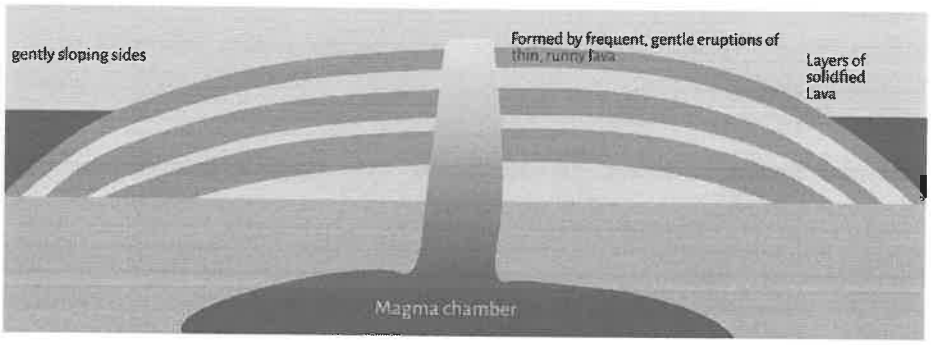


Figure 1.10 Hawaii Volcano Layers

Practice 2: Mapping Earth's Features

1. Look at figure 1.8. Which two earth layers closest to shift to for a trench in the ocean? Select **two** correct answers.

   A Continental Crust

   B Lithosphere

   C Asthenosphere

   D Volcanic arc

2. How could a map help develop a solution for coastal erosion in Louisiana?

   A It can stop human activity in the area.

   B It can help engineer see where levees are needed.

   C It can predict weathering events.

   D It can help engineers build hurricane proof walls on beaches.

Making Waves

Ocean Waves and the Earth's Surface

Most ocean waves are caused by wind. Waves on the surface of the ocean are created by the friction between the surface of the water and wind. As wind speed increases, so does the height of the waves. The height of a wave is its amplitude. The amplitude is the height of a wave from the midline to the crest. (See the diagram below.) Ocean waves are mechanical waves meaning they need a medium to travel through. The medium for ocean waves is water. Waves can also be caused by earthquakes beneath the surface. These eathqueakes can cause a tsunami, a huge wave. Waves are also affected by the pull of the sun and the moon.

Figure 1.11 Waves

The height of waves varies. A wave is divided into a crest and trough. The crest is the tall part of the wave. The trough is the shallow part. Waves of the same type will have different amplitudes. Although they are from the same ocean, the heights are different. Imagine you are surfer. You want to find the tallest waves to surf. You also want multiple tall waves to continue surfing. Each wave you surf on is still a different height.

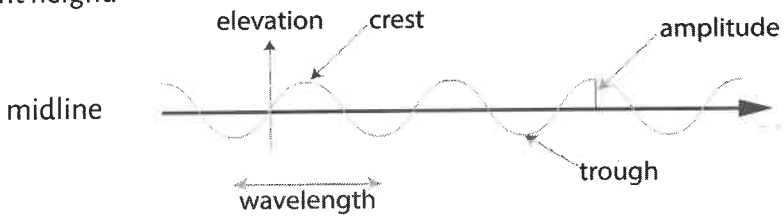


Figure 1.12 Waves

Ocean waves affect the earth's surface. First, water covers 71 % of the Earth's surface. It has shaped the land above and below its surface. There are mountains, volcanoes, and trenches underneath the ocean. These features are constantly changing. The ocean waves help form beaches and shorelines. The waves carve out these areas over time. The weather, in combination with waves, greatly affects the Earth's surface. Hurricanes can cause the waves to grow in height, creating a storm surge. Storm surges can wash away beaches and buildings. They also cause flooding. The flooding of New Orleans during Hurricane Katrina was caused by storm surges. When there is a large earthquake, either on land or the ocean, it can cause a **tsunami**. A tsunami is a large, destructive wave. Tsunamis have the ability to travels long distances across the ocean. When they hit land, they destroy anything in their path. Entire towns may disappear. People have built walls and levees to decrease the damage done by waves. However, sometimes the power of waves is too strong for walls and levees.

