

Geography

Mountains, Volcanoes and Earthquakes



Atlantic Academy Portland
an Aspirations Academy

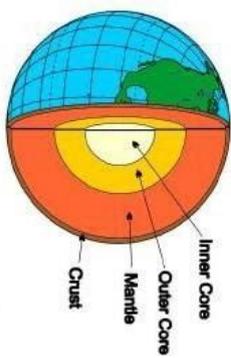


Year 3 - Spring 2

Name: _____

Class: _____

Mountains, Volcanoes & Earthquakes | Year 3 | Spring 2

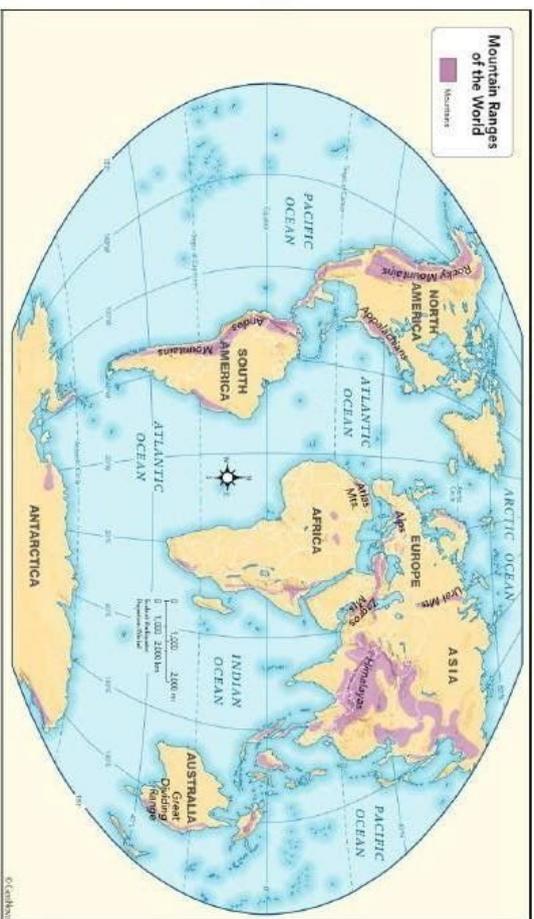


Structure of the Earth

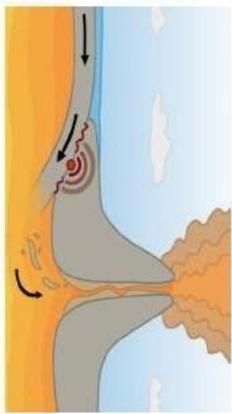
Crust:	solid rock; 0-60 km thick; continental (granite) and oceanic (basalt); broken into tectonic plates
Mantle:	liquid/molten rock; ~2,900 km thick
Outer core:	liquid metal; iron and nickel; ~4,000°C
Inner core:	solid metal; iron and nickel; ~6,100°C

Keywords

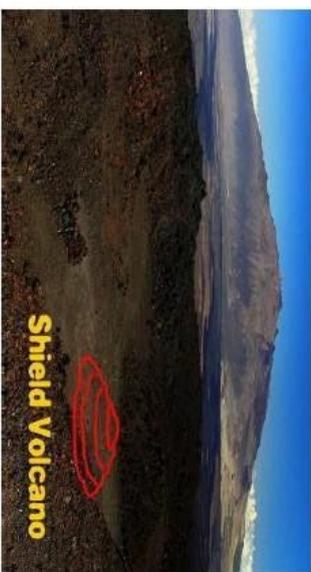
Magma	Molten rock in the mantle
Lava	Magma that has reached the surface
Pressure	Physical force (pressure builds up when tectonic plates lock together and can't move)
Friction	Resistance or difficulty in moving. Tectonic plates are rough and so there is friction when they move.
Basalt	Dark-coloured volcanic rock.
Granite	Hard rock
Fold mountain	Mountains formed when tectonic plates collide and cause the plates to wrinkle
Ocean trench	A deep valley formed on the ocean floor where one tectonic plate subducts under another.
Tsunami	Large ocean wave caused by underwater earthquake.



Earthquakes occur when plates jolt forward after getting stuck.



Volcanoes erupt when magma rises to the surface.



Shield Volcano

Shield volcano:	Largest volcanoes on earth; wide base; low height; not steep. Example: Kilauea (Hawaii) and Erta Ale (Ethiopia)
Stratovolcano (composite):	Most of the world's volcanoes are composite volcanoes: made of layers of lava and ash; steep sides; tall.

Volcanoes

Location	Japan	Guatemala
Primary Effects	16,000 people died 4000 people missing 6000 people injured	110 deaths 200 people missing 300 injured

Secondary Effects	Tsunami wave and flooding (reached 39 m high, travelled 10 km inland on eastern side of Japan) Disruption to: travel and farming	Heavy rain caused landslides Hunger due to crops being destroyed Disruption to travel and farming
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Immediate Responses	Military aircraft identified areas needed most urgent help Roads cleared to bring water/food/ medical care / tents	Search & Rescue teams clear roads to reach people Water / food / medical care / tents Evacuation
Long-term Responses	Continued training, education and earthquake drills Rebuild infrastructure (roads, electricity, buildings)	Education and evacuation drills New and improved emergency response systems Rebuilding infrastructure



Lesson You will learn:

