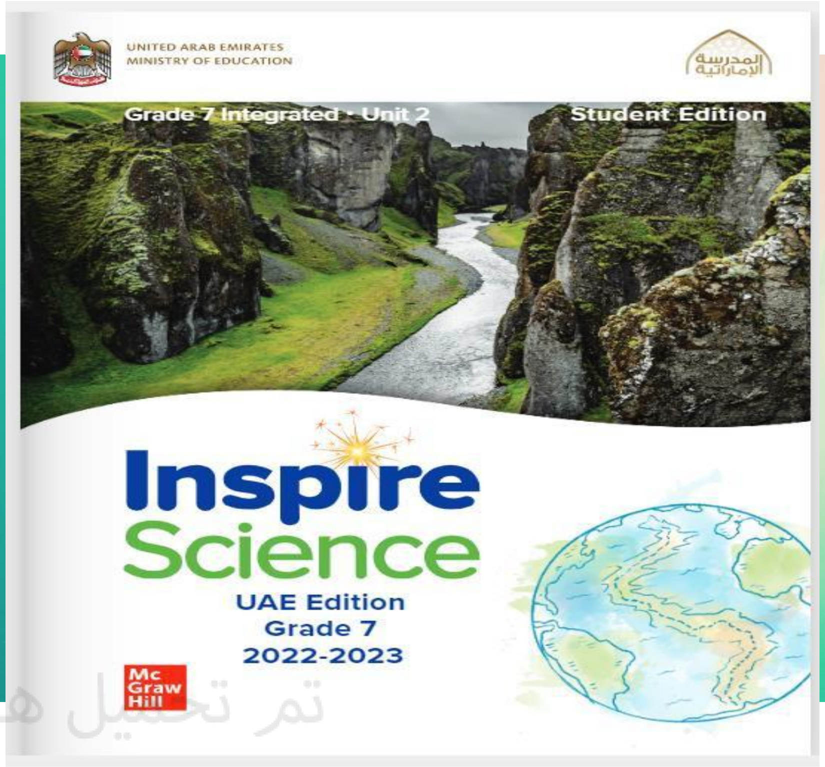
الملف تجميعة أسئلة وفق الهيكل الوزاري الجديد انسباير



EOT 3 EXAM

GRADE 7 Science

PART 1 (MCQ)

Part 1 الجزء الأول	1	Conclude that continentals were once joined, from the evidence of matching coastlines of Africa and South America and how they can fit together like puzzle pieces	Textbook	7
	2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36
	3	Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults	Textbook, figures, 3D	52, 54
	4	Explain how ice is considered a weathring agents	Textbook, figures	87, 88
	5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171
	6	Compare between different magniteds of earthquake using Richter magnitude scale	Textbook, investigation, figure	142, 143

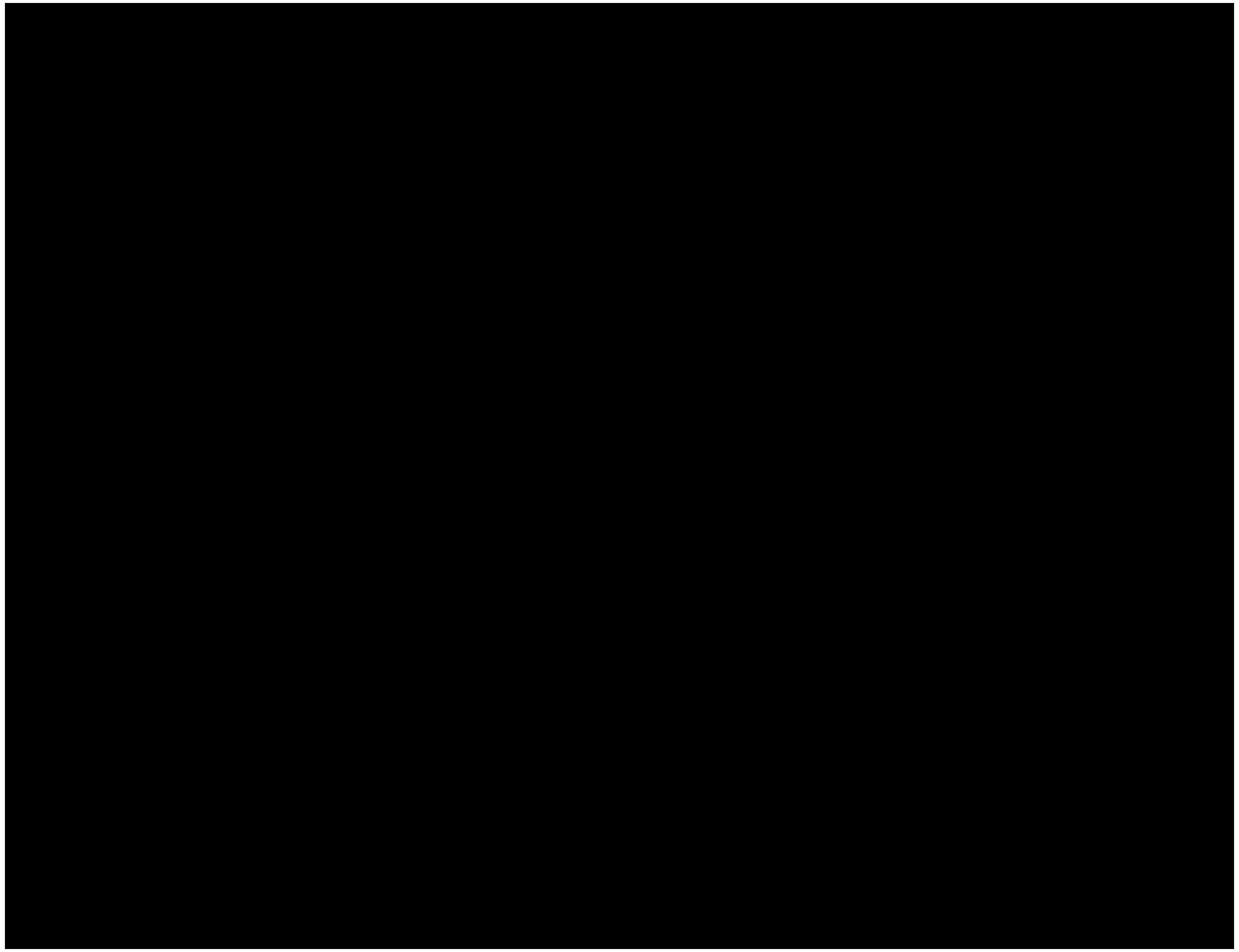
1	**Conclude that continentals were once joined, from the evidence of matching coastlines of Africa and South America and how they can fit together like puzzle pieces**	**Textbook**	**7**

ENCOUNTER THE PHENOMENON | Why do South America and Africa have matching coastlines?

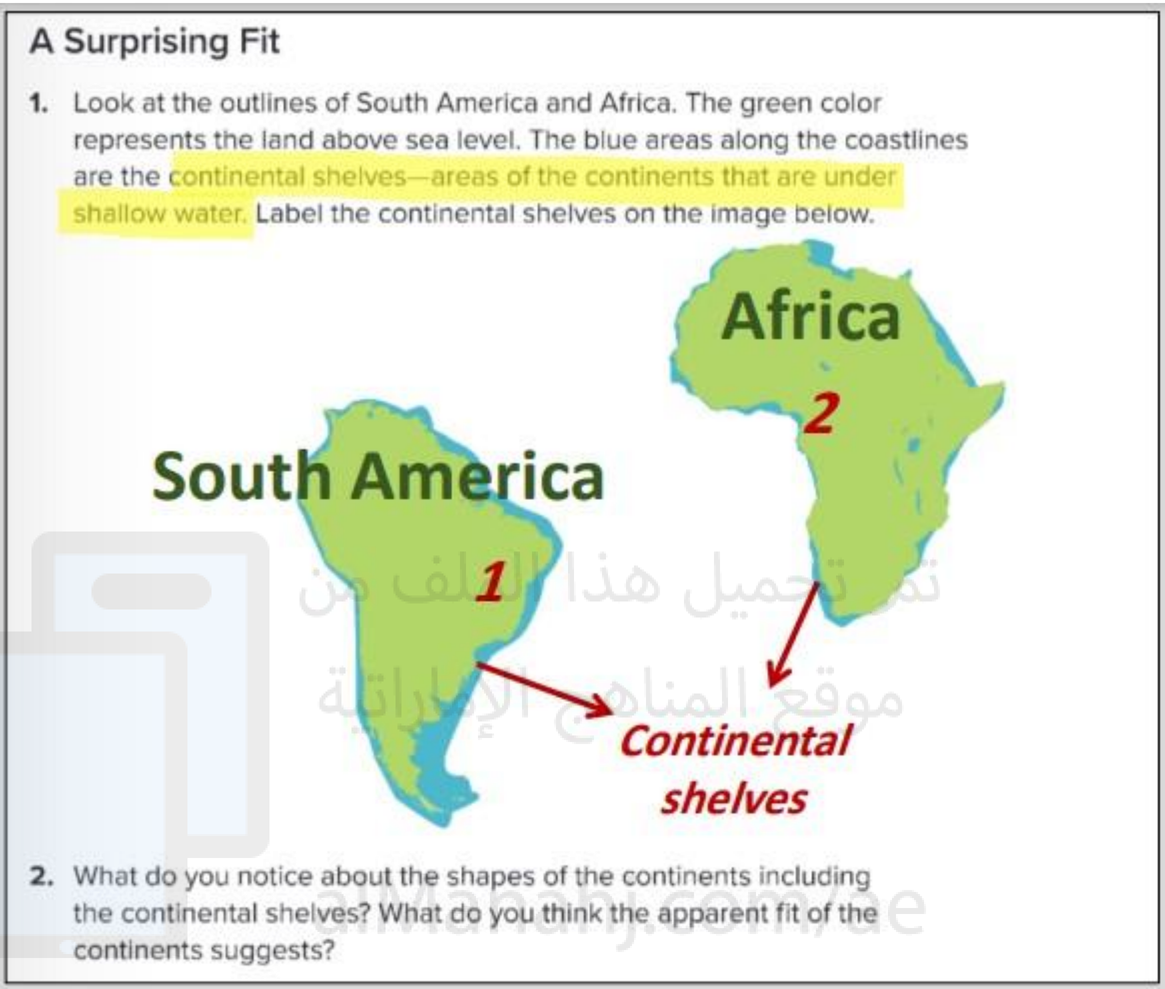
Africa and South America could fit together like pieces of a giant jigsaw puzzle. How do you use clues to put puzzle pieces together? Using scissors, cut a page from a magazine into a large irregular shape. Cut the piece of paper into at least 12 but not more than 20 pieces. Exchange your puzzle with a partner and try to fit the new puzzle pieces together. Make a list of the clues you used to put together your partner's puzzle.

1. align text (words, sizes of text, or fonts)
2. connect edges of photographs
3. connect regions of the same color
4. align shapes

GO ONLINE Watch the video *Moving Continents* to see this phenomenon in action.



1	**Conclude that continentals were once joined, from the evidence of matching coastlines of Africa and South America and how they can fit together like puzzle pieces**	**Textbook**	**7**



A Surprising Fit

1. Look at the outlines of South America and Africa. The green color represents the land above sea level. The blue areas along the coastlines are the continental shelves—areas of the continents that are under shallow water. Label the continental shelves on the image below.

2. What do you notice about the shapes of the continents including the continental shelves? What do you think the apparent fit of the continents suggests?

Coasts 1 and 2 fit together, which suggest that they were once joined in the past like pieces of puzzle.

Alfred Wegner noticed that the coastlines of Africa and South America matched.

- This was one evidence he used to support the Continental Drift Hypothesis.

1	Conclude that continentals were once joined, from the evidence of matching coastlines of Africa and South America and how they can fit together like puzzle pieces	Textbook	7

9) Point out two changes that occur between the 65 mya time period and the present.

65 Million Years Ago   Present

India has collided with Asia to form the Himalayas. Australia has separated from Antarctica.
A rift valley is forming in east Africa.

9) Why did Alfred Wegener believe that all of the continents once had been joined?

Explanation: the coastlines (edges) of the continents looked like they could fit together like the pieces of a puzzle

1) The presence of the same ______ on several continents supports the hypothesis of continental drift.

- **A)** fossils
- **B)** rocks
- **C)** neither a nor b
- **D)** both a and b

5) Matching _____ on different continents are evidence for continental drift.

- **A)** river systems
- **B)** rock structures
- **C)** weather patterns
- **D)** wind systems

7) Wegener believed that the continents were assembled as part of a supercontinent about _____ years ago.

- **A)** 250 million
- **B)** 350 million
- **C)** 450 million
- **D)** 550 million

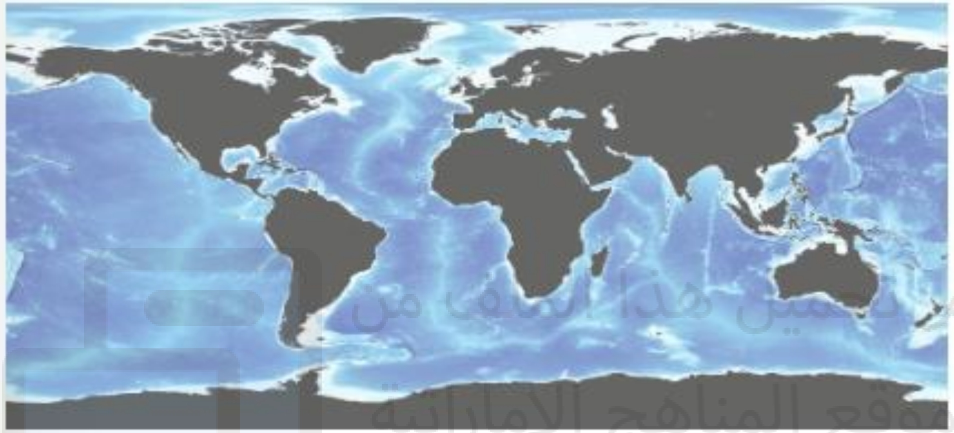
2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36

Ocean Floor Topography Once ocean depths were determined using sonar, scientists used these data to create a topographic map of the seafloor, much like you did in the *Simulating Sonar* lab. These new topographic maps uncovered a few surprising landforms. Let's dive in!

INVESTIGATION

Under the Sea

Examine the map below. The different colors indicate changes in water depths. Light blue indicates shallower depths; dark blue indicates deeper depths. The land regions are shaded in black.



1. Notice the light blue linear features that run along the ocean floors? These are vast mountain ranges deep below the ocean's surface called **mid-ocean ridges.** One such mountain range—the Mid-Atlantic Ridge—runs through the center of the Atlantic Ocean. Can you locate the Mid-Atlantic Ridge on the map above? Label it on the map.
2. The maps also revealed that underwater mountain chains had counterparts called ocean trenches. **Ocean trenches** are deep, underwater troughs on the seafloor. The Mariana Trench in the Pacific Ocean is the deepest landform on Earth. It is so deep it could fit Mount Everest with six Empire State buildings stacked on top! Can you identify an ocean trench on the map above? Label it on the map.
3. Return to the profile you created in the *Simulating Sonar* lab. Can you identify a mid-ocean ridge on your seafloor? Label it on your profile.

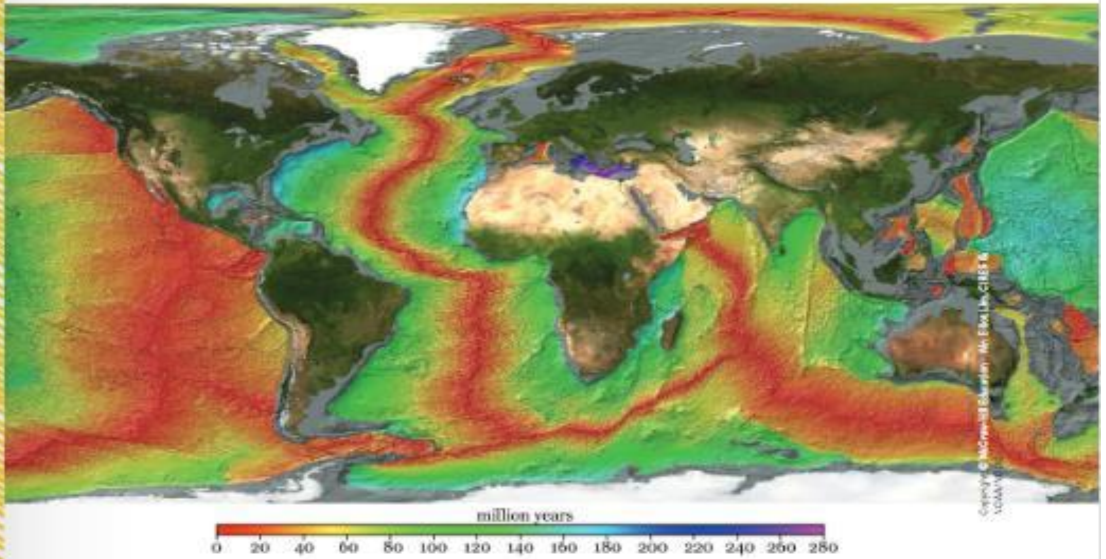
What pattern can be found on the seafloor?

Rock samples from the seafloor also revealed a surprise. Scientists were able to determine the age of the ocean floor and create isochron maps. An isochron is an imaginary line on a map that shows points that have the same age—that is, they formed at the same time. These isochron maps revealed an interesting pattern.

INVESTIGATION

Stripes on the Seafloor

Study the isochron map of the seafloor. Each colored band on this isochron map represents the age of that strip of crust.



1. What pattern do you observe?

Students should note that the colored bands are symmetrical on either side of a mid-ocean ridge.

2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36

Over billions of year, continents have moved great distances, collided, and spread apart. Tectonic plates move slowly, *only 1–9 cm per year.* But these plates have so much force to cause changes that:

Occur slowly:

Mountains

Valleys

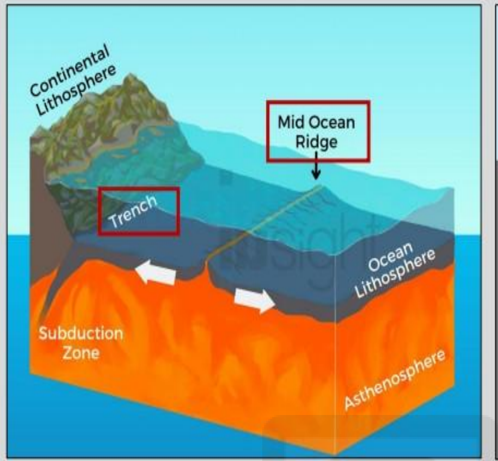
Occur quickly:

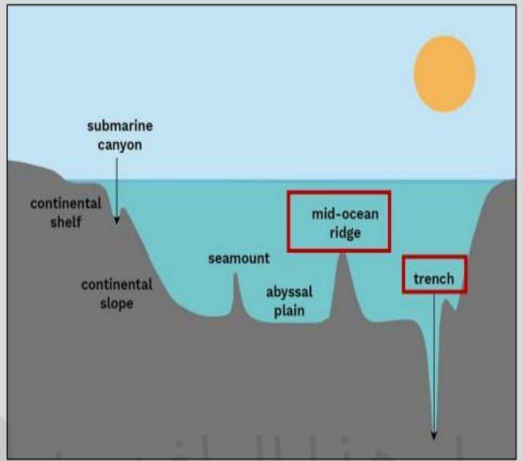
Volcanos

Earthquakes

2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36

Ocean floor topography





- **Mid Ocean Ridges:** are mountains ranges deep below the ocean's surface.
- **Ocean trenches:** are deep, underwater troughs on the sea floor.

Ocean floor topography

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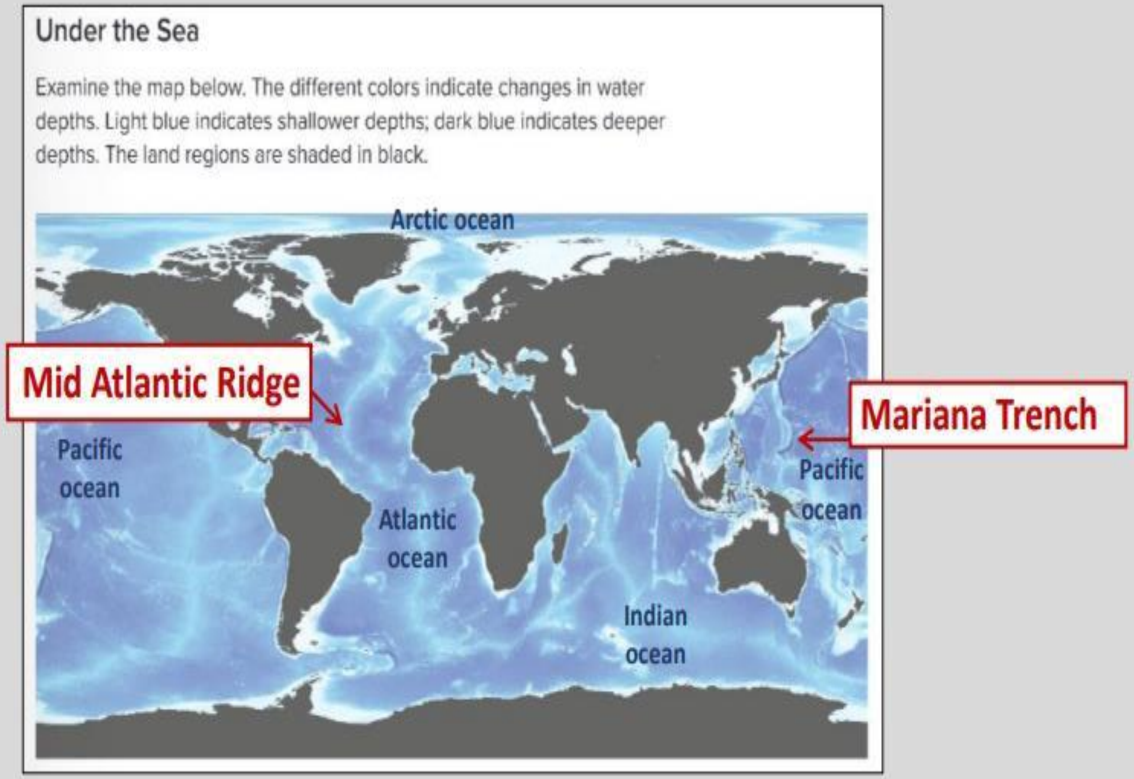
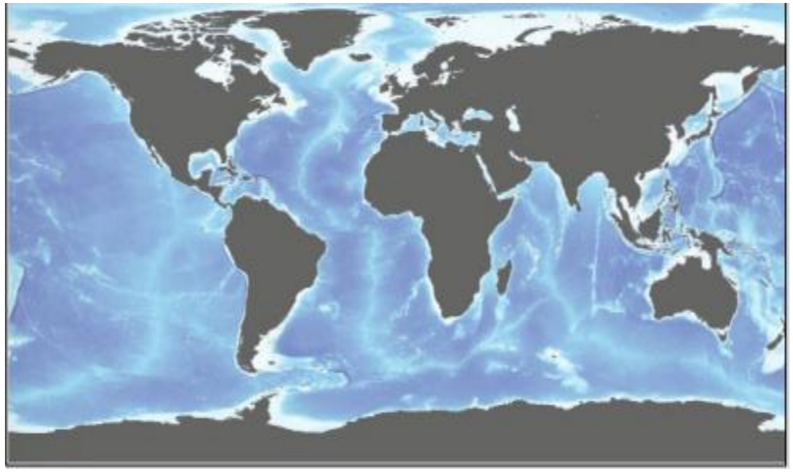
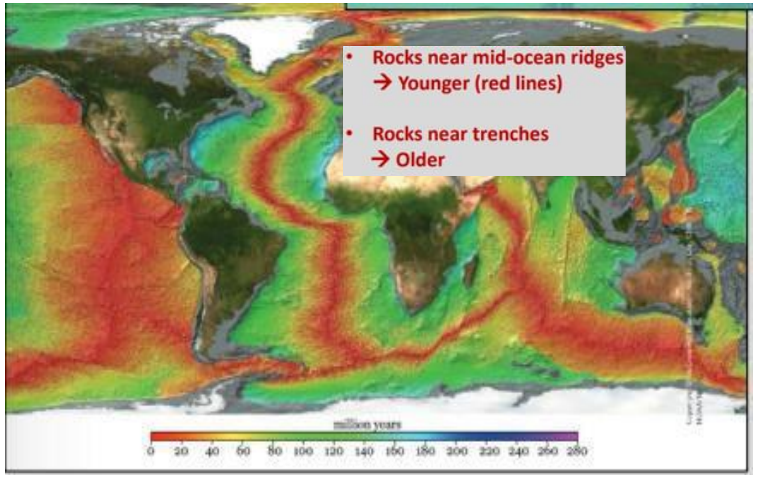


1. The mid Atlantic Ridge – runs through the center of the Atlantic ocean. Can you locate it?

2. The Mariana trench in the pacific ocean is the deepest landform on earth. Can you identify it on the map above?

2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36





A Topographic map

Used to show seafloor topography

Light blue shallower depths

Midocean ridge is where new oceanic floor is being made and are light blue

Vast mountain rages called **mid-ocean ridges**

Dark blue deeper depths

Ocean trench is where ocean floor is being destroyed and is darker blue in color.

Deepest landform on earth called the **Mariana Trench** in the pacific ocean

An Isochron map

Used to determine the age of the ocean floor

An isochron is an imaginary line on a map that shows point that have the same age

new rocks form at the midocean ridges.

older rocks get pushed out to ocean trenches where they destroyed.

Plate tectonics map

State that Earth's surface is made of rigid slabs of rock or plates that move with respect to each other

2	Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor	Textbook, investigation, 3D, figures	30, 32, 36

What is the theory of plate tectonics?

By the late 1960s, the concepts of continental drift and seafloor spreading led to a more complete theory called plate tectonics. The theory of **plate tectonics** states that Earth's surface is made of rigid slabs of rock, or plates, that move with respect to each other.

THREE-DIMENSIONAL THINKING

Analyze the tectonic plate map below. Compare this map with the topographic map in the *Under the Sea* investigation and the isochron map in the *Stripes on the Seafloor* investigation.

What **patterns** do you notice between the three maps? Using the concepts you've learned in this lesson, **construct an explanation** for these patterns in your Science Notebook.

Over billions of years, continents have moved great distances, collided, and spread apart. Tectonic plates move slowly, only 1–9 cm per year. But these massive plates have so much force they can build tall mountains, form deep valleys, and rip Earth's surface apart. Because tectonic plates move very slowly, most changes to Earth's surface take a long time. But some changes, like earthquakes and volcanic eruptions, occur very quickly and violently. You will learn about these changes in the following lesson.

COLLECT EVIDENCE

How is seafloor topography evidence of plate tectonics? Record your evidence (D) in the chart at the beginning of the lesson.

2) The youngest rocks on the ocean floor are located _____.

- **A)** near continents
- **B)** at mid-ocean ridges
- **C)** far from mid-ocean ridges
- **D)** near Asia

4) New ocean crust is continually formed at _____.

- **A)** mid-ocean ridges
- **B)** trenches
- **C)** subduction zones
- **D)** ocean basins

1) Ocean trenches are formed along lines where two plates <u>diverge</u> under the water.

- True
- False

2) Mid-ocean ridges are formed along lines where two plates <u>diverge</u> under the water.