Practice 3: Making Waves

1. Amplitude is
   - **A** the length of the wave.
   - **B** the depth of the wave.
   - **C** the sound of the wave.
   - **D** the height of the wave.

Figure 1.13 Hurricane Katrina

2. Which event caused the most damage to New Orleans during your lifetime?
   - **A** a hurricane
   - **B** a tornado
   - **C** a tsunami
   - **D** an underwater earthquake

Chapter 1 Key Term Activity

Fill in the blank with the correct word.

Word Bank

Waves	Amplitude
Glaciers	Erosion
Vegetation	

Logan takes a trip around the world. In the North pole, he sees 1. _____ made of ice. After that, he travels all the way south to see the Grand Canyon. The canyon was formed by the process of 2. _____. Logan then travels to the Amazon rainforest. There, he sees many types of 3. _____. After the jungle, Logan goes to the beach. There, he observes the movement of the 4. _____. Logan remembers it the 5. _____ of the waves is their height.

Key terms are defined in the book's glossary. Answers to Key Term Activities are found in the Teacher's Guide.

Chapter 2
Earth's Processes

Standars Covered: 4-ESS1-1, 4-ESS2-2

Essential Questions:

- How are fossils formed?
- How do fossils help in telling the earth's age?
- How are rock layers important to earth's history?
- How can mapping help in telling's earth's age?

Earth over Time

Geologic Time

Fossils are the remains of ancient plants and animals which were preserved (saved) in sediment, tar, or even ash from a volcano. **Sediment** is sand and tiny pieces of soil. Scientists who study fossils are called paleontologists.

Fossils are found all over the world. However, not all organisms become fossils. Scavengers and bacteria usually eat dead organisms. As a result, very few living things fossilize (turn into fossils).

Evidence of Past Life

Fossils teach scientists about the history of Earth. Fossils tell us when plants and animals first developed. They also tell scientists about the structure of animals. They can show when animals developed body adaptations (changes) like legs or feathers.

Scientists find the age of fossils based on the age of rocks or other fossils found nearby. The oldest fossil found (so far) is over 4 billion years old. It was discovered in Australia. It is a fossil of bacteria that lived when the Earth was full of volcanoes and did not have the atmosphere that it does today.

Fossilized remains can tell scientists about the previous environment. They tell scientists if it was wet or dry or hot or cold, based on the type of plants and animals that lived there. In the case of dinosaurs fossils can also tell scientists if an area was once a lake or an ocean. One example is the Megalodon. It is the ancestor of today's sharks.

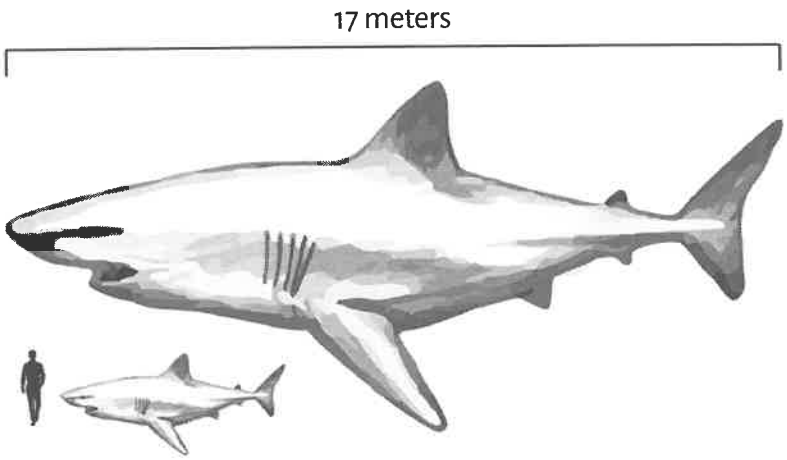


Figure 2.1 Megalodon in Comparison to a Modern Great White and a Man

Fossils can also tell scientists about disasters. Fossils trapped in volcanic ash show scientists where active volcanoes were.

Figure 2.2 fossil

Each fossil is another piece of information about Earth's past. Remember, no one was around to write down what Earth was like in the distant past. Fossils have helped us figure out some of Earth's history.