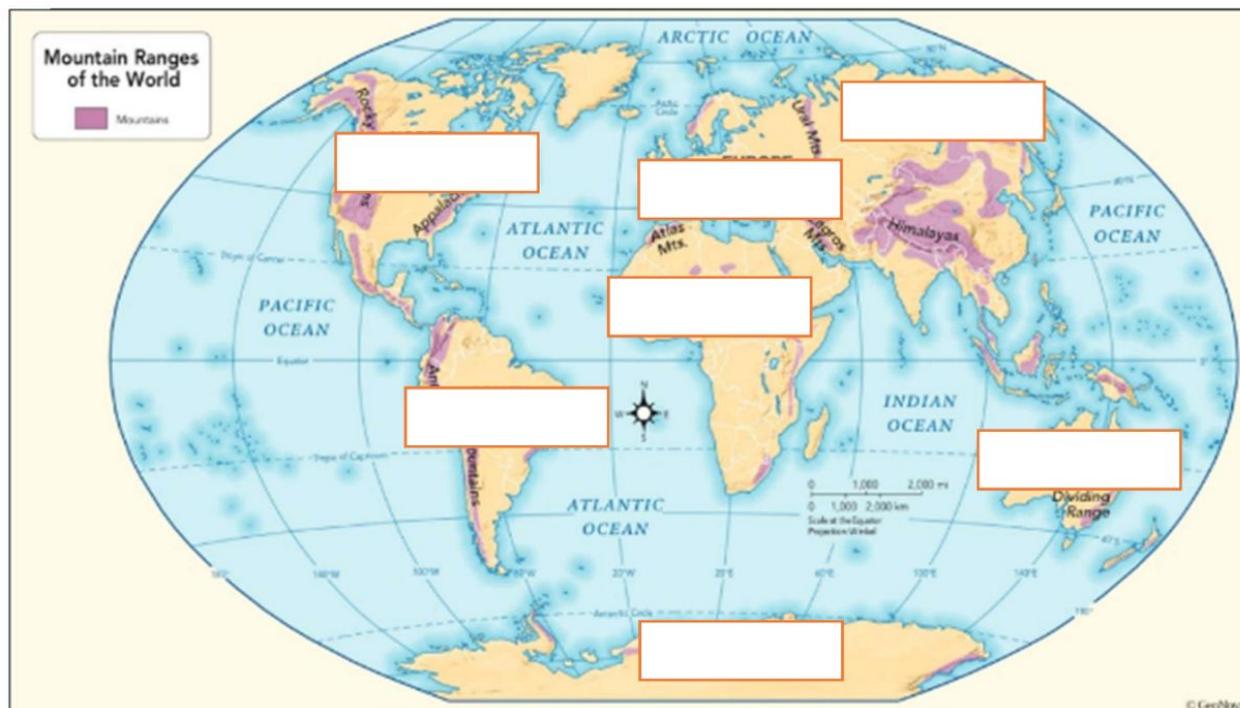
Question

<p>What is the earth made of?</p>	<p>The structure of the earth. What the earth is made of. Where volcanoes and earthquakes form.</p>	
<p>What are fold mountains?</p>	<p>What fold mountains are. Where fold mountains are found. How fold mountains form.</p>	
<p>How are volcanoes made?</p>	<p>How stratovolcanoes form and what they are like. How shield volcanoes form and what they are like. Where the different volcanoes are found.</p>	
<p>How does an earthquake occur?</p>	<p>How tectonic plates move. How earthquakes form. Why earthquakes are usually a surprise.</p>	
<p>What happens when a volcano erupts?</p>	<p>Volcanic eruption case study: Fuego Volcano, Guatemala 2018. Causes, effects, responses Advantages and disadvantages of a volcanic eruption.</p>	
<p>What happens when an earthquake occurs?</p>	<p>Earthquake case study: Tohoku, Japan 2011 Causes, effects, responses What is a tsunami?</p>	

LESSON ONE: What is the Earth made of?

Retrieval Practise

The Earth is split into 7 major continents. Name these continents on the map below.



Write down everything that you already know about the Earth's continents here:

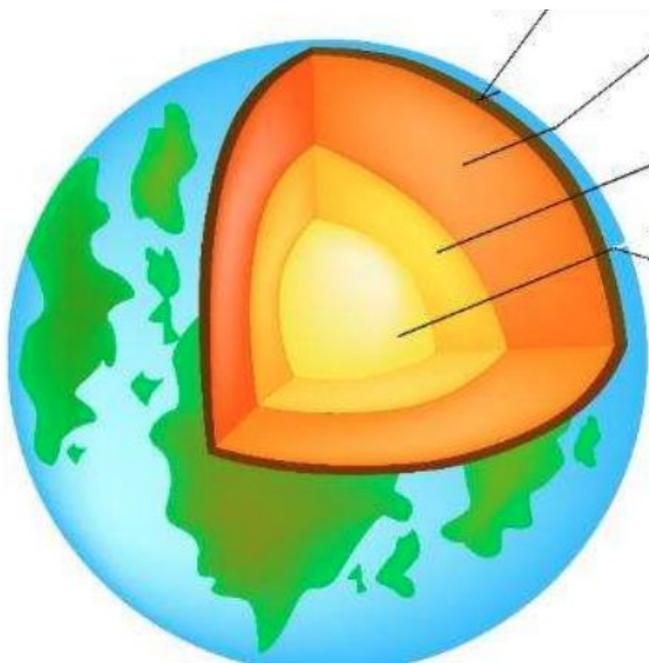
Glossary

Term	Definition
Continental	Part of the Earth's crust that forms large land masses
Mantle	Layer of the work made of liquid/ molten rock
Molten	Liquefied by heat
Magma	Molten rock in the magma
Oceanic	Part of the earth's crust that forms the sea floor
Tectonic plate	Area of the Earth's crust that move over the mantle

Structure of the Earth:

The earth is a slightly squashed sphere; it is made up of 4 main layers. These are called the inner core, outer core, mantle and crust.