- True
- False

2	**Analyze the ocean topographic map by identify, classify and interpret various features visible on the ocean floor**	**Textbook, investigation, 3D, figures**	**30, 32, 36**

5) A vast, underwater mountain chain is called a(n) __________.

- **A)** deep-sea trench
- **B)** oceanic crust
- **C)** ocean ridge
- **D)** ocean floor sediment

What are mid-ocean ridges?

answer choices

- Vast mountain ranges deep below the ocean's surface
- Deep underwater troughs on the seafloor
- The process by which new oceanic crust is continuously formed and destroyed
- molten rock below Earth's surface

What are ocean trenches?

answer choices

- Vast mountain ranges deep below the ocean's surface
- Deep underwater troughs on the seafloor
- The process by which new oceanic crust is continuously formed and destroyed
- molten rock below Earth's surface

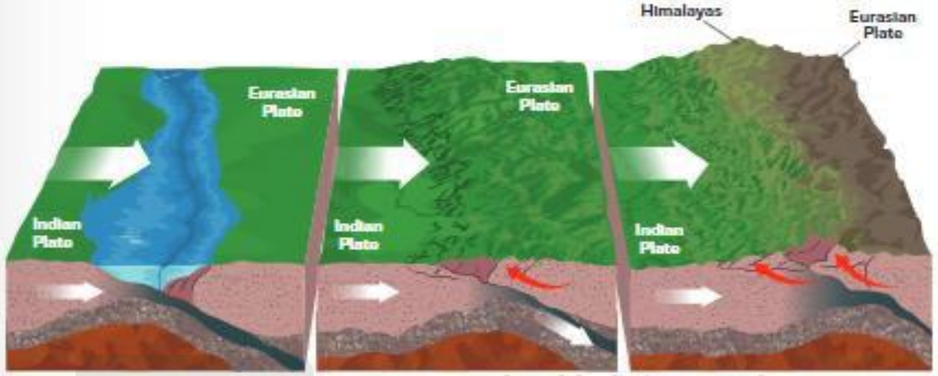
The Mariana Trench is the deepest landform on Earth

answer choices

- True
- False

3	Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults	Textbook, figures, 3D	52, 54

Fold Mountains As you just modeled in the *Fold Mountains* lab, squeezing—or compressional—forces can create mountains. When two continental plates collide at a convergent boundary large mountain ranges form. The tectonic plates are under extreme pressure and fold or crumple upward, forming fold mountains. But the mountains form slowly and in stages over millions of years. The Himalayas, for example, formed as the Indian Plate converged with the Eurasian Plate, as shown in the figure below. The Himalayas are the largest and highest mountain range in the world, and they are still growing!



The Andes are also an example of fold mountains. As the denser Nazca Plate collides with the South American Plate, it is forced under the South American Plate in a process called **subduction.** This causes the leading edge of the South American Plate to fold upward. The Andes, shown to the right, are the longest mountain range on Earth.

Not all of Earth's mountains are fold mountains. You have probably heard of faults. A **fault** is a break in Earth's crust along which movement occurs. What you might not be aware of is that faults can create mountains.

COLLECT EVIDENCE

How did the Andes form? Record your evidence (B) in the chart at the beginning of the lesson.

Analyze and Conclude

7. How does the thickness of the crust relate to the height of the mountains?

In general, as crust thickens mountains grow higher. Fault-block mountains are an exception to this rule.

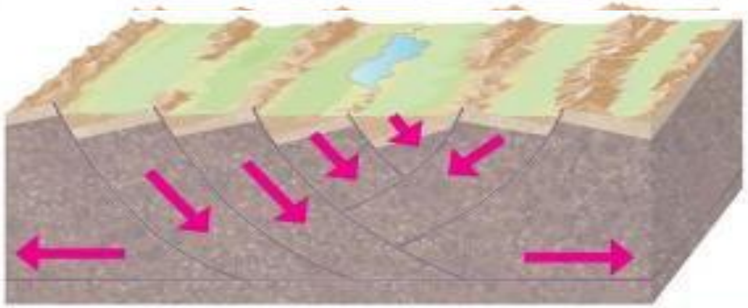
8. Make a claim about how you think fault-block mountains are produced. Use evidence from the experiment to support your claim.

Fault-block mountains form as tension pulls apart the crust. Gravity causes the "blocks" to slide over onto their side. The high parts that remain extending up are the mountains, and the low parts between the books are the valleys between the mountains.

Fault-Block Mountains Where plates move apart, tension stresses stretch Earth's crust. Sometimes tension stresses within a continent create mountains. As tension pulls crust apart, faults form. At the faults, some blocks of crust fall and the others rise. The Basin and Range Province in Nevada, Utah, California, Arizona, and northwestern Mexico consists of dozens of parallel fault-block mountains that are oriented north to south. The tension that created the mountains pulled in the east-west directions.

THREE-DIMENSIONAL THINKING

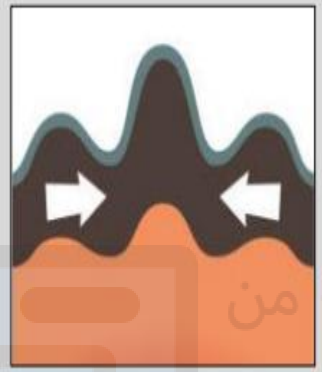
Draw arrows on the image below to **model** the **cause** of fault-block mountains and the movement of crust along the faults.

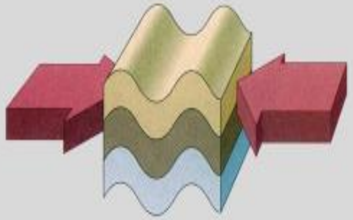


3	Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults	Textbook, figures, 3D	52, 54

Formation of large mountains

1. Fold mountains





Type of force: Compression

Two continental plates collide (convergent boundary)

↓

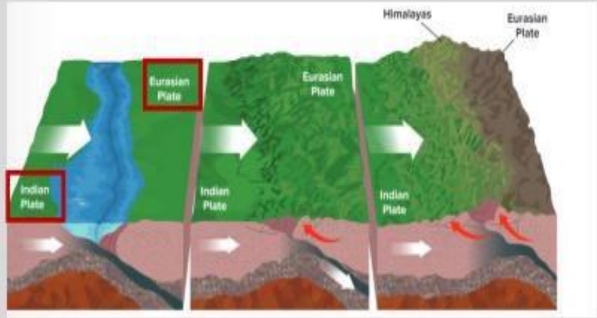
Plates become under high pressure and fold upward

↓

Fold mountains are formed

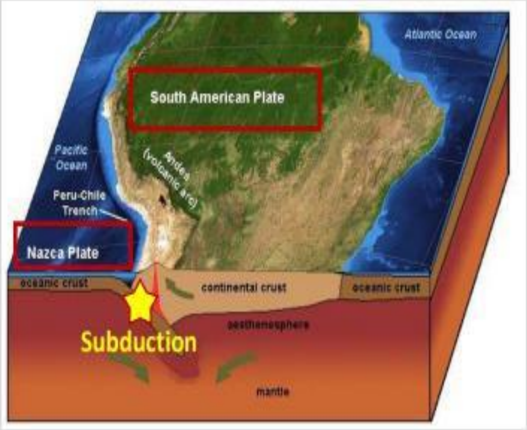
Formation of large mountains

Example 1 – The Himalayas (the highest mountains):



- ____Indian____ plate converged with ____Eurasian____ plate

Example 2 – The Andes (the longest mountains):



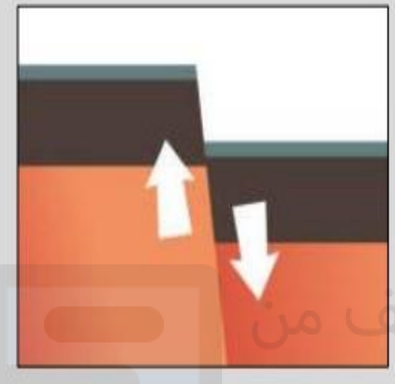
- ____Nazca____ plate converged with ____South America____ plate.
- Nazca plate forced under South America plate because it is ____denser____
- This process is called **subduction: A process in which one edge of one plate is forced below the edge of another**

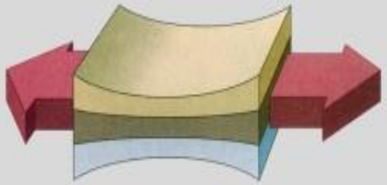
3	Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults	Textbook, figures, 3D	52, 54

Formation of large mountains

2. Fault-block mountains

Fault: is a break in earth's crust along which movement occurs.





Type of force: Tension

Plates move apart (divergent boundary)

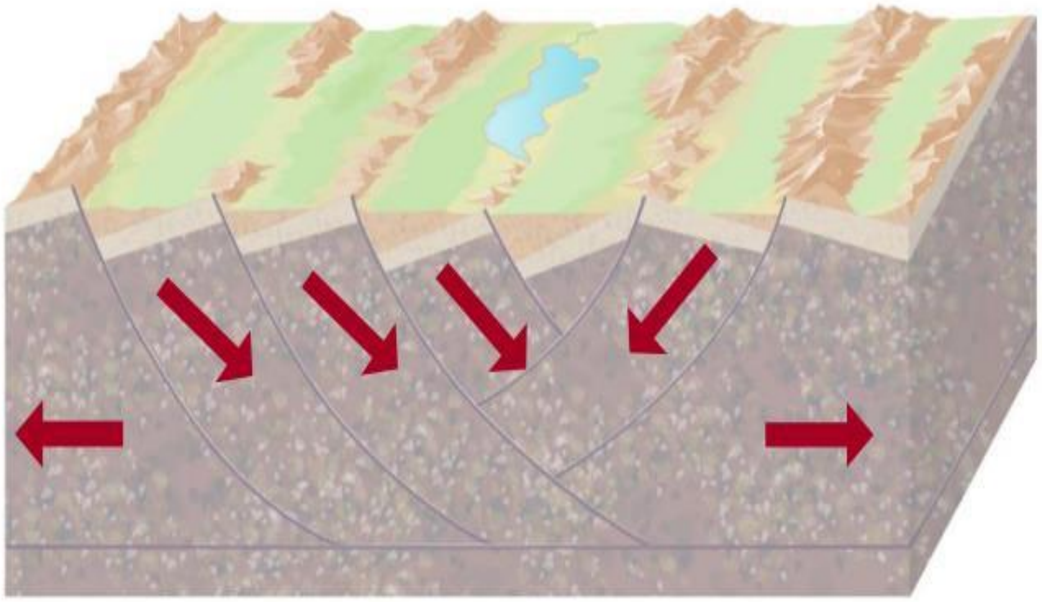
↓

Faults forms, some blocks of crust fall and others rise

↓

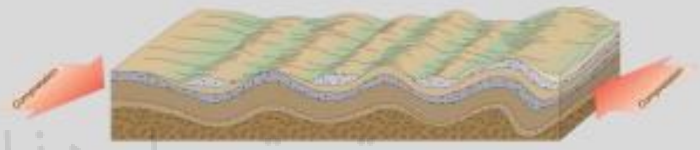
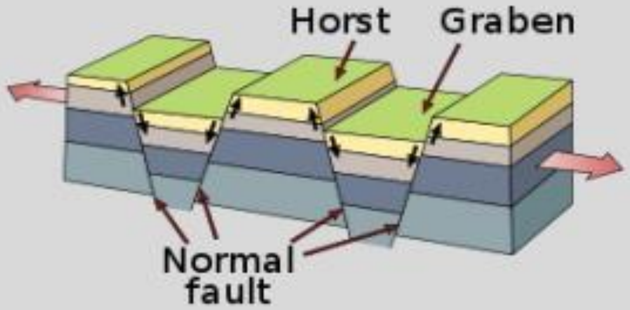
Fault-block mountains are formed

Draw arrows on the image below to **model** the **cause** of fault-block mountains and the movement of crust along the faults.



3	Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults	Textbook, figures, 3D	52, 54

Compare between fold mountains and fault-block mountains:

	Fold Mountains	Fault-block mountains
Diagram		
Plate boundaries	Convergent	Divergent
Type of force	Compression	Tension

3	**Diffrentiate between fold mountains and fault-block mountains, and Define subduction and faults**	**Textbook, figures, 3D**	**52, 54**

18) The Himalayan mountain range of India was formed at a _____.

- **A)** convergent boundary
- **B)** divergent boundary
- **C)** hot spot
- **D)** transform boundary

3) At an oceanic-oceanic convergent plate boundary, _____.

- **A)** new crust is created
- **B)** old crust is recycled by subduction
- **C)** old crust is deformed or fractured
- **D)** plates side past one another

14) A break in Earth's lithosphere along which movement occurs is called a(n) _____.

- **A)** fault
- **B)** earthquake
- **C)** strain
- **D)** stress

4) What type of mountains are formed when molten rock erupts onto Earth's surface and hardens?

- **A)** uplifted mountains
- **B)** fold mountains
- **C)** volcanic mountains
- **D)** fault-block mountains

2) _____ are formed when two continental plates collide.

- **A)** Volcanoes
- **B)** Strike-slip faults
- **C)** Mountain ranges
- **D)** Rift valleys

7) Fault-block mountains occur where _____.

- **A)** compression squeezes the crust
- **B)** tension pulls the crust apart
- **C)** tension squeezes the crust
- **D)** compression pulls the crust apart

4	Explain how ice is considered a weathring agents	Textbook, figures	87, 88

Erosion by Ice As you just observed, the ice cube glacier transported and deposited some of the colored sand as it moved downhill. Glaciers erode Earth's surface as they slide over it. Let's investigate the types of materials that glaciers transport and how glaciers change Earth's surface.

INVESTIGATION

Glacial Shaping

GO ONLINE Watch the video *Glacial Landscapes.*

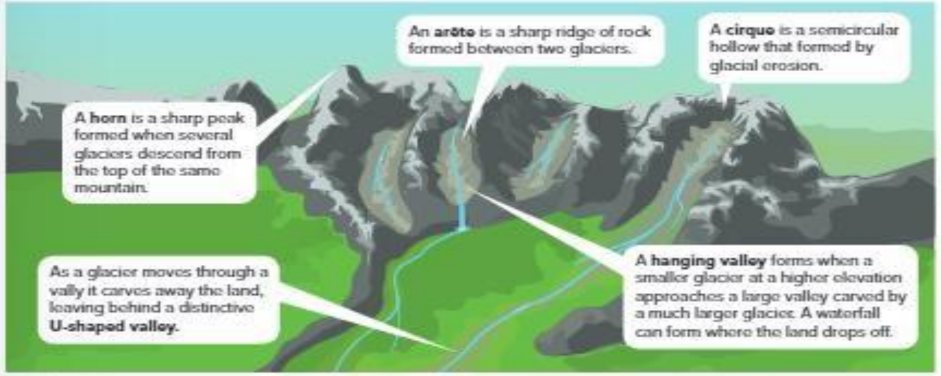
1. What evidence did you gather that glaciers transport materials on Earth's surface?

Sample answer: As glaciers move, they pick up rocks and boulders. These rocks scrape and chip away at the rocks below. Boulders, pebbles, silt, and even the color of the water deposited from the glacier are the result of materials being moved by ice.

2. How might glaciers change the landscape over time?

Sample answer: As glacial ice picks up rocks, it scrapes the surface of Earth below. The glacier acts like an enormous piece of sandpaper, carving out valleys and lakebeds. Over time glaciers carve deep valleys into mountains.

Glacial Debris Glaciers carry an unsorted collection of large, commonly angular rocks to pulverized, fine-grained sediment. The sides of most glaciers contain especially abundant sediment because they receive loose materials from the slopes of hills and mountains that flank the glacier. This sediment is eroded as the ice pushes forward. Rocks and grit frozen within the ice create grooves and scratches on underlying rocks as they are transported downhill. When glaciers melt, the water produced by the melting ice does not flow fast enough to carry sediment. The sediment is deposited where the ice melts. Till is a mixture of various sizes of sediment deposited by a glacier. Deposits of till are poorly sorted.



Glacier Features Glaciers act as giant bulldozers. Glacial features are formed as a glacier moves through an area and carves away the land. Some of the distinct features produced by glaciers are identified in the image above.

THREE-DIMENSIONAL THINKING

Explain how the mountains and the valley in the image above would be different if a glacier had not passed through.

Sample answer: The valley would likely be V-shaped (formed by a river) instead of U-shaped (formed by a glacier). There would not be ridges carved into the mountains, so you would not see features such as horns, arêtes, cirques, and hanging valleys.

GO ONLINE for an additional opportunity to explore!

Examine how glaciers change Earth's surface by performing the following activity.

☐ **Read** the **Scientific Text** *Glaciers and Landforms* to learn about how glaciers have impacted North America.

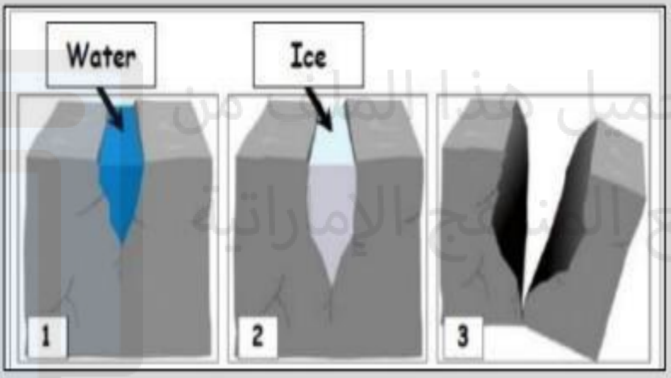
COLLECT EVIDENCE

How can a glacier change a mountainous landscape? Record your evidence (D) in the chart at the beginning of the lesson.

4	Explain how ice is considered a weathring agents	Textbook, figures	87, 88

Ice weathering:

Ice expansion in rocks causes them to break into smaller sediments. (weathering)



Frequent freezing and melting

Ice erosion and deposition

Glaciers: is large mass of ice that forms on land and moves slowly across earth surface.

- Glaciers form in areas where snowfall greater than snowmelt
- Glaciers appear motionless, but they mover several centimeter each day.
- Glaciers can form U-shaped valleys

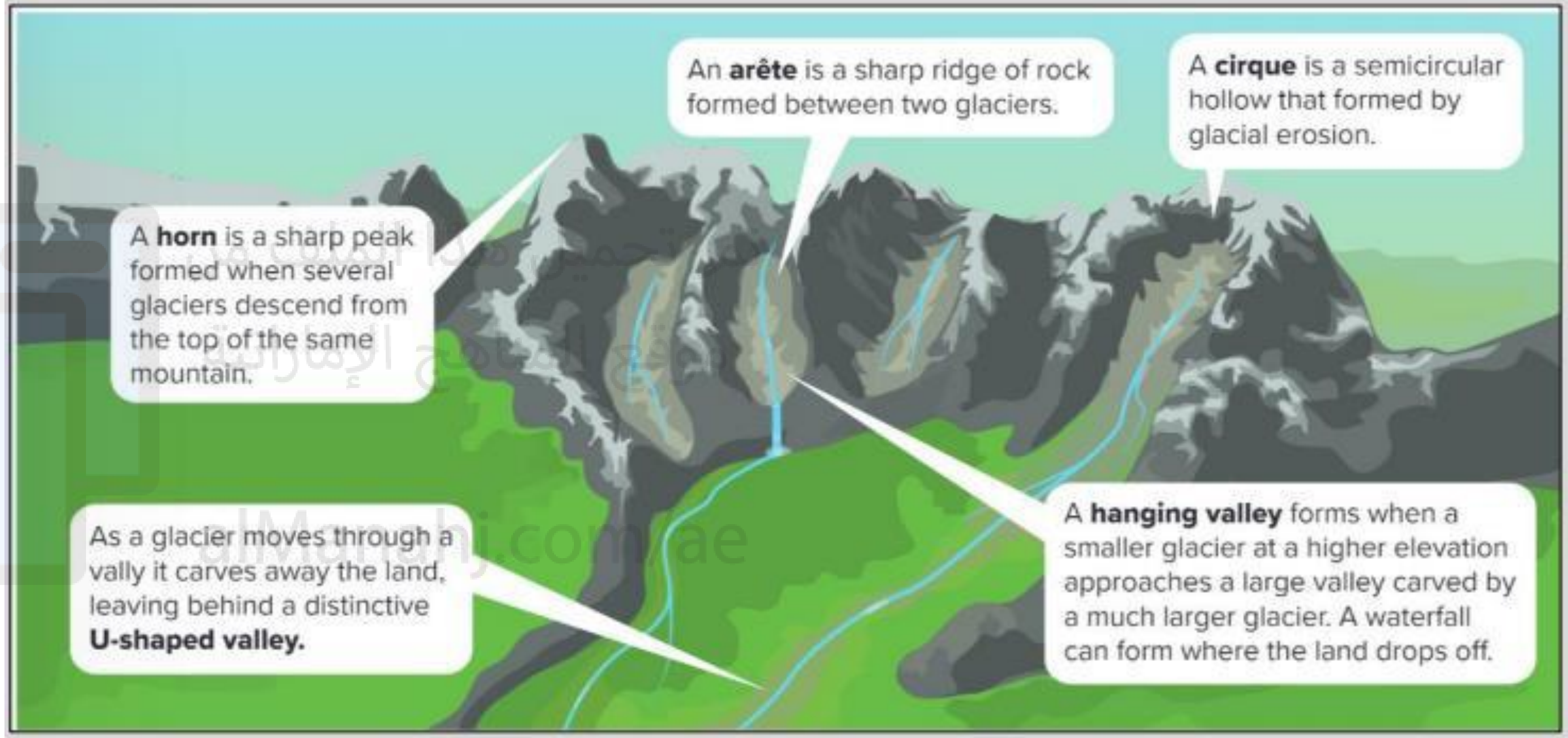
- Glaciers can transport different sizes of sediments and rocks.
- The eroded sediments create grooves and scratches on the rocks below.
- Sediments deposited where ice melts.

Glacial grooves

4	Explain how ice is considered a weathring agents	Textbook, figures	87, 88

Ice erosion and deposition

Glacial features



4	Explain how ice is considered a weathring agents	Textbook, figures	87, 88

How do glaciers transport and deposit sediments?

answer choices

- As the glacierflows down a mountain, it moves rocks and sediment.The sediment is eroded as the ice pushes forward.The sediment is deposited when the ice melts because the water does not flow fast enough to carry the sediment.
- As the glacierflows up a mountain, it removes rocks and sediment.The sediment is eroded as the ice pushes forward.The sediment is deposited when the ice melts because the water does not flow fast enough to carry the sediment.
- As the glacierflows down a mountain, it removes rocks and sediment.The sediment is eroded as the ice pushes forward.The sediment is deposited when the ice melts because the water does not flow fast enough to carry the sediment.

Is a mixture of various size of sediment deposited by a glacier (poorly sorted)

answer choices

- Till
- rock melt
- glacial debris
- melted glacial

Is a sharp ridge of rock formed between two glaciers called

answer choices

- arete
- horn
- cirque
- hanging valley

What is the name of the semicircular shaped hollow created by glacial erosion on a mountain side?

answer choices

- Corry
- Arete
- cirque
- Pyramidal Peak

as a glacier moves through a vally it carves away the land and form

answer choices

- V shaped valleys
- Galactic troughs
- Glacial troughs
- U shaped valleys

Is a sharp peak formed when several glaciers descend from the top of the same mountain called

answer choices

- A pyramidal peak
- Twin peaks
- An arete
- A horn

all are glacier features except

answer choices

- horn
- U-shaped valley
- V-shaped vally
- hanging valley
- arete

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

Where do earthquakes occur?

The surface of Earth is in constant motion because of forces inside the planet. These forces cause sections of Earth's surface to move. This movement puts stress on the rocks. To relieve this stress, the rocks tend to bend, compress, or stretch. If the force is great enough, the rock will break, causing an earthquake. Let's investigate where earthquakes occur on Earth.

Want more information?
Go online to read more about the locations, magnitudes, and frequencies of earthquakes.

FOLDABLES
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.

INVESTIGATION

Around the World

The locations of major earthquakes are shown on the map below. Use this map to answer the following questions.

1. What patterns do you notice among earthquake locations and plate boundaries?

Students should observe that most earthquakes form along the edges of plate boundaries.

Three-Dimensional Thinking

Use the map below to answer question 4.

4. What can be inferred about the locations with only slight or minor earthquake risk?
   - **A** These locations have too low of an elevation for earthquakes to occur.
   - **B** These locations are not located on or near a plate boundary or fault line.
   - **C** These locations are too mountainous for earthquakes to occur.
   - **D** These locations are too far from the San Andreas Fault to be affected by an earthquake.

5. If a city has experienced a damaging earthquake in the past, what can you infer about the likelihood of a future earthquake event?
   - **A** An earthquake is not likely. Earthquakes never occur twice in the same location.
   - **B** An earthquake is not likely. Earthquakes only occur on coastlines.
   - **C** An earthquake is likely. How frequently an area experiences an earthquake determines its risk.
   - **D** An earthquake is likely. However, it will never exceed the magnitude of the first earthquake that occurred.

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

Where do volcanoes occur?

Recall that a volcano is a vent in Earth's crust through which molten rock flows. As you read this, approximately 20 volcanoes are erupting. In any given year, volcanoes will erupt in about 60 different places on Earth. Let's investigate where volcanoes occur on Earth.

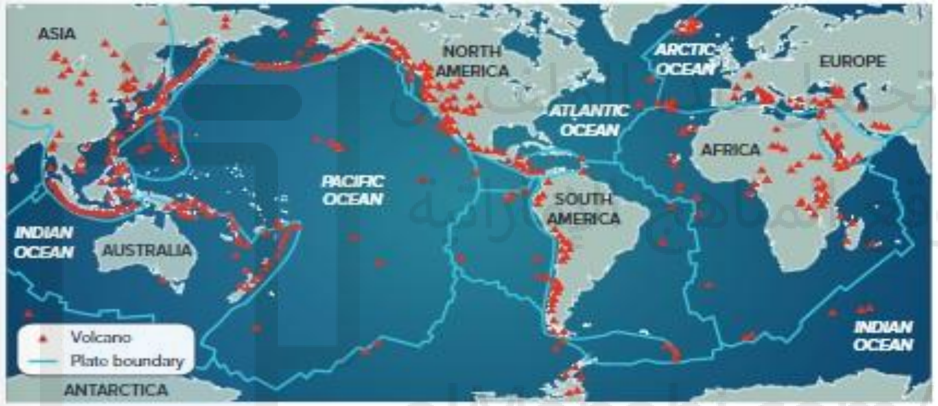
Want more information? Go online to read more about the locations, frequencies, and severity of volcanic eruptions.

FOLDABLES Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.

INVESTIGATION

Volcano Patterns

The locations of volcanoes across the globe are shown on the map below. Use this map to answer each question.



1. What patterns do you observe among volcano distribution and plate boundaries?

Students should observe that most volcanoes form at plate boundaries.

2. Some volcanoes are not located near any type of plate boundary. Record the locations of these volcanoes.

Students should observe that most of these volcanoes are located in the middle of the Pacific Ocean, west of North and South America, and central Africa and Asia.

Location, Location, Location Recall that the slow and large-scale motion of Earth's tectonic plates causes the formation of volcanoes and the rapid and sometimes catastrophic eruptions that result. Volcanoes form at active plate boundaries including convergent boundaries and divergent boundaries, and away from plate boundaries at hot spots.

