ROCK LAYERS

differentiated passages

LEXILE

780L

Name: _____ Date: _____

Rock Layers

Earth gives us clues about its history in its rock layers, or **strata**. There are three types of rocks found on Earth. **Igneous rocks** are made when molten rock cools and turns to a solid. **Metamorphic rocks** are the result of existing rocks being changed by heat, pressure, mineral-rich fluids, or a combination of these. **Sedimentary rocks** are formed from pieces of rock that are loosened by weathering. These pieces, or **sediments**, get buried deeply, creating layers like a cake. These layers get pressed together. They become cemented into larger rocks. Most of the rocks at the surface of Earth are sedimentary.

Each layer of sedimentary rock is a different color in this photograph

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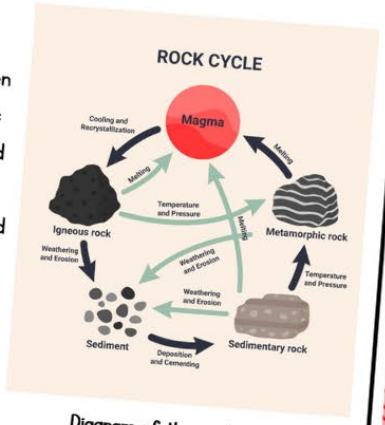
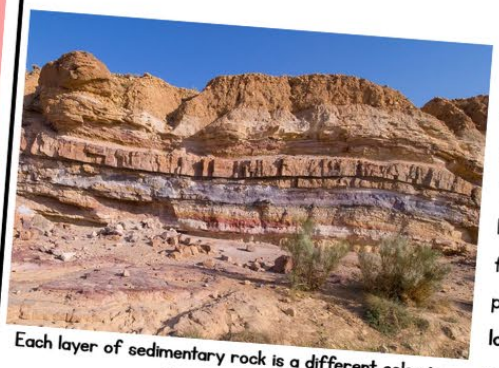


Diagram of the rock cycle.



Each layer of sedimentary rock is a different color in this photograph

Fossils are often found in sedimentary rock layers. The layers at the bottom are the oldest while the ones closer to the surface are the youngest. Thinking about cake again, the bottom layer goes down first then frosting or filling is added. A new layer of cake is placed on top of that. This is called the **law of superposition**, and it allows scientists to figure out the age of
rock layers. The fossils in the
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periods. The fossils can be compared to what an area is like more recently and
Earth has changed over time.

Mag CORE

4th Grade NGSS 4-ESS1-1

ABOUT LEXILE LEVELS

MagiCore Learning, LLC is a certified Lexile® Partner. These texts are officially measured and approved by Lexile and MetaMetrics® to ensure appropriate rigor and differentiation for students.

The Lexile Framework® for Reading measures are scientific, quantitative text levels. When the Lexile of a text is measured, specific, measurable attributes of the text are considered, including, but not limited to, word frequency, sentence length, and text cohesion. These are difficult attributes for humans to evaluate, so a computer measures them.

Common Core State Standards uses Lexile level bands as one measure of text complexity. Text complexity ranges ensure students are college and career ready by the end of 12th grade. Lexile measures help educators scaffold and differentiate instruction as well as monitor reading growth.

Grade Band	Lexile® Bands Aligned to Common Core Expectations
K-1	N/A
2-3	420L-820L
4-5	740L-1010L
6-8	1185L-1385L

Keep in mind when using any leveled text that many students will need scaffolding and support to reach text at the high end of their grade band. According to Appendix A of the Common Core Standards, "It is important to recognize that scaffolding often is entirely appropriate. The expectation that scaffolding will occur with particularly challenging texts is built into the Standards' grade-by-grade text complexity expectations, for example. The general movement, however, should be toward decreasing scaffolding and increasing independence both within and across the text complexity bands defined in the Standards."

Evidence from Rock Layers

4th grade

Table of Contents

Each passage set includes two differentiated passages on a fourth-grade level (one at the beginning of the band, one towards the end) and a question set geared towards comprehension and science mastery. The first question is differentiated to include a fill-in-the-blank diagram (lower complexity) or an open-ended diagram (higher complexity).

How to Use This Resource

This resource was created with the NGSS Science Standards in mind. It includes six differentiated passages aligned to the following standard:

4-ESSI-I: Evidence from Rock Layers

Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.

Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.

