

Introduction

Volcanoes of the Auvergne



This area is famous for having the greatest preserved **EXTINCT** volcanoes in Europe. They are spread over most of the region and although none have erupted for over 3,400 years, they still have their original shape with **CRATERS** and **LAVA FLOWS**. The only major change now is that they are covered with vegetation. They lie on a basement of much older rocks created during the mountain building period, over 300 million years ago. In most places, these older rocks are now hidden; however fragments of them have been brought to the surface through the volcanic **VENTS** and preserved in the **LAVAS**.

Although some early volcanic activity in the Massif Central took place during the **PALAEOCENE** (shortly after the extinction of dinosaurs 65 million years ago), the vast majority of it dates from the last 20 million years during the **TERTIARY** and **QUATERNARY** periods.

Most volcanic activity is restricted to **PLATE MARGINS** where two plates are either pulling apart (**CONSTRUCTIVE MARGIN**, e.g. Iceland) or pushing together (**DESTRUCTIVE MARGIN**, e.g. Japan). There was however no plate boundary in this area at the time that the volcanoes erupted. It seems that the eruptions were caused simply by **TENSION** pulling the crust apart or to the presence of a **HOT SPOT** (a column of hot rock rising from the mantle and burning through the overlying crust, e.g. Hawaii).

Welcome to Vulcania

The following worksheets are designed to help you learn and understand the world of volcanoes. It is best to work in small groups exploring:

- ▶ The show room, rumbling chamber, Mt Etna, lava tunnel and volcanic garden (1-5)
- ▶ Planets and Volcanoes (6-11)
- ▶ On the Trail of the Volcanoes (12-17)
- ▶ Man and Volcanoes (18-25)

Each section is numbered on the map from 1 – 25 so it is best to visit them in this order to enable you to answer the questions more efficiently.

Have Fun!



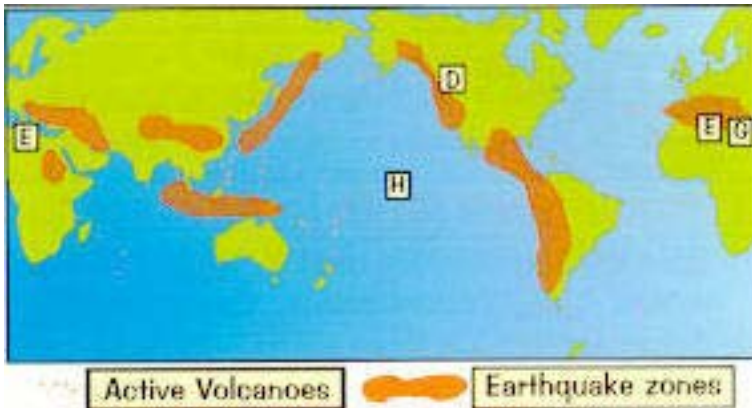
Beginning Your Visit: 1-5

Earth, a volcanic Planet

It is estimated that the Earth was formed 4.6 billion years ago and volcanoes have been appearing upon its surface since that time.

A **VOLCANO** is a conical hill or mountain that has been formed by material from the mantle being forced through an opening in the Earth's crust, the **VENT**

*Volcanoes can be described as **EXTINCT**, **DORMANT** or **ACTIVE**.*



Extinct: Unlikely to erupt again
e.g. – Devils Tower, Wyoming (**D**)

Dormant: Hasn't erupted in many years
e.g. – Santorini, Greece (**G**)

Active: It has erupted recently and may erupt again. e.g. Mt Etna, Sicily (**E**)

Look at the map situated outside the show room (1):-

1: Where are the majority of the world's active volcanoes located?

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2: Why do you think that volcanic eruptions occur in some areas but not in others?

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Go inside the show room (1) opposite the information desk. The film introduces you to the Earth as a volcanic planet.

3: What reasons are given in the film as to why people still choose to live near volcanoes?

1)

3)

2)

4)



Head towards the 'rumbling chamber' (2) and le salle Etna (3) situated next to the show room. Here you will experience the noise the Earth makes during a volcanic eruption and see the consequences of a lava flow.