🔍 Label the diagram below with the 4 main layers of the Earth.



The inner core:

The **inner core** is made from a mixture of solid metals. These metals are called iron and nickel. The centre of the earth is extremely hot, about 6100°C.

The outer core:

The inner core is surrounded by the **outer core**, this section is made of the same two metals, iron and nickel but they are liquids. The outer core is slightly colder, about 4,400 °C.

Which two metals are the main components of the Earth's inner and outer core?



_____ + _____

The mantle:

The mantle is about 2,900Km thick and is made of **molten** rock. This molten rock is called **magma**. The average temperature of the mantle is 3000 °C.

The crust:

The crust is made of solid rock which is between 0 and 60 Km thick. The two main types of rock are **granite** and **basalt**. This layer is broken into tectonic plates which move around on top of the mantle.

Number the following layers from coldest (1) to hottest (4)

	Inner core
	Outer core
	Mantle
	Crust

Composition of the Earth's Crust

Oceanic crust

The **oceanic crust** makes up the seafloor. It is made of **basalt** and is heavier than the continental crust. This makes it sink to the bottom of the sea. The oceanic crust is less than 200 million years old.

Continental crust

The **continental crust** forms large land masses. It is mainly made of **granite**. It is lighter than the oceanic crust and is more than 1500 million years old. It cannot be renewed or destroyed.



Complete these sentences:

The two types of crust are called

The oceanic crust is made from

The heavier crust is called

The older crust is called

The continental crust cannot be

Tectonic Plates

The Earth's crust is split into **plates** that move across the mantle. The plates move because the mantle under the plates is very hot. This means that the plates, which are made from solid rock, can be moving away from each other or towards each other.

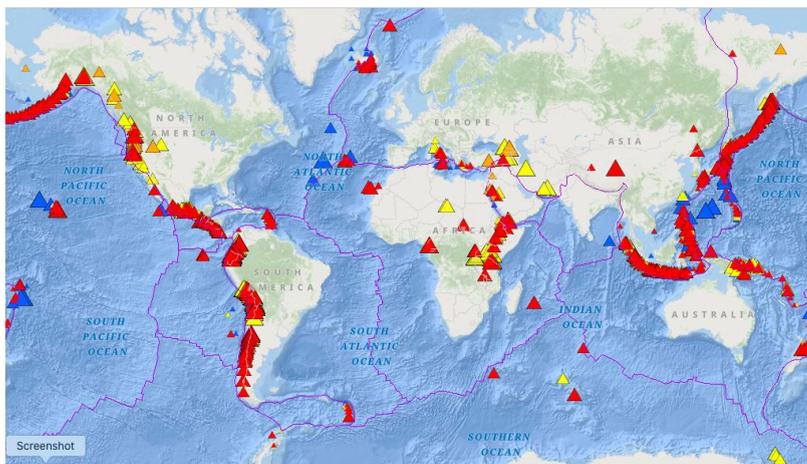


 Look at the map of tectonic plates above. Which are the three largest plates?

1. _____
2. _____
3. _____

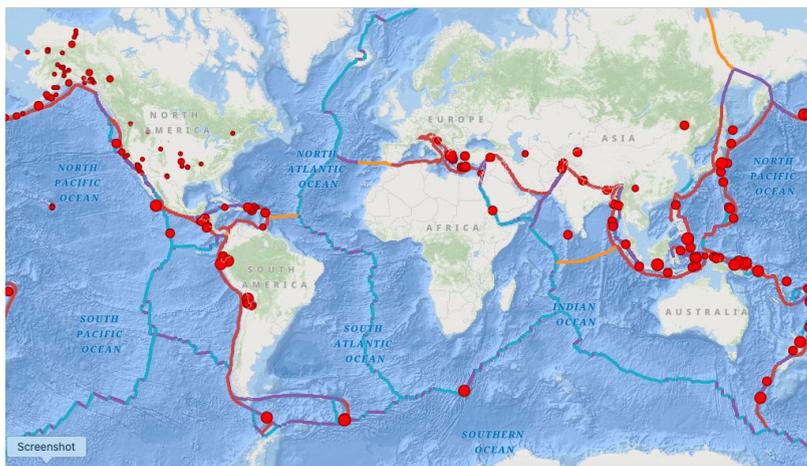
 What do you think might happen as a result of the plates moving?

Where do volcanoes and earthquakes happen?



👁️ Map of active volcanoes

What does this map tell you about where most volcanoes erupt?



👁️ Map of recent earthquakes

What does this map tell you about where most earthquakes happen?

Plate Tectonics

Tectonic plates are always moving but it is so slow that we do not notice it. Tectonic plates move between 1 and 10cm every year. Some plates are moving towards each other whilst other plates are moving away from each other. The slow movement of these plates leads to violent earthquakes and volcanic eruptions.

However the movement of these plates also leads to the creation of beautiful mountain ranges such as the Andes and Himalayas.