Here are some suggestions for using these passages:

- Use as independent work after you have taught an overview of this standard. Assign the different levels based on the passage students can read and comprehend independently.
- Use as a reading center to reinforce key comprehension and science concepts at the same time!
- Use as a homework or review packet.
- Use as an intervention for students who need to revisit science concepts.

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Name: _____ Date: _____

Rock Layers

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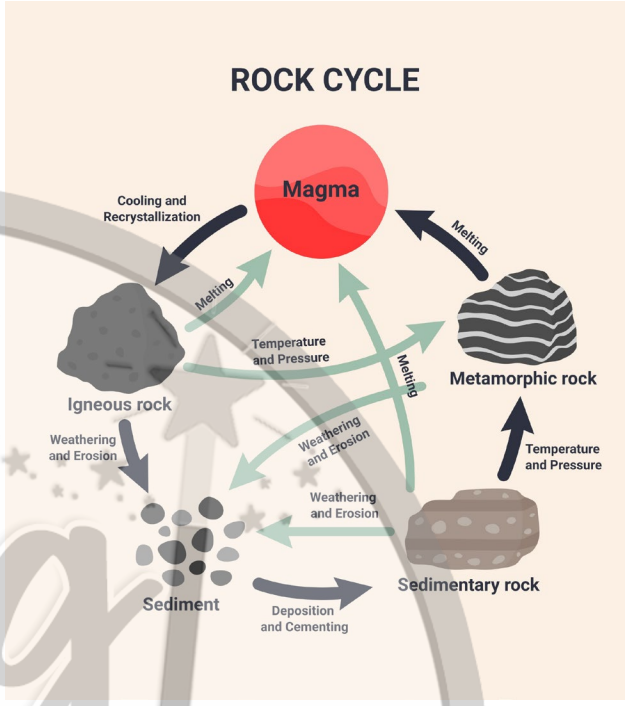

Diagram of the rock cycle.

Each layer of sedimentary rock is a different color in this photograph

Fossils are often found in sedimentary rock layers. The layers at the bottom are the oldest. The ones closer to the surface are the youngest. Think about cake again. The bottom layer goes down first then frosting or filling is added. A new layer of cake is placed on top of that. This is called the **law of superposition**. It allows scientists to figure out the age of the rock layers. The fossils in the layers provide evidence about the plant and animal life that existed on Earth during different time periods. The fossils can be compared to what an area is like more recently. They show us how Earth has changed over time.

Visible fault lines in rock layers.

Rock layers are made in an organized way. Rocks are originally laid down horizontally when they get deposited from above. Picture cake batter being poured into a pan. See it spread out into an even layer. This is called the **law of original horizontality**. Sometimes scientists find rock layers that are not horizontal. The layers have all been shifted. The shift creates a break in the horizontal pattern. This tells scientists that some event happened to disrupt the layers. Examples of events that can affect original horizontality are an earthquake along a **fault line** or mountains building from shifting **continental plates**. Layers that are not horizontal tell a story. They help scientists figure out what was happening long ago.

Paying attention to layers of rock found on Earth allows humans to learn more about the planet's past. As scientists continue to study rock layers, more of Earth's secrets are revealed.

Rock Layers Questions

1. Use the chart below to name and define the main types of rocks presented in the text.

Type of Rock	Definition
Igneous	
	Made when existing rocks are changed by heat, pressure, mineral-rich fluids
Sedimentary	

2. Which of the following are events that can affect original horizontality? (choose all that apply)
   a. Heavy rain
   b. Earthquakes
   c. Tsunamis
   d. Mountains shifting

3. Look at the image from the article again. Imagine scientists found fossils at point A and at point B. Which fossils would be older? Use text evidence in your answer.