Major Volcano Belts The volcanoes associated with plate boundaries form two major belts. One is called the Ring of Fire. It represents an area of earthquake and volcanic activity that surrounds the Pacific Ocean. The Ring of Fire stretches along the western coasts of North and South America, across the Aleutian Islands, and down the eastern coast of Asia. It is associated with convergent plate boundaries.

The Alpide Belt, or Alpine-Himalayan Belt, is a seismic belt that includes an array of mountain ranges. These ranges extend along the southern margin of Eurasia, stretching from Java to Sumatra through the Himalayas, to the Mediterranean, and out into the Atlantic. This belt is smaller than the Pacific Ring of Fire and includes two well-known volcanoes in Italy—Mount Etna and Mount Vesuvius. The Alpide Belt corresponds to the boundaries between the Eurasian, African, and Arabian plates. The tectonic plates here are also converging.

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

Where do earthquakes occur?

Around the World

The locations of major earthquakes are shown on the map below. Use this map to answer the following questions.

1. What patterns do you notice among earthquake locations and plate boundaries?

Most of the earthquakes form along the edges of plate boundaries

Investigation: Volcano Patterns

Volcano: is a vent on earth's crust through which molten rock flows.

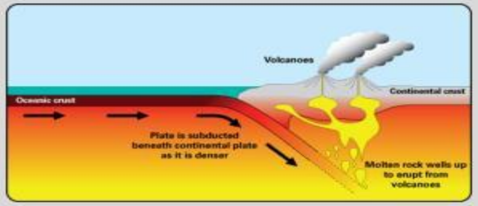
Volcano Patterns

The locations of volcanoes across the globe are shown on the map below. Use this map to answer each question.

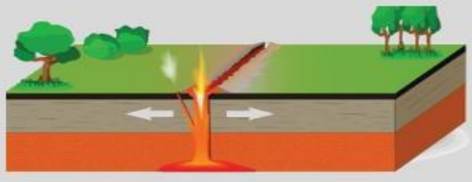
1. What patterns do you observe among volcano distribution and plate boundaries?

Most Volcanoes forms at plate boundaries

- **Volcanos form at:**



Convergent boundaries



divergent boundaries

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

Major Volcano Belts:

- Ring of Fire
- Alpide belt (smaller)

Where do volcanoes occur?

Use the map to fill the blanks:

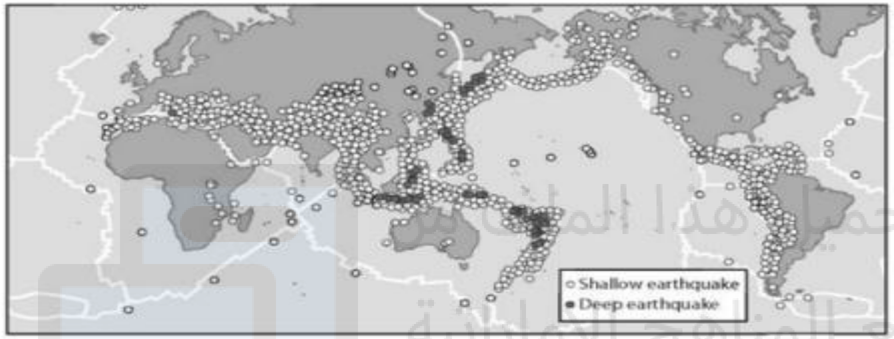
- Ring of fire is an area of earthquakes and volcanos' activity that surrounds the __Pacific ocean__. The ring stretches along the western coasts of __North & south America__ and the eastern coasts of __Asia__.
- It is associated with convergent plate boundaries.

Where do volcanoes occur?

- Alpide belt is seismic belt that includes mountains ranges. These ranges extend along the southern margin of Eurasia. Stretching from Java to Sumatra through the Himalayas, to the Mediterranean and out into the Atlantic.
- It is associated with convergent plate boundaries.

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

2) What pattern do you see?



Explanation

Volcanoes and earthquakes tend to occur along plate boundaries.

8) When the force on rocks is great enough, they break, producing vibrations called ____.

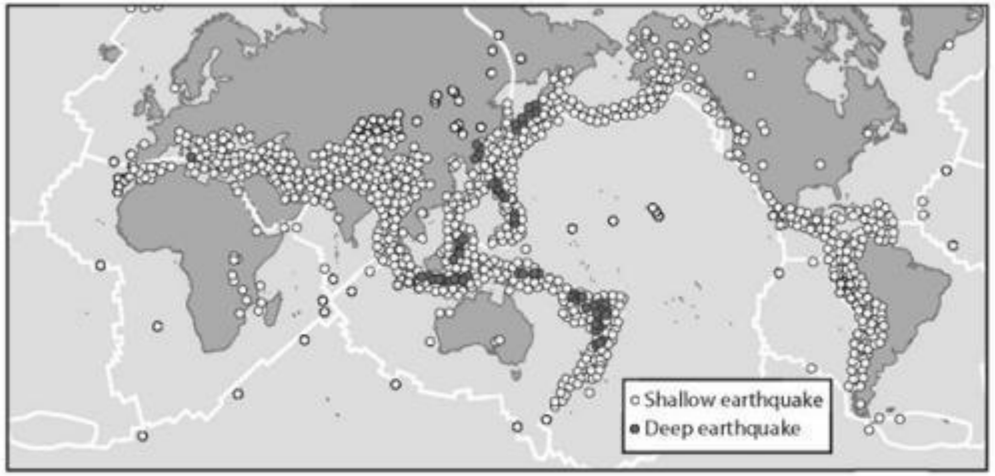
- **A)** faults
- **B)** earthquakes
- **C)** strains
- **D)** stresses

6) Most earthquakes occur <u>in the centers of continents</u>.

- True
- False

13) When rocks break because of stress, the energy released is in the form of a(n) ___ earthquake ___.

7) Looking at the figure that shows world-wide earthquake distribution, the white lines represent plate boundaries. Which statement is true?



- **A)** Deep earthquakes are more common than shallow earthquakes.
- **B)** Shallow earthquakes are more common than deep earthquakes.
- **C)** Shallow earthquakes and deep earthquakes are equally common.
- **D)** Shallow earthquakes do not occur along plate boundaries, but deep earthquakes do.

5	List the main natural hazards on Earth, and analyze maps to conclude information from it	Textbook, fig, 3D	140, 163, 170, 171

1) Locations where volcanoes form far from plate boundaries are called ____hot spots____.

5) How many volcanoes erupt each year, on average.

- **A)** less than 5
- **B)** around 20
- **C)** around 60
- **D)** more than 100

4) Volcanoes can form on the ocean floor.

- True
- False

Most volcanoes form around the Pacific Ocean in an area known as the ....

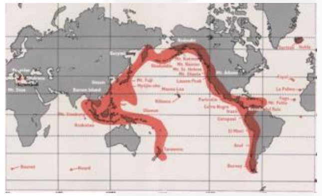
answer choices

- circle of eruptions
- ring of fire
- oval of magma

Where do most volcanoes occur?

answer choices

- in the center of the ocean
- in the centers of continents
- along boundaries between continents
- along boundaries between continents and the ocean



This is the name for the chain of volcanos around the edge of the Pacific Plate.

answer choices

- Circle of Fire
- Ring of Lava
- Ring of Fire
- Circle of Magma

Is a seismic belt that includes an array of mountain ranges- this belt is smaller than pacific ring

answer choices

- Alpide belt
- Ring of fire
- Circle of fire
- Mountain belt

6	Compare between different magniteds of earthquake using Richter magnitude scale	Textbook, investigation, figure	142, 143

How are earthquakes measured?

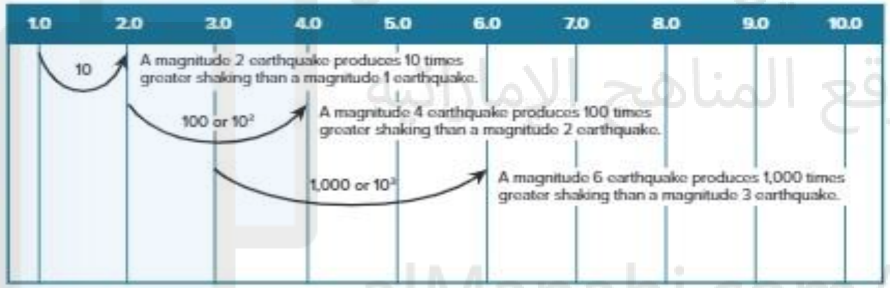
Earthquakes range from unnoticeable vibrations to devastating waves of energy. Magnitude describes the amount of energy released by an earthquake. Scientists have developed several methods for describing the size of an earthquake.

The **Richter magnitude scale** is a numerical rating system that measures the energy, or magnitude, of the largest seismic waves produced by an earthquake. This scale is based on the height, or amplitude, of the lines on a seismograph, a digital instrument used for measuring earthquake waves. Let's investigate how the energy of an earthquake is measured using the Richter magnitude scale.

INVESTIGATION

Magnitude Measurement

Analyze the figure below.



1. Infer how the height of the lines on a seismograph change with an increase in earthquake magnitude?

Sample answer: As the magnitude of an earthquake increases, so will the height, or amplitude, of the line recorded by the seismograph.

2. **MATH Connection** Approximately how much shaking does a magnitude 7 earthquake produce compared to a magnitude 5 earthquake?

$10^2 = 10 \times 10 = 100$ times more shaking

3. **MATH Connection** Approximately how much more shaking is produced by a magnitude 8 earthquake compared to a magnitude 4 earthquake?

$10^4 = 10 \times 10 \times 10 \times 10 = 10{,}000$ times more shaking

Earthquake Magnitude The Richter scale begins at zero, but there is no upper limit to the scale. Each increase of 1 unit on the scale represents ten times the amount of shaking, or ground motion, a seismic wave produces. For example, a magnitude 8 earthquake produces a seismic wave that is 10 times greater than a magnitude 7 earthquake and 100 times greater than a magnitude 6 earthquake. The largest earthquake ever recorded was a magnitude 9.5 in Chile in 1960.

The differences in the amount of energy released by earthquakes are even greater than the differences between the amplitude of their waves. The units on this scale are exponential. For each increase of one unit on the scale, an earthquake releases approximately 32 times more seismic energy. For example, a magnitude 6 earthquake releases 1,024 times (32 x 32) more energy than a magnitude 4 earthquake.

6	Compare between different magniteds of earthquake using Richter magnitude scale	Textbook, investigation, figure	142, 143

How are earthquakes measured?

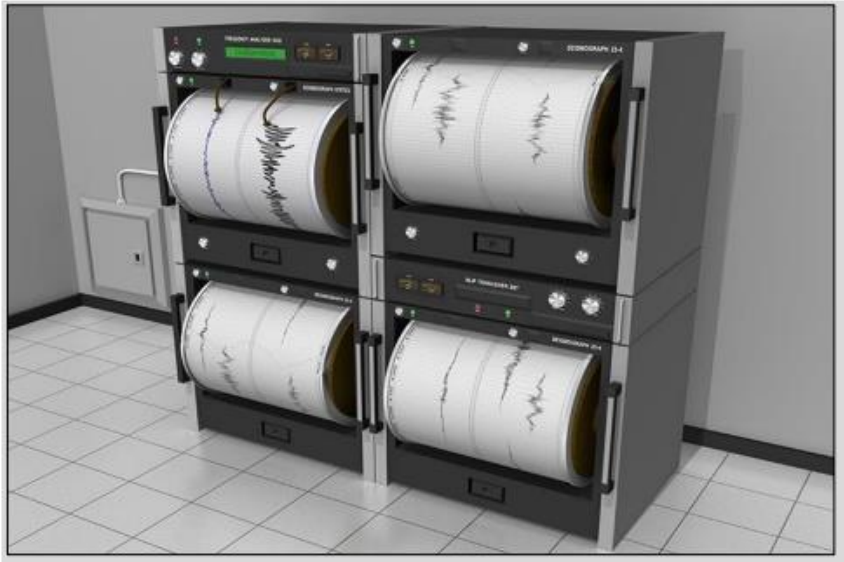
Earthquakes can be:

Unnoticeable ⟶ **Devastating**

غير ملحوظ — مدمرة

Earthquakes can be measured by:

Richter Magnitude scale: is a numerical rating system that measures the energy (or magnitude) of the largest seismic waves produced by an earthquake.



Richter Magnitude scale is based on:

- Hight (or amplitude) of the lines on seismograph
  - **Seismograph: digital instrument used for measuring earthquakes waves.**

1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0

- **Amplitude (earth motion/shaking): each number higher is 10 times more amount of ground motion**

Examples:

How much more shaking does an earthquake of magnitude 8 produce compared to an earthquake of magnitude 5? $10^3 = 10 \times 10 \times 10 = 1000$

- **Magnitude (wave energy): each number higher is 32 times more energy**

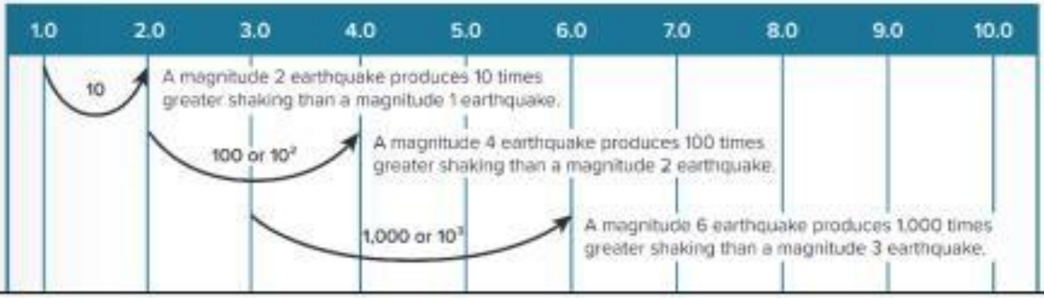
Examples:

How much more energy does an earthquake of magnitude 8 produce compared to an earthquake of magnitude 5? $32^3 = 32 \times 32 \times 32 = 32{,}768$

6	Compare between different magniteds of earthquake using Richter magnitude scale	Textbook, investigation, figure	142, 143

Magnitude Measurement

Analyze the figure below.



1. Infer how the height of the lines on a seismograph change with an increase in earthquake magnitude?

As the magnitude of an earthquakes increases, the height (or the amplitude) of the line will also increase.

2. MATH Connection Approximately how much shaking does a magnitude 7 earthquake produce compared to a magnitude 5 earthquake?

$10^2 = 10 \times 10 = 100$ times more shaking

3. MATH Connection Approximately how much more shaking is produced by a magnitude 8 earthquake compared to a magnitude 4 earthquake?

$10^4 = 10 \times 10 \times 10 \times 10 = 10{,}000$ times more shaking

6	Compare between different magniteds of earthquake using Richter magnitude scale	Textbook, investigation, figure	142, 143

5) For the Richter scale, each increase on the scale represents ten times the amount of ground motion recorded on the seismogram. How much more motion is there for a magnitude 7 earthquake than a magnitude 4 earthquake?

- A) 3 times
- B) 30 times
- C) 1000 times (marked)
- D) 3000 times

7) For the moment magnitude scale, each increase on the scale represents 31.5 times more energy released by the earthquake. Which is a good estimate of about how much more motion there is for a magnitude 7 earthquake than a magnitude 4 earthquake?

- A) 90 times
- B) 27,000 times (marked)
- C) 900 times
- D) 3000 times

10) The magnitude of an earthquake is measured by the _____.

- A) Richter scale (marked)
- B) moho discontinuity
- C) modified Mercalli scale
- D) elastic limit

12) The Richter scale is based on the height of the lines traced by a(n) __seismograph__.

11) An earthquake with a(n) __magnitude__ of 7.2 releases about 30 times as much energy as an earthquake that registers 6.2 on the Richter scale.

PART 2 (MCQ)

Part 2 الجزء الثاني

7	Show how do fossils provide evidence support the continental drift	Textbook, Figure, 3D	17, 21
8	Order the ocean-floor features according to their age by using the proposed seafloor spreading process	Textbook, figure	34
9	Explain how volcanic landscapes form and diffrentiate between types of volcanoes on Earth and Hot spots	Textbook	58, 173
10	Understand the effects quick changes can have on Earth's surface from earthquake (e.g.: landslide, fault zone, tsunami), and others like meteoroid strikes that creat impact craters	Textbook, Tables, figures	62, 63
11	Define crystallization and diffrentiate between igneous rocks (extrusive and intrusive)	Textbook, Figure, 3D	104, 105
12	Describe how sedimentary rocks are classified, and list the common sedimentary rock types. Describe the processes of lithification, compaction and cementation	Textbook, figures, table	112, 114
13	Compare between the scales used to classify and measure the strength of earthquackes	Textbook, figures, tables	144, 145
14	Compare between volcanic hazards	Textbook, figures, table	174, 175
15	Explain how can volcanic eruptions predicted and how to reduce volcanic hazards	Textbook, investigations, fig, table	184, 185, 186
16	Diffrentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207

7	Show how do fossils provide evidence support the continental drift	Textbook, Figure, 3D	17, 21

Evidence from Fossils As you just discovered in the Lab *Reconstructing Gondwana*, fossils provide compelling evidence for continental drift. Fossils of *Glossopteris*, shown below, have been discovered in rocks from South America, Africa, India, Australia, and Antarctica. These continents are far apart today. Wegener reasoned that the area separating these fossils was too large to have a single climate. Also, because *Glossopteris* grew in temperate climates, these places must have been closer to the equator.

Which of the continents would not support *Glossopteris* growth today?

In addition to *Glossopteris* fossils, Wegener also used fossils of various reptiles to support his hypothesis. Fossils of a coastal reptile, *Mesosaurus*—shown to the right—and two terrestrial reptiles, *Cynognathus* and *Lystrosaurus*, have been found on continents that are now separated by vast oceans. Wegener reasoned that these creatures could not have swam the distances that now separate the fossil locations, which added to his cache of evidence.

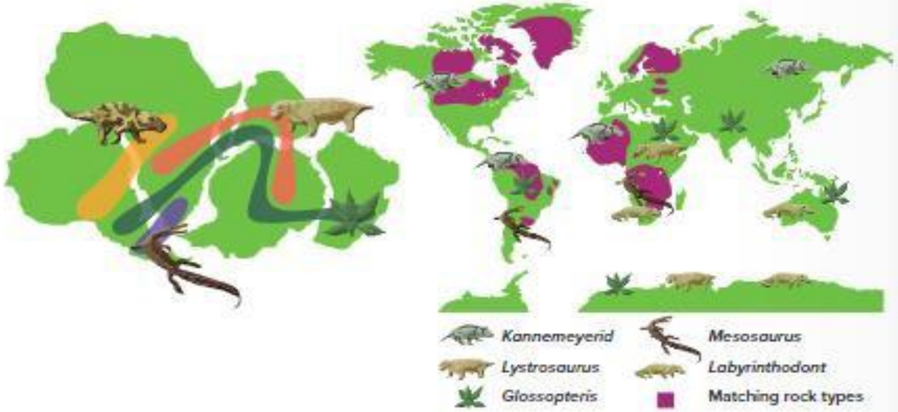
The similarity of rocks and fossils on continents now several thousand kilometers apart and separated by wide oceans suggests that the continents have not always been in their present positions. They must have been joined in the past.

COLLECT EVIDENCE

What fossil evidence is similar between South America and Africa? Record your evidence (D) in the chart at the beginning of the lesson.

Three-Dimensional Thinking

Alfred Wegener found different types of evidence to help support the hypothesis of continental drift. He found fossils of a reptile called *Mesosaurus* on land areas that were once part of Pangaea. The locations where the fossils are found are shown in the figure below.



2. Which statement below describes how the presence of *Mesosaurus* fossils in South America and Africa helps support the hypothesis of continental drift?

   A A reptile would not have been able to swim across an entire ocean, so the landmasses must have been closer together.

   B It shows that the climates of both continents were different during the time that *Mesosaurus* lived.

   C This suggests that South America and Africa moved apart, but India, Antarctica, and Australia remained stationary.

   D It shows that *Mesosaurus* could only exist on South America and Africa because all other continents were covered in ice.

7	Show how do fossils provide evidence support the continental drift	Textbook, Figure, 3D	17, 21

Evidences from fossils

Evidences from fossils

Fossils provide evidences for continental drift.

Example 1:

Glossopteris

Glossopteris grew in temperate climate, and it have been discovered in south America, Africa, India, Australia and Antarctica. What does this mean?

This mean that these continents were close to each other and near the equator.

Evidences from fossils

Example 2:

Lystrosaurus

Mesosaurus

Cynognathus

Fossils of different reptiles has been found in different places, and these creatures can't swim long distances. So, this evidence suggest that continents have been joined in the past.

7	Show how do fossils provide evidence support the continental drift	Textbook, Figure, 3D	17, 21

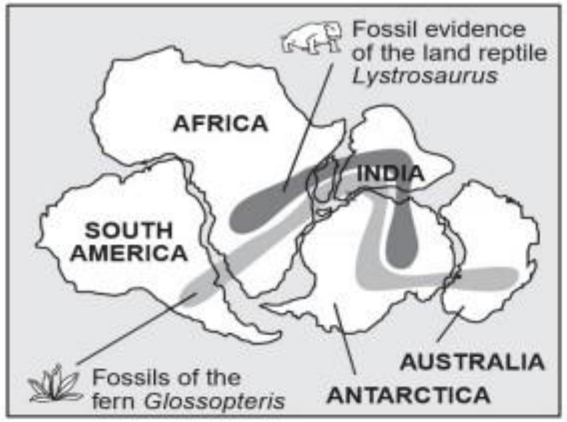
1) The presence of the same ______ on several continents supports the hypothesis of continental drift.

- **A)** fossils
- **B)** rocks
- **C)** neither a nor b
- **D)** both a and b

6) _____ is a fossil fern that helped support Wegener's hypothesis of continental drift.

- **A)** *Gondwanaland*
- **B)** *Kannemeyerid*
- **C)** *Mesosaurus*
- **D)** *Glossopteris*

7) The diagram shows where fossils of two different species, *Lystrosaurus* and *Glossopteris*, have been found on more than one continent.



How is this kind of evidence **best** used by scientists?

- **A)** to determine how the rocks formed on the different continents

  Rationale: Scientists would not be able to use fossils to determine how all rock types formed, only sedimentary rocks.

- **B)** to predict how the continents might look in the future with continued plate movement

  Rationale: Although scientists can expect that the plates will continue to move, they do not use fossil evidence to predict the arrangement of continents in the future.

- **C)** to explain the process of how the continents are in different locations today than in the past

  Rationale: Scientists do not use fossil evidence to explain the process of plate tectonic motion.

- **D)** to support the theory that these continents were once joined together but then moved apart over time

  Rationale: Since both of these organisms lived on land, the most reasonable conclusion is that these land masses were once connected.

8	**Order the ocean-floor features according to their age by using the proposed seafloor spreading process**	**Textbook, figure**	**34**

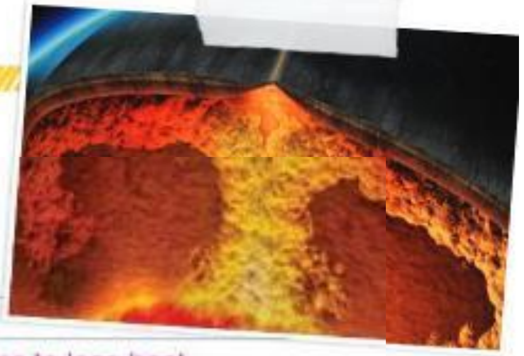
So how do continents "drift?"

Why would the seafloor age as you move further away from mid-ocean ridges? In the 1960s, scientists proposed a new process that helped explain ocean-floor features, ages, and continental drift. This process is called seafloor spreading. **Seafloor spreading** is the process by which new oceanic crust continuously forms along mid-ocean ridges and is destroyed at ocean trenches. Why does this process occur?

INVESTIGATION

Seafloor Spreading

GO ONLINE Watch the video *Seafloor Spreading.*



What causes Earth's crust to spread?

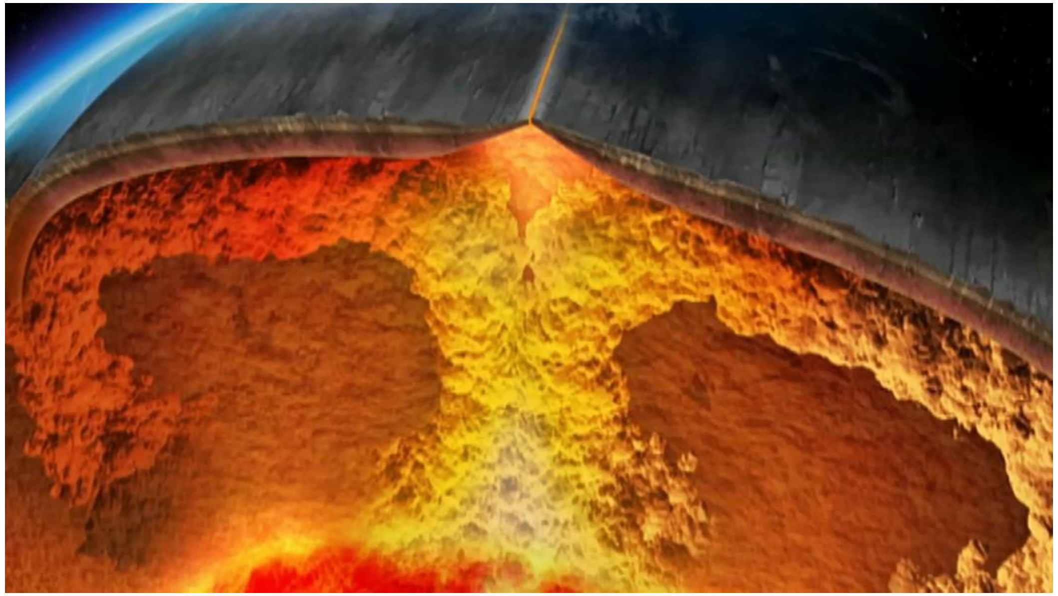
Hot rock rises, heated by Earth's core. Near the surface, the rock spreads in two directions and goes sideways. It begins to lose heat. Eventually the much cooler rock sink backs down. Through this spreading process Earth's crust is very slowly dragged apart.

The Conveyor Belt Rock under Earth's surface is heated by Earth's hot interior. When the seafloor spreads, the rock below the seafloor becomes molten. Molten rock below Earth's surface is called **magma.** Magma is less dense than the surrounding rock and rises upward through cracks in Earth's crust along the mid-ocean ridge. When magma erupts onto Earth's surface it is called **lava.** As lava cools and crystallizes, it forms new oceanic crust. Two halves of the oceanic crust spread apart slowly, and move apart like a conveyor belt. As the seafloor continues to spread apart, the older oceanic crust moves away from the mid-ocean ridge and sinks at ocean trenches.

A mechanism to explain continental drift was finally discovered long after Wegener proposed his hypothesis. Continents do not plow through the solid rock on the seafloor. Instead, continents move as the seafloor spreads along a mid-ocean ridge!

COLLECT EVIDENCE

What is the relationship between seafloor spreading, mid-ocean ridges, and ocean trenches? Record your evidence (C) in the chart at the beginning of the lesson.



- **Seafloor Spreading:** is the process by which new oceanic crust continuously forms along mid-ocean ridges and is destroyed at ocean trenches.

