



Volcanoes

EARTH SCIENCE • GEOLOGY • VOLCANOES

Section 1: Anatomy of a Volcano

• What is a volcano?

A volcano is a point on the Earth's surface through which magma that is under tremendous pressure erupts as lava. This may be a single point, or a long line (vent). The opening will usually be at a place where the Earth's lithosphere is thin or has a weakness. The lava may be accompanied by gas and ash, and fragments of rock known as 'pyroclastics'. The volcano itself is often a conical hill, or mountain, composed largely of material erupted from the volcano over time. There are many different types of volcanoes, each with their own structure and behaviour, and some are more active than others. Despite the risks involved, many volcanoes have people living on their slopes.



Lanin volcano in Argentina

• Suggested Film

- What Is a Volcano?

• What are the main characteristics of volcanoes?

The features that can be seen above the surface of the Earth are only part of the system of a volcano. The volcano is fed by magma – molten rock from within the Earth – which collects in a magma chamber deep below the surface. Magma is transported to the surface through a vent or pipe, and if the conditions are right it erupts at the surface as lava. The rising magma often triggers earthquakes, which can provide some advance warning to a volcanic eruption. The volcano is often surrounded by layers of lava, ash and pyroclastics, which accumulate over time and can spread for kilometres from the actual opening in the lithosphere.

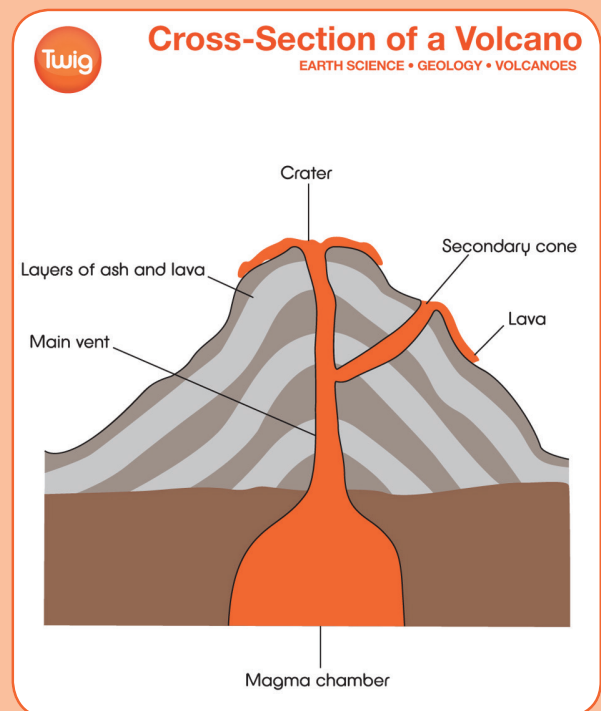


Mount Kilauea, Hawaii, is one of the world's most active volcanoes

• Suggested Activity

- Ask the students to draw a series of diagrams illustrating the formation of a volcano. These could be done in the form of a flip-book so that the volcano comes to life as the pages are flicked.

DIAGRAM 01:



• Suggested Film

- What Is a Volcano?

• Where do volcanoes occur?

Volcanoes are generally found at the boundaries of the Earth's tectonic plates. They can form where the plates are diverging, such as at mid-ocean ridges (e.g. Iceland), or converging (e.g. along the coast of South America). However, they can also occur within tectonic plates, where columns of magma rise up from the mantle at what are known as 'hot spots'. The Hawaiian island chain is an example of what happens when volcanoes occur within tectonic plates.

• Suggested Film

- **Kilauea: The Island Maker**

• Suggested Activity

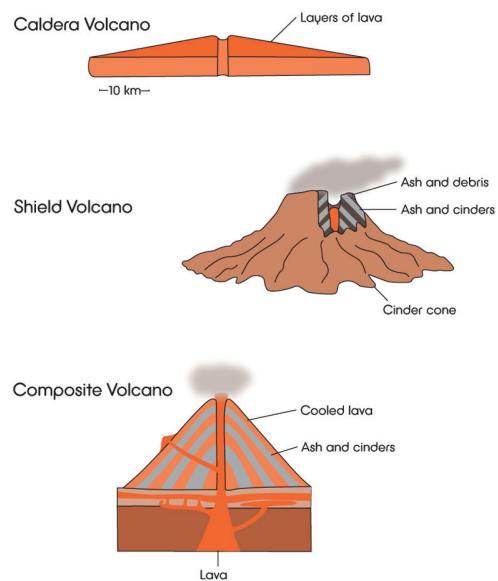
- Ask the students where the nearest volcano is to where they live.
- Ask the students to research and write a 500-word report on the eruption of the Eyjafjallajökull volcano in 2010.

DIAGRAM 02:



Different Types of Volcanoes

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Section 2: Volcanic Eruptions

• Are all volcanoes the same?