Enter the Lava Tunnel (4)

4: How does a lava tunnel form?

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Visit the volcanic garden and the outside valley (5). Here you will see tree ferns from New Zealand and flora found in the Massif Central growing together.

Planets and Volcanoes: 6-11

Internal Dynamics of the Earth

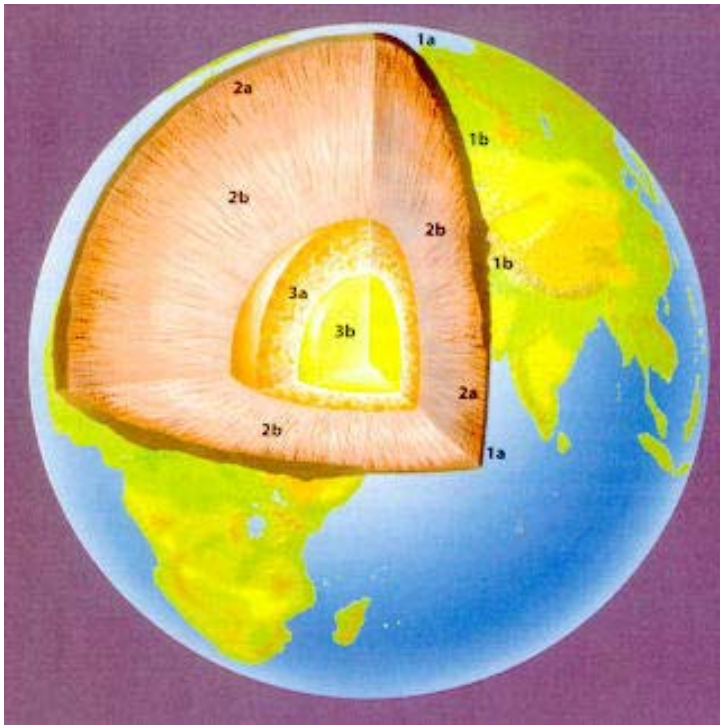
Head towards 'planets and volcanoes' situated on level 2 (6-11)

Look at the large scale diagram of the internal dynamics of the Earth (6).

The Earth is made up of three distinct layers: **CORE**, **MANTLE** and **CRUST**.

It also has two sub-layers known as the **ASTHENOSPHERE** (layer within the mantle) and the **LITHOSPHERE** (part of the crust and inner mantle).

5: Using the diagram put the correct number with the matching term



- Oceanic Crust:** (SIMA)
- Continental Crust:** (SIAL)
70 km thick. The crust & top part of the mantle are called the '**LITHOSPHERE**'.
- Outer Core:** Semi-molten
- Mantle:** Extends to a depth of 2900km where temperatures reach 5000°C.
- Inner Core:** Solid
- Asthenosphere:** Where rocks are kept in a semi molten state

6. What is the main material found within the Earth's core?

.....

.....

7. Respond to these statements true or false:

True **False**

a) The planet Earth is made up of mainly liquid.

b) Materials within the Earth get hotter and denser the deeper you go inside.

c) The temperature of the core is about 5000°C, that is equivalent to the temperature of the sun.

The **LITHOSPHERE** is divided up into what is known as **PLATES**. These plates are rigid but float like rafts on the underlying molten material of the mantle.

This movement is caused by what is known as **CONVECTION CURRENTS** generated by the heat from the centre of the Earth.

A beaker of water over a Bunsen burner can illustrate the heat transfer process during **CONVECTION**.



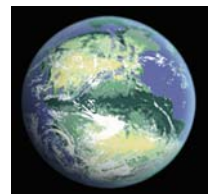
Radiation from the Bunsen burner heats up the water inside the beaker. This gives rise to **CONVECTION CURRENTS** within it. The glass of the beaker becomes hot because of **CONDUCTION** along it from the hot liquid.