The Fossil Record

The fossil record provides information on past organisms and environments on Earth. Some types of fossilized organisms could only live in specific environments and under particular climate conditions. The extinction of organisms is on the fossil record, too. Fossils can also be useful in understanding geologic time. Remember, a fossil is the remains or impression of an organism which lived in the past. The **fossil record** refers to all fossils found since the start of fossil study.

Figure 2.3 Rock Layers

The Ordering Of Rock Layers

Scientists read the rock layers to learn when each layer was deposited on top of other layers. The **Law of Superposition** states each rock layer is older than the one above it. The law focuses on rock layers. With this understanding of layering, scientists infer that the relative age of the rock, or fossil in the rock, is older further down in the rock layers.

Over millions of years, tectonic plate motion changed the layers. As a result of folding, breaking, and uplifting of layers, the youngest layers of rock are not always found on top. There are different types of fossils based on their formation. The formation process of fossils depends on where and under what environmental conditions they formed. Read table 2.1 to learn about the different types of fossils.

Type of Fossil	Description
Mold fossil	forms when sediments bury an organism and the sediments change into rock; the organism decays leaving a cavity in the shape of the organism.
Cast fossil	forms when a mold is filled with sand or mud that hardens into the shape of the organism.
Index fossils	are the remains of animals which existed for a relatively short period of geologic history.
Petrified fossil	forms when minerals soak into the buried remains, replacing the remains and changing them into rock.
Preserved fossil	forms when entire organisms or parts of organisms are prevented from decaying by being trapped in rock, ice, tar, or tree sap.
Carbonized fossil	forms when organisms or parts, like leaves, stems, flowers, fish, are pressed between layers of soft mud or clay that hardens, squeezing almost all the decaying organism away and leaving the carbon imprint in the rock.
Trace fossil	forms when the mud or sand hardens to stone where a footprint, trail, or burrow of an organism was left behind.

Table 2.1 Fossil Types

Perhaps these animal species were around for only a few thousand years. When an index fossil is found in a unit of sedimentary rock, scientists can quickly know the time period in which the rock formed. The age of the stone is thought to be the same as the age of the fossil.

Can you name each type of fossil pictured below?

The shorter a period a species lived, the better an index it is.

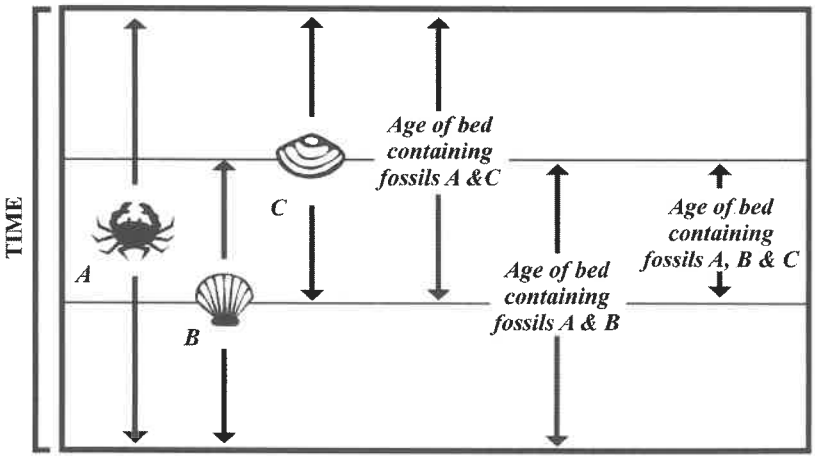


Table 2.2 Index Fossil Chart

Where do fossils come from? Most come from organisms which have hard body parts. Things like **bones** or **shells** will fossilize more easily than soft-bodied organisms. As you go backward in geologic time, sedimentary rock layers get older. The fossils found in these older layers are also very old. Their shapes and bodies are different from today's species. It is accepted that the older the rock layer, the greater the differences in the fossilized organisms.