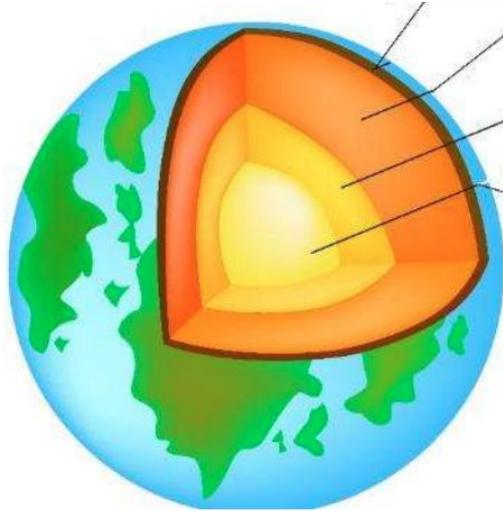


Turn to page 3 and complete the learning review

LESSON TWO: What are Fold Mountains?

Retrieval Practise

What are the 4 layers of the Earth?



Where do earthquakes usually occur? Why is that?

The layers of the Earth get hotter towards the middle of the Earth.

True / False

Which two metals make up the inner and outer core?

- a. iron and copper
- b. iron and nickel
- c. nickel and cobalt
- d. cobalt and iron

The continental crust is made of basalt and sinks to the sea floor.

True / False

Glossary

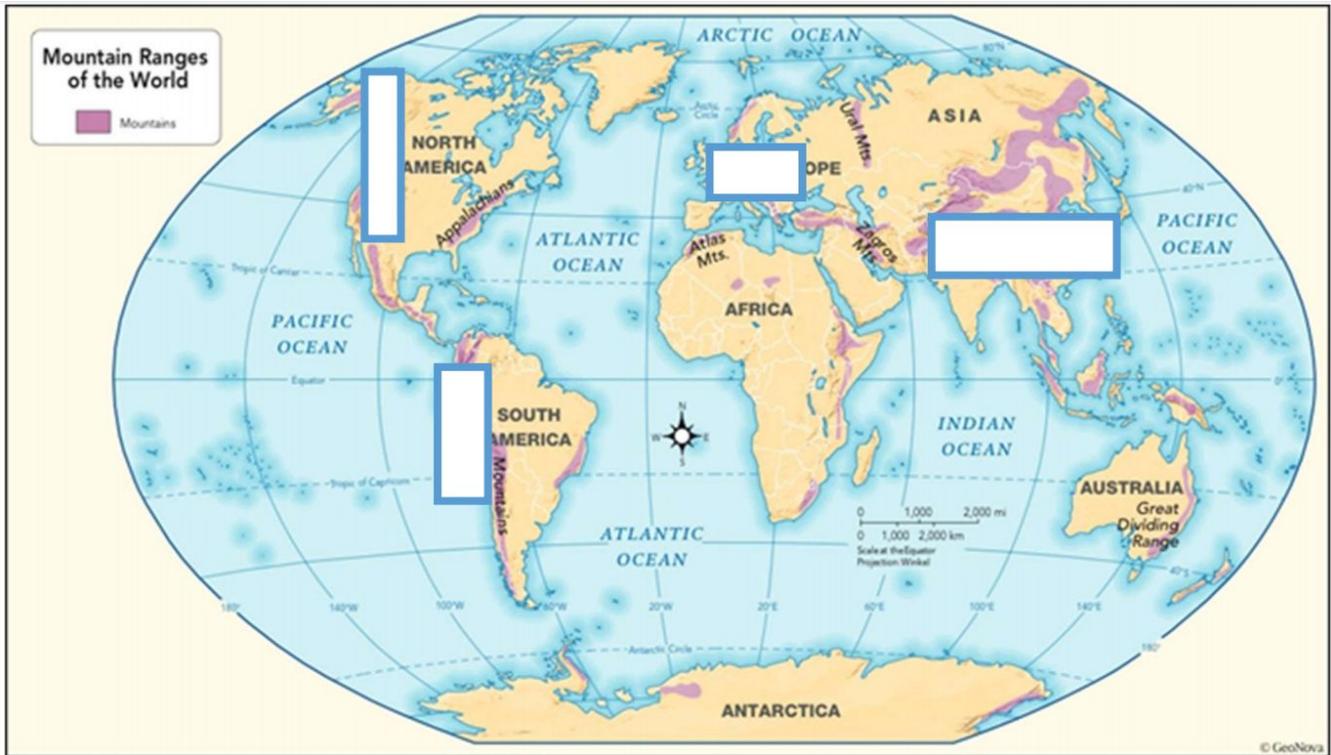
Term	Definition
Fold mountain	Mountains formed when tectonic plates collide and cause the plates to wrinkle
Mount Everest	The Earth's tallest mountain (8848m)
Continental plates	Part of the Earth's crust that forms large land masses
Mariana Trench	The Earth's deepest ocean trench (10,809 m)
Subduction	The movement of a plate into the earth's crust beneath another plate

Mountain Ranges

A mountain range is a series of mountains or hills that are in a line and connected by high ground. Mountain ranges are formed when tectonic plates **collide**. The tallest mountain on Earth is called **Mount Everest**, it is 8,848m tall. Mount Everest is in the Himalayas which travel through Afghanistan, Pakistan, India, Nepal, China and Bhutan. Mount Everest is in Nepal. Other big mountain ranges include: the Andes in South America; the Rocky Mountains in North America and the Alps in Europe.



Name the following mountain ranges.



Mountain Passes



A mountain pass is a travelable route through a mountain range or over a ridge.