8. By what process does heat move in the lithosphere and in the asthenosphere?

Lithosphere →

Asthenosphere →

PLATE TECTONICS is the study of the movement of these plates and their resultant landforms. There are TWO types of plate: **OCEANIC** (SIMA) & **CONTINENTAL** (SIAL).

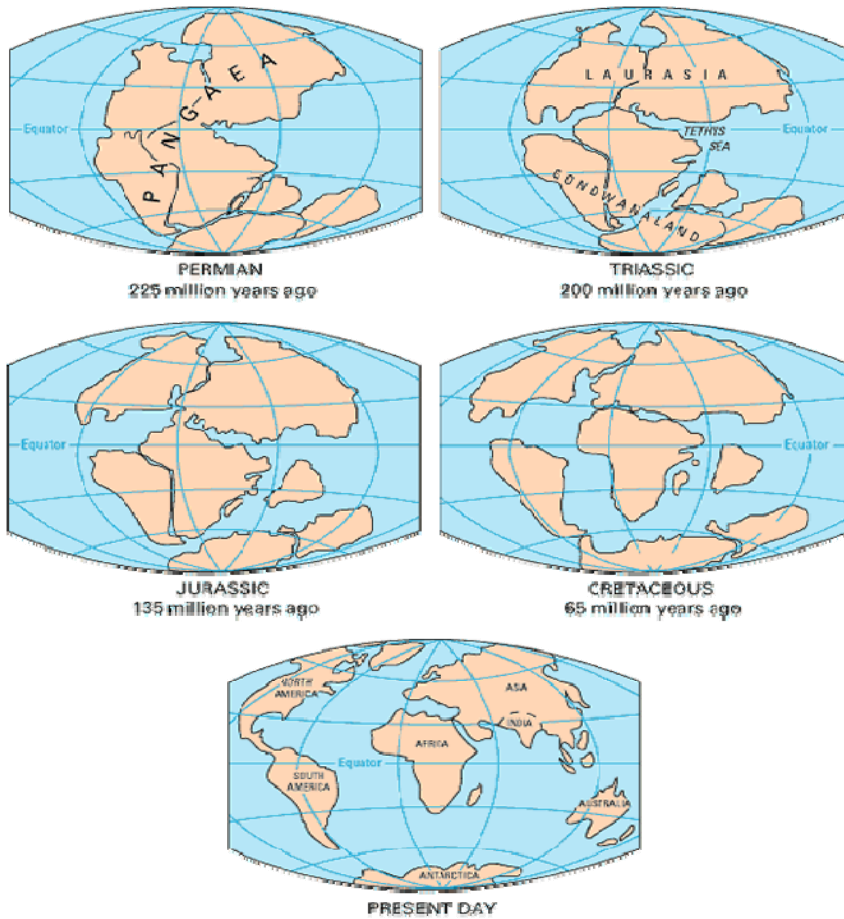


Look at the series of information boards on the theory behind volcanic activity

(6) and answer the following set of questions:

In 1912, a German Meteorologist called Alfred Wegener published his theory that all the world's continents were once joined together in one large super-continent which he named **PANGEA**. Later, this landmass somehow split up and the various continents as we know them drifted apart.

This theory is known as '**CONTINENTAL DRIFT**'.



2. What **THREE** pieces of evidence are now available that helps to support this theory?

- 1).....
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- 2).....
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- 3).....
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These discoveries have led to the development of the theory of **PLATE TECTONICS** which is now universally accepted.