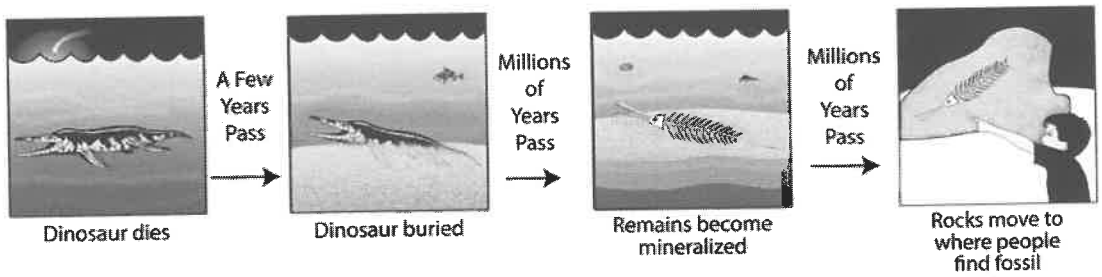


Figure 2.4 Fossil Formation

There are many processes on the Earth's surface which break down and destroy living tissue. For example, trees and animals rot and become food for other living creatures. Fossils are more likely to form when animals are buried over a few years. Occasionally, the conditions are right for fossil formation. Catastrophic events, like **floods, mudslides, earthquakes,** and **ash deposition** from volcanoes usually lead to fossil formation. The rarity of fossils makes each one valuable to scientific study. Estimates indicate the fossil record only represents about 0.1% of all the organisms that have lived on the planet. It is important to note that no one knows how many organisms have lived, or currently live, on Earth. Figure 2.5 shows a basic history of the Earth. Notice when insects and vertebrates (animals with spines) first appeared in the fossil record.

Some fossils have been frozen in ice or dried in the desert. Frozen or dried fossils are young compared to other fossils. These fossils can still have hair or skin. Dried mummies or frozen woolly mammoths are two examples. Don't think because these kinds of fossils have hair or skin that means they can come to life. Like all fossils, they are dead. They CANNOT come to life.

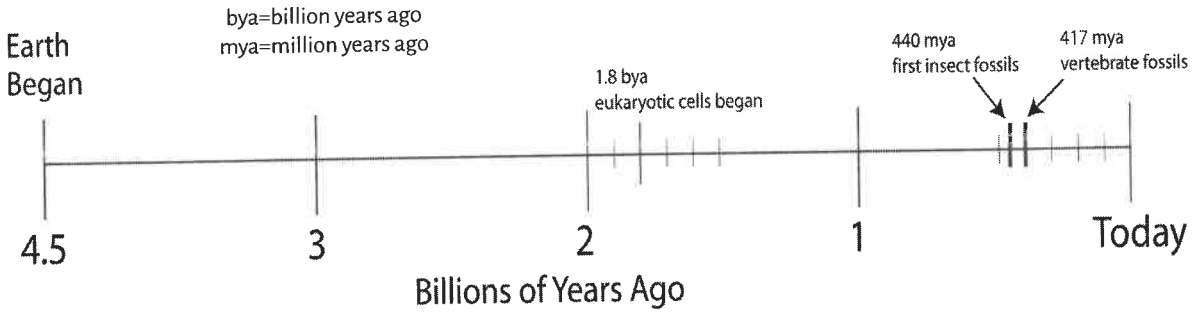


Figure 2.5 Timeline of Earth's Existence

Sedimentation

Figure 2.6 Sediment layers at the Grand Canyon

During the process of sedimentation, minerals suspended in fluid become deposited in layers as a solid. The layers of sediment are made from fossils and mineral deposits. The fossils are the remains of living organisms settled into the layers. The layers build up over time. The more layers there are, the higher the landform. For example, the Grand Canyon has many layers of sedimentary rocks. Sedimentary rocks are classified as organic or chemical. An example of organic sedimentary rock is coal. Coal's composition is pressurized layers of decayed plant material. Rock salt is an example of chemical sedimentary rock. It is made of a combination of two chemically different minerals that form a compound. Sediment tells scientists about what types of plants, minerals, and animals existed during different time periods on Earth. In short, sediments tell the history of the planet.