Crossing mountain ranges can be difficult and so mountain passes have played a key role in trade, war and migration. One example of a mountain pass is Thorong La Pass in Nepal. It is 5,416m above sea level and is used by walkers on the Annapurna circuit and by locals to travel between two mountainous villages Manang and Mukinath.



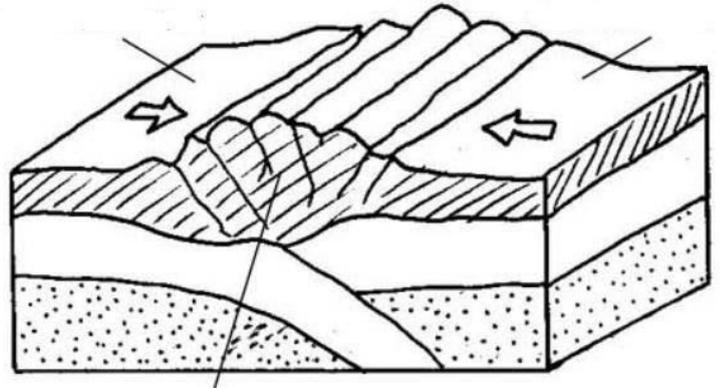
Why do you think mountain passes are important to people who live in mountain ranges?

How are Fold Mountains formed?

When two **continental plates** collide it causes the two plates to crumple and wrinkle in the same way as if two cars had collided.

An example of a Fold Mountain region is the Himalayas. When the Himalayas were formed **Indian** plate and the **Eurasian** plate collided. Both plates are continental plates and so when they collided they crumpled and wrinkled forming the Himalayas.

These two plates are still moving towards each other and so the mountains in this region are getting taller. Mount Everest is growing by 1cm per year.



Arrange the words below to make sentences explaining how the Himalayas were formed.

The Eurasian plate are moving towards each other and the Indian plate

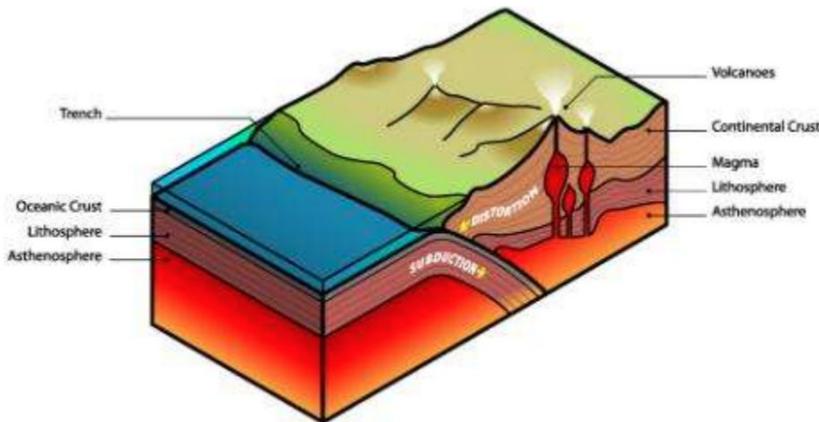
and Indian plate The Eurasian are examples of continental plate

When two continental plates forming fold mountains collide they wrinkle

move towards If plates continue to each other get taller the mountains

Ocean Trenches

Ocean Trenches occur when two **oceanic plates** collide. The deepest ocean trench is called the **Mariana trench**. The deepest part of the Mariana trench is called the **Challenger Deep**, which is 10,809m below sea level.



When the Pacific plate and the Philippine plate collided, the heavier Philippine plate sank below the Pacific plate. This process of sinking is called **subduction**. Where the two pieces of crust collide a deep trench forms, one of the plates sinks into the Earth's mantle and is slowly destroyed.

What is meant by subduction?

Life in the Mariana Trench

At the bottom of the Mariana Trench it is completely dark and under extreme **pressure**. The pressure is more than 1,000 times the pressure felt at sea level which is like having 50 jumbo jets sitting on top of a person. There are also high levels of liquid carbon dioxide and molten sulphur which is not seen anywhere else on Earth.

Despite these difficult conditions there are animals living in the deepest, most inhospitable parts of the trench. Some microbes have even adapted to use the sulfur in their diet. The three main types of organism living in the trench are: xenophyores, amphipods and small sea cucumbers.

What conditions make it difficult for animals to survive in the Mariana trench?



Turn to page 3 and complete the learning review.

LESSON THREE: How are volcanoes formed?

Retrieval Practise

Fold mountains are formed when:

- Two continental plates collide
- Two oceanic plates collide
- A continental and oceanic plate collide
- The Eurasian plate collides with something else

Where do volcanoes usually occur? Why is that?

Subduction is the movement of a plate into the earth's crust beneath another plate .

True / False

Which of the following statements is correct?

- The oceanic crust is older than the continental crust
- The continental crust can be renewed and destroyed
- The oceanic crust is heavier
- The continental crust makes the sea bed 5

There is no life at the bottom of the Mariana Trench because the conditions are inhospitable

True / False

Glossary

Term	Definition
Shield volcano	Volcanoes with a wide base. They are short and not very steep
Stratovolcano	Volcanoes are made of layers of lava and ash. They have steep sides and are tall.
Active volcano	A volcano that has erupted in the last 10,000 years.
Subduction zone	Boundary between two tectonic plates where an oceanic plate is sinking into the mantle beneath another tectonic plate.
Dormant Volcano	An active volcano that is not erupting but is supposed to erupt again.