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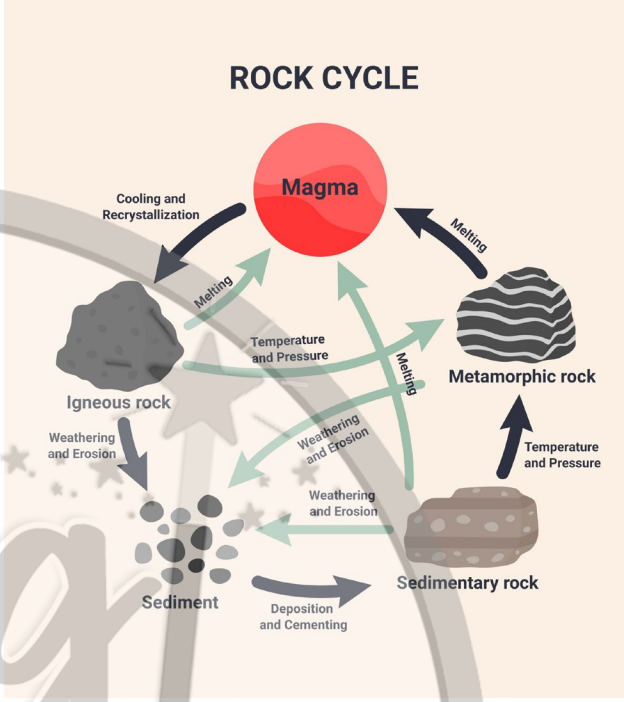

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Name: _____ Date: _____

Cliffs at Whanganui

Whanganui is a city in New Zealand near the mouth of the Whanganui River. There are coastal cliffs to the west of this city. They span a distance of 85 kilometers between Whanganui and Hāwera, another town on New Zealand's North Island. The layers of these cliffs are made of **sedimentary rock** ranging in age from 3.5 million to 700,000 years old. Scientists have studied the layers that make the cliffs. They are the most complete sequence of rocks on land of this age in the world.

View of the cliffs from the water.

The cliffs at Whanganui are full of fossils which help scientists find the age of the rock layers. The fossils give clues about the landscape at the time the rock layers were formed. The layers at the bottom of the cliffs are the oldest. The ones at the top are more recently made. Shifting **tectonic plates** have tilted the rock layers slightly so they are not perfectly horizontal.

Huge fossilized oyster shells found in this area.

Fossils are easy to spot in this region. Many of them are fossils from the same species that are alive today. This tells scientists what kind of environment was in this area in the past. One of the most common fossils found here belongs to a species of **extinct** oyster. With shells that are silvery-gray, smooth, and circular in shape, they are clearly not modern oysters. Instead, these huge oysters were around about 2.5 million years ago.

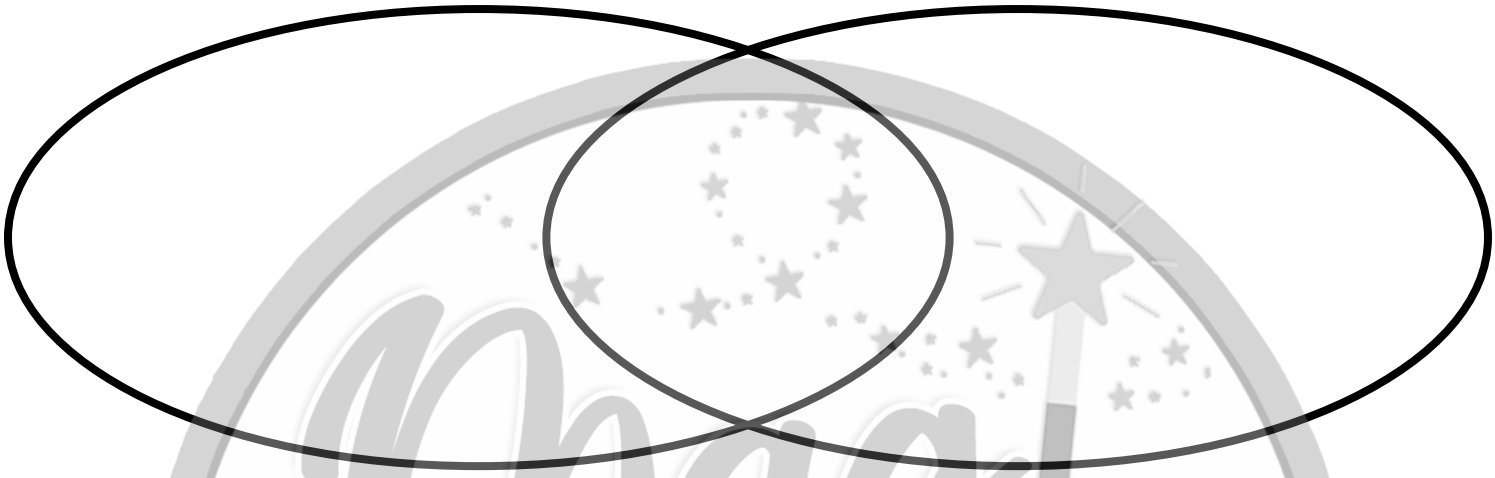
Scallop shells are another fossil often found near the Whanganui cliffs. Again, observing the shells closely reveals differences from scallops that still exist today. These scallop shells from the past, preserved as fossils, are boxier in shape and are less than a million years old.