The Dinosaurs

The most famous fossils come from dinosaurs. **Dinosaurs** appeared between 233 and 243 million years ago. The dinosaurs got around on land on either two or four legs. Most dinosaurs were reptiles. However, today's birds are descendants of feathered dinosaurs. The largest dinosaur discovered was the Brachiosaurus. The Brachiosaurus was as tall as a four-story building. The smallest was the Compsognathus. It was no bigger than a chicken. You probably know the most famous dinosaur, the Tyrannosaurus Rex. Dinosaur fossils were discovered for centuries, but no one knew what they were. It was during the 1800s when people began digging up and studying dinosaur fossils. The study of dinosaurs is paleontology.

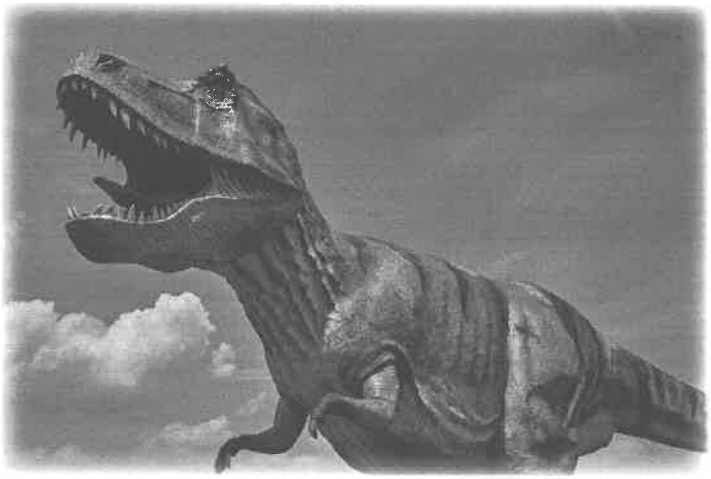
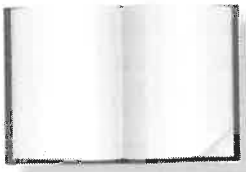


Figure 2.7 T-Rex

Science Journal



Objective: To learn about one dinosaur species

Notes: Research and take some notes about one dinosaur species you are interested in.

Data: Discuss what the dinosaur ate and how it acted. Describe what type of fossil the dinosaur became.

Summary: Share your findings with the class.

The Age of Geologic Events

How do scientists know what type of environment the animals lived in?

Well, they use techniques that allow them to "read" the rock deposits. These are called sedimentary rock layers. The types of rocks found in a particular environment are a direct result of the changes taking place when the rocks were deposited. One such example is with the slow build up of a sedimentary layer of halite (rock salt).It is a mineral formed in ancient seas and salt lakes as they slowly evaporated millions of years ago. Another is limestone; it can form from shells, coral, algae, and other debris that accumulate on the ocean floor.

On the other hand, the eruption of a volcano occurs very rapidly. Eruptions deposit several feet of volcanic ash on the surrounding land in a matter of days. By looking at the type of rock formed, scientists understand the environment that was around when it was deposited. It can give them valuable information about the environment. They can also look at the fossils themselves. Finding marine fossils, like clams and fish, can tell scientists that an area was once part of a sea or ocean.

Feature: The La Brea Tar Pits

Figure 2.8 Animals in the tar pit

In Los Angeles, California, there is a place called the La Brea Tar Pits. The area is famous for the tar seeping up through the soil. The tar brings up dinosaur bones millions of years old. Many creatures became stuck in tar pits during its long history. Prehistoric animals like the Wooly Mammoth and Sabertooth tiger got stuck in the tar. The fossiles are only 10,000 to 40,000 years old. Many fossils of saber-toothed cats have been found in the La Brea Tar Pits. They chased prey (animals they wanted to eat) into the tar pits. They had dinner, but they were stuck, and the tar and the tar preserved their fossils. New tar pits and prehistoric animal fossils are found all the time.

Mapping Earth's Changes

With today's technology, it's easier to map and document changes to the Earth. Satellites and drones help to create these maps. People looking at these maps see change over time to Earth's surface. Maps also tell them the history of the Earth. We will look at some examples of these maps.