Volcanoes

A volcano is a mountain or hill which has a crater or vent. In an **eruption** lava, rock fragments, hot vapour or gasses are pushed out of the crater. An **active volcano** has had at least one eruption in the last 10,000 years. A **dormant volcano** is an active volcano that is not erupting but is expected to erupt again.

What comes out of a volcano in an eruption?

What is meant by a dormant volcano?



Mayon Volcano, Philippines

Picture of a volcano



Label the following on the diagram:

- Ash cloud
- Crater
- Lava flow

Types of volcano

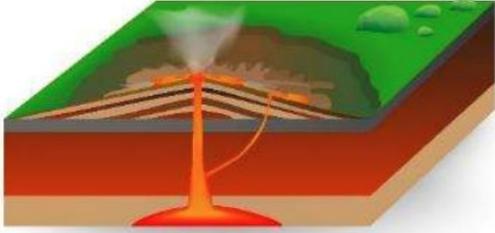
There are two types of volcanoes, **shield volcanoes** and **stratovolcanoes**.

Shield volcano



Stratovolcano



Type	Shield Volcanoes	Stratovolcanoes
Diagram	 <p style="text-align: center;">Shield volcano</p>	 <p style="text-align: center;">Stratovolcano</p>
Formation	Lava flows easily so a broad volcanic mountain is built up over time by repeated eruptions.	Lava does not flow as far so many layers of hardened lava build up a steep volcano after repeated eruptions.
Height	Short with sides that are not steep.	Tall with sides that are steep.
Eruption	Liquid lava emitted from a central vent.	Thicker lava and explosive debris emitted from a small vent.
Example	Kilauea (Hawaii) and Erta Ale (Ethiopia)	Mount Vesuvius (Italy) and Bárðarbunga (Iceland)

What are the two types of volcano?

 Describe the difference in appearance of **shield volcanoes** and **stratovolcanoes**.

Where are volcanoes found

Stratovolcanoes are most commonly found along subduction zones. A subduction zone is the boundary between two tectonic plates where an oceanic plate is sinking into the mantle beneath another tectonic plate. The stratovolcanoes are found in chains along the upper tectonic plate. An example of this is the **Ring of fire**.



Shield volcanoes are formed when two plates move away from one another. Shield volcanoes are commonly found over the Mid-Atlantic Ridge where the North American plate and the Eurasian plate are moving away from each other.



Describe what is happening to tectonic plates when shield volcanoes are formed.



Describe what is happening to tectonic plates when stratovolcanoes are formed.



Turn to page 3 and complete the learning review.

LESSON FOUR: How does an earthquake occur?

Retrieval Practise

Ocean trenches are formed when:

- a. Two oceanic plates collide
- b. A continental and oceanic plate collide
- c. A continental plate subducts another plate
- d. An oceanic plate subducts another plate

Name two mountain ranges. Which continent are they in?

Stratovolcanoes form when two plates are moving away from each other.

True / False

Which of the following statements is correct? a

- a. Shield volcanoes are short and have steep sides
- b. Shield volcanoes are tall and have steep sides
- c. Shield volcanoes are short and do not have steep sides
- d. Shield volcanoes are tall and do not have steep sides 5