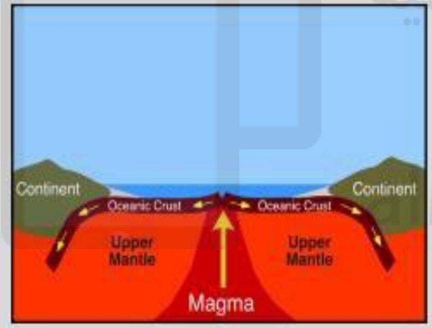
8	Order the ocean-floor features according to their age by using the proposed seafloor spreading process	Textbook, figure	34

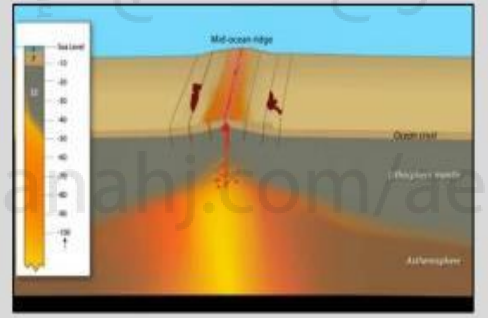
The Conveyor Belt

Magma: Molten rock below earth surface. When magma erupts onto earth's surface it is called **Lava**.

ESSAY

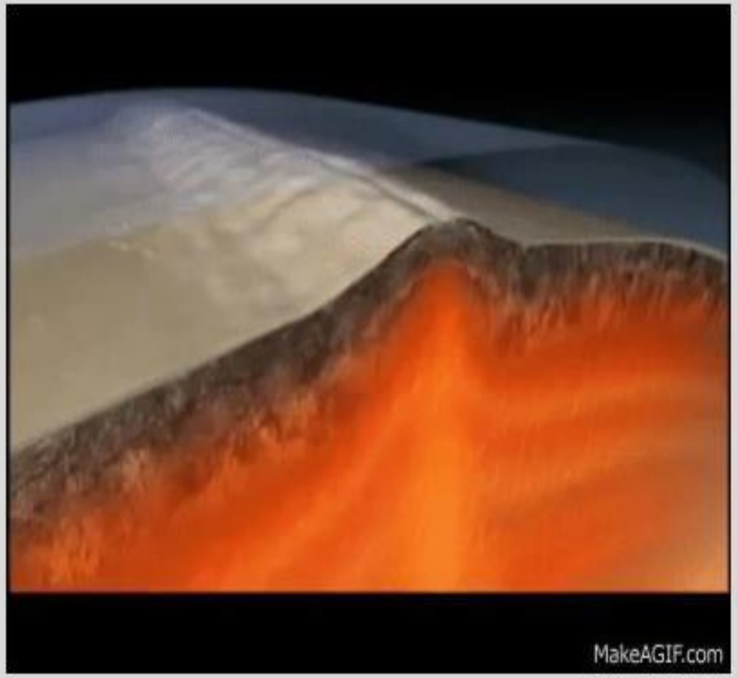
As lava cools and crystallizes, it forms new oceanic crust. Oceanic crust spread apart slowly and moves apart like a conveyor belt.





The Conveyor Belt

As the seafloor continuous to spread apart, the older oceanic crust moves away from the mid-ocean ridge and sinks at ocean trenches.



8	Order the ocean-floor features according to their age by using the proposed seafloor spreading process	Textbook, figure	34

11) The molten material deep inside Earth from which igneous rocks form is called _____.

- **A)** magma
- **B)** lava
- **C)** neither a nor b
- **D)** both a and b

3) Which of the following best explains the age of oceanic crust and ocean-floor features?

- **A)** seafloor spreading
- **B)** continental drift
- **C)** subduction
- **D)** crystallization

4) New ocean crust is continually formed at _____.

- **A)** mid-ocean ridges
- **B)** trenches
- **C)** subduction zones
- **D)** ocean basins

5) The theory of seafloor spreading explains how new crust is created at mid-ocean ridges.

Magma that reaches the surface is called ....

answer choices

- Vent
- Hot spot
- Lava
- crater

Scientists think that the movement of Earth's tectonic plates are caused by convection currents, that are located in the ________?

answer choices

- outer core
- inner core
- mantle

9	**Explain how volcanic landscapes form and diffrentiate between types of volcanoes on Earth and Hot spots**	**Textbook**	**58, 173**

Volcanoes on Earth The slow and large-scale motion of Earth's tectonic plates causes the formation of volcanoes and the rapid and sometimes catastrophic eruptions that result. Sometimes lava that flows from volcanoes slowly covers the region surrounding the volcano. At other times, volcanoes can erupt explosively. Volcanic eruptions constantly shape Earth's surface. They can form large mountains, create new crust, and leave a path of destruction behind. Let's look at a few examples of volcanoes on Earth.

Volcanoes can form in the ocean where oceanic plates converge and one plate subducts. These volcanoes emerge as islands. A curved line of volcanoes that forms parallel to a plate boundary is called a **volcanic arc.** Most of the active volcanoes in the United States are part of the Aleutian volcanic arc in Alaska. They formed as a result of the Pacific Plate subducting under the North American Plate. ▸

◂ Volcanic arcs can also form on land where an oceanic plate subducts under a continental plate. Volcanoes in the Cascades, such as Mount Shasta shown to the left, are a result of the Juan de Fuca plate subducting under the North American Plate. Recall that the Andes Mountains in South America are also a result of an oceanic plate subducting under a continental plate. The world's highest active volcano is located in the Andes. Nevada Ojos del Salado is nearly 6,900 m tall!

Lava does not erupt only from volcanic mountains on land. More than 60 percent of all volcanic activity on Earth occurs along mid-ocean ridges. As the seafloor slowly spreads apart along mid-ocean ridges, lava erupts into the rift formed by the separating plates. This lava takes the form of giant pillows, like those shown to the right, and is called pillow lava. Eruptions at divergent boundaries tend to be nonexplosive. ▸

COLLECT EVIDENCE

How did the volcanic peaks in the Andes form? Record your evidence (C) in the chart at the beginning of the lesson.

INVESTIGATION

Rate of Growth

Use the data from the passage *Coming Up: Island Under Construction* to help answer the questions below.

MATH Connection If Loihi reaches sea level in 10,000 years, what would its average rate of growth per year be?

969 m/10,000 y = approximately 0.10 meters per year

MATH Connection What would its average rate of growth per year be if it reaches sea level in 100,000 years?

969 m/100,000 y = approximately 0.001 meters per year

Hot Spots Volcanoes that are not associated with plate boundaries are called hot spots. The Hawaiian Islands are in the middle of the Pacific Plate, far from its edges. They sit on top of a hot spot under the Pacific Plate. Hot rock at these areas is forced toward the crust where it melts partially to form hot spot volcanoes. The Pacific Plate is moving over a stationary hot spot. Kauai, the oldest Hawaiian island, was once located where the Big Island, Hawaii, is situated today. As the plate moved, Kauai moved away from the hot spot and became a dormant volcano. As the Pacific Plate continued to move, the other Hawaiian Islands were formed. The Hawaiian Islands formed over a period of about 5 million years.

COLLECT EVIDENCE

What factor(s) influence where volcanoes occur? Record your evidence (A) in the chart at the beginning of the lesson.

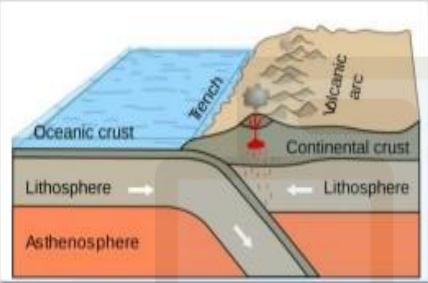
9	Explain how volcanic landscapes form and diffrentiate between types of volcanoes on Earth and Hot spots	Textbook	58, 173

Volcanos on earth

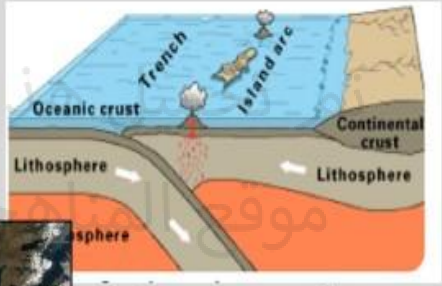
How volcanos shape earth surface?

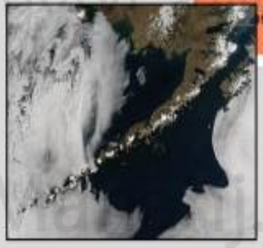
1. Volcanic arcs and mountains: A curved line of volcanoes that forms parallel to plate boundary.

How does it form?



Convergent of:
Oceanic + Continental





Convergent of:
Oceanic + Oceanic

2. Underwater volcanos

- 60% of the volcanos occur along mid-ocean ridges
- Lava erupt when seafloor spread
- Lava takes the form of giant pillow, and they are called ***pillow lava***
- Eruptions are divergent boundaries are nonexplosive

- Volcanoes can form large mountains at convergent boundaries.
- Volcanoes can create new crust at divergent boundaries (mid-ocean ridges).

9	Explain how volcanic landscapes form and diffrentiate between types of volcanoes on Earth and Hot spots	Textbook	58, 173

Hot Spots: Volcanos that are ***not associated*** with plate boundaries

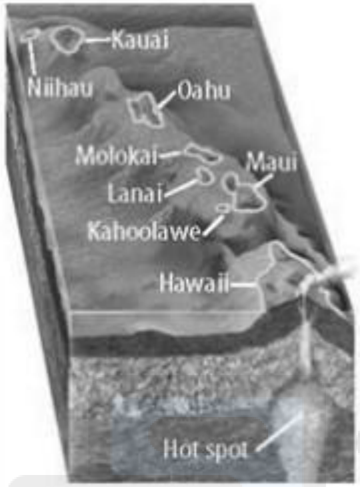
- **Hot rocks at these areas are forced toward the crust where it melts to form hot spot volcanos.**

- Pacific plate is moving over a hot spot.
- As the plate moves, the islands move away from the hot spot and became ***dormant volcanoes (inactive volcanoes)***
- The Hawaiian islands formed over a period of 5 millions years.

The oldest island

9	**Explain how volcanic landscapes form and diffrentiate between types of volcanoes on Earth and Hot spots**	**Textbook**	**58, 173**

6) Volcanoes can form over a plume, or rising current of hot mantle. As a tectonic plate slowly moves over a plume, a volcano will form and then become extinct as it moves away from the hot spot. Then the next volcano will form. If the hot spot shown made all the islands in the figure, is the plate pictured below moving toward you or away from you?



- ○ **A)** The plate is moving toward me.
- ● **B)** The plate is moving away from me.
- ○ **C)** There is no way to tell.
- ○ **D)** It is stationary.

10	**Understand the effects quick changes can have on Earth's surface from earthquake (e.g.: landslide, fault zone, tsunami), and others like meteoroid strikes that creat impact craters**	**Textbook, Tables, figures**	**62, 63**

When the Ground Shakes An **earthquake** is the rupture and sudden movement of rocks along a break or a crack in Earth's crust. Earthquakes result from the buildup and rapid release of stress along active plate boundaries. An earthquake can change Earth's surface quickly and dramatically. We see the results of earthquakes in faults, landslides, and tsunamis.

Faults associated with earthquakes can be visible at Earth's surface. Natural and human-made features that cross the fault, such as streams and railroads, are shifted by earthquakes. Some faults, such as the San Andreas Fault in California, can be more than 1,000 km long. The San Andreas Fault is not a single fault. Many smaller faults exist in the area around the San Andreas Fault. An area of many fractured pieces of crust along a large fault is called a **fault zone.** ▶

◀ Earthquakes can also trigger landslides, quickly changing Earth's surface. A **landslide** is the rapid downhill movement of soil, loose rocks, and boulders. The vibrations of an earthquake can cause large amounts of Earth materials to separate from a slope. Gravity quickly causes materials to come crashing downhill. The 2016 Kumamoto earthquakes in Japan triggered numerous landslides, including the one shown in the photograph to the left.

Underwater earthquakes can cause catastrophic tsunamis. A **tsunami** is a wave that forms when an ocean disturbance suddenly moves a large volume of water. As blocks of crust move up along a fault, the water above is displaced and forms a gigantic wave. Tsunamis can quickly destroy coastlines. This photo was taken five years after the 2004 Indian Ocean earthquake and tsunami, and the destruction is still clearly visible. ▶

COLLECT EVIDENCE

Why does the western coast of South America experience earthquakes? Record your evidence (D) in the chart at the beginning of the lesson.

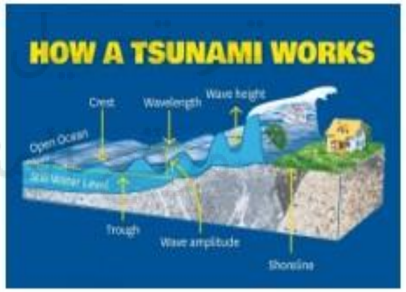
Besides plate motion, what else creates major features on Earth?

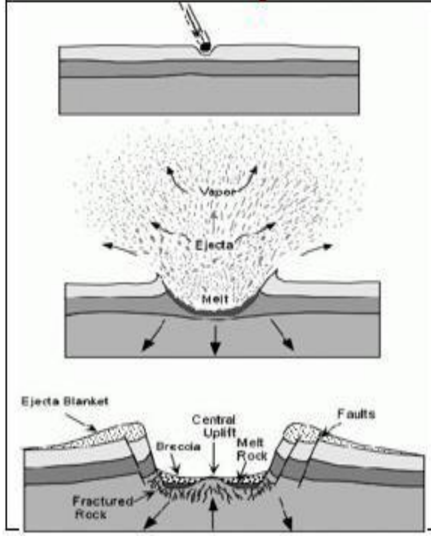
Not all major features on Earth's surface are caused by plate motion. For example, craters are not formed by the movement of tectonic plates. Instead, they form when a meteoroid from space strikes Earth's surface. These impacts leave giant, circular depressions in Earth's surface, called **impact craters.** There are more than 170 impact craters on Earth.

Like volcanic eruptions and earthquakes, meteoroid impacts are catastrophic changes that create surface features over a very short period of time. And just like mountains and other landforms on Earth, impact craters are subject to further changes over time. The Barringer Crater, shown above, is estimated to have lost between 15–20 m in height due to erosion and weathering processes on Earth.

Canyons, such as the Fish River Canyon shown below, are also not a result of plate motion. These landforms are created by weathering and erosion over time. You will learn more about these features and the processes that create and shape them in the next lesson.

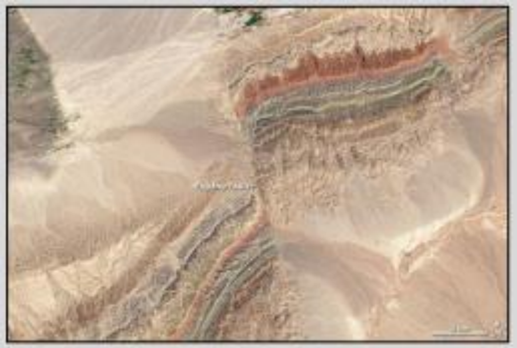
10	**Understand the effects quick changes can have on Earth's surface from earthquake (e.g.: landslide, fault zone, tsunami), and others like meteoroid strikes that creat impact craters**	**Textbook, Tables, figures**	**62, 63**

Earthquake		
An **Earthquake** is the rupture and sudden movement of rocks along a break or a crack in Earth's crust. Earthquakes result from the buildup and rapid release of stress along active plate boundaries. An earthquake can change Earth's surface quickly and dramatically:		
Fault zone	**A landslide**	**A tsunami**
Fault zone an area of many fractured pieces of curst along large fault Natural and human made features that cross the fault such as streams and railroads, are shifted by earthquakes. San Andreas fault in California	**A landslide** is the rapid downhill movement of soil, loose rocks and boulders. The vibrations of an earthquake can cause large amounts of Earth materials to separate from a slope, gravity quickly causes materials to come crashing downhill.	**A tsunami** is a wave that forms when an ocean disturbance suddenly moves a large volume of water. As blocks of curst move up along a fault, the water above is displaced and forms a gigantic wave. Tsunamis can destroy coastlines
		

Besides plate motion, what else creates major features on Earth?	
Craters form when a meteoroid from the space strikes Earth's surface. Thes impacts leave giant, circular depressions in Earth's surface called **impact craters**	**Canyon's** landforms are created by weathering and erosion over time
	

10	Understand the effects quick changes can have on Earth's surface from earthquake (e.g.: landslide, fault zone, tsunami), and others like meteoroid strikes that creat impact craters	Textbook, Tables, figures	62, 63

How do earthquakes affect earth's surface?



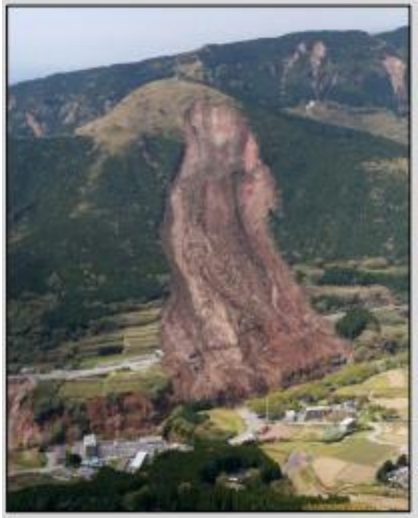
Earthquake: is the rupture and sudden movements of rocks along a break or a crack in earth's crust.

- Earthquakes can change earth's surface quickly

How earthquakes shape earth surface?

1. Faults:

- **Fault:** is a fracture or crack where two rock blocks slide past one to another.
- **Fault zone:** an area of many fractured pieces of crust along a large fault



2. Landslides:

- **Landslides:** the rapid downhill movement of soil, loose rocks, and boulders.

Earthquakes can cause mountains to separate, and gravity quickly causes materials to come crashing downhill.

3. Tsunami:

- **Tsunami:** is a wave that forms when an ocean disturbance suddenly moves a large volume water.

As crust blocks move up along a fault, the water above is displaced and forms a gigantic wave.

Tsunamis can quickly destroy coastlines

10	Understand the effects quick changes can have on Earth's surface from earthquake (e.g.: landslide, fault zone, tsunami), and others like meteoroid strikes that creat impact craters	Textbook, Tables, figures	62, 63

What else create features on earth?

- **Impact craters:** is a giant, circular depressions in earth's surface

Meteoroid → Craters

- There are more than 170 craters on earth
- Meteoroid cause catastrophic and rapid changes on earth

11	Define crystallization and diffrentiate between igneous rocks (extrusive and intrusive)	Textbook, Figure, 3D	104, 105

Igneous Rock Formation Melted rock material is present both on and below Earth's surface. Recall that molten rock is called magma when it is inside Earth. Molten rock that erupts onto Earth's surface is called lava. As magma or lava cools, mineral crystals begin to form. All minerals form through a process called crystallization. The process of **crystallization** occurs when particles dissolved in a liquid, such as lava or magma, solidify and form crystals. Minerals can crystallize as molten rock cools. Earth's internal heat energy drives the processes of melting and crystallization by changing the atomic arrangement of elements in rocks, a chemical change.

PHYSICAL SCIENCE Connection Each pure substance has characteristic physical and chemical properties. A chemical change is a change in matter in which the substances change into other substances with new physical and chemical properties. The arrangement of elements determines the properties of the rock. The substances that undergo a change have different properties because they no longer have the same atomic arrangement.

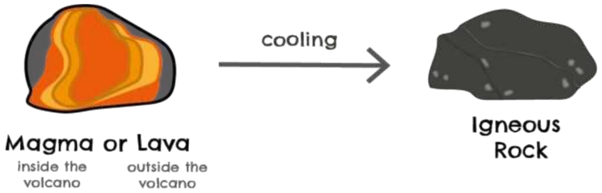
THREE-DIMENSIONAL THINKING

How does the flow of energy from Earth's hot interior drive the formation of igneous rocks?

Sample answer: Earth's hot interior allows for rock, deep inside of Earth, to melt. For igneous rocks to form, molten rock, above and below Earth's surface, must cool and crystallize.

COLLECT EVIDENCE

How does lava flowing out of a volcano relate to the formation of igneous rock? Record your evidence (A) in the chart at the beginning of the lesson.



Where do igneous rocks form?

When lava cools and crystallizes on Earth's surface, the igneous rock that forms is called **extrusive rock.** Lava at Earth's surface cools so quickly, that mineral crystals either have no time to grow, as in the obsidian to the right, or are very small in size. Geologists describe the texture of igneous rocks with small crystals as fine-grained. ▶

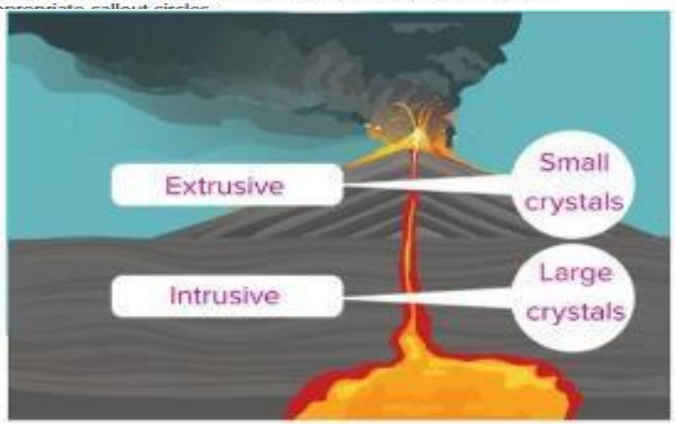
Extrusive rock

Intrusive rock

◀ When magma cools and crystallizes inside Earth, the igneous rock that forms is called **intrusive rock.** Deep below Earth's surface, magma is insulated by solid rock and therefore cools slowly. The crystals have more time to grow and are larger, as shown in the diorite rock to the left. Geologists describe the texture of igneous rocks with large crystals as coarse-grained.

THREE-DIMENSIONAL THINKING

What is the effect of location on crystal size? Label the location of intrusive and extrusive igneous rocks on the diagram below. Then, illustrate the crystal size of the rock formed at that location in the appropriate callout circles.



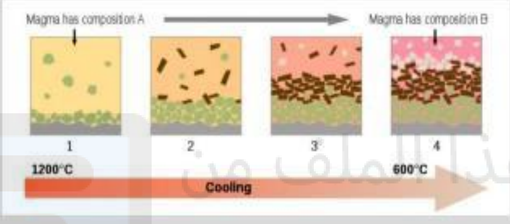
11	Define crystallization and diffrentiate between igneous rocks (extrusive and intrusive)	Textbook, Figure, 3D	104, 105

How do igneous rocks form?

- *How do igneous rocks form?*

Magma erupts on earth's surface and becomes lava. ⇨ Lava cools down and crystallizes ⇨ Minerals and igneous rocks form

Crystallization: the process by which particles dissolved in a liquid solidify and form crystals.



The process of melting and crystallization changes the atomic arrangement of elements in rock → Chemical change

Types of igneous rocks

Read page 105 to fill the table:

	Extrusive rocks	Intrusive rocks
Appearance		
Where does it form?	*On earth surface*	*Inside earth surface*
When does it form?	*When lava cools*	*When magma cools*
Mineral crystal size, why?	*Small, because lava cools down quickly, and they have no time to grow.*	*Large, because magma cools down slowly, and they have time to grow.*
Texture	*Fine - grained*	*Coarse - grained*

12	Describe how sedimentary rocks are classified, and list the common sedimentary rock types. the processes of lithification, compaction and cementation	Describe	Textbook, figures, table	112, 114

4. What role does the sugar have in the formation of the "rock"?

Students should suggest that the sugar is holding the sand together to create the "rock".

5. Why is a cementing material needed to hold sedimentary rocks together?

Pressure alone can't make grains stick together. A cementing material acts to hold them together.

6. What do you think is the "glue" holding sediments together in a sedimentary rock such as sandstone?

Students may suggest that the "glue" is minerals or other deposits left after the water evaporates.

Cementing Rock Together **Lithification** is the process through which sediment turns into rock. Imagine sediment deposits becoming thicker over time. Younger sediment layers bury older sediment layers. As time passes, more and more layers are deposited and the old and young layers of sediment are buried by even younger sediment deposits. The weight from the layers of sediment forces out fluids and decreases the space between grains during a process called **compaction.**

Compaction is often followed by a process called cementation. When minerals dissolved in surrounding water crystallize between grains of sediment, **cementation** occurs. Mineral cement holds the grains together, as shown to the left.

COLLECT EVIDENCE

How do sedimentary rocks form from sediment? Record your evidence (B) in the chart at the beginning of the lesson.

What are the different types of sedimentary rocks?

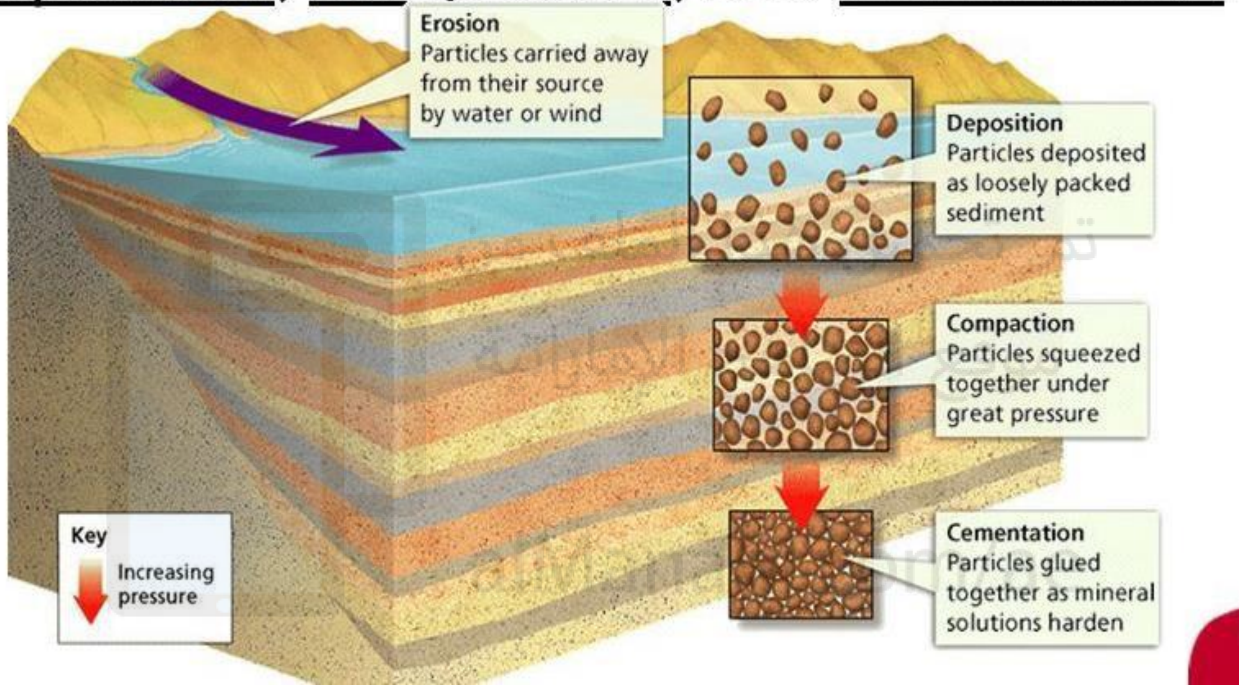
All sedimentary rocks form from the cementing of different types of sediment. Types of sedimentary rocks include clastic sedimentary rocks, chemical sedimentary rocks, and biochemical sedimentary rocks.