The map below shows the sediment layers at the Grand Staircase formation in Utah. The sediment layers show how they increased the formation's height over time. Each deposit adds to the height of the natural structure.

The map below shows how the continents changes over time. Earth's continents were once one land mass called Pangea. The growth of plants and oceans, along with another process, cause it to break into smaller continents.

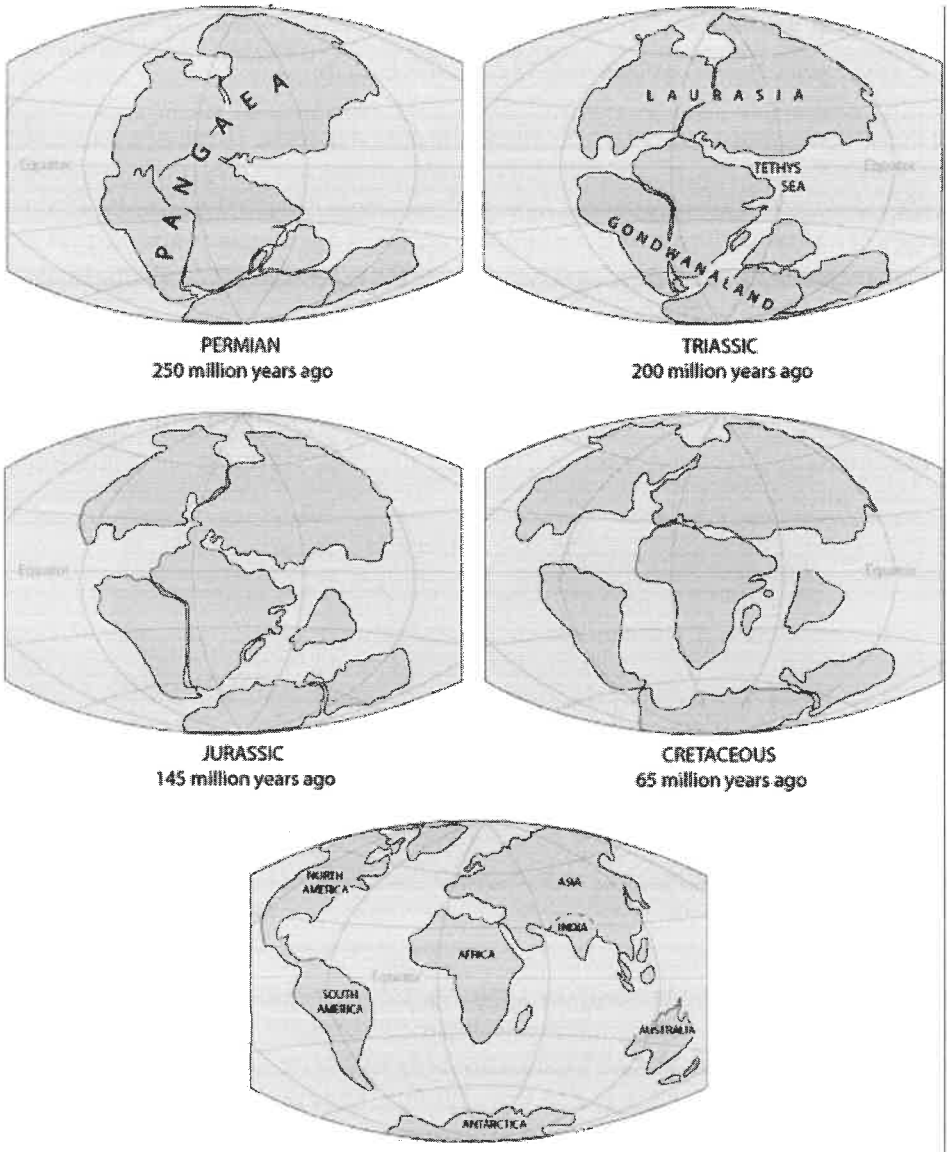


Figure 2.9 Pangea to present