Fossilized sand dollars are yet another example of fossils these New Zealand cliffs contain. They are noticeable with their circular shape, but their hardness and heavier weight are clues they are older than the lightweight and easily breakable sand dollars of today.

By studying the cliffs at Whanganui, scientists are able to add to their knowledge about planet Earth. The cliffs offer a peek into the past with their interesting rock layers.

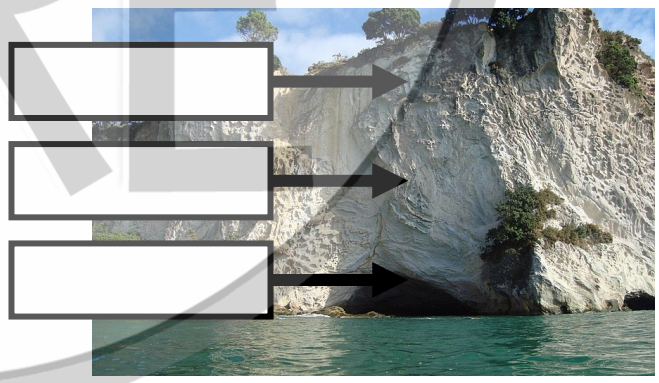
Cliffs at Whanganui Questions

1. The article describes several kinds of fossils found in this location. Each of the fossils described is related to an organism still found in the area. Use the Venn diagram to compare and contrast the fossils with today's organisms.



2. How can scientists tell that the fossils mentioned in the article are of animals that have gone through changes to become the animals that live there now?
   a. They are similar but different in size, shape, and appearance.
   b. They are found in a different area than the animals that live there now.
   c. They do not resemble the current animals in any way.
   d. They are all much smaller than the animals living today.

3. Look at the image from the text again. Number the boxes 1, 2, and 3 with 1 being the oldest layer and 3 being the newest layer.



4. The fossils described in this article are all of sea creatures. Which of the following is more likely a true statement? Explain how you know.
   a. The cliffs were once underwater
   b. The cliffs have always been dry land

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Badlands National Park

Badlands National Park in South Dakota

Badlands National Park is located near the Black Hills of South Dakota. The area is known for its **geological** formations called **buttes**. Buttes are craggy, steep hills. These hills are made of colorful layers of **sedimentary rock**. They include white volcanic ash, orange iron oxide, gray and tan mixtures of silt, clay, ash, and purple oxidized manganese. There aren't many plants on these rocky layers, but grasslands surround them. This land has harsh temperatures. There is little water. The **terrain** is tough. The Lakota Native Americans named it *mako sica*, or "bad lands," for these reasons.

Ocean water covered the Badlands in the past. The water retreated. That action left **sediment** behind. Wind, rain, and water flowing from the Black Hills **eroded** these bits of rock half a million years ago. Buttes, **valleys**, and rock towers called **pinnacles** were created. This erosion is still happening today. This causes the Badlands to lose one inch every year. **Geologists** believe that the Badlands will be completely gone after another half a million years.

A sign explaining rock layers in the Badlands.

How do scientists know the Badlands were once full of water? What led them to believe saber tooth cats once lived in the area? The answer is fossils. **Marine** and **terrestrial** creatures are buried in the layers of rock. Fossils are found in two major formations in the Badlands. The Chadron is one area. It is made of sedimentary rock between 34 and 37 million years ago. The climate of South Dakota at that time was **subtropical**. It was much warmer than it is today. Fossils tell us animals such as crocodiles and a now-extinct rhino lived in the area.

Fossilized rabbit found in the Brule formation.