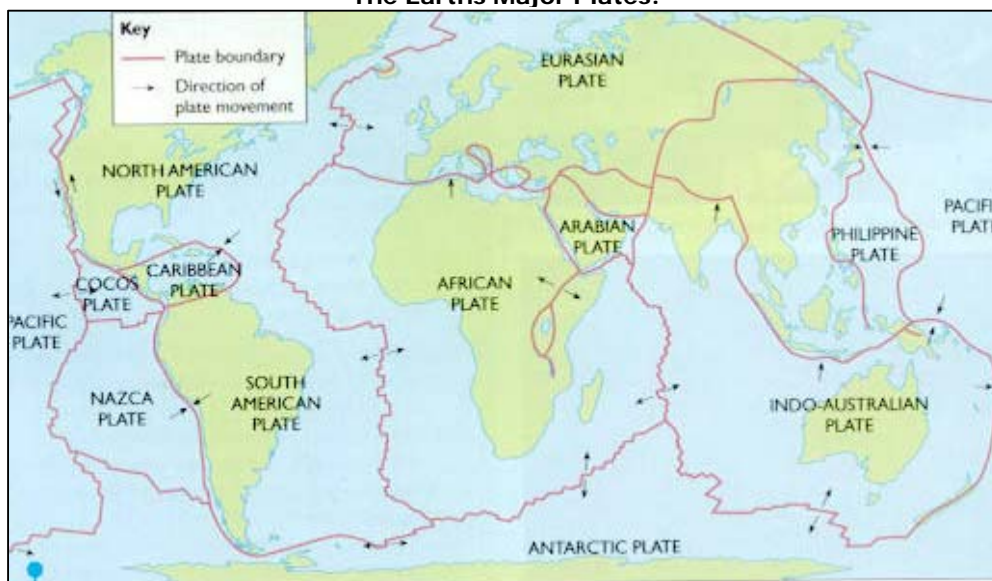
10. Read the following text and then fill in the gaps with the appropriate word.

Remember, you're not allowed to use the same word twice!

Volcanic and seismic (earthquake) activity is primarily limited to '**PLATE BOUNDARIES**'.
Approximately plates exist on Earth.

- Some are hidden in the bottom of the oceans in what's known as zones of This is where two plates move apart (**converge**) to create new oceanic crust, e.g. Mid-Atlantic Ridge.
- The others are concentrated on the borders of continents and in zones of This is where a Plate sinks (**diverges**) under a continental plate. The Andes were formed in this way by the plunging of the Pacific Ocean plate under the South American plate.
- Some volcanoes however are not limited to such plate boundaries. Some volcanic activity is found at points known as This is where magma rises from very deep points within the Earth along channels known as They punch through the surface regardless of plate boundaries forming a volcano, e.g:

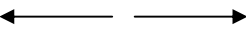
The Earth's Major Plates:



Plates meet at **PLATE BOUNDARIES** or **MARGINS**. When two plates touch, they can move in different directions. This leads to instability causing **NATURAL HAZARDS** such as earthquakes and volcanoes:

A **NATURAL HAZARD** is a physical event that occurs naturally in the Earth which may lead to a threat to people, property and the environment.

Different types of plate boundaries exist:

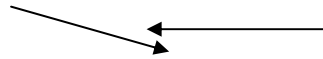
Plates that move apart:  are known as **DIVERGING** and are **CONSTRUCTIVE** plate boundaries as new features are formed (Zones of Accretion).

11. Read the following text and fill in the gaps with the appropriate word.

REMEMBER: You can only use the same word once!

- Constructive plate margins occur when two plates or move away from one another and new is created at the boundary.
- Sea floor spreading occurs in the Mid-Atlantic where the and South American plates are being pulled apart by currents. This may cause huge valleys to form on the sea floor.
- However, molten rock or from the mantle rises to fill any possible between the two plates.
- This magma produces-..... volcanoes which in time may grow above sea level e.g: Surtsey, Iceland.
- As the basaltic magma it adds new land to the separating plates.


When oceanic crust moves towards continental crust:



These are known as CONVERGING and are **DESTRUCTIVE** plate boundaries (Zones of Subduction) where the oceanic crust sinks under the continental crust.

12. At destructive plate boundaries why does the oceanic crust sink under the continental crust?

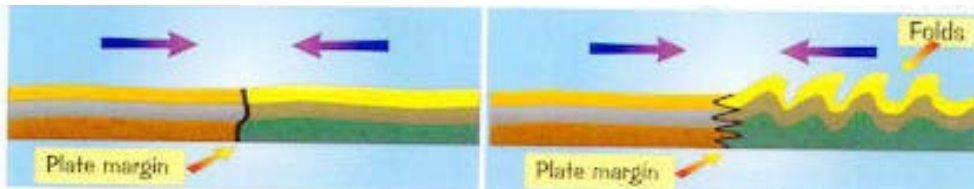
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When two continental plates collide:  they are known as

COLLISION plate margins.