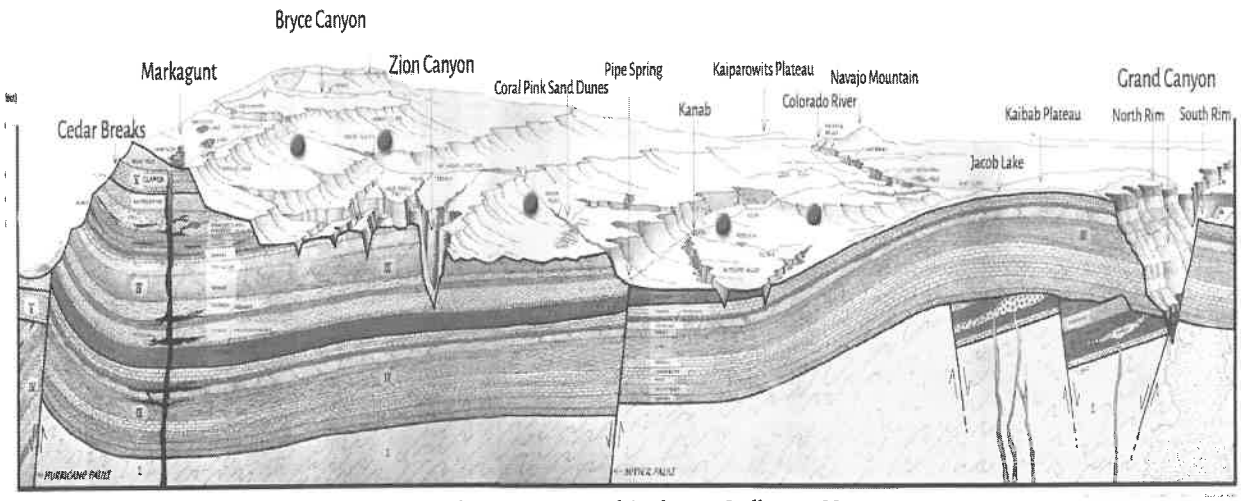


Figure 2.10 Grand Staircase Sediment Map

If you look at the map below, you can see the loss and gain of land on Louisiana's coast. It helps in understanding how geological processes and human activity have changed Louisiana's coast.

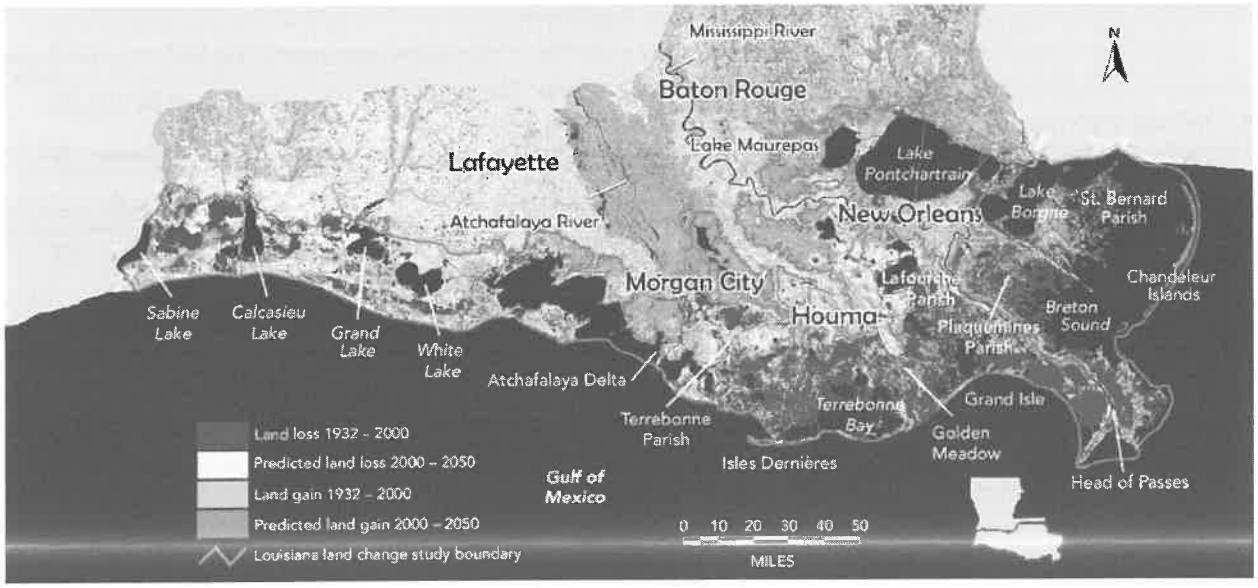


Figure 2.11 Coastal Change

The map below shows the different layers of the Earth and the fossils found within them. It shows not only an Earth process but the history of living things during each period.