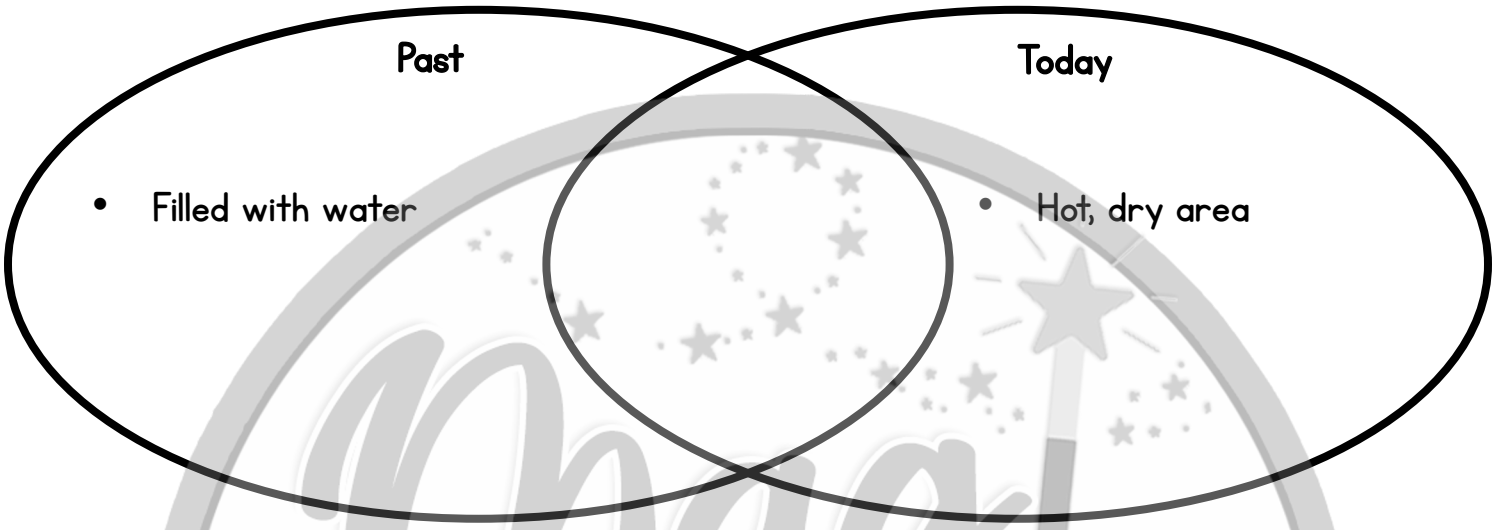
The second rock formation filled with fossils is the Brule. These layers of sedimentary rock were formed between 29 and 34 million years ago. The rock layers here are thin. They tell scientists the climate had changed to something cooler and drier. This caused water to be harder to find. Some animals died out. Fossil remains show that different animals such as camels and rabbits lived in the Badlands at that time. The most complete collection of mammal fossils is found in the Brule formation.

Another formation, the Sharps, is above the Brule. This makes it a younger rock layer. It was formed 25 to 30 million years ago. It creates the more rugged peaks and canyons of the Badlands. This layer includes volcanic ash. The ash gives scientists evidence that volcanoes once erupted in the Great Basin. Sandstone river channels in the Sharps formation also show that the climate was still growing cooler and drier.

Badlands National Park provides interesting information about the planet's past conditions and the creatures that roamed the land. There is much to be learned from studying rock layers and the fossils that hide there.

Badlands National Park Questions

1. Use the Venn diagram below to compare and contrast the environment in the badlands in the past with the environment today.



2. Use the chart below to describe what is found in each section of Badlands National Park.

The Chadron	
The Brule	
The Sharps	

3. Why are people concerned about the erosion still happening in the badlands today?

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Topanga Canyon Formation

California is home to the Santa Monica Mountains, a young mountain range at just 4 million years old. These mountains were formed by the movement of **tectonic plates**. The Pacific Plate travels northwest, and the North American Plate moves southwest. A chunk of the Pacific Plate broke off in a block. It rotated clockwise about 120 degrees from the coast and gave the Santa Monica Mountains their rare east-west spread. The ancient sea floor rose to the top of the mountains as the plates pushed against each other, exposing volcanoes.

The Santa Monica Mountains are part of the Transverse Ranges. You can see them here, at the bottom near the ocean.

Topanga Canyon

The Topanga Canyon Formation is part of the Santa Monica Mountain range. This formation was created about 20 million years ago. It has many **marine** fossils, providing evidence that the area was once covered by the ocean. The Topanga Canyon Formation's color ranges from yellowish-brown to orange, and it was once a beach. Waves disturbed the sand which then settled and made sandstone. This formation's rocky layers are mostly sandstone with some shale.