13. Explain how FOLD MOUNTAINS are formed? Use the diagram below to help.

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14. Give an example of a series of mountains formed in this way.

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Plates which move sideways against each other:  are known as **CONSERVATIVE MARGINS** and material isn't gained or lost.

Volcanoes are rare in this situation but earthquakes are common.

Visit the other areas of planets and volcanoes (7-11).

Explore the planets and the solar system in the theatre of the universe (11).





[On the Trail of the Volcanoes: 12-17](#)

Different Types of Volcano

Head towards 'On the trail of the Volcanoes' section situated opposite planets and volcanoes.

*Visit the geysers and mud volcanoes (12 -14). These are minor **EXTRUSIVE** volcanic features that are often associated within areas of declining volcanic activity.*

At section 15 you will see how volcanoes can provide many riches for the benefit of mankind

15. List FOUR economic benefits of volcanic activity.

- a)
- b)
- c)
- d)

Go to section 16 where you will see information on the different types of volcano.

The term **VOLCANOLOGY** includes all the processes by which **SOLID, LIQUID & GASEOUS** materials are forced into the Earth's crust or ejected onto the surface.

Different types of volcano exist on Earth and they are often grouped according to their **shape** and the nature of its **eruption**.

All volcanoes begin life as a crack or hole in the ground. As the volcano erupts, **LAVA** and **ASH** pile up around this crack or hole. They gradually build up into a hill or mountain .This is called the **CONE** of the volcano.

16. Read the following text and fill in the gaps to distinguish between two different types of volcano giving an example of where one can be found.

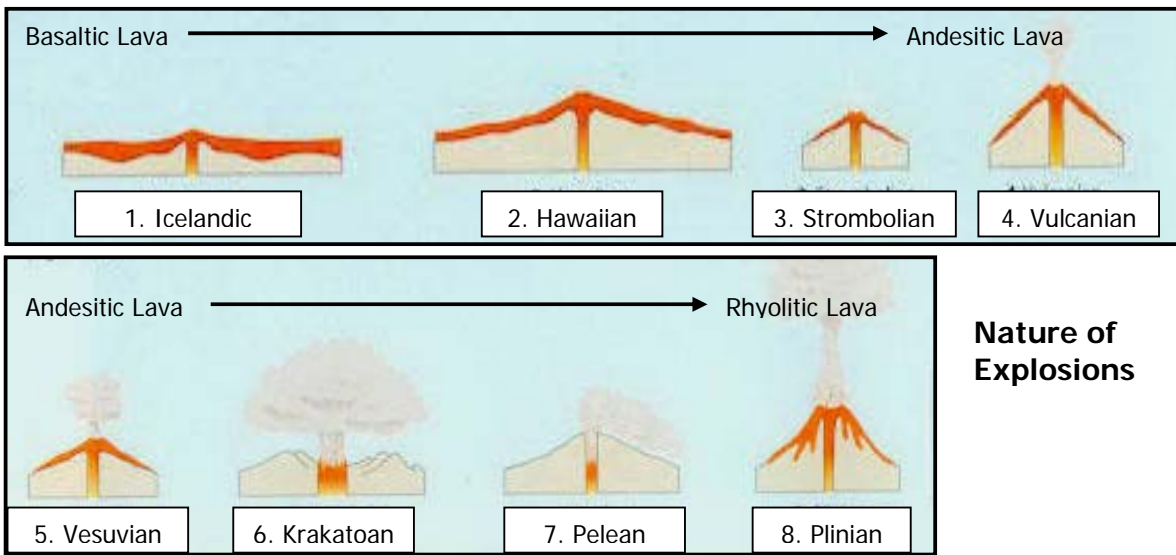
a) volcanoes are built up from eruptions of fluid lava caused by the rising of hot This builds up a volcano with sloping sides. The lava flows quickly and easily, spreading over large areas to form wide, flat features.

e.g.

b) A **COMPOSITE** or are built up by repeated eruptions of lava. Magma accumulates in a deep magma where it may remain for 100's of years. The pressurised gases cause a violent with ash, gas and pieces of rock known as ejected through the

e.g.