5. Temperature decreases as you get closer to the Earth's inner core.

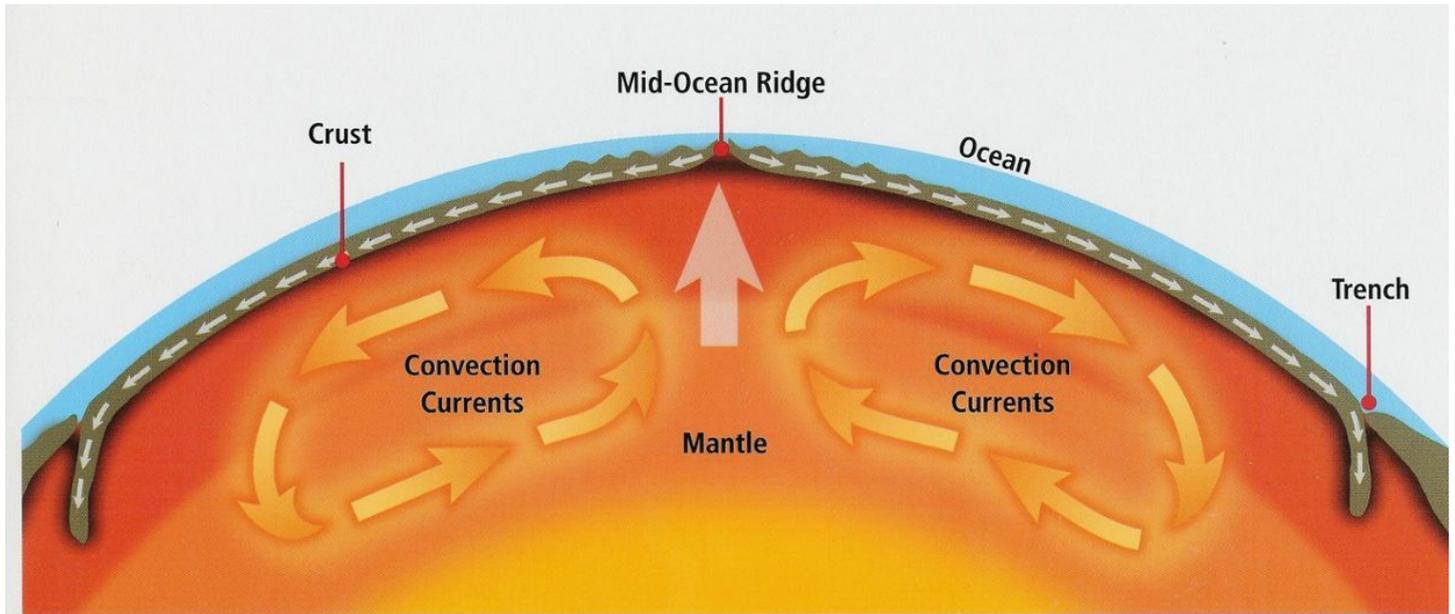
True / False

Glossary

Term	Definition
Radioactive decay	A process where large atoms break apart releasing energy
Convection current	The movement of hot liquid that causes the tectonic plates to move
Earthquake	When the ground suddenly and violently shakes
Epicentre	The place on the Earth's surface above where a rock breaks causing an earthquake
Tsunami	A huge wave caused by an earthquake

Movement of tectonic plates

Materials deep inside the Earth's core undergo **radioactive decay** this results in the release of lots of energy. This energy heats the mantle and causes it to move. Hot mantle rises, cools, sinks back down and is heated again. This is called a **convection current**. The movement of the mantle causes the tectonic plates to move.



What is a convection current?



What happens when convection currents cause plates to move apart?



What two things can happen when convection currents cause plates to move towards each other?

What is an Earthquake?

Sometimes when the tectonic plates move against each other it causes the ground to shake violently. This is called an **earthquake**. An earthquake generally causes huge devastation as buildings may fall down which can kill or injure people. The size of an earthquake is measured using the **Richter Scale**. Earthquakes that measure over 6.0 on the Richter scale can cause lots of damage.



What scale is used to measure the size of an earthquake?

What causes an Earthquake?

Earthquakes happen when two plates rub against each other along a fault line. A fault line is the place where two plates meet and move past each other. An example of a fault line is the San Andreas Fault in California which was formed by the North American plate and the Pacific plate moving past each other. It is a crack in the Earth's crust that is about 1,200Km long and the plates are moving between 30 and 50mm per year.

When the plates move past each other sometimes they get stuck, the plates continue to push on each other until small bits of rock break off. This causes the plates to jolt forwards and results in an earthquake. The **epicentre** of an **earthquake** is the place on the Earth's surface above where the rock broke off.

🔍 Earthquakes happen when:

- Two plates move towards each other
- Two plates rub against each other
- Two plates move away from each other
- One plate breaks in two



San Andres Fault

🔍 The **epicentre** of an earthquake is:

- The centre of an earthquake
- The place where the rocks broke
- The place on the Earth's surface above where the rock broke
- The crack in the Earth's surface left behind after an earthquake

Why are earthquakes usually a surprise?

Earthquakes happen very often because plates are moving past each other all the time. About 50,000 earthquakes happen every year. However some of these are really small and not noticed by humans.

Bigger earthquakes can be very dangerous, however scientists have not yet found a way of accurately predicting when an earthquake will happen or how large it will be. So people who live in these places need to be prepared.



Complete the following sentences to recap your learning:

Earthquakes happen frequently because...

Earthquakes happen frequently but...

Earthquakes happen frequently so...

What happens when earthquakes are really big?

When the ground shakes violently due to a massive earthquake it can cause a **tsunami**. A tsunami is a huge wave caused by an earthquake. In 2011 there was an earthquake in Tohoku, Japan. It measured 9.0 on the Richter scale which meant it was classified as a 'great earthquake'. The tsunami wave reached 39m high and travelled 10km inland causing lots of flooding.



Tohoku tsunami



Turn to page 3 and complete the learning review.

LESSON FIVE: What happens when a volcano erupts?

Retrieval Practise

Which continent are the Himalayas in?

- a. Europe
- b. Africa
- c. Asia
- d. South America

Name the process in magma that causes tectonic plates to move.

Earthquakes happen when two plates rub together at a fault line.

True / False

Which of the following statements is correct?

- a. A dormant volcano is currently erupting
- b. A dormant volcano has erupted before but will not erupt again
- c. A dormant volcano has erupted and will erupt again
- d. A dormant volcano is a volcano that erupted over 10,000 years ago

Scientist can predict when an earthquake will happen and how big it will be.

True / False

Glossary

Term	Definition
Evacuation	When people are moved away from their home to keep them safe
Infrastructure	Structures such as buildings, roads and power supplies
Natural disaster	A natural event such as an earthquake or eruption that causes death or extreme damage
Power station	The place where electricity is generated and supplied

Volcanic Eruptions



How do you think the eruption of Fuego affected people?



Read the information about the Fuego eruption

Case Study: Fuego Volcano

Location: Guatemala, South America

Date: 03/06/2018

Explosively index: 3 (moderate volcano)

Immediate effects:

- o 110 deaths
- o 200 people missing
- o 300 people injured

Secondary effects

- o Hunger due to crops being destroyed
- o Heavy rain caused landslides
- o Disruption to travel and farming

Immediate response:

- o Search and rescue teams clear roads to rescue people
- o Water, food, medical care and tents provided
- o Evacuation

Long-term response

- o Education and evacuation drill
- o New and improved emergency response systems
- o Rebuilding infrastructure



 How many people died in the Fuego eruption?

 What did the search and rescue team do to help?

The effects of the eruption can be split into different categories depending on whether they impact people - **social**, money - **economic** or the surrounding area - **environmental**.