The most common fossils found are turritella shells.

The fossils found in the Topanga Canyon Formation include **gastropods**, fish, and shells. Fossils of mammals such as sea lions and whales have also been uncovered. These fossils range in age from the Late Jurassic to Pleistocene periods. Ice Age mammal fossils have been discovered here as well such as mammoths and giant land sloths. A Miocene-era sea bird with teeth and a wingspan of over 15 feet was found, too. Some of these fossils are actual body parts such as complete shells or bones. These are called **body fossils**. **Mold fossils** which are impressions that have been left behind in the rock from plant and animal parts are a type of fossil also found in the Topanga Canyon Formation.

Many of the important fossil sites are protected by the Santa Monica Mountains National Recreation Area. They are still vulnerable to **erosion** though. Fossils that have existed for millions of years can be erased when wind and rain wear them down over time. Though some fossils may be lost, there have been many amazing discoveries in Topanga Canyon Formation. There are also fossils still to be found.

Topanga Canyon Formation Questions

1. Why is the location of the Santa Monica Mountains significant? Use evidence from the text and map to support your answer.

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2. Write 2 pieces of text evidence from the article that support the following claim:

The area that is now the Topanga Canyon formation in the Santa Monica mountains was once covered by ocean.

1. _____

_____

2. _____

_____

2. Use this sentence from the text to answer the questions below:

"A Miocene-era sea bird with teeth and a wingspan of over 15 feet was found too."

What is an example of a body fossil that could have been found?

_____

What is an example of a mold fossil that could have been found?

_____

3. Why are the fossil sites here protected by the Santa Monica Mountains National Recreation Area?

a. This is the only place scientists have found ice-age era fossils.
b. The fossils are vulnerable to erosion and could be lost.
c. A special type of fossil called mold fossils is found here.
d. The mountains have a rare east-west spread.

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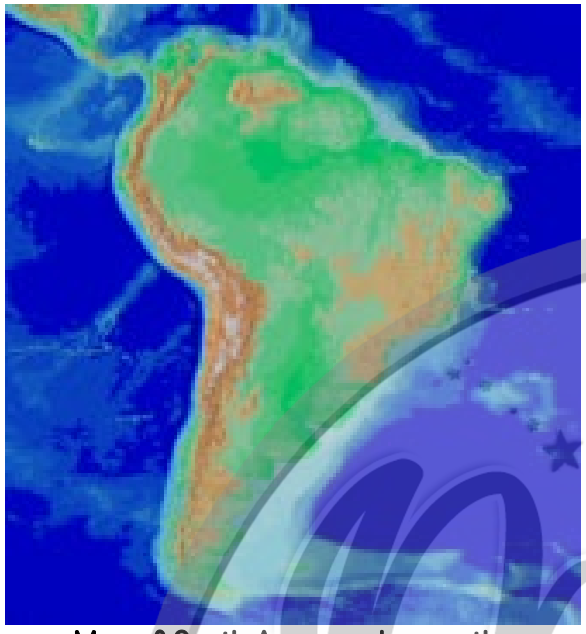
Andes Mountains Fossils



Map of South America showing the Andes Mountains in brown.

The Andes Mountains border the western side of South America. They are the world's largest mountain range at about 5,500 miles long. This mountain range runs through seven countries. Some of those countries are Venezuela, Bolivia, and Chile. The Andes have some of the highest peaks in the Western Hemisphere. Mount Aconcagua is the highest. It is over 22,000 feet tall. These mountains were formed by shifting **tectonic plates**. This caused the land to rise when the plates pushed against each other. The Andes are over 50 million years old. They are really a collection of mountain chains.

The dark colored layer at the bottom is made of deep seafloor deposits.

Mountain ranges often have fossils buried in their rock layers. The Andes Mountains have fossils, too. Scientists like to study these fossils. They give clues about how climate change affected species of the past. One scientist found a fossil from a tortoise. It was nearly five feet long. This fossil suggests that a high plain area of the Andes Mountains was less than a mile above sea level about 13 million years ago. Other shell fossils show that smaller, **aquatic** turtles were in the area, as well. These turtle fossils give more support about the new sea level estimates, too. It was thought the Andes were higher above sea level before these fossils were found.