Types of Sedimentary Rocks	
Clastic Sedimentary Rocks Sedimentary rocks that are made up of broken pieces of minerals and rock fragments are known as clastic (KLAH stik) sedimentary rocks. The broken pieces and fragments are called clasts.	
Chemical Sedimentary Rocks Chemical sedimentary rocks form when minerals crystallize from water. Water can only hold a certain amount of dissolved solids. During dry conditions, as water evaporates, solids crystallize out of the water and form minerals.	
Biochemical Sedimentary Rocks Biochemical rock is a sedimentary rock that was formed by organisms or contains the remains of organisms. Some marine organisms such as mussels, clams, corals, and snails make their shells from dissolved minerals in the ocean. When these organisms die, their shells settle onto the seafloor. This sediment is compacted and cemented together. The most common biochemical sedimentary rock is limestone.	

12	Describe how sedimentary rocks are classified, and list the common sedimentary rock types. the processes of lithification, compaction and cementation	Describe	Textbook, figures, table	112, 114

From Sediment to Rock

Most sedimentary rocks are formed through a series of processes: erosion, deposition, compaction, and cementation.



Sediments can be small or big and they are the building block of sedimentary rocks.

Lithification: process through which sediments turn into rocks.

How do sediments become stuck together to form rocks?

More and More sediments deposit forming layers. → old layers of sediments are buried by younger sediments. → **compaction**: weights from layers forces out fluids between them and decrease space between grains. → **Cementation**: Dissolved minerals in water crystallizes between grains holding them together.

12	Describe how sedimentary rocks are classified, and list the common sedimentary rock types. the processes of lithification, compaction and cementation	Describe	Textbook, figures, table	112, 114

Sedimentary Rock Classification

Clastic
(mostly siliciclastics)
(aka terrigenous)

Chemical
(mostly evaporites)
(aka orthochemical)

Biochemical
(mostly carbonates)
(aka allochemical)

What are different types of sedimentary rocks?

1. Clastic sedimentary rocks

Made up of broken pieces of minerals and rock fragments that are called **clasts**.

2. Chemical sedimentary rocks

Water holds dissolved solids, and when it evaporates, solid crystallizes out of water and forms minerals.

3. Biochemical sedimentary rocks

Formed by remains of organisms such as mussels, clams, corals, and snails make their shells from dissolved organisms. When they die, sediments from shells compact and cement together

- Example: Limestone

12	Describe how sedimentary rocks are classified, and list the common sedimentary rock types. the processes of lithification, compaction and cementation	Describe	Textbook, figures, table	112, 114

13) Sedimentary rocks are _____.

- **A)** formed from magma
- **B)** a type of foliated igneous rock
- **C)** formed because of changes in temperature and pressure, or the presence of hot watery fluids
- **D)** formed when loose materials become pressed or cemented together or when minerals form from solutions

13	Compare between the scales used to classify and measure the strength of earthquackes	Textbook, figures, tables	144, 145

As you just learned, the Richter magnitude scale is based on the height of the lines on a seismograph. As earthquake magnitude increases, so does the amplitude of the seismograph line. What other factors do you think might make an earthquake reading even more accurate?

INVESTIGATION

Accuracy Counts

With a partner, brainstorm factors that you think would help scientists make a more accurate earthquake assessment.

Students' answers will vary. Students may suggest knowing the structural integrity of a building, the local geography, or the amount of damage produced from the earthquake as being useful to help scientists make a more accurate earthquake assessment.

- **Richter scale vs. moment scale**

Similarities:

Both measure the magnitude of an earthquake by the seismic energy released.

Differences:

Moment scale use newer technology to produce more accurate measurement

Moment Magnitude Scale When an earthquake is first reported, the Richter magnitude scale is usually applied first. After further study, the moment magnitude can be determined and is applied to the earthquake. The **moment magnitude scale** is a rating scale that measures the energy released by an earthquake, taking into account the size of the fault that breaks, the motion that occurs along the fault, and the strength of the rocks that break during an earthquake. Both scales measure the magnitude of a quake by the seismic energy released and the readings generated by the two can be very similar, but the moment magnitude scale uses newer technologies to produce a more accurate measurement of a specific earthquake event.

Modified Mercalli Scale Another way to measure and describe an earthquake is to evaluate the damage that results from shaking. Shaking is directly related to earthquake intensity, or strength. The **Modified Mercalli Intensity scale** measures earthquake intensity based on descriptions of the earthquake's effects on people and structures. The Modified Mercalli Intensity scale ranges from I, when shaking is not noticeable, to XII, when everything is destroyed. Let's investigate how the damage of an earthquake can vary based on location.

LAB Damage Detective

Materials

colored pencils

Procedure

1. Read the Modified Mercalli Intensity scale below so you become familiar with the descriptions.

I	Earth movement is not felt by people.
II	A few people may feel movement if they are sitting still. Hanging objects may sway.
III	Felt noticeably indoors, especially on upper floors. May not be recognized as an earthquake. Vibrations feel like the effects of a truck passing by.
IV	Felt by many people indoors but by few people outdoors. Dishes, windows, and doors rattle.
V	Felt by almost everyone. Sleeping people are awakened. Some windows are broken and plaster cracked. Some unstable objects are overturned. Bells ring.
VI	Felt by everyone. Many people are frightened and run outdoors. Some heavy furniture moves. Some plaster falls from walls and some chimneys are damaged.
VII	People run outdoors. Earth movement is noticed by people driving cars. Damage is slight in well-built buildings and considerable in poorly built structures. Some chimneys are broken.
VIII	Damage is slight in well-designed buildings and extreme in poorly built structures. Chimneys and walls may fall.
IX	Damage is considerable in well-designed buildings. Buildings shift from their foundations and partly collapse. Ground may crack, and underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. Ground is badly cracked. Rails are bent and landslides are common.
XI	Few, if any, structures remain standing. Bridges are destroyed. Railroad rails are greatly bent. Broad fissures and cracks form in the ground.
XII	Total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

13	Compare between the scales used to classify and measure the strength of earthquackes	Textbook, figures, tables	144, 145

Modified Mercalli Scale **Richter Magnitude Scale** **Moment Magnitude Scale**

Modified Mercalli Scale: Measures earthquake intensity based on descriptions of earthquake effects on people and structures.

- It is ranging from:

I (1) → XII (12)

Not noticeable — Destroy everything

Richter Magnitude Scale: is a numerical rating system that measures the energy (or magnitude) of the largest seismic waves produced by an earthquake.

Moment Magnitude Scale: is a rating scale that measures the energy released by an earthquake, considering the fault and the broken rocks.

14	Compare between volcanic hazards	Textbook, figures, table	174, 175

What factors affect the amount of damage caused by a volcano?

On average, about 60 different volcanoes erupt each year. There are many factors that determine the severity of damage produced by a volcano. These factors are called volcanic hazards. Explore the different types of volcanic hazards in the table.

Volcanic Hazards

Mudflows
The thermal energy a volcano produces during an eruption can melt snow and ice on the summit. This meltwater can then mix with mud and ash on the mountain to form mudflows. Mudflows are also called lahars.

Lava Flows
Lava flows are usually slow moving, so they're rarely deadly. But these rivers of red molten rock are still damaging. Lava melts everything in its path as it flows. When the lava hardens, it can leave behind thick, black layers of rock. Farmland is lost and homes cannot be rebuilt on the land.

Volcanic Ash
During an explosive eruption, volcanoes can emit large volumes of volcanic ash. Ash columns can reach heights of more than 40 m. A deposit of volcanic ash about 1 cm thick could disrupt air traffic and cause engines to stop in mid-flight as shards of rock and ash fuse onto hot engine blades. It could also damage electrical equipment, farm machinery, and crops. Ash can also affect air quality and cause serious breathing problems.

Volcanic Hazards, continued

Volcanic Gases
The dissolved gases in magma include water vapor and small amounts of carbon dioxide and sulfur dioxide. Water vapor does not harm living things, but sulfur dioxide can irritate the skin and eyes, and carbon dioxide can be deadly. When this gas is given off during eruptions, it can settle in low-lying areas and reach higher concentrations. A concentration of 3 percent can cause headaches and dizziness. Concentrations of 15 percent can cause death.

Landslides
Landslides are the rapid downhill movement of soil, loose rocks, and boulders. During an eruption, the mountain shakes and rocks are weakened. Massive landslides of rocks ranging from particles to boulders are common.

Pyroclastic Flows
Explosive volcanoes can produce fast-moving avalanches of hot gas, ash, and rock called pyroclastic flows. Pyroclastic flows travel at speeds of more than 100 km/hr and have temperatures greater than 1000°C.

Volcanic Hazards A violent volcanic eruption can have far-reaching impacts. Its hazards can affect all Earth systems. Volcanic ash can block sunlight and disrupt air travel. Lava flows can cover large areas of land. Volcanic gases can harm living things. Pyroclastic flows can destroy communities and kill thousands of people. A volcano can exhibit one or more of these hazards.

14	Compare between volcanic hazards	Textbook, figures, table	174, 175

Volcanic Hazards

There are 60 different volcanos erupts every years !!!

There are different types of volcanic hazards:

Mudflows

Heat of volcanoes

↓

Melt ice and snow

↓

Meltwater + ash + mud = mudflows

Lava Flows

Lava flows slowly and melt everything in its path

When it hardens, it creates thick, black layers of rock

Volcanic Ash

Ash height more than 40m

It disrupt air traffic, damage electrical equipment, farms, cause pollution and breathing problems

Volcanic gasses

Dissolved gasses in magma such as CO_2, SO_2, H_2O.

Harmful gases can irritate skin, eyes and lead to death.

Landslides

During an eruptions, the mountain shakes and cause massive landslides

Pyroclastic Flows

These are the fast-moving hot gases, ash and rock.

Speed: 100km/hr
Temp.: >1000 °C

14	Compare between volcanic hazards	Textbook, figures, table	174, 175

4) Which statement accurately describes a pyroclastic flow?

- **A)** Pyroclastic flows move at speeds of more than 100 km/hr and have temperatures over 1,000°C.
- **B)** Pyroclastic flows occur when the snow and ice of the summit are melted and mix with the ash and mud on the mountain.
- **C)** Pyroclastic flows move very slowly, and are rarely deadly.
- **D)** Pyroclastic flows move very quickly but are relatively cool.

1) Long streams of molten rock from volcanoes are called ______.

- **A)** volcanic ash
- **B)** a caldera
- **C)** lava flows
- **D)** a seismic event

A ______ occurs when part of a volcano collapses and cause a rapid downhill movement of rock and soil.

answer choices

- pyroclastic flow
- landslide
- acid rain
- geyser

8) Ash, lava, and ____gases____ erupt from the crater of a volcano.

15	Explain how can volcanic eruptions predicted and how to reduce volcanic hazards	Textbook, investigations, fig, table	184, 185, 186

1. Would you issue a warning for an eruption for this volcano? Why or why not?

Sample answer: Yes, a warning should be issued. Seismic activity, dome expansion, tilt, and volcanic gas emissions have been on a steady increase, and most have risen sharply over the past 10 days. These features and phenomena suggest an increase in volcanic activity below the surface.

2. What might an increase in dome expansion and tilt indicate about the volcano?

Sample answer: Magma must be accumulating near the surface, causing the volcano to swell. An increased rate of swelling indicates that an eruption could occur in the near future.

Predicting Volcanoes Can volcanoes be predicted? Yes! However, the exact moment of the eruption cannot be predicted. Most volcanoes give off warning signs before they erupt. This enables scientists to usually give people enough advance warning to allow them to safely evacuate the area. To predict a volcanic eruption, scientists monitor factors such as:

- earthquake activity,
- changes in the tilt of the volcano and surrounding ground,
- gas emissions,
- lava samples, and
- thermal changes in the volcano.

All these factors, in addition to the past eruptive history of a volcano, go into evaluating the possibility of future eruptions.

The USGS has established five volcano observatories to monitor the potential for future volcanic eruptions in the United States. Because large populations of people live near volcanoes such as Mount Rainier, the USGS has developed a hazard assessment program that predicts where and when an eruption will occur. Examine the table to learn more about how volcanoes are monitored.

Monitoring Volcanoes	
Gas	From the ground and the air, scientists collect samples of gases released at vents. They analyze these samples in the lab. Increases in certain gases can indicate a potential eruption.
Deformation	Scientists use tiltmeters, GPS, and surveying equipment to monitor the ground around volcanoes and the volcano itself. As magma rises toward Earth's surface, the ground might tilt, sink, or bulge from pressure.
Ground Vibration	Earthquake activity beneath a volcano is an indicator of impending eruptions. One way to monitor earthquakes is to check seismic activity. Scientists place earthquake sensors near the vents of volcanoes.
Remote Sensing	Scientists use remote sensing to determine how much heat a volcano is emitting and to create 3-D maps of the area around a volcano. These data can be used to predict where lava might flow and how hot it will be.
Lava Collection	Imagine standing next to moving lava that is 1,170°C! To get a direct measurement of lava temperature or to collect a sample, scientists must wear protective gear and watch where they step. Samples are collected with heat-resistant materials and immediately cooled in a container to prevent contamination from the surrounding air. Samples of lava help scientists learn about the properties of magma before it erupts, and to compare samples from other active volcanoes to identify patterns.

Gas

Lava Collection

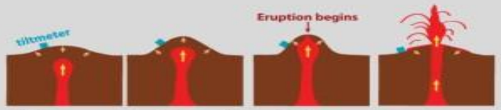
15	Explain how can volcanic eruptions predicted and how to reduce volcanic hazards	Textbook, investigations, fig, table	184, 185, 186

Predicting Volcanoes

Can volcanoes be predicted? ***YES, But the exact moment cannot be predicted***

To predict a volcanic eruptions, Scientists monitor the following factors:

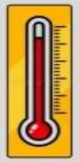
Earthquake Activity



Changes in the tilt of the volcano and the surrounding ground

Gas emissions

Lava Samples



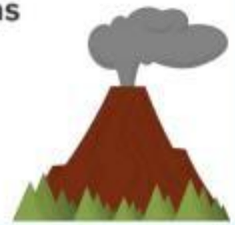
Thermal changes

All the monitored factors + the history of the volcano will enable scientist to evaluate the possibility of future eruptions

Lava Collection

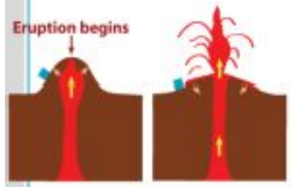
Imagine standing next to moving lava that is 1,170°C! To get a direct measurement of lava temperature or to collect a sample, scientists must wear protective gear and watch where they step. Samples are collected with heat-resistant materials and immediately cooled in a container to prevent contamination from the surrounding air. Samples of lava help scientists learn about the properties of magma before it erupts, and to compare samples from other active volcanoes to identify patterns.

Gas



From the ground and the air, scientists collect samples of gases released at vents. They analyze these samples in the lab. Increases in certain gases can indicate a potential eruption.

Deformation

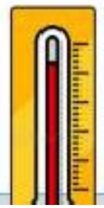


Scientists use tiltmeters, GPS, and surveying equipment to monitor the ground around volcanoes and the volcano itself. As magma rises toward Earth's surface, the ground might tilt, sink, or bulge from pressure.

Ground Vibration

Earthquake activity beneath a volcano is an indicator of impending eruptions. One way to monitor earthquakes is to check seismic activity. Scientists place earthquake sensors near the vents of volcanoes.

Remote Sensing



Scientists use remote sensing to determine how much heat a volcano is emitting and to create 3-D maps of the area around a volcano. These data can be used to predict where lava might flow and how hot it will be.

15	**Explain how can volcanic eruptions predicted and how to reduce volcanic hazards**	**Textbook, investigations, fig, table**	**184, 185, 186**

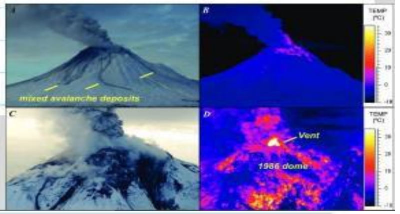
INVESTIGATION

Volcanic Technologies

WRITING Connection Obtain information by researching one of the technologies presented on the previous page or a new technology that you find that engineers have developed to study volcanoes.

1. Construct an explanation about how the technology you researched can help forecast the likelihood of a future volcanic eruption.

- **GPS**
- **Tiltmeter**
- **Seismographs**
- **Instruments that measure gas emission**
- **Electronic distance measurement**
- **Infrared cameras**



2. Organize your research in your Science Notebook and communicate your findings by presenting them to your class.
3. Create a table that lists the features of each technology you and your classmates researched. Evaluate the effectiveness of each technology.
4. Why does technology used to mitigate the effects of volcanoes vary from region to region and over time? Write your response in your Science Notebook.

Reducing Volcanic Hazards Understanding what a volcano can do is the first step in mitigating volcanic hazards. Active volcanoes in the United States are regularly monitored for signs of activity. They are ranked on a scale that ranges from normal (non-erupting) to warning (major eruption predicted). Scientists and government officials cannot stop a volcano from erupting, but they can take steps to reduce the negative effects of an eruption and ensure the safety of the community.

COLLECT EVIDENCE

What technologies are used to mitigate the effects of volcanic eruptions? Record your evidence (C) in the chart at the beginning of the lesson.

3) Which of the following is NOT studied by geologists to predict volcanic eruptions?

- **A)** ground deformation
- **B)** earthquake swarms
- **C)** change in shape of the volcano
- **D)** animal behavior

Scientists use .... To determine how much heat a volcano is emitting and to create 3-D maps of the area around a volcano.

answer choices

- Lava collection
- Remote sensing.

scientist use and to monitor the ground around volcano and volcanoes itself

answer choices

- Lava and Pyroclastic
- Tiltmeters, GPS and surveying equipments
- Ground vibration
- Locations

Reducing Volcanic Hazards

Active volcanos are regularly monitored for signs of activity. They are ranked on a scale that ranges from:

Normal (Non erupting) → **Warning (Major eruption)**

Governments can't stop volcanos, but they can take steps to reduce the negative effects by:

1. Monitor the warning signs

2. Give people enough advance warning to evacuate the area

16	Diffrentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207

What kinds of damage do tornadoes cause?

Dr. Ted Fujita developed a method to classify tornadoes based on the damage they cause. The scale is called the Enhanced Fujita Damage Intensity scale. Each category of tornado becomes progressively more devastating. Let's investigate this scale.

INVESTIGATION

Twisting in the Wind

Complete the chart with statements from the word bank in the space provided.

Large debris becomes airborne. Manufactured homes are damaged.
Small buildings are destroyed. Trees are completely debarked.
Tree branches are broken. Windows are broken.

Enhanced Fujita Damage Intensity Scale		
Category	Wind Speed	Damage
EF–0	105-137 km/h	1. Tree branches are broken.
EF–1	138-177 km/h	2. Windows are broken.
EF–2	178-218 km/h	3. Manufactured homes are damaged.
EF–3	219-266 km/h	4. Small buildings are destroyed.
EF–4	267-322 km/h	5. Large debris becomes airborne.
EF–5	>322 km/h	6. Trees are completely debarked.

Tornado Damage On the Enhanced Fujita Damage Intensity Scale, EF–0 tornadoes cause light damage, breaking tree branches and damaging billboards. EF–1 though EF–4 tornadoes cause moderate to devastating damage, including tearing roofs from homes, derailing trains, and throwing vehicles in the air. EF–5 tornadoes cause incredible damage, such as demolishing concrete and steel buildings and pulling the bark from trees. Examine the table to learn more about how tornadoes are categorized.

Enhanced Fujita Damage Intensity Scale		
Category	Wind Speed	Damage
EF–0	105–137 km/h (65–85 mi/h)	**Light Damage** Chimneys are damaged; tree branches are broken; shallow-rooted trees are toppled.
EF–1	138–177 km/h (86–110 mi/h)	**Moderate Damage** Roof surfaces are peeled off; windows are broken; tree trunks are snapped.
EF–2	178–218 km/h (111–135 mi/h)	**Considerable Damage** Roof structures are damaged; manufactured homes are destroyed.
EF–3	219–266 km/h (136–165 mi/h)	**Severe Damage** Roofs and some walls are torn from structures; small buildings are destroyed; most trees in forests are uprooted.
EF–4	267–322 km/h (166–200 mi/h)	**Devastating Damage** Some structures are lifted from their foundations and blown some distance. Cars also are blown some distance. Large debris becomes airborne.
EF–5	>322 km/h (>200 mi/h)	**Incredible Damage** Strong frame houses are lifted from foundations; reinforced concrete structures are damaged. Automobile-sized debris becomes airborne. Trees are completely debarked.

Tornado Safety Tornadoes can be dangerous. To help keep people safe, forecasters issue a tornado watch when the correct conditions are present to form a tornado. If a funnel cloud or tornado is spotted, forecasters issue a tornado warning. If a tornado warning is issued for your area, go inside a sturdy building. If possible, go to the basement. If an underground shelter is not available, move to an interior room or hallway on the lowest floor and get under a sturdy piece of furniture.

The National Weather Service stresses that despite advanced tracking systems, some tornadoes develop very quickly. In these cases, advance warnings might not be possible. However, the threat of tornado-related injury can be substantially decreased when people seek shelter, such as the one shown to the right, at the first sign of threatening skies.

COLLECT EVIDENCE

Why are some areas at a greater risk for tornadoes? Record your evidence (B) in the chart at the beginning of the lesson.

16	Differentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207

Tornadoes: A violent, whirling column of air in contact with the ground.

- Tornadoes can be powerful and destroy everything in their path and usually the last for few seconds.
- They can move objects and species to new area.

- The strength of a tornado can be measured by a scale called *Enhanced Fujita Damage Intensity.*

- Tornadoes are classified by:
  - wind speed
  - damage they cause

Tornadoes strength

- EF-0 cause light damages
- EF-1 to EF-4 cause moderate to devastating damage
- EF-5 cause incredible damage

Table 1 Enhanced Fujita Damage Intensity Scale

Category	Wind Speed	Damage	
EF-0	105–137 km/h (65–85 mi/h)	**Light Damage** Chimneys are damaged; tree branches are broken; shallow-rooted trees are toppled.	ضرر خفيف
EF-1	138–177 km/h (86–110 mi/h)	**Moderate Damage** Roof surfaces are peeled off; windows are broken; tree trunks are snapped.	ضرر متوسط
EF-2	178–218 km/h (111–135 mi/h)	**Considerable Damage** Roof structures are damaged; manufactured homes are destroyed.	ضرر بالغ
EF-3	219–266 km/h (136–165 mi/h)	**Severe Damage** Roofs and some walls are torn from structures; small buildings are destroyed; most trees in forests are uprooted.	ضرر شديد
EF-4	267–322 km/h (166–200 mi/h)	**Devastating Damage** Some structures are lifted from their foundations and blown some distance. Cars also are blown some distance. Large debris becomes airborne.	ضرر مدمر
EF-5	>322 km/h (>200 mi/h)	**Incredible Damage** Strong frame houses are lifted from foundations; reinforced concrete structures are damaged. Automobile-sized debris becomes airborne. Trees are completely debarked.	ضرر غير معقول

16	Differentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207

Summary

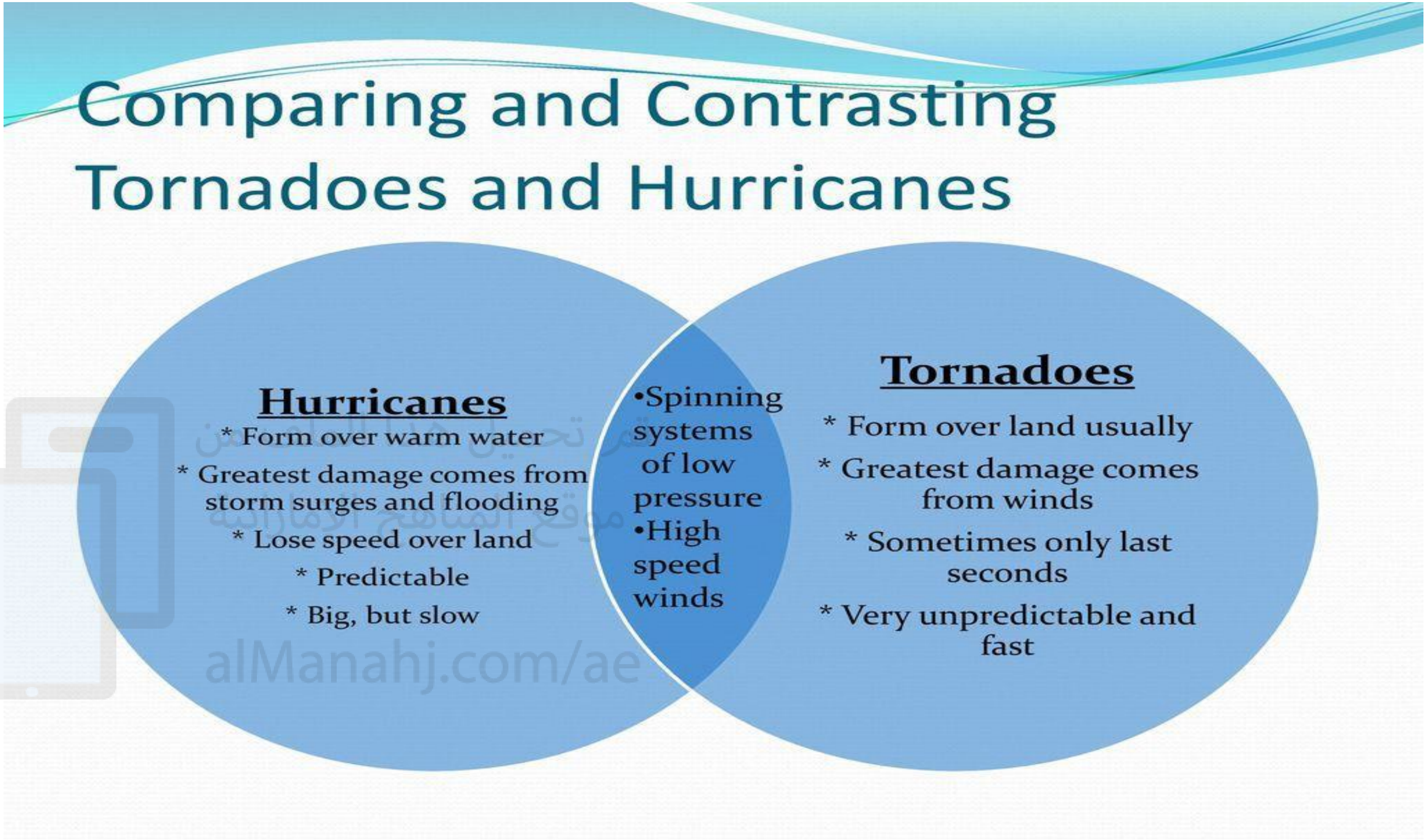
	Tornadoes	Hurricanes
Definition	A violent, whirling column of air in contact with the ground.	is an intense tropical storm with winds exceeding 119 km/h.
Where they form?	Over lands	Over warm water
How long they last?	Seconds – 1 hour	Few days - few weeks
Measured by	Enhanced Fujita scale	Saffir-Simpson Scale

Similarities

- Both are forms of severe weather
- Both can cause major damage
- People are alerted by a watch or a warning
- Both have strong winds

- ***Hurricanes* generally produce more damage**

16	Diffrentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207



16	Differentiate between hurricanes and tornadoes, and assign the category of a tornadoe using the "Enhanced Fujita Damage Intensity Scale"	Textbook, Investigation, figures	206, 207

15) A tornado watch means?