Categorise the immediate and secondary effects.

	Social	Effects that have an impact on people
	Economic	Effects that have an impact on money
	Environmental	Effects that have an impact on the environment

Evacuation

When natural disasters such as volcano eruptions occur the government might decide that it is necessary to **evacuate** people for their own safety. An evacuation is similar to what happens at school when the fire alarm rings.

In an evacuation people are moved out of their houses to a place of safety away from the natural disaster. A person who has been evacuated is called an evacuee. When it is safe evacuees are allowed to return home.

 An evacuation is permanent

True / False

 An evacuation is used to protect people from harm

True / False

Why do people live near volcanoes?

Although volcanoes are dangerous they can also be really useful which is why some people choose to live near them.

The energy from volcanoes can be used to run power stations and produce electricity. We use electricity all the time to power our phones, computers and light bulbs. This is a really good way of producing electricity because it does not release harmful gasses into the environment.

Tourists come to visit the volcano which means that people living there can make money by selling things or offering a place to stay. This is a positive economic impact.

Finally, the areas around a volcano are great for farming because the lava produces excellent soil for growing crops.

The people who live near volcanoes pay for training in emergency response and evacuation to protect themselves in the event of an eruption.



Complete the following sentences to recap your learning:

It is dangerous to live near a volcano because...

It is dangerous to live near a volcano but...

It is dangerous to live near a volcano so...



Turn to page 3 and complete the learning review.

LESSON SIX: What happens when an earthquake occurs?

Retrieval Practise

What is the oceanic crust made from?

- a. Nickel and iron
- b. Granite
- c. Basalt
- d. Magma

How many people died in the Fuego volcano eruption?

Fold Mountains tend to form in straight lines.

True / False

Which of the following statements is correct?

- a. Fold mountains occur when tectonic plates move towards each other
- b. Earthquakes occur when tectonic plates move apart
- c. Volcanoes occur when tectonic plates rub against each other
- d. Earthquakes occur when tectonic plates move towards each other

Despite being dangerous there are advantages to living near a volcano.

True / False

Glossary

Term	Definition
Tsunami	A giant wave caused by the movement of tectonic plates
Infrastructure	Structures such as buildings, roads and power supplies
Social effects	Effects that have an impact on people
Economic effects	Effects that have an impact on money

Earthquakes



How do you think the earthquake at Tohoku affected people?

Photo: Tohoku earthquake



Read the information about the Tohoku earthquake

Case Study: Tohoku Earthquake

Location: Japan, Asia

Date: 11/03/2011

Size: 9.0 Richter Scale Immediate effects:

- o 16,000 deaths
- o 4,000 people missing
- o 6,000 people injured

Secondary effects

- o Tsunami wave and flooding
- o Tsunami wave reached 39m high and travelled 10Km inland
- o Disruption to travel and farming

Immediate response:

- o Military aircraft identified areas that needed most urgent help
- o Roads cleared to bring in water/ food/ medical care and tents

Long-term response

- o Continued training, education and earthquake drills
- o Rebuild infrastructure



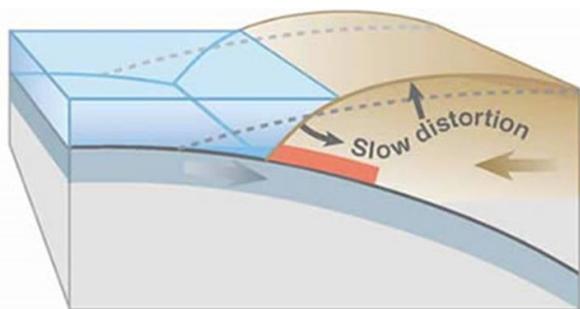
Where did the Tohoku earthquake happen?



Categorise the immediate and secondary effects into the following categories:

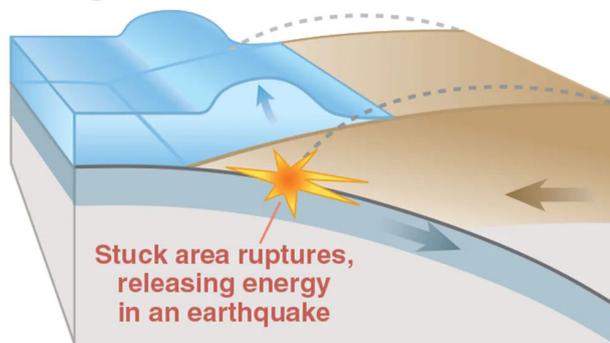
	Social	Effects that have an impact on people
	Economic	Effects that have an impact on money
	Environmental	Effects that have an impact on the environment

What causes a tsunami?



During subduction the seabed can get dragged downwards by the motion of the crust, sinking back down into the mantle. This is the cause of most earthquakes.

Earthquake starts tsunami



Eventually, the forces become so great that the crust springs back up into place. When this happens it forces the ocean above it to rise and flow outward

The result is a Tsunami, a giant wave caused by the earthquake. When these tectonic plates jolt, it can cause millions of tons of water to be pushed towards the shore in waves that measure miles from front to back.

Tsunamis can grow really big; the one in the Tohoku earthquake was 39m tall. This much water can cause huge floods and damage to infrastructure.

 What is a tsunami?

 Why can tsunamis be dangerous?

Which natural disaster do you think had a bigger impact, the Tohoku earthquake or the Fuego volcano? Explain your answer using examples from the social, economic and environmental table.

 **Turn to page 3 and complete the learning review.**