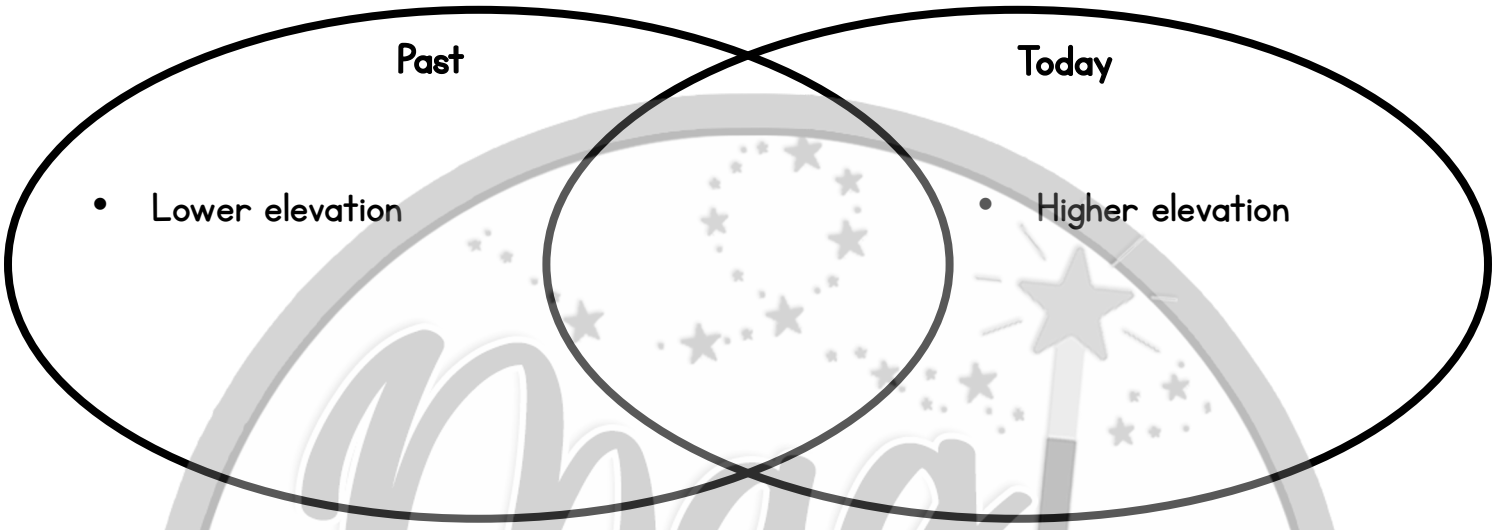
The tortoise and turtle fossils also show that the climate of the Andes was warmer in the past. It was also wetter. This is because the mountains were at a lower **elevation**. Similar reptiles are found today in tropical South America. The climate had to have been tropical in the past for the fossilized **specimen** to have lived there. The ancient tortoise and turtle wouldn't have been able to live at higher elevations. It would have been too cold. Fossilized leaves and a large snake fossil were also found in the Andes. These support the idea of warmer temperatures with more precipitation as well.

Turtle shell fossil found in the Andes Mountains.

Scientists like to study fossils not to just learn about the past. They use them to help understand the future as well. The more we learn about climate changes long ago, the more we may be able to make models of what to expect next. The Andes Mountains have given us a peek into the past. This peek allows scientists to get closer to the truth.

Andes Mountains Fossils Questions

1. Use the Venn diagram below to compare and contrast the Andes Mountains of long ago with their environment today.



2. Explain how the discovery of a tortoise fossil changed what scientists thought about the Andes Mountains.

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3. Read the facts below. Then, based on the information in the article, which plant fossil would more likely be found with the ancient turtle and tortoise shells?

   A) Aspen trees are tall, narrow trees with gray or white bark that prefer to live in cooler climates with high elevations.

   B) Seaweed is the common name for many types of algae that grow in oceans, rivers, lakes, and other bodies of water.