- ● **A)** The conditions are right for a tornado, but it is not occurring yet.
- ○ **B)** A tornado is occurring.
- ○ **C)** A tornado has passed through and it is now safe to go outside.
- ○ **D)** It is the season during which tornadoes occur.

16) The most powerful severe storm is the ____.

- ○ **A)** thunderstorm
- ○ **B)** tornado
- ● **C)** hurricane
- ○ **D)** front

5) Which classification of tornado on the Enhanced Fujita scale does the most damage?

- ○ **A)** EF0
- ○ **B)** EF2
- ○ **C)** EF4
- ● **D)** EF5

How do the conditions for a tornado differ from the conditions for a hurricane?

answer choices

- ● Tornadoes never form when there is rain, while hurricanes always form with rain.
- ● Tornadoes form under low pressure, while hurricanes form under high pressure
- ● Tornadoes form in a stable atmosphere, while hurricanes form in an unstable atmosphere
- ● Tornadoes form over land, while hurricanes form over bodies of water

What is the scale that is used to measure tornadoes?

answer choices

- ● Mohs Scale
- ● Enhanced Fujita Scale
- ● Saffir Simpson Scale
- ● McDonalds Scale

PART 3 (WRITTEN)

Part 3 الجزء الثالث	17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14
	18	Compare and contrast between plate boundaries according to: shape, movment, and location	Textbook, figures, summerize it	48, 49, 64
	19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84
	20	List the major groups of rocks: (igneous, sedimentary, and metamorphic), differentiate between lava and magma and assign them on a volcano diagram	Textbook, figures	34, 102

Bonus Questions - الأسئلة الإضافية	21	unannounced		
	22	unannounced		

17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14

How do rocks provide evidence that continents move?

Wegener argued that the continents were once joined together in a single supercontinent he named **Pangaea** and later drifted apart. He named this new hypothesis **continental drift.** Several types of evidence have been used to support the idea that Earth's continents were once joined and drifted slowly over time to their present positions. How can you use rock evidence to reconstruct Pangaea?

LAB Reconstructing Pangaea

Safety

Materials

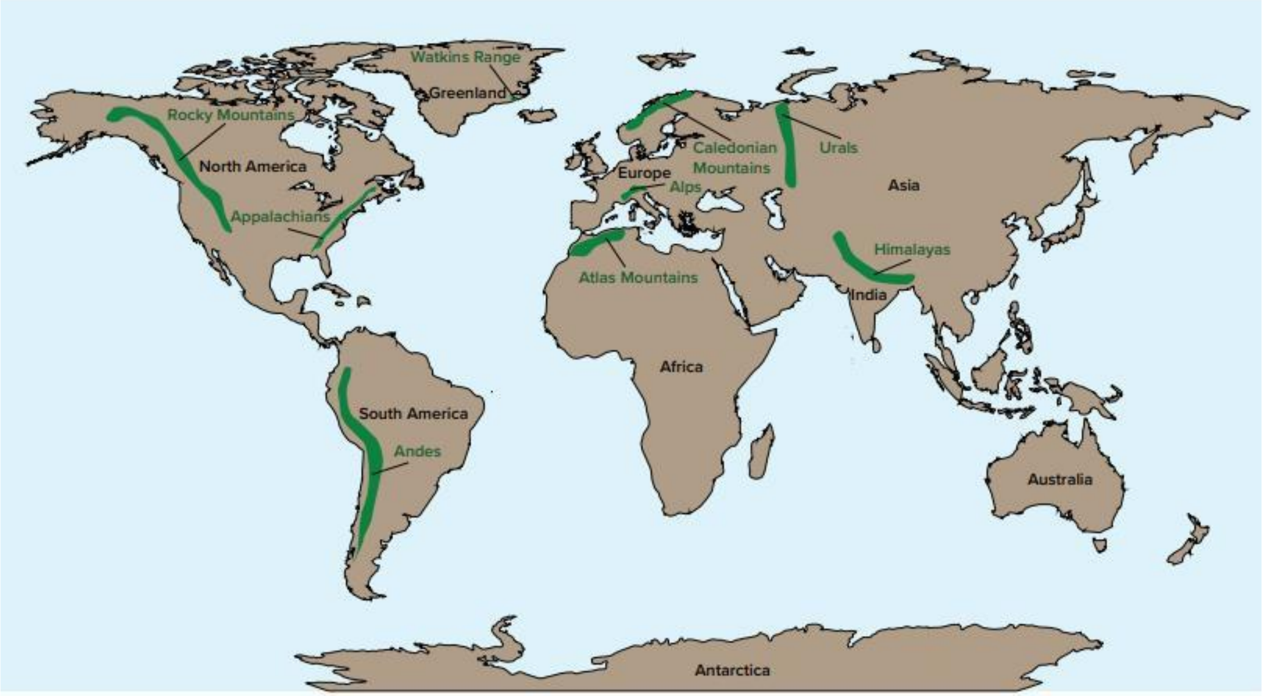
world map scissors glue stick

Procedure

1. Read and complete a lab safety form.
2. Obtain a world map from your teacher. Carefully cut out Greenland, North America, South America, Africa, Australia, Eurasia, which is Europe and Asia, and Antarctica.
3. Study the pieces. Locate mountain ranges on each landmass. Similar rock types and similar geologic structures in certain mountain ranges are evidence that some features once formed continuous mountain chains.
4. Use the shapes of the landmasses and the locations of the mountain chains to reconstruct Pangaea.
5. When you are sure of your reconstruction, glue the supercontinent in your Science Notebook. Create a sketch of your Pangaea in the Data and Observations section.

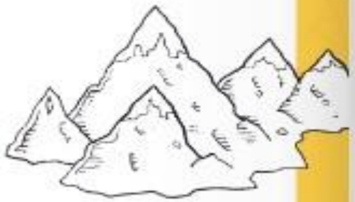
Data and Observations

LAB Reconstructing Pangaea



17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14

Analyze and Conclude



6. Describe what your map represents. Which mountains likely formed continuous chains long ago?

The Appalachians, parts of the Alps and Atlas Mountains, the mountains along the Greenland coast, and the Caledonians were likely one continuous chain in the past.

7. Make a claim about how geologic data supports the idea that continents move. Use evidence from the investigation to support your claim.

Sample answer: Widely separated mountain chains with similar rocks and geologic structures indicate that Earth's continents were once joined and slowly drifted apart over time.

Evidence from Rock Formations Wegener reasoned that when Pangaea began to break apart, large geologic structures, such as mountain ranges, became separated as the continents drifted apart. Using this reasoning, Wegener thought that there should be areas of similar rock types on opposite sides of the Atlantic Ocean. Today, geologists can determine when these rocks formed. For example, geologists suggest that large-scale volcanic eruptions occurred on the western coast of Africa and the eastern coast of South America at about the same time hundreds of millions of years ago. The volcanic rocks from the eruptions are identical in both chemistry and age.

COLLECT EVIDENCE

What do similar rocks tell you about South America and Africa? Record your evidence (B) in the chart at the beginning of the lesson.

Evidence from Glacial Features When Wegener was trying to piece Pangaea together, he studied sediments in South America, Africa, India, and Australia. Beneath these sediments, Wegener discovered 290-million-year old glacial grooves, or deep scratches in rocks made as glaciers moved across land.

THREE-DIMENSIONAL THINKING

Analyze the map below. The white areas show the locations of glacial grooves.

Interpret the map. Could ice caps, similar to the one that covers Antarctica today, exist on these continents in their present locations? How do **patterns** of glacial features provide evidence of continental drift?

These areas are too warm to have massive ice sheets today. If the Southern Hemisphere continents could be reassembled into Pangaea, the presence of an ice sheet would explain the glacial features on these continents today.

Evidence from Coal Deposits Wegener found additional evidence in rocks that the climates of some continents had changed drastically. For example, coal deposits have been found in Antarctica. Coal forms from the compaction of ancient swamp plants that grew in warm, wet regions. The presence of coal beds in Antarctica indicated that this frozen land once had a tropical climate. Wegener used this evidence to conclude that Antarctica must have been much closer to the equator sometime in the geologic past.

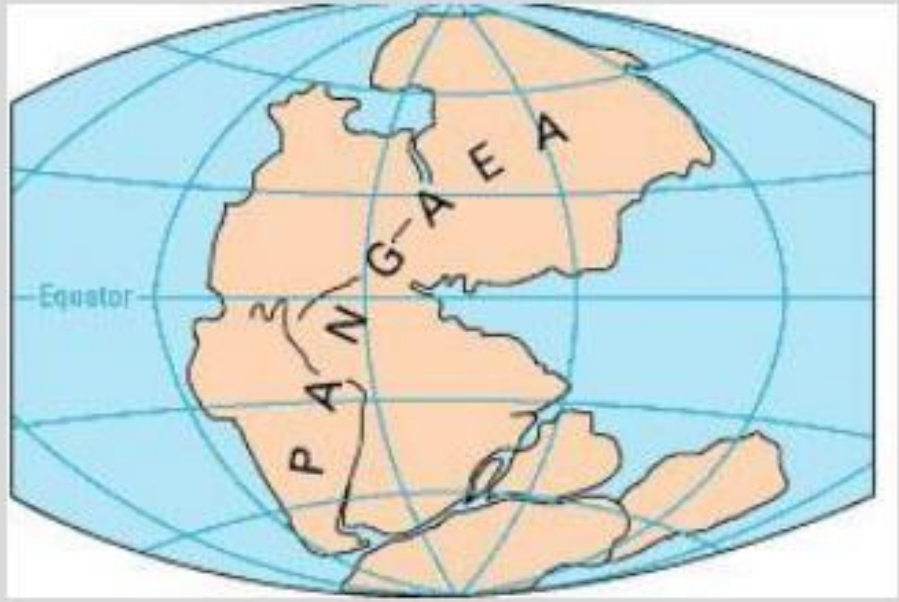
COLLECT EVIDENCE

Do South America and Africa share other geologic similarities? Record your evidence (C) in the chart at the beginning of the lesson.

17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14

Compare between Pangaea and Gondwana:

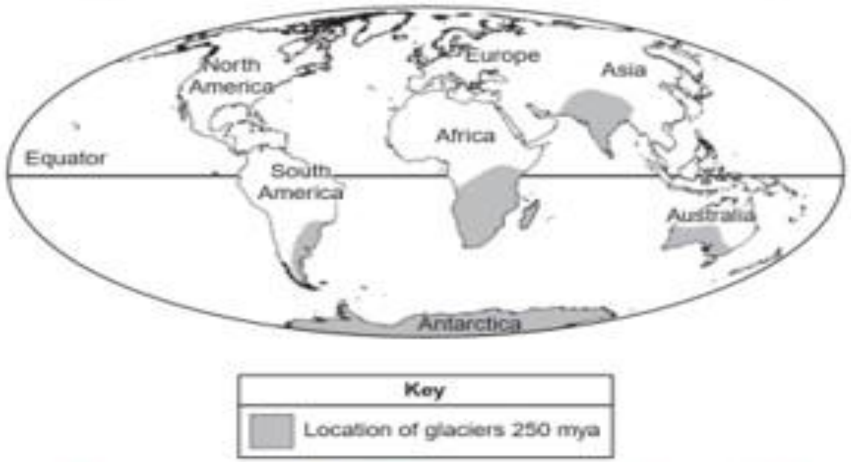
Gondwana : A southern supercontinent. It formed when Pangaea broke up, and consists of Africa, south America, India, Australia, and Antarctica.



Pangaea: **was a supercontinent or a single landmass, composed of all the continents of Earth that existed 250 million years ago**

17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14

The map shows where glaciers existed 250 million years ago.



How do patterns of glacial features provide evidence of continental drift?

These areas are too warm to have massive ice sheets today. If the Southern Hemisphere continents could be reassembled into Pangaea, the presence of an ice sheet would explain the glacial features on these continents today.

Why did Alfred Wegener believe that all the continents once had been joined?

The edges looked as if they would fit together like the pieces of a puzzle.

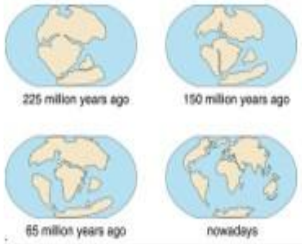
Identify two pieces of evidence used to support the hypothesis of continental drift.

Rocks of the same age and composition have been found on different continents, indicating that the rocks formed at the same time and place. Fossils of land-dwelling organisms, such as *Cynognathus*, have been found on continents that are now separated by vast oceans. These discoveries are evidence that the continents were once joined together, and drifted apart over time.

17	Compare between Pangaea and Gondwana, and List the evidences that led Wegnar to estate his theory "the Continental drift"	Textbook, figures, 3D	12, 13, 14

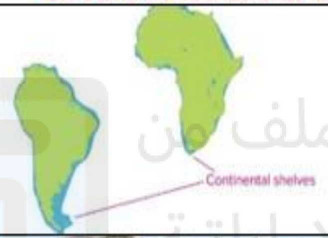
Lesson 1 moving continents

In 1912, a German scientist named **Alfred Wegner** notice that the coastlines of different and faraway continents line up and match.

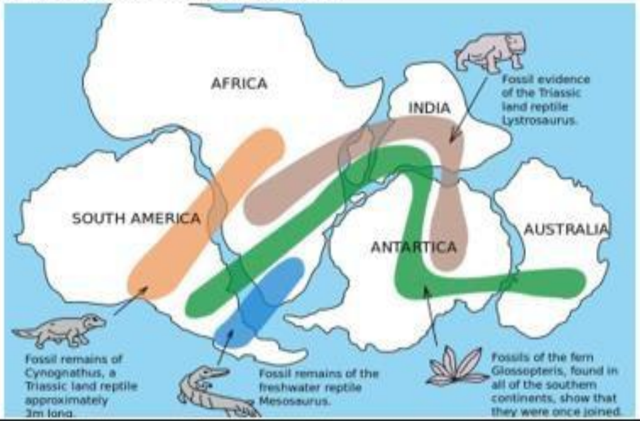


Pangaea was a supercontinent or a single landmass, composed of all of the continents of Earth.

Continental drift hypothesis that over millions of years, Pangaea split up and the continents drifted over Earth's surface.

<table>
<tr><th colspan="3">Evidence of continental drift hypothesis</th></tr>
<tr><td>Matching shapes of continents</td><td></td><td>The eastern coast of South America and the western coast of Africa appear to fit together, which suggest they were once joined in the past</td></tr>
<tr><td>Evidence from rock formations</td><td></td><td>Matching mountain ranges and volcanic rocks from volcanic eruptions occurred on the western coast of Africa and eastern coast of south America are identical in both chemistry and age.</td></tr>
</table>

<table>
<tr><td>Evidence from glacial features</td><td></td><td>In south America, Africa, India, and Australia found matching old glacial groove, or deep scratches in rock as glaciers moved across land. These areas are too warm to have massive ice sheets today.</td></tr>
<tr><td>Evidence from coal deposits</td><td colspan="2">Presence of coal beds in Antarctica indicated that their frozen land once had a tropical climate. Coal forms from the compaction of ancient swamp plant that grow in warm, wet region. Antarctica must have been much closer to the equator some time in the geologic past.</td></tr>
<tr><td>Evidence from fossils

1.Plants Glossopteris (south America-Africa-Australia-antarctica).
2.Coastal reptiles Mesosaurus.
3.Terrestrial reptiles Cynognathus-Lystrosaurus.</td><td></td><td>similar fossils on continents now several thousand kilometer apart and separated by wide oceans suggest that the continents mush have joined in the past</td></tr>
</table>

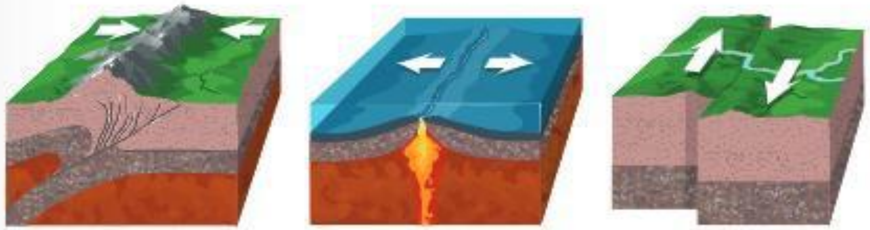
What was missing? **Wegener could not explain how continents moved across the solid rock of the ocean floor.**

18	Compare and contrast between plate boundaries according to: shape, movment, and location	Textbook, figures, summerize it	48, 49, 64

Analyze and Conclude

Analyze the movement of the crackers in each of your models. As plates move relative to each other, they form different types of boundaries. The type of boundary depends on the relative motion of the plates.

Study the diagram of plate boundaries below. Then answer the questions that follow.



Convergent boundary Divergent boundary Transform boundary

12. What type of plate boundary do the crackers in Part I represent?

In Part I of the lab, students are modeling a transform boundary, in which the plates slide past each other.

13. How does the model in Part I simulate an earthquake?

The rubbing crackers vibrate and crumble as they slide past each other. The vibrations represent an earthquake.

14. What type of plate boundary do the crackers in Part II represent?

In Part II of the lab, students modeled a convergent boundary. In this boundary type, two plates collide.

15. What landform does Part II model?

The wet graham crackers represent mountains that form when two plates collide.

16. Suppose you substituted a piece of thick cardboard for one of the graham crackers in Part II. Which material would slide beneath the other? What ocean structure might this model?

Because the cardboard is more dense, it would slide beneath the cracker, modeling an ocean trench.

17. What type of plate boundary do the crackers in Part III represent?

In this part, students are modeling a diverent boundary, in which the plates move away from each other.

18. What shape does the yogurt create when the crackers move? What do you think the yogurt represents?

The yogurt creates a triangular peak and represents magma at a mid-ocean ridge.

THREE-DIMENSIONAL THINKING

WRITING Connection **Explain** why examining time and space phenomena using small-**scale models** such as those in the Lab *Living on the Edge* helps you better understand the **system.**

Sample answer: In science, phenomena often occur on various spatial and temporal scales that are difficult to study in nature. For example, the plate tectonics system involves changes on a planetary scale over a range of time from fractions of a second to billions of years. Models can be used to study systems and phenomena that are too big or too small, or that happen too quickly or too slowly to observe directly.

Plate Boundaries In the *Living on the Edge* lab you modeled the three types of plate boundaries. When two plates move toward each other, the boundary between them is called a **convergent boundary.** A **divergent boundary** is where two plates move apart from each other. **Transform boundaries** are where plates slide horizontally past each other.

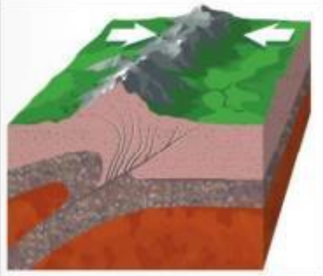
COLLECT EVIDENCE

What happens where plates meet? Record your evidence (A) in the chart at the beginning of the lesson.

18	Compare and contrast between plate boundaries according to: shape, movment, and location	Textbook, figures, summerize it	48, 49, 64

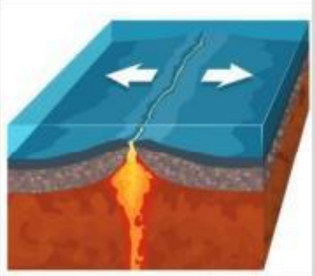
	Convergent Boundary	Divergent Boundary	Transform Boundary
Description of Plate Motion	Plates collide	Plates spread apart	Plates move past on another
Example of a Result of This Type of Plate Motion	Mountains, Volcanos, earthquakes, faults, ocean trenches	Mid-ocean ridges, earthquakes, faults, underwater mountains	earthquakes, faults
Scale of Example (Rapid or Slow/Large or Small)	Large scale Mountains forms slowly Small scale earthquakes occurs rapidly		

<u>The three types of plate boundaries:</u>



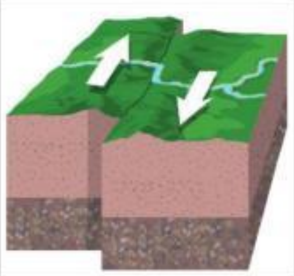
Convergent Boundary

When two plates move toward each other



Divergent Boundary

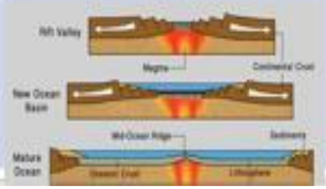
When two plates move apart from each other



Transform Boundary

When plates slide horizontally past each other

18	Compare and contrast between plate boundaries according to: shape, movment, and location	Textbook, figures, summerize it	48, 49, 64

Plate tectonic boundaries	Divergent	Convergent	Transform
Diagram			
Motion	Move apart from each other Spreading	Move toward each other Subduction	Slide horizontally past each other Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Force	Tension	Comparison	Shear
Earthquake activity	Yes	Yes	Yes
Volcanic activity	Yes	Yes	No
Topography	**Ridge** Example: mid- Atlantic Ocean **Rift** **Underwater mountain** **Occur slowly** 	 Trench occur slowly Example: Mariana trench in pacific ocean Fold mountain occur slowly  Example: Andes- Oceanic- continental  Example: Himalayas- Continental-continental Volcanic Arc  Example: Aleutian Oceanic-Oceanic	**Fault Zone** Example: San Andreas Fault in California **Occur rapidly** 

18	**Compare and contrast between plate boundaries according to: shape, movment, and location**	**Textbook, figures, summerize it**	**48, 49, 64**

17) Plates slide past one another at _____.

- ○ **A)** subduction zones
- ● **B)** transform boundaries
- ○ **C)** convection currents
- ○ **D)** divergent boundaries

2) _____ are formed when two continental plates collide.

- ○ **A)** Volcanoes
- ○ **B)** Strike-slip faults
- ● **C)** Mountain ranges
- ○ **D)** Rift valleys

19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

Analyze and Conclude

7. Compare and contrast the "rocks" from each cup.

Students' answers should reflect that the rocks are alike in that they are still rocks. They differ in that they are smoother, smaller, and more broken the more they are shaken.

8. Are rocks on Earth's surface stable? What might cause rocks to change? Explain your reasoning.

Sample answer: Rocks seem stable, however they can change over time. For example, as rocks hit against each other, they can break into smaller pieces.

Weathering Any natural process that changes objects on Earth's surface over time is called **weathering**. Two types of weathering can occur: physical and chemical. Physical weathering breaks rocks into small pieces without changing the composition or chemical make-up of the rock.

LIFE SCIENCE Connection Plants and animals can physically weather rocks. Animals that live in soil create holes in the soil where water enters and causes weathering. Animals burrowing through loose rock, like this mole, can also help to break down rocks as they dig.

The roots of plants can grow into cracks in rocks, as shown on the previous page. The force from the growing roots can pry the rock open.

What happens to a rock when it is exposed to chemical weathering?

Want more information?
Go online to read more about how weathering, erosion, and deposition change Earth's surface over time.

FOLDABLES
Go to the Foldables® library to make a Foldable® that will help you take notes while reading this lesson.

After Weathering... You just discovered that materials on Earth are slowly weathered over time through both physical and chemical processes. What happens to weathered material? Let's look at an example.

INVESTIGATION

Bye-Bye Beach

Examine how this beach changes from one photo to the next below.

1. How did this beach change over time?

Sample answer: The beach has become narrower. The space between the water and the buildings has decreased over time.

2. What do you think caused these changes?

Sample answer: As waves crashed onto the beach, sand was removed by the water and carried to new locations.

Erosion and Deposition As you just investigated, weathered material can be moved or transported to new locations. Geologists use the term **erosion** to describe the moving of weathered material, or sediment, from one location to another. **Deposition** is the laying down or settling of eroded material.

Together, the processes of weathering, erosion, and deposition change the surface of Earth. These processes can occur at spatial scales ranging from large to microscopic, over time periods ranging from seconds to millions or billions of years.

COLLECT EVIDENCE

What processes change Earth's surface over time? Record your evidence (A) in the chart at the beginning of the lesson.

19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

Weathering

Weathering: the process that break down rocks into sediment, changing earth's surface over time.

Types of weathering:

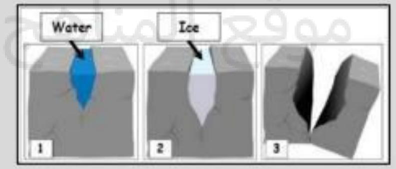
1 Physical weathering

2 Chemical weathering

1 **Physical weathering:** The process of breaking rock into small pieces without changing the composition of the rock.

The roots of plants cracks in rock.

The animals the live in soil



Frequent freezing and melting

2 **Chemical weathering:** The process of changing the composition of the rocks when breaking it into smaller pieces.

Reaction between Rocks and Chemicals in air and water

CO_2 + water = acid water

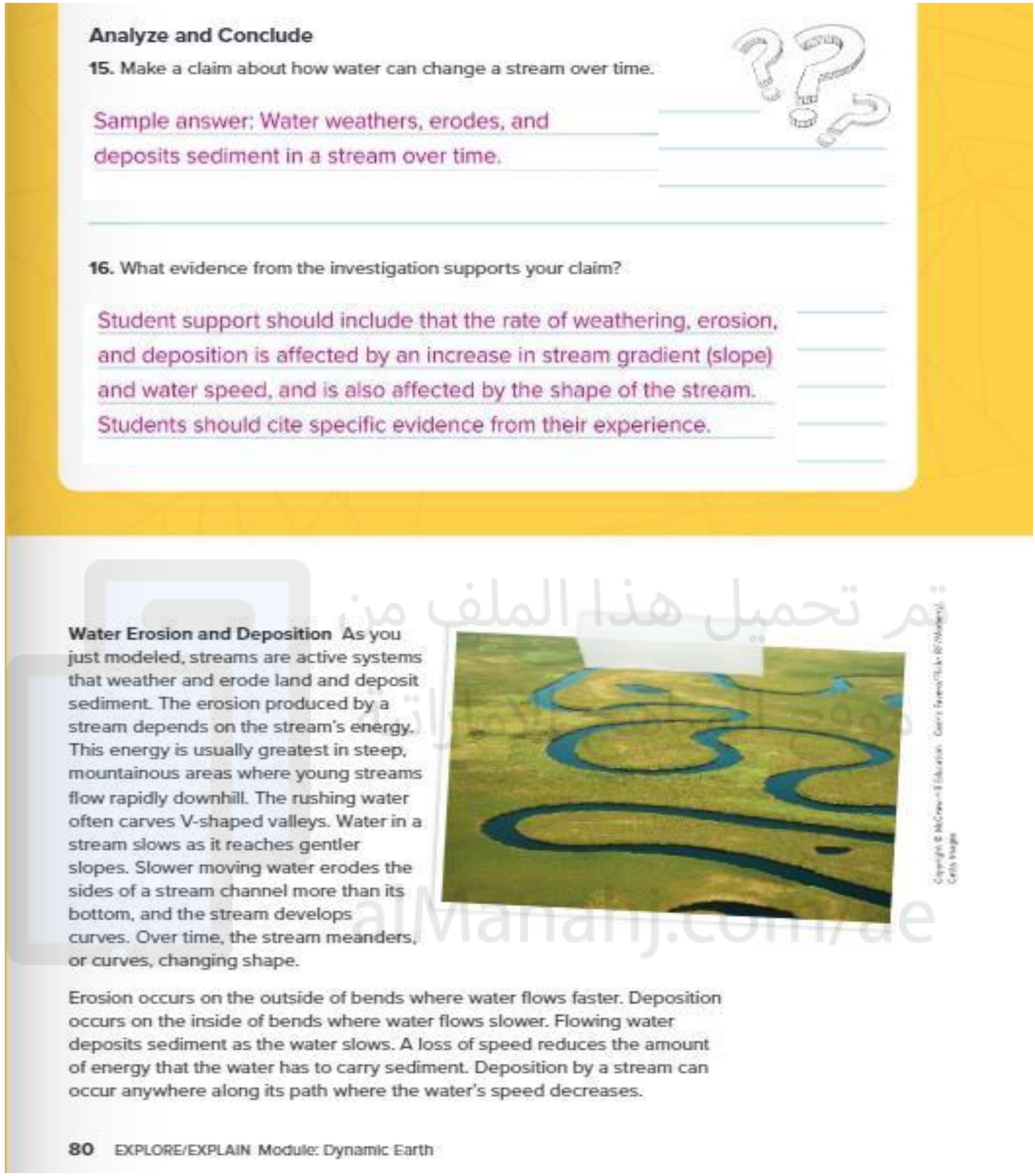
↓

Acid water + rocks (limestone) = New substance (caves)

Erosion: the moving of weathered material, or sediment from one location to another.