17. Using the diagram below, match up the correct type of volcanic eruption to its definition (1-8).



- a)** Lava is emitted gently but from a vent
- b)** Violent explosion after a long period of inactivity
- c)** Violent eruption is accompanied by pyroclastic flows &/or a nuées ardente
- d)** Small but very frequent eruptions occur
- e)** Large amounts of lava & pyroclastic material are ejected
- f)** More violent and less frequent
- g)** Lava flows gently from a fissure
- h)** An exceptionally violent explosion that may remove much of the cone

18. What are the differences between lava, magma and volcanic rock?

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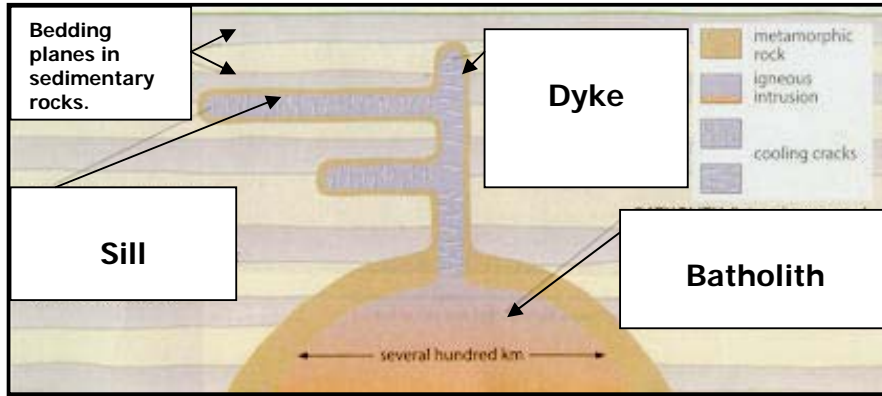
When lava and other materials reach the surface, they are called **EXTRUSIVE**. They create distinct landforms as the magma reaches the surface quickly before cooling. Materials that are formed when the magma cools before reaching the surface are called **INTRUSIVE**.

Both extrusive and intrusive materials cooled from magma are known as **IGNEOUS** rocks.

19. Match the right term to its definition from the words in the box, circling whether it's an intrusive or extrusive landform. (Use the diagram on the next page to help you).

- a)..... 'Material ejected by volcanoes. This includes cinders, ash, small stones, pumice and volcanic bombs'
Intrusive / Extrusive
- b)..... 'Vertical intrusions of magma which cuts across the bedding planes of sedimentary rocks'
Intrusive / Extrusive
- c)..... 'A build up of ash and lava around the opening of a volcano to create a 'dome' feature'
Intrusive / Extrusive
- d)..... 'Deep seated feature surrounded by hot rock. The magma cools so slowly that crystals may form'
Intrusive / Extrusive
- e)..... 'During an eruption, the lava may form a large flat terrain, filling in hollows rather than building up into a coned peak'
Intrusive / Extrusive
- f)..... 'Horizontal intrusions along bedding planes between the existing sedimentary rock'
Intrusive / Extrusive

LAVA PLATEAUX	CONE	DYKES	SILLS	BATHOLITH	PYROCLASTICS
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After watching the short film of the volcanoes of the world (17):

20. List **THREE** countries in the world where volcanic activity is common and give the name of one of its active volcanoes, e.g: USA, Mount St Helens

- 1)
- 2)
- 3)

Case Study: 18-19

Mount St. Helens, Washington, USA

The catastrophic eruption on May 18th 1980 was preceded by two months of intense activity from the volcano, a warning that an intense explosion was imminent.