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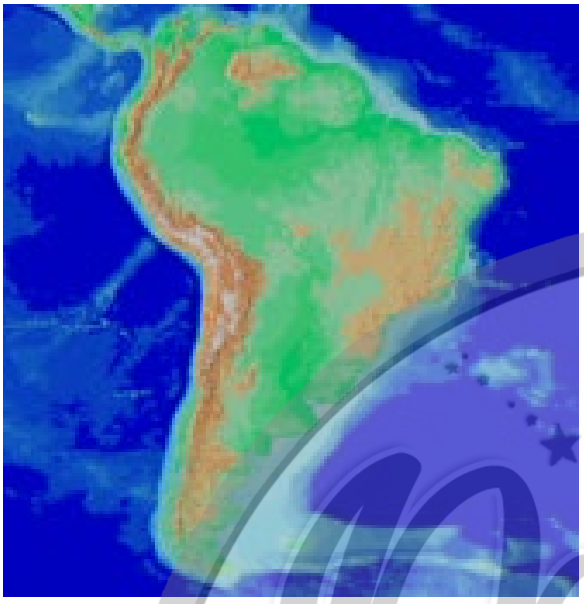
Andes Mountains Fossils



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The dark colored layer at the bottom is made of deep seafloor deposits.

Mountain ranges often have fossils buried in their rock layers. The Andes Mountains are no exception. Scientists like to study these fossils because they give clues about how climate change affected species of the past. One scientist found a fossil from a tortoise that was nearly five feet long. This fossil suggests that a high plain area of the Andes Mountains was less than a mile above sea level about 13 million years ago. Other shell fossils show that smaller, **aquatic** turtles were in the area as well. These turtle fossils give more support about the new sea level estimates, too. It was thought the Andes were higher above sea level before these fossils were found.

The tortoise and turtle fossils also show that the climate of the Andes was warmer and wetter in the past. This is because they were at a lower **elevation**. Similar cold-blooded reptiles are found today in tropical South America. In order for the fossilized **specimen** to have lived there, the climate had to have been tropical, as well. The ancient tortoise and turtle wouldn't have been able to live at higher elevations because it would have been too cold. Fossilized leaves and a large snake fossil were also found in the Andes support the idea of warmer temperatures with more precipitation.

Turtle shell fossil found in the Andes Mountains.

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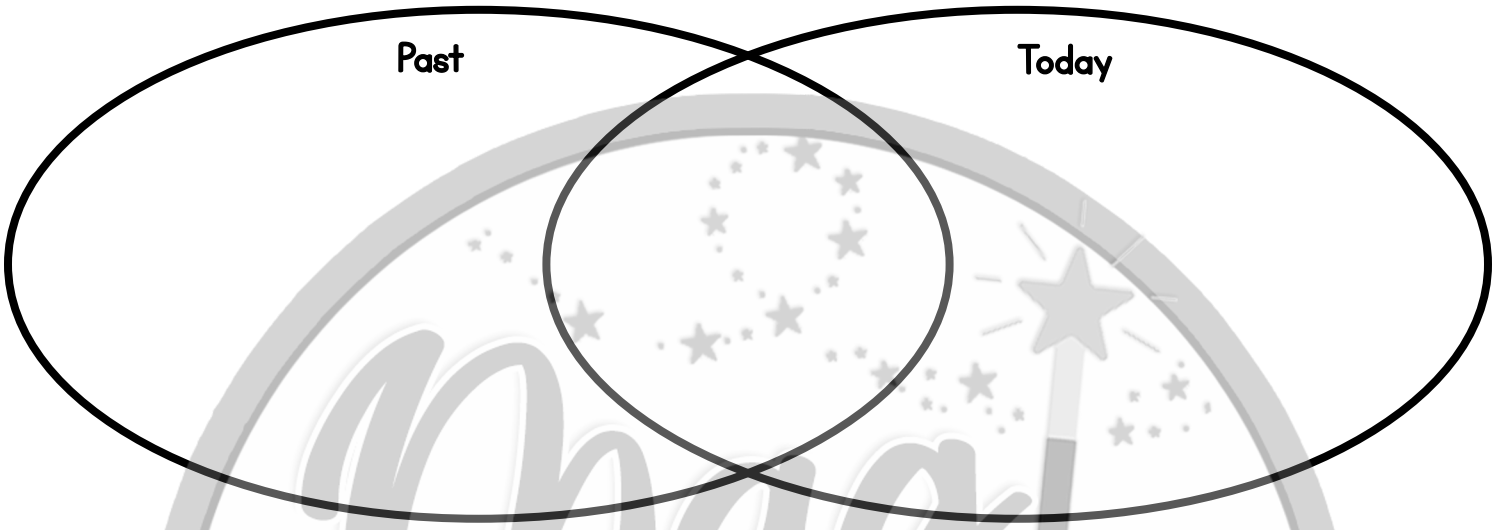

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