Deposition: the laying down or setting of eroded materials.

19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84



Analyze and Conclude

15. Make a claim about how water can change a stream over time.

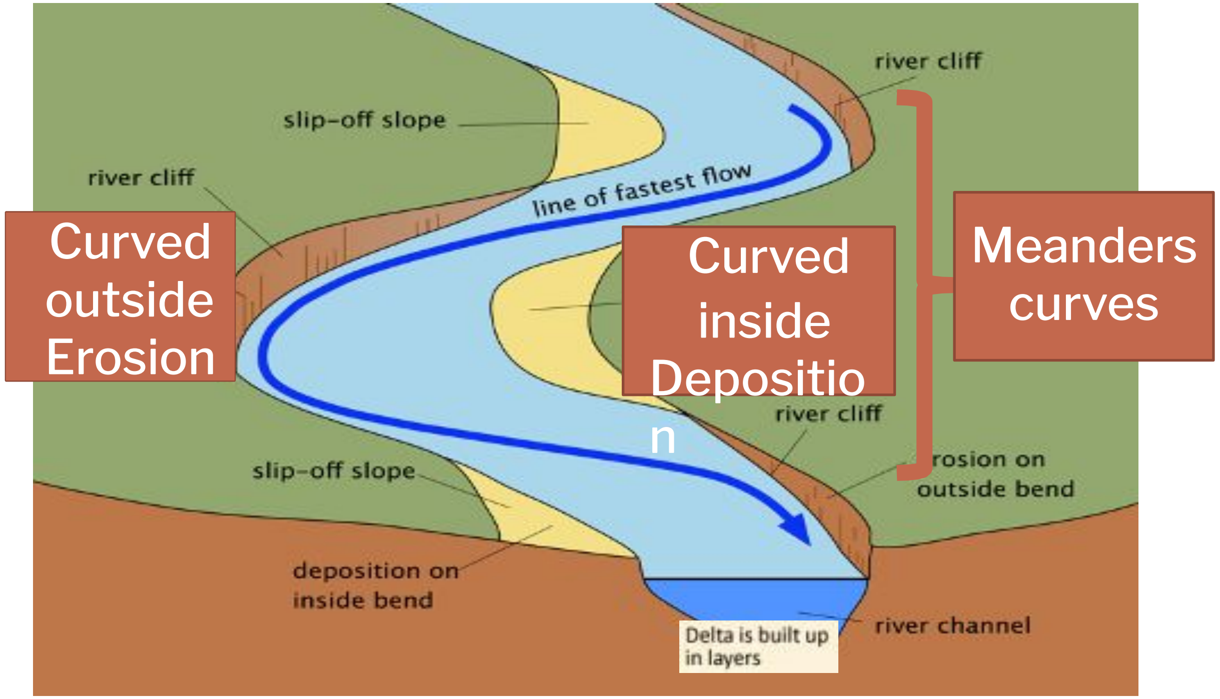
Sample answer: Water weathers, erodes, and deposits sediment in a stream over time.

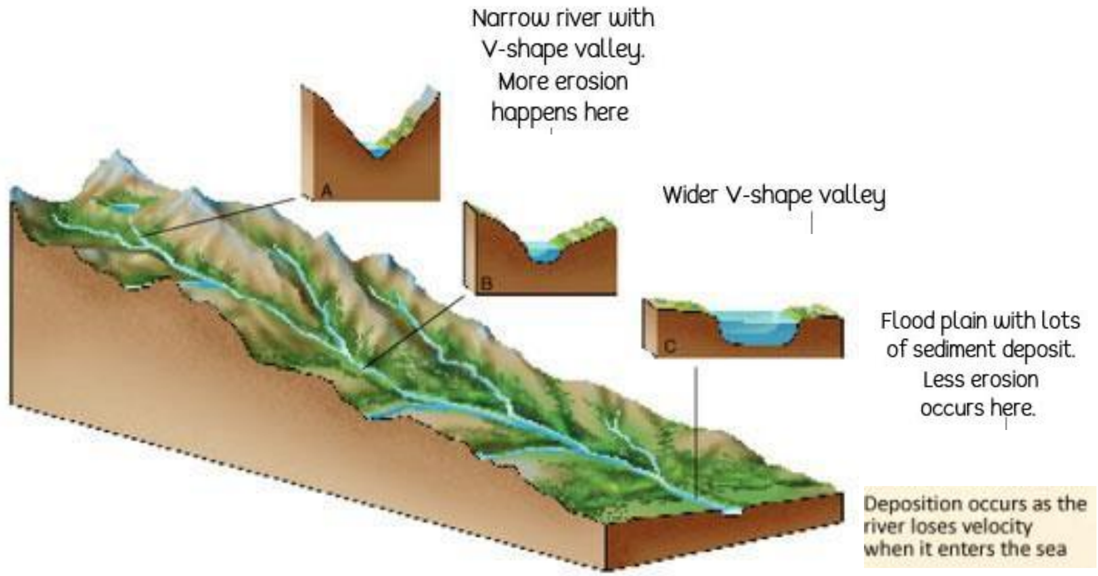
16. What evidence from the investigation supports your claim?

Student support should include that the rate of weathering, erosion, and deposition is affected by an increase in stream gradient (slope) and water speed, and is also affected by the shape of the stream. Students should cite specific evidence from their experience.

Water Erosion and Deposition As you just modeled, streams are active systems that weather and erode land and deposit sediment. The erosion produced by a stream depends on the stream's energy. This energy is usually greatest in steep, mountainous areas where young streams flow rapidly downhill. The rushing water often carves V-shaped valleys. Water in a stream slows as it reaches gentler slopes. Slower moving water erodes the sides of a stream channel more than its bottom, and the stream develops curves. Over time, the stream meanders, or curves, changing shape.

Erosion occurs on the outside of bends where water flows faster. Deposition occurs on the inside of bends where water flows slower. Flowing water deposits sediment as the water slows. A loss of speed reduces the amount of energy that the water has to carry sediment. Deposition by a stream can occur anywhere along its path where the water's speed decreases.

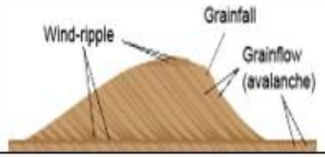




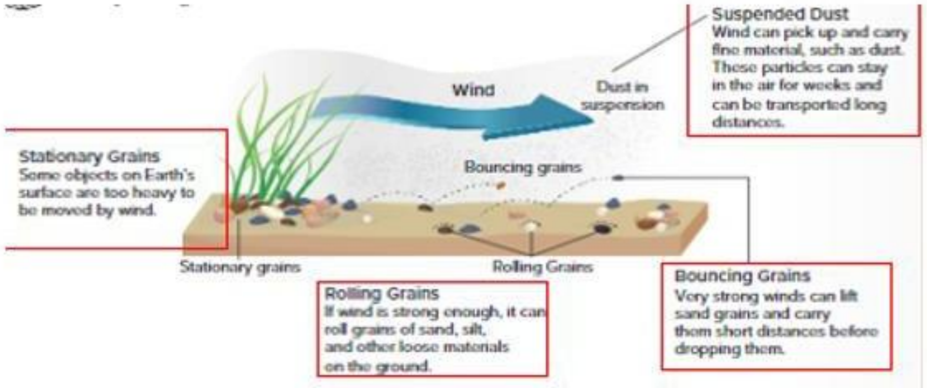
19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

Wind Erosion and Deposition Strong winds also can erode and deposit weathered sediment. In some places, wind and water work together to weather and erode rocks and make them look so smooth and polished. The erosion and deposition of materials by wind can form different types of features on Earth's surface.

Land Features	
Sand Dunes The shapes of dunes are mostly controlled by whether wind blows consistently in one direction or is more variable in direction. Some dunes can be many kilometers long. Grain by grain, sand dunes migrate in the direction the wind blows. Dunes can take on irregular shapes and are constantly changing.	
Loess Wind-deposited silt and clay is called loess. One type of loess forms from rock that was ground up and deposited by glaciers. Wind picks up this fine-grain sediment and redeposits it as thick layers of dust called loess.	
Arches As wind carries weathered sediment along, the sediment cuts and polishes exposed rock. Abrasion is the grinding away of rock or other surfaces as weathered particles carried by wind, water, or ice scrape against them.	
Scoured and Sandblasted Rocks Wind can bombard rocks on the surface with windblown sand, silt, or even ice, essentially sandblasting them. Many such rocks take on a smooth, polished appearance as sharp, rough spots are smoothed by debris. Others take on odd shapes like the rock shown here.	

Wind erosion and deposition Strong winds can erode and deposit	
Land features	
Sand dunes Dunes cand take on irregular shapes and are constantly changing. And cand migrate in the direction the wind blows.	
Loess Wind-deposited silt and clay Wind picks up fine-grain sediment from glacier deposited and redeposits it as thick layer of dust.	
Arches As wind carries weathered sediment along the sediment cuts and polishes exposed rock **Abrasion** is the grinding away of rock or other surfaces as weathered particles carried by wind, water, or ice scrape against them.	
Scoured and sandblasted rocks Wind can bombard rocks on the surface with windblown sand, silt, or even ice, sandblasting them. Rocks take on a smooth, polished appearance as sharp, rough spots are smoothed by debris.	

Sediment transport and wind: The effects of wind vary, depending on the size of the sediment particles.



19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

Process	**Weathering** Is a natural process that slowly breaks apart or changes rock .	**Erosion** The moving of weathered materials or sediment.	**Deposition** Is the laying down or settling of eroded materials
Water	Occurs along the river valley and sides as the water flow fast and carry the sediments and carves V-shapes. Chemical weathering process in which the combination of water and carbon dioxide and form weak acid that dissolve minerals in the rock and form cave.	Occurs on the outside of bends where water flow faster and becomes muddy. Meanders Fast-moving water eroded more than slow-moving water	Occurs on the inside of bends where water flows slower. Occur anywhere along its path where the waters speed decrease and move more slowly and the water clears. Dalta.
Wind	winds cuts and polishes exposed rocks. Abrasion is the grinding away of rock and form Arches. Wind smooth, polished appearance as sharp rough spots and form Scoured and sandblasted rock.	Wind can pick up or moving sand and finer sediment. Microscopic grain moved easily and over long distances Larger sediment take more time and force.	Wind slow down and become weak: Wind- deposited silt and clay and form loess. Wind- deposited sand and form sand dunes.
ICE	The liquid form of water enters into small cracks of rocks and when the temperature shifts below freezing, it causes the water to turn to ice. The ice within the rocks cause cracking, expansion, and leads to the rock breaking or splitting.	As glaciers slide over earth surface its carry an unsorted collation of large, pulverized and fine-grained sediment As ice pushes sediments forward it create grooves and scratches on underlying rocks.	When the glaciers melt, the water produced does not flow fast enough to carry sediment. The sediment is deposited and form till. Till is poorly sorted mixture of various sizes of sediments

19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

1. **Describe** how water, wind, and ice can change Earth's surface through the processes of weathering, erosion, and deposition.

Water	causes physical and chemical weathering both above and below Earth's surface; causes most erosion and deposition; fast-moving water erodes more than slow-moving water; slow-moving water deposits more than fast-moving water
Wind	when strong enough, can cause erosion; can change desert landscapes; can pick-up, transport, and suspend small grain materials
Ice	can carve features on Earth's surface; erode the land over which it moves; when glaciers melt they deposit rocks and other sediment

19	List the process that change Earth's surface (Weathering, erosion, deposition) and coclude how water and wind play a significant role in changing the Earth's surface	Textbook, figers, table	73, 76, 80, 84

9) Explain the four major causes of erosion and deposition.

Explanation

Gravity causes material to move downhill. Mass wasting is the downhill movement of a large mass of rocks or soil due to gravity. One type of mass wasting is a landslide.

Moving water causes erosion. As the moving water slows down, sediment is deposited.

Wind can erode solid rock. Sand dunes and ripples are landforms made by wind.

Sliding and flowing ice can wear away rocks, carving deep valleys. When a glacier melts, it deposits sediment.

7) How are ice and plant roots weathering agents?

- **A)** They melt minerals in rocks.
- **B)** They grind and polish rock by moving particles against it.
- **C)** They expand within cracks in rock to break the rock apart.
- **D)** They are not weathering agents.

6) In areas where freezing and thawing occur frequently, rocks weather rapidly because of the _____ of freezing water.

- **A)** evaporation
- **B)** expansion
- **C)** leaching
- **D)** oxidation

8) Chemical weathering _____.

- **A)** is caused by freezing and thawing
- **B)** breaks apart rocks by physical processes
- **C)** occurs when chemical reactions dissolve or change the minerals in rocks
- **D)** none of above

7) Mechanical weathering _____.

- **A)** breaks apart rocks by physical processes
- **B)** occurs when chemical reactions dissolve or change the minerals in rocks
- **C)** occurs when iron is exposed to oxygen and water
- **D)** none of the above

3) Where do erosion and deposition occur in a river?

- **A)** Erosion occurs where fast-moving river water picks up soil and moves it downstream. Deposition occurs where a river current slows as it enters a larger body of water and drops the soil.
- **B)** Deposition occurs where fast-moving river water picks up soil and moves it downstream. Erosion occurs where a river current slows as it enters a larger body of water and drops the soil.
- **C)** A river erodes land. There is no deposition.
- **D)** A delta forms at the mouth of a river from deposition. There is no erosion.

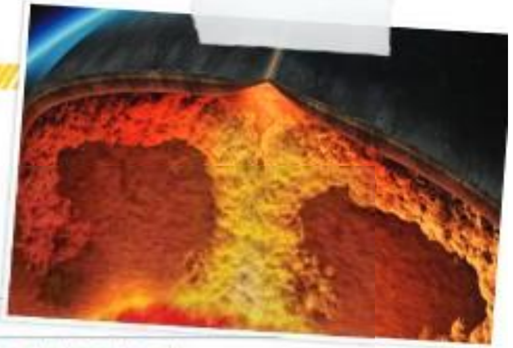
2) What happens when sediment eroded by water, ice, and wind slows down or stops moving?

- **A)** The sediment is deposited in a new location.
- **B)** The sediment continues to erode.
- **C)** The sediment instantly turns into soil.
- **D)** The sediment mixes with other sediment to become rock.

20	List the major groups of rocks: (igneous, sedimentary, and metamorphic), differentiate between lava and magma and assign them on a volcano diagram	Textbook, figures	34, 102

So how do continents "drift?"

Why would the seafloor age as you move further away from mid-ocean ridges? In the 1960s, scientists proposed a new process that helped explain ocean-floor features, ages, and continental drift. This process is called seafloor spreading. **Seafloor spreading** is the process by which new oceanic crust continuously forms along mid-ocean ridges and is destroyed at ocean trenches. Why does this process occur?



INVESTIGATION

Seafloor Spreading

GO ONLINE Watch the video *Seafloor Spreading*.

What causes Earth's crust to spread?

Hot rock rises, heated by Earth's core. Near the surface, the rock spreads in two directions and goes sideways. It begins to lose heat. Eventually the much cooler rock sink backs down. Through this spreading process Earth's crust is very slowly dragged apart.

The Conveyor Belt Rock under Earth's surface is heated by Earth's hot interior. When the seafloor spreads, the rock below the seafloor becomes molten. Molten rock below Earth's surface is called **magma.** Magma is less dense than the surrounding rock and rises upward through cracks in Earth's crust along the mid-ocean ridge. When magma erupts onto Earth's surface it is called **lava.** As lava cools and crystallizes, it forms new oceanic crust. Two halves of the oceanic crust spread apart slowly, and move apart like a conveyor belt. As the seafloor continues to spread apart, the older oceanic crust moves away from the mid-ocean ridge and sinks at ocean trenches.

A mechanism to explain continental drift was finally discovered long after Wegener proposed his hypothesis. Continents do not plow through the solid rock on the seafloor. Instead, continents move as the seafloor spreads along a mid-ocean ridge!

COLLECT EVIDENCE

What is the relationship between seafloor spreading, mid-ocean ridges, and ocean trenches? Record your evidence (C) in the chart at the beginning of the lesson.

How do igneous rocks form?

There are three major groups of rocks: igneous, sedimentary, and metamorphic. These rock types form as a result of natural processes that occur on and below Earth's surface. Igneous rocks, like the one shown to the right, are the most abundant rocks on Earth. Most of them form deep below Earth's surface, but some form on Earth's surface. Igneous rocks might form in different places, but they all form in a similar way. Let's investigate!

INVESTIGATION

Sugar Rocks

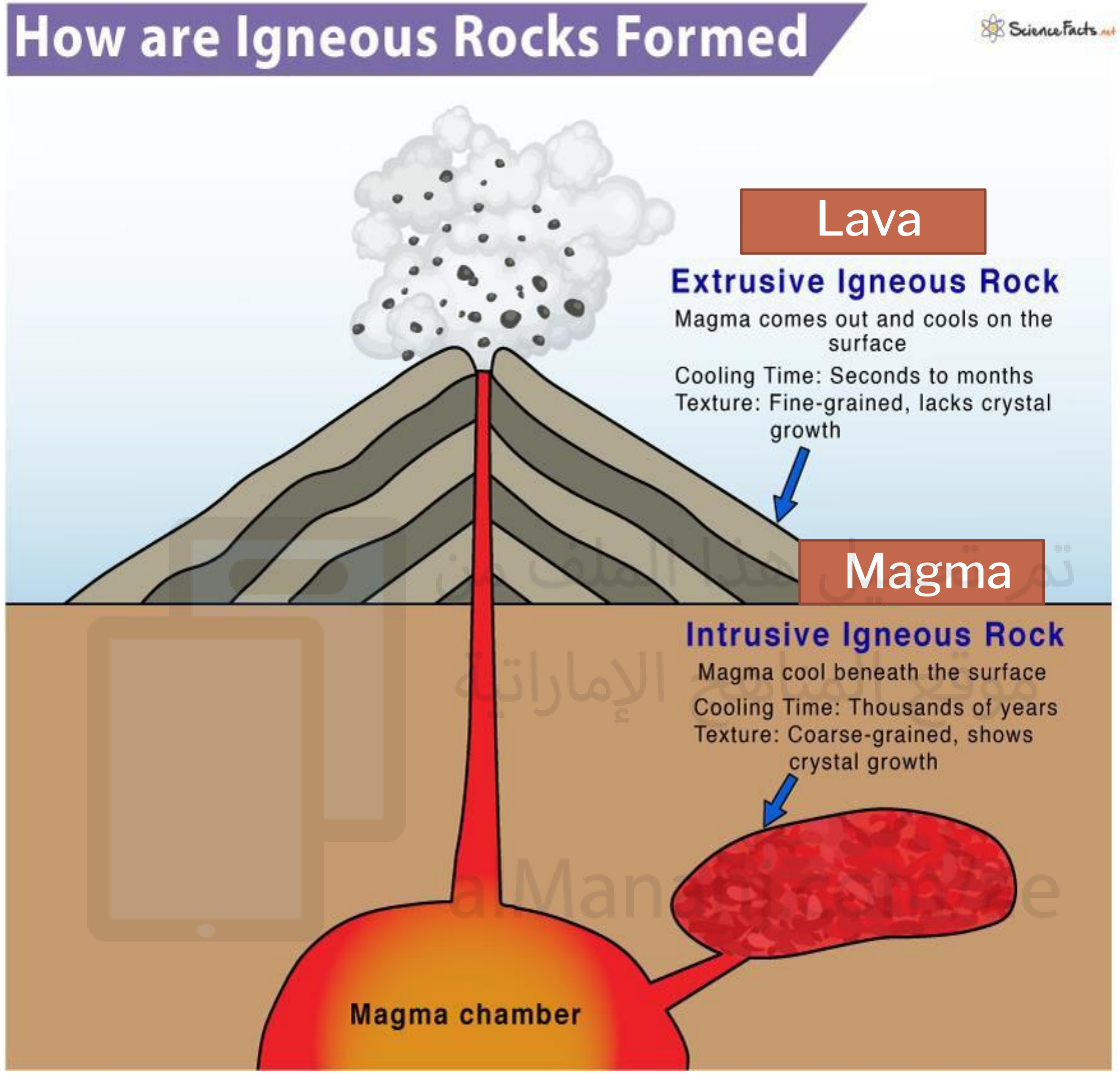
1. Observe as your teacher drips hot, melted sugar slowly into a beaker of cold water. Record what happens in the space below.

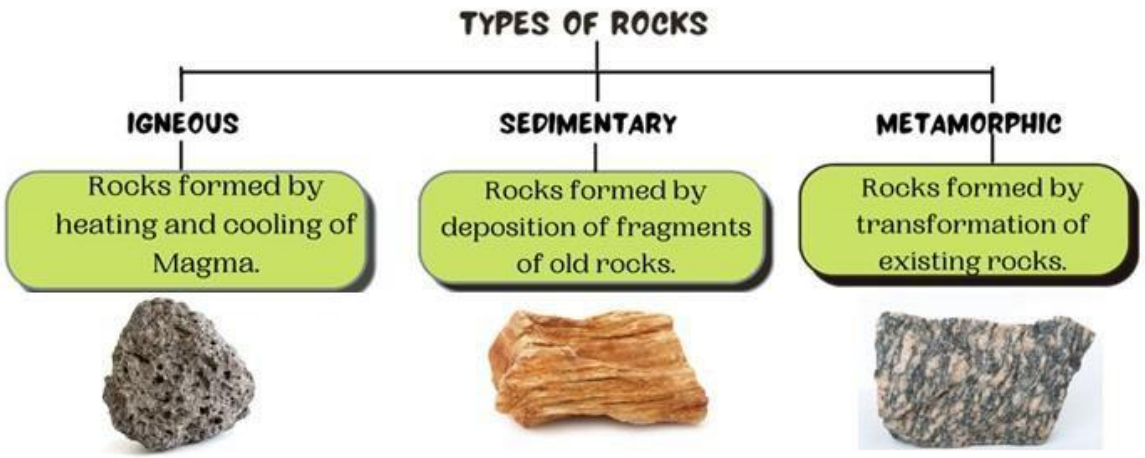
The teacher let small amounts of the melted sugar slowly drip from the end of the stirring rod into the first beaker of cold water. When the melted sugar hit the water, it hardened into small pieces and fell to the bottom of the beaker.

2. Observe as your teacher pours hot, melted sugar into a beaker of cold water. Record what happens in the space below.

The teacher poured small amounts of melted sugar quickly into the second beaker of cold water. The sugar crackled, bubbled, and steamed as it cooled.

20	List the major groups of rocks: (igneous, sedimentary, and metamorphic), differentiate between lava and magma and assign them on a volcano diagram	Textbook, figures	34, 102





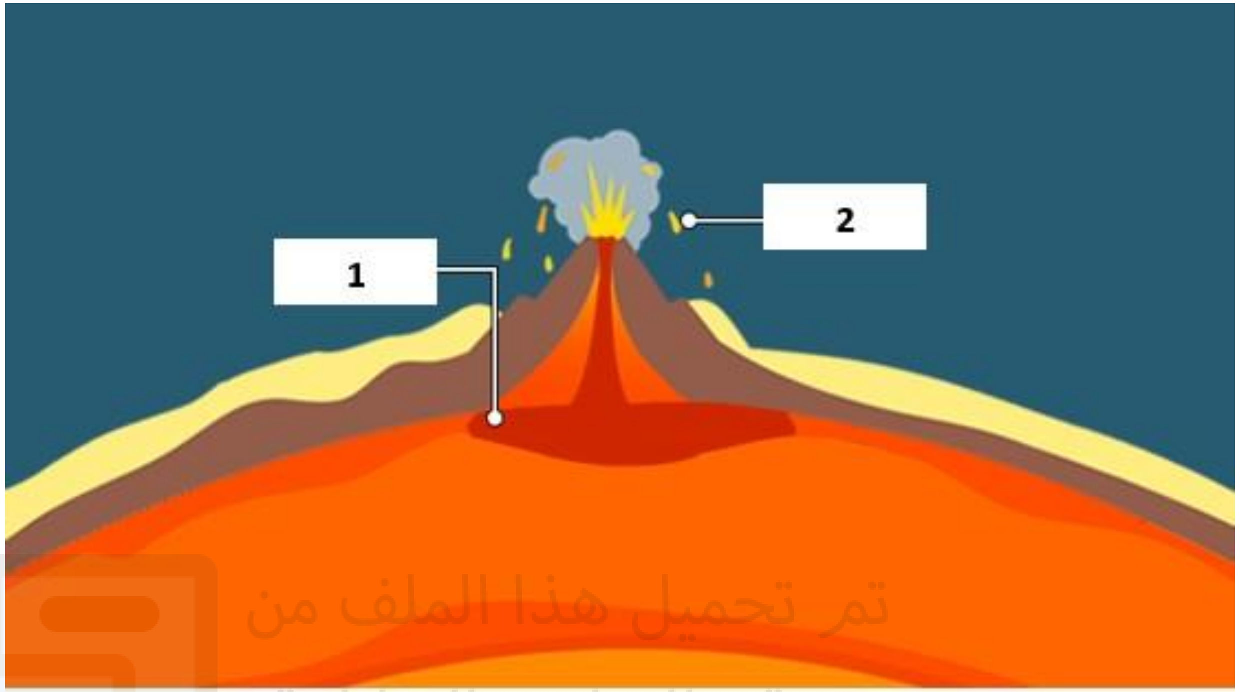
Igneous rocks form from ____ when it cools.

- **A)** magma
- **B)** lava
- **C)** neither a nor b
- **D)** both a and b

The crystals that form in slowly cooled magma produce ____ mineral grains.