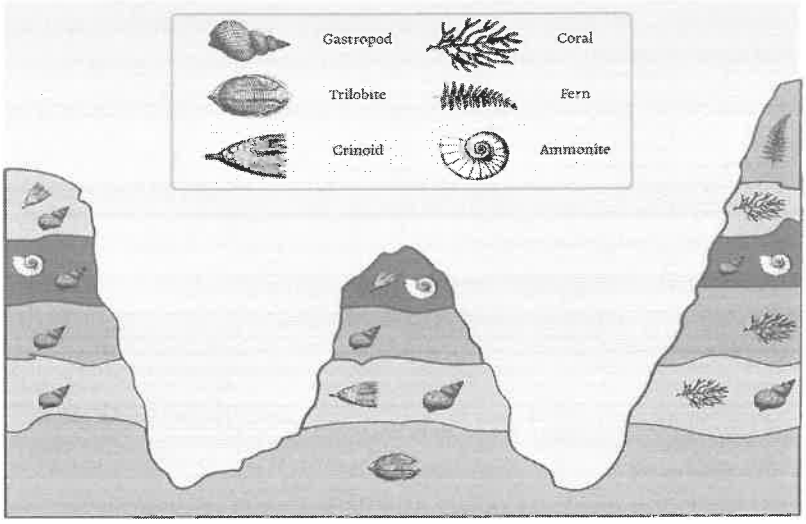


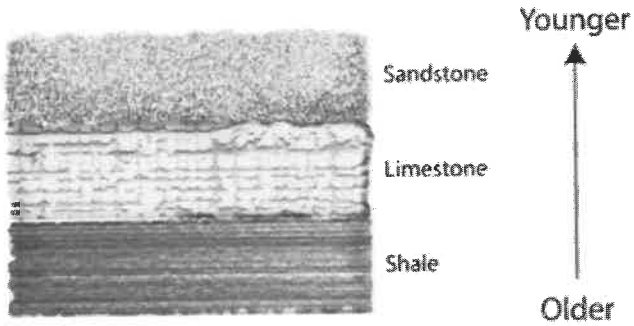
Figure 2.12 Fossil Layers

Practice 1: Earth Over Time

1. Which statement **best** describes a preserved fossil?
   - **A** a fossil that is preserved between mud layers
   - **B** a fossil that is preserved in amber
   - **C** a fossil formed when the mud has hardened to stone
   - **D** a fossil formed when sand or mud forms a mold

2. Which event listed below does not usually lead to fossil formation?
   - **A** flood
   - **B** forest fire
   - **C** earthquake
   - **D** mudslide

3. What statement is true of the Law of Superposition?
   - **A** Each layer of sedimentary rock is younger than the unit above it.
   - **B** Each layer of sedimentary rock is older than the unit above it.
   - **C** Each layer of sedimentary rock is the same age.
   - **D** The oldest layer of sedimentary rock is the top layer.



4. Based on the picture above, which layer of soil is the oldest?
   - **A** limestone
   - **B** sandstone
   - **C** shale
   - **D** both limestone and shale

Chapter 2 Key Term Activity

Fill in the blank with the correct word.

Word Bank

Index fossil	Fossils
Sediment	Law of Superposition
Ash deposition	

The earth is very old. One of the ways we can tell the age of the Earth is from 1. _____.

Fossils are found in 2. _____. The 3. _____ states the older layers of rock are on the bottom. If a certain species only lived for a short time, it is

a(n) 4. _____. Many events can cause the formation of fossils. A volcano can form

fossils through 5. _____.

Key terms are defined in the book's glossary. Answers to Key Term Activities are found in the Teacher's Guide.