At 08:32am on May 18th, the volcano erupted. The northern side slid away in one of the largest landslides in history, triggering a destructive lethal blast of hot gas (**Nuées Ardente**), steam and rock debris that swept across the landscape. Temperatures within the blast reached as high as 300 °C, melting the snow and ice on the volcano. This formed torrents of water and rock debris that swept down river valleys from the volcano.



Lahar: Mt St. Helens, 1982



Pyroclastic Flow: Mt St. Helens, 1980

Head towards the Mt St Helens display (18-19) on level 4 downstairs through the volcanic garden. After watching the short film (18) answer the following questions:

21. Fill in the gaps with the appropriate numbers. (Using each number once!)

- During the eruption, the avalanche of debris travelled a total distance of km.
- The surrounding forests were completely devastated. km² of trees were completely flattened. That is equivalent to six times the size of Paris.
- The trees were decapitated by the blast at an estimated speed ofkm/h.
- The energy released by the volcano was equivalent to atomic bombs falling.
- During the eruption, the melt water from the snow mixed with mud to form **LAHARS**, a fast flow of muddy, wet material.
- In total, the eruption killed people.

57	1000	25	600	27 000
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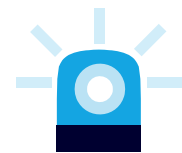
Man and Volcanoes (18-25)

Managing hazards & Observation

It is estimated that 500 million people around the world are exposed to natural hazards. A large number of **ACTIVE** volcanoes are situated within the Pacific Ocean in countries such as Japan, Indonesia and the Philippines. This concentration of tectonic activity has been nicknamed the '**RING OF FIRE**' or '**PACIFIC RIM**'

After the Mount St. Helens display, follow the 'Nuées Ardentes ramp' into the 'Man & Volcanoes' section (18-25)

*Sections 20 – 21 show the impact of a volcanic eruption upon people and the environment and how to **MANAGE** a crisis situation. After watching the short film (21), answer the following questions:*



22. Answer the following set of questions true or false:

- | | True | False |
|---|--------------------------|--------------------------|
| a) The local authority experts must first assess the seriousness of the situation and the damage following a volcanic eruption. | <input type="checkbox"/> | <input type="checkbox"/> |
| b) A volcanic eruption that happens in a rural area will have a bigger impact than a disaster in an urban area. | <input type="checkbox"/> | <input type="checkbox"/> |
| c) LEDC's often have better emergency plans in place than MEDC's. | <input type="checkbox"/> | <input type="checkbox"/> |
| d) PERCEPTION is how individuals or groups of people view the hazard risk. | <input type="checkbox"/> | <input type="checkbox"/> |

LEDC's may encounter more problems than **MEDC's** when a natural disaster occurs.

23. List **FOUR** possible reasons as to why you think this is so.

- 1)
- 2)
- 3)
- 4)



24. Give an example of TWO volcanic eruptions in an LEDC.

Try to give as much detail as you can including the date, number of people killed, area devastated e.t.c.

1)

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2)

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25. How does the impact of a volcanic eruption differ between an LEDC and an MEDC? (Use your case studies in question 21 & 24 to help you).

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26. Suggest TWO possible impacts of a volcanic eruption on PEOPLE and TWO possible impacts on the ENVIRONMENT.

PEOPLE

ENVIRONMENT

1)

1)

2)

2)

The impacts of a volcanic eruption can be described as either **SHORT TERM** or **LONG TERM**.

27. Give TWO examples of a short-term impact and a long-term impact following a volcanic eruption.

Short-Term

Long-Term

1).....

1).....

2).....

2).....

It is possible to **PREDICT** natural hazards in advance and scientists can use special instruments to **MONITOR** the Earth's movements.



Look at section 22 on the means and techniques of observation.

28. What sort of signals can indicate an imminent volcanic eruption?

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Over 100 observatories have been established near active volcanoes.

29. What is their function, what sort research is carried out and how can this save lives?

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Visit sections 23-25, the Kraft room, learn about cities that have disappeared due to an eruption and see the world of meteorites!

END OF QUESTIONS!

Make sure you check your answers with your teacher and don't forget to visit the 3D cinema in the amphitheatre, the great showroom and the earthquake simulator!