- **A)** tiny
- **B)** invisible
- **C)** fine-grained
- **D)** large

20	List the major groups of rocks: (igneous, sedimentary, and metamorphic), differentiate between lava and magma and assign them on a volcano diagram	Textbook, figures	34, 102



label the missing parts:

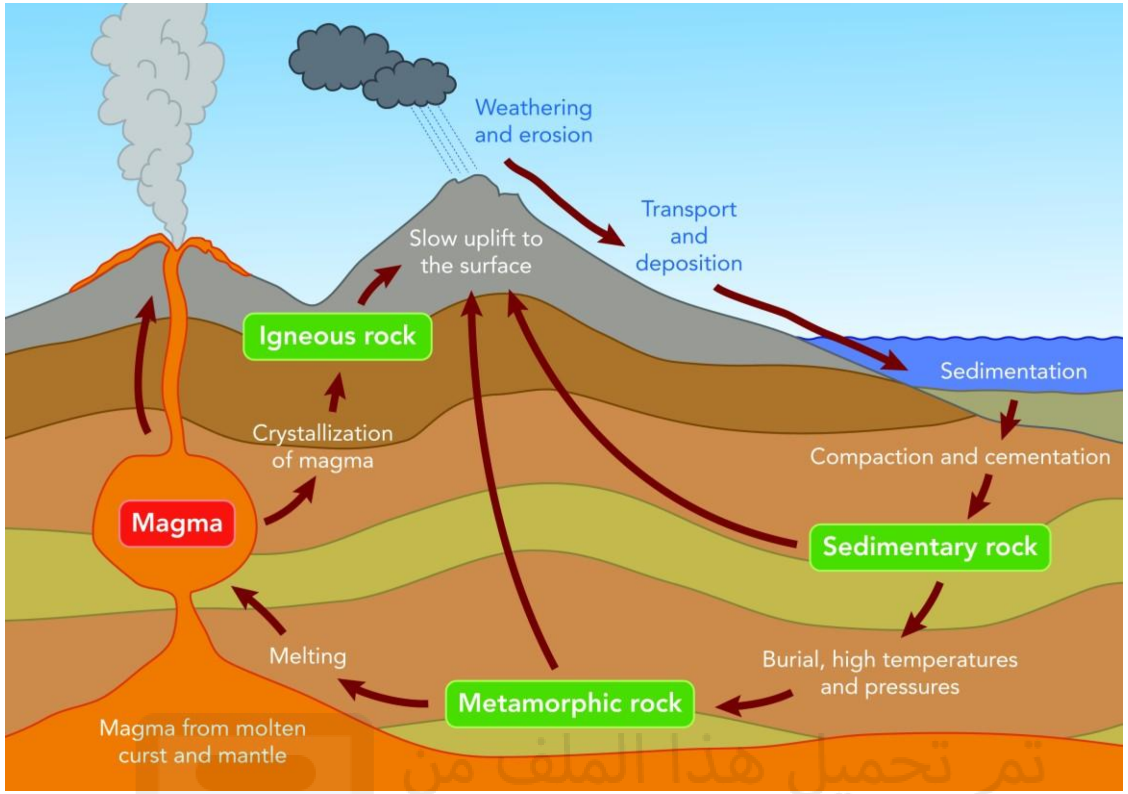
1- ...**magma**... (molten rock under earth surface)

2- ...**Lava**... (molten rock above earth surface)

3- ...**Sedimentary** ... rocks formed by deposition, cementation, and compaction.

4- ......**Igneous**....rocks are formed by melting and crystallization.

5- ...**Metamorphic** ..rocks are formed by high heat and pressure.



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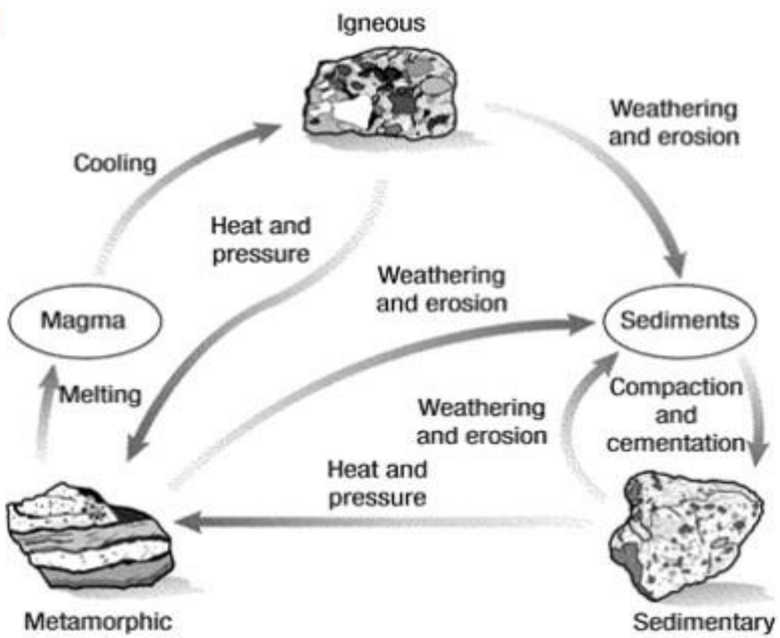


Sedimentary rocks are changed to sediments by ____.

- **A)** compaction
- **B)** weathering and erosion
- **C)** cementation
- **D)** heat and pressure

The rock cycle can change the sedimentary rock limestone into _____ through metamorphosis.

- **A)** conglomerate
- **B)** gneiss
- **C)** granite
- **D)** marble

BOUNCE

EXTRA

Three-Dimensional Thinking

For many years, scientists thought that the ocean floor was flat. During World War II, U.S. Navy ships patrolled the oceans. A captain of one of the ships, Harry Hess, was also a geologist. He used a new device called an echo sounder to map the ocean floor. The echo sounder data showed that the ocean floor had mountains and volcanoes in addition to flat areas.

When scientists took samples of the rocks that made up the ocean floor, they discovered something surprising. The rocks closer to the mid-ocean ridge were younger in age than the rocks far away from the mid-ocean ridge. They concluded that this difference in age was another way to support the theory of plate tectonics.

2. **HISTORY Connection** Which best describes how the scientists could explain their observations?

- **A** They thought that sediment washing in from the shore formed the ocean floor, and continued to build out from the shore.
- **B** They thought that strong ocean waves pushed the younger rock material toward the middle of the ocean.
- **C** They thought that wave erosion at the shore removed the younger rock layers that were on top of the older rock layers.
- **D** They thought the young rock formed at the mid-ocean ridge and pushed the older rock toward the shore.

3. **MATH Connection** A continent travels 0.006 m/year. How long would it take the continent to travel 100 m?

- **A** 600 years
- **B** 16,667 years
- **C** 60,000 years
- **D** 167 years

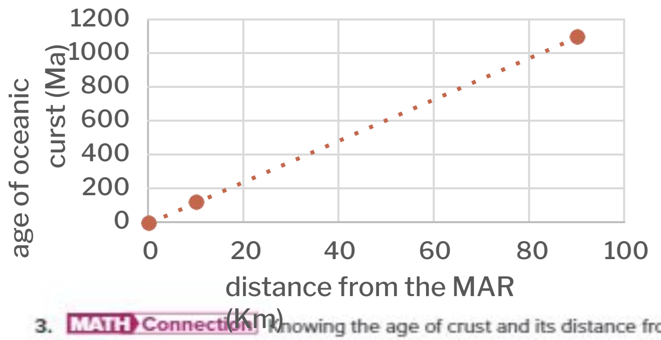
THREE-DIMENSIONAL THINKING

Imagine it is 1965 and you have landed your dream job as a geologist investigating seafloor spreading. You are presented with the following information.

1. **READING Connection** The average age of the oceanic crust along the Mid-Atlantic Ridge (MAR) is 0 million years old. At the equator, 125 km west of the MAR, the ocean crust is approximately 10 million years old. About 1100 km west of the MAR at the equator, the oceanic crust is about 90 million years old. Create a data table to express this information visually.

Distance from the MAR (km)	Age of Oceanic Crust (Ma)
0	0
125	10
1100	90

2. What relationship or **pattern** can you identify in the **data?** Illustrate the pattern through a simple line graph.



3. **MATH Connection** Knowing the age of crust and its distance from the ridge allows you to calculate the spreading rate. How exciting! Use the formula below to calculate the rate of movement. Express the spreading rate in cm/yr.

$$\text{rate} = \frac{\text{distance}}{\text{time}}$$

1.25 cm/yr

Three-Dimensional Thinking

The Lighthouse of Palo Duro Canyon State Park is a famous rock formation in Texas. Examine the photo of the Lighthouse below.

2. Which statement best explains how this rock formation likely formed over time?

   A The Lighthouse formed as water erosion carved away the softer rock around the structure over time.

   B The Lighthouse formed from multiple episodes of wind erosion and deposition over time.

   C The Lighthouse formed as repeated flash floods deposited sediments and rocks on the structure over time.

   D The Lighthouse formed as desert plants protected some of the rock layers from erosion over time.

What Is the Difference Between Rocks and Minerals?

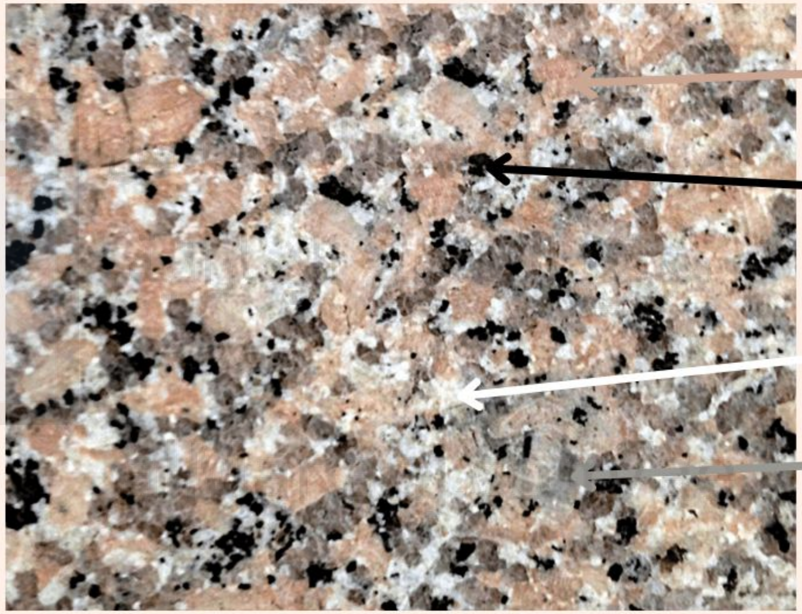
A rock is a solid made up of minerals. A mineral is an inorganic solid with a crystalline structure and characteristic chemical composition.

rock

Granite

minerals

minerals fit like puzzle pieces



THREE-DIMENSIONAL THINKING

A river delta is a landform that forms from deposition of sediment carried by a river as the flow leaves its mouth and enters slower-moving or standing water. Examine the locations indicated in the photo of a delta below.

1. At which location would the largest grains of sediment be located? The smallest? **Explain** your reasoning.

The largest grains of sediment would be located at the mouth of the river, location A. The smallest grains of sediment would be concentrated further out into the ocean, location C. Heavier sediments will fall out of the water first as it begins to slow down. Only small, fine sediments will make it further out into the ocean.

2. Deposition, also called sedimentation, cycles matter through which type of **change**, physical or chemical? Explain your reasoning.

The deposition of sediment does not change the atomic arrangement of the sediment. Therefore, it is a physical change.

3. Develop a **model** that could describe why deposition occurs. Record details and descriptions about your model in your Science Notebook.

Metamorphic Rocks When temperature and pressure combine and change the texture, mineral composition, or chemical composition of a rock without melting it, a metamorphic rock forms. The addition of hot chemical fluids can also cause rocks to become metamorphic. The high temperatures required for metamorphism are ultimately derived from Earth's internal heat, either through deep burial such as at a subduction zone, or from nearby igneous intrusions. The high pressures required for metamorphism come from deep burial or from compressional forces where Earth's tectonic plates meet. During metamorphism, the minerals that make up the rock's composition change as well as the texture, or arrangement, of the individual mineral grains.

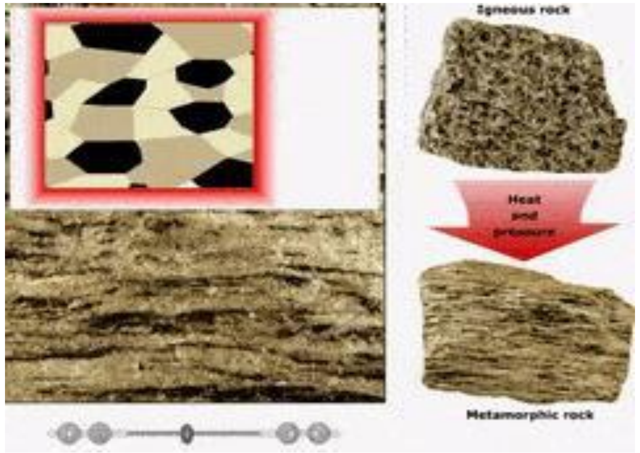
PHYSICAL SCIENCE Connection How do minerals change without melting? During metamorphism, the minerals in a rock change into new minerals that are stable under the new temperature and pressure conditions. Minerals that change in this way are said to undergo solid-state alterations.

THREE-DIMENSIONAL THINKING
How does the flow of energy from Earth's hot interior drive the formation of metamorphic rock?

Earth's internal heat is responsible for the movement of plates along Earth's surface. When rocks are exposed to extreme temperature and pressure, such as along plate boundaries, they can change to metamorphic rocks.

COLLECT EVIDENCE
What conditions in Earth cause metamorphic rocks to form? Record your evidence (C) in the chart at the beginning of the lesson.

Uplift Some metamorphic and igneous rocks form deep within Earth. How are they exposed at Earth's surface? The process of uplift is a tectonic process that brings rocks from deep in the crust to Earth's surface where they are exposed to the environment. Uplift slowly moves large amounts of rock up to Earth's surface and to higher elevations. Uplift is driven by Earth's internal heat energy which results in tectonic motions and often is associated with mountain building.

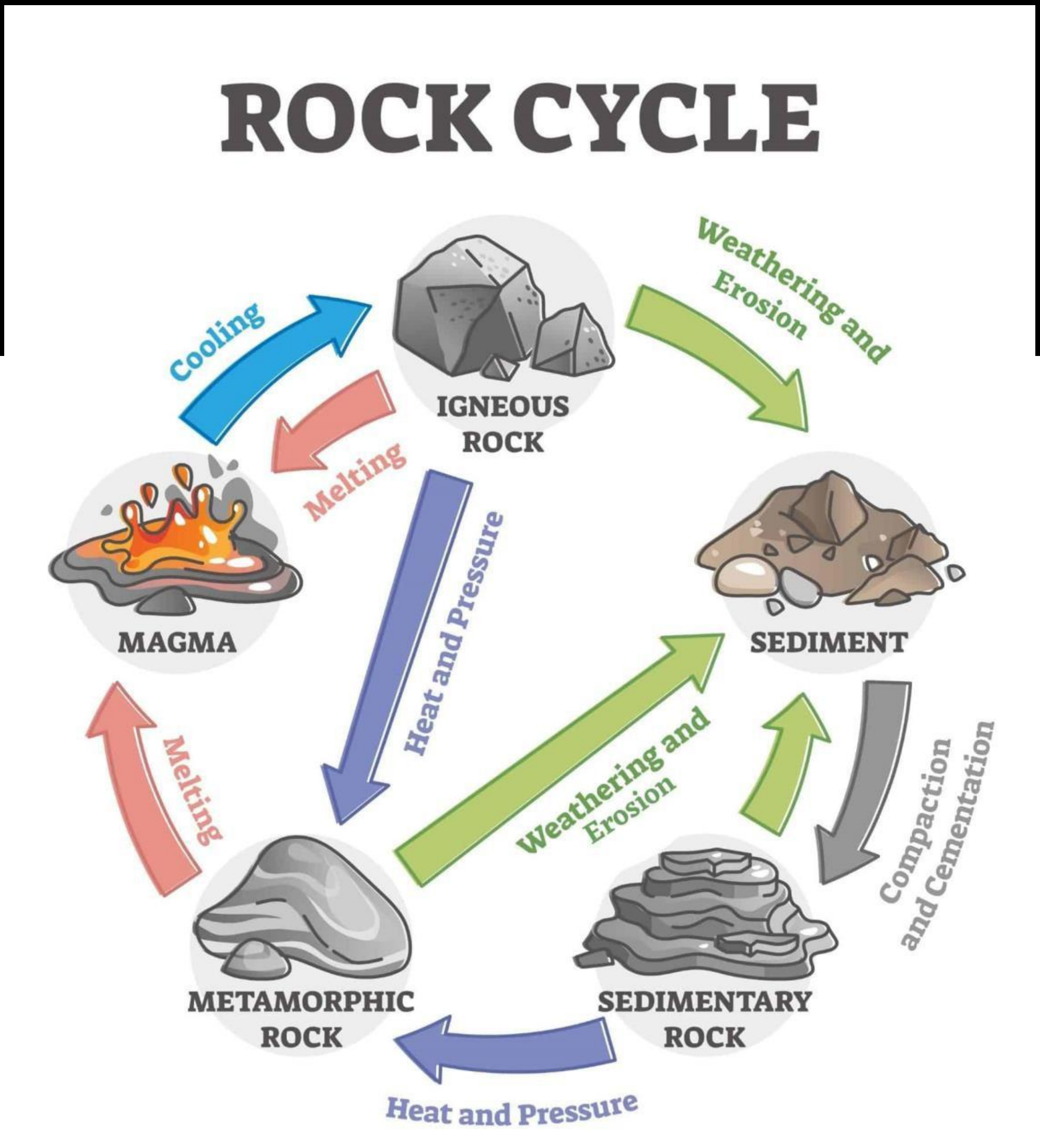


Granite igneous rock

Gneiss metamorphic rock

The rock cycle the series of processes that change one type of rock into another type of rock.

At times, the material might not be rock at all. It might be sediment magma, or lava



Three-Dimensional Thinking

A team of scientists who are studying volcanoes took core samples to find out how long ago the volcanoes erupted. A core sample shows rock layers that relate to different environmental conditions and geological events over time. Core sampling is a technique that allows scientists to see layers of rock beneath the surface of the ground. This helps them understand what happened a long time ago. In one core sample, the scientists discovered a light-colored igneous rock at a depth of 60 m below the surface. They found a thick layer of sedimentary rock directly above this that stretched from a depth of 34 m to 54 m below the surface.

2. What could best explain these observations?

A A long period with no volcanic activity allowed the slow buildup of sand and debris which then changed into rock.

B A long period of volcanic activity was followed by a massive eruption that was preserved in the rock record.

C A long period with no volcanic activity allowed the light-colored rock to form deep below Earth.

D A long period of volcanic activity was followed by a period of intense heat and pressure.

Two students are working together to develop a visual model to help them determine what types of rocks a sedimentary rock can change into and the processes involved in those changes. They begin by writing the word "sedimentary rock" in the center of their paper. A connection is made by drawing an arrow from the sedimentary rock to an igneous rock. The arrow is labeled with the process "melting and crystallization." Another connection is made from the sedimentary rock to a metamorphic rock. The arrow is labeled "temperature and pressure."

3. The students evaluate their model. What component of their model is missing or incorrect?

A The arrow pointing to the igneous rock should read "temperature and pressure."

B The arrow pointing to the metamorphic rock should be labeled "melting and crystallization."

C An arrow labeled "weathering, erosion, sedimentation, and lithification" connecting back to the sedimentary rock is missing.

D The students should remove the arrow pointing to the metamorphic rock. Sedimentary rocks cannot become metamorphic rocks.

Three-Dimensional Thinking

Use the map below to answer the question.

2. Which explanation best supports if one of the following cities, Denver, Bellingham, Albuquerque, or Bend, is at a high or low risk of a future volcanic event?

   A Denver is at a high risk. Cities located in mountainous regions that have not experienced volcanic activity are still susceptible to volcanic eruptions.

   B Bellingham is at high risk. This city is located in close proximity to a volcano that has been active in the past putting it at the highest risk. This volcano is most likely to erupt again.

   C Albuquerque is at high risk. Its location in proximity to a potentially active volcano makes it vulnerable to future eruptions.

   D Bend is at a low risk. This city is located near a volcano that has erupted in the past 2,000 years. Once a volcano has erupted, it will never erupt again.

Real-World Connection

Notable Volcanic Eruptions			
Volcano	**Date**	**Volume of Material Ejected**	**Height of Ash Plume**
Toba	74,000 years ago	2,800 km³	50–80 km
Vesuvius	A.D. 79	4 km³	32 km
Tambora	1815	150 km³	44 km
Krakatau	1883	21 km³	36 km
Mount St. Helens	1980	1 km³	19 km
Mount Pinatubo	1991	5 km³	35 km

3. **Hypothesize** Why was the eruption of Vesuvius in A.D. 79 more deadly than the eruption of Mount Pinatubo in 1991, even though the eruptions released approximately the same amount of debris and the ash clouds were almost the same height?

: people lived very close to Mount Vesuvius; the volcanic hazards for each eruption were different; there was more warning for Pinatubo because of more modern detection methods.

Still have questions?
Go online to check your understanding about volcanoes.

REVISIT PAGE KEELEY SCIENCE PROBES
Do you still agree with the student you chose at the beginning of the lesson? Return to the Science Probe at the beginning of the lesson. Explain why you agree or disagree with that student now.

EXPLAIN THE PHENOMENON

Revisit your claim about how understanding the complexities of volcanic eruptions helps scientists develop technologies to mitigate their effects. Review the evidence you collected. Explain how your evidence supports your claim.

KEEP PLANNING
STEM Module Project
Engineering Challenge
Now that you have learned how understanding the complexities of volcanic eruptions helps scientists develop technologies to mitigate their effects, go back to your Module Project to continue planning your design.

Where do floods and droughts occur?

Tornadoes and hurricanes are severe weather events. Floods and droughts are some effects of severe weather. A **flood** occurs when a large volume of water overflows its boundaries. Rivers, lakes, and even oceans can flood. A **drought** is an extended period of well-below-average rainfall. The table below compares and contrasts floods and droughts.

Flood	Drought
	
Cause: Heavy rains from powerful storms or steady, persistent rains from mild storms	**Cause:** High-pressure weather systems that persist for weeks or months over an area; the sinking air in the system blocks moisture from rising and cloud formation cannot occur
Effects: Cause of most weather-related deaths in the United States; billions of dollars worth of property damage each year; loss of habitats	**Effects:** Extensive damage to crops; decrease in water supply; increase in heat-related illnesses; damage to property through wildfires related to dry conditions

Floods When a single thunderstorm unleashes enough rain, or when hurricanes cause torrential downpours, a flood can occur. Often, this pattern leads to flash floods, or sudden local floods that can form without advance warning. Floods can also occur when weather patterns cause even mild storms to persist over the same area for an extended period of time. Are some areas more prone to floods? Let's investigate the areas in your state that are at the highest risk of floods.

Drought Hazards Too much dry weather can cause nearly as much damage as too much rainfall. In areas that experience periods of droughts, below-average precipitation can last for several months or years. Examine the table below to learn more about drought hazards.

Drought Hazards	
Soil Erosion Changing atmospheric patterns can cause drought. For example, changing wind patterns can block fronts from reaching an area, preventing precipitation. This means less water in rivers and other ecosystems. If plants die because of lack of water, the top layer of soil can be removed by wind.	
Wildfires Lightning strikes can start wildfires, especially during dry conditions. Every year, thousands of acres of wilderness and many homes are destroyed by fire. Wildfires can cause extensive damage to vegetation and can continue to impact ecosystems once the fire is out. These aftereffects include risks of floods, extensive soil erosion, landslides, and reduced water quality in an area.	
Decrease in Water Supply As rainfall decreases over a span of weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and depth to reach groundwater increases.	
Agricultural Impact Dry conditions can have a devastating effect on livestock, crops, and the people who depend on these resources. A decrease in water from droughts can cause limited water supply for animals and crop irrigation. Harvests may be small which can affect consumer food prices.	

Flooding along rivers and streams can be the result of natural processes or human-caused events. Examine the table below to learn more about some of the factors that cause floods.

Factors that Cause Floods
Snowmelt Flooding occurs when warming temperatures or rainfall melt snow and ice in the drainage basin of a river or stream.
Dam Failure Dams occur as both natural and human-constructed features. Poorly engineered dams have failed, releasing floodwaters into downstream channels.
Local Heavy Precipitation Some floods are caused by heavy rainfall over a short period of time, causing a brief, but dangerous, flash flood.
Volcanic Eruption If volcanic peaks are covered with snow when a volcano erupts, the snow will melt and cause flooding or catastrophic mudflows.
Urbanization When urban growth replaces natural lands or farms, the area responds differently to precipitation and snowmelt. Urbanization increases runoff.
Regional Precipitation Regional floods occur when abnormally high precipitation falls over a large area over days, weeks, or months, such as precipitation associated with hurricanes or monsoons.

LIFE SCIENCE Connection Wetlands and other ecosystems along streams usually develop in part from regular flooding. Allowing flooding to occur along streams helps keep these ecosystems healthy and viable.

LESSON 3
Review

Summarize It!

1. **Organize** Complete the concept map to organize information you learned throughout the lesson about hurricanes, tornadoes, floods, and droughts.

Severe Weather

1. Hurricanes

a. Cause(s): Very large thunderstorms over warm oceans

b. Effects: Storm surges, high winds, high waves, heavy rains, tornadoes

2. Tornadoes

a. Cause(s): Upward movement of air in thunderstorms and hurricanes

b. Effects: Winds can damage structures and move houses, trees, soil, and species.

3. Floods

a. Cause(s): Heavy or persistent rains over an area

b. Effects: Property and environmental damage, loss of habitats

4. Droughts

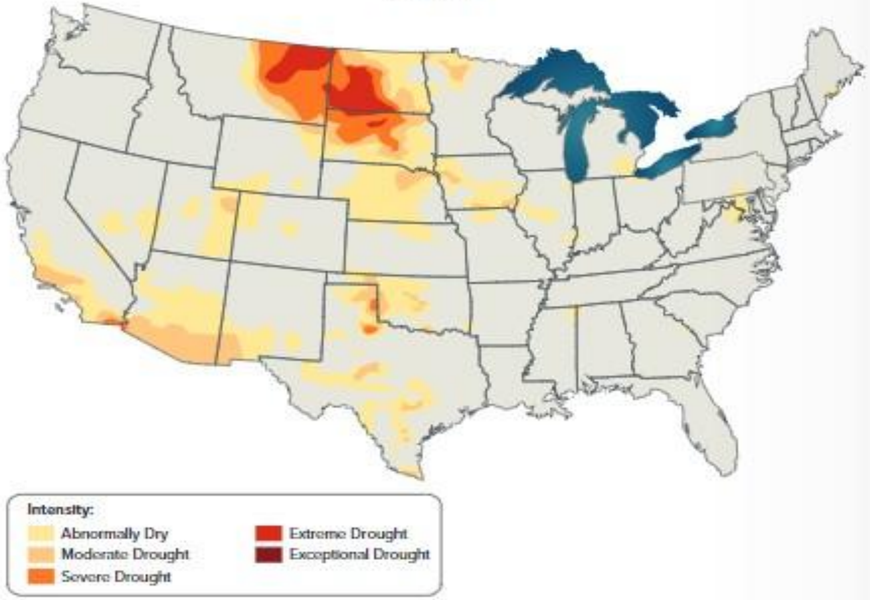
a. Cause(s): High-pressure system stalled over an area resulting in hot weather for relatively long periods of time.

b. Effects: Drops in water levels, water shortages, soil erosion, forest fires

Three-Dimensional Thinking

Use the map to answer the question below.

July 2017



2. What can be determined about future droughts from examining this map?

A The same areas will experience droughts in the future.

B Future droughts cannot be determined, only predicted.

C Droughts move from west to east so the eastern coast of the United States will experience droughts.

D Droughts move from east to west so the western coast of the United States will experience droughts.