No. Although the underground systems of all volcanoes are similar, their features above ground can be very different. Composite volcanoes, or 'stratovolcanoes', are probably what you imagine when you picture a volcano: tall, steep-sided and conical in shape. Shield volcanoes are large and broad with shallow slopes; the Hawaiian islands are composed of shield volcanoes. Cinder cone volcanoes form by the collection of lava around a central crater, while lava domes form when thick magma erupts from a vent. Lava can also erupt through flat cracks at volcanic fissure vents. In addition to difference in physical form, volcanoes can also be classified depending on the composition of the magma that feeds them.



An explosion at Anak Krakatau, Indonesia

• Suggested Film

- **FactPack: Extreme Eruptions**

Extension Questions

Q1. In what cases can volcanoes be described as active, dormant or extinct?

A volcano that erupts regularly, or has had at least one eruption in the last 10,000 years, can be referred to as 'active'. If a volcano has been recorded as active in the past but has not erupted in recent times, it is referred to as 'dormant'. A volcano which has not erupted for around 10,000 years, and is not expected to erupt again, is referred to as 'extinct'.

Q2. Can extinct volcanoes ever become active again?

It may be difficult to determine whether a volcano is truly extinct, as many volcanoes can remain dormant for a long time. If a volcano is truly extinct, it no longer has a magma supply and it is therefore very unlikely that it will erupt again. Edinburgh castle sits on top of an extinct volcano.

• How do volcanoes erupt?

Magma collects in chambers below the Earth's surface, and because it is less dense than the surrounding rocks, it tends to rise upwards. The magma is under tremendous pressure and eventually escapes through vents and fractures at the surface, erupting as lava. The nature of the eruption depends on the type of volcano and the composition of the magma. There may be a plug of solidified rock in the opening, which will prevent an eruption happening for some years or decades. Other volcanoes erupt regularly.

• Suggested Films

- **Danger: Volcanic Ash**
- **The Last Day of Pompeii**

• Why are some eruptions so destructive?

When the magma supplying a volcano is thick, the gases within it cannot escape and tend to accumulate. This accumulation of gas causes pressure to build within the volcano until eventually it violently escapes. This sudden release of pressure can increase a volcano's power, such as the Mt St Helens, USA, eruption in 1980. Violent eruptions don't occur with less viscous magma because the gas can escape easily. When explosive eruptions occur, ash, gases and volcanic bombs are emitted and forced down the slopes as fast-moving flows, which reach extremely high temperatures and cover vast areas of land. Because of this they are very hazardous. This type of eruption led to the evacuation of large areas of the Caribbean island of Montserrat.

When the products of a volcanic eruption, for example, pyroclastic material, ash and rocky debris, are mixed with water from rain or melting glaciers, a type of mudflow/debris flow known as a lahar is formed. Like pyroclastic flows, they can travel large distances and can also occur after the initial eruption.



Yellowstone National Park sits on a massive supervolcano

• Suggested Activity

- **Ask students to research the Yellowstone supervolcano and write a piece of creative writing about a possible eruption.**

• Suggested Film

- **Yellowstone: Supervolcano**

Extension Question

Q3. What is a supervolcano?

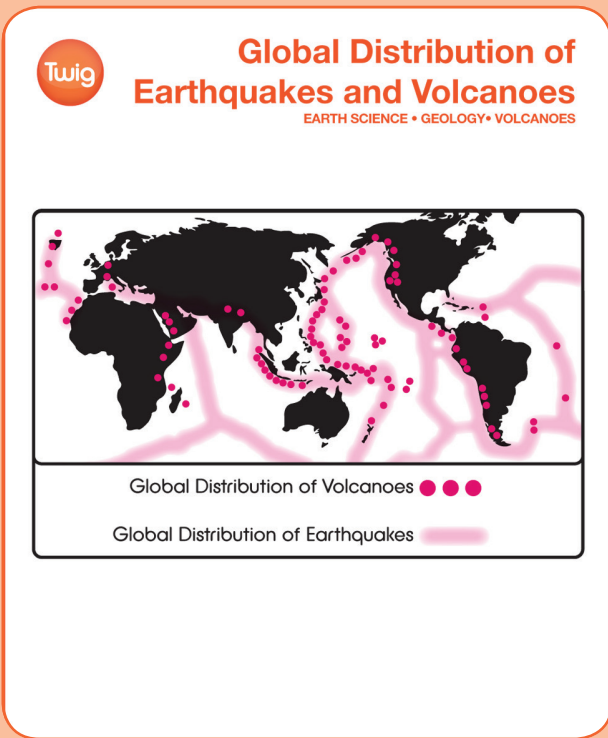
Supervolcanoes are hundreds of times more powerful than normal volcanoes, and would be capable of ejecting over 1000km³ of debris and magma.

The eruptions of supervolcanoes have been recorded in the geological past, and are thought to have occurred when vast quantities of magma accumulated under the surface but were unable to break through, eventually resulting in a violent eruption affecting huge areas, sometimes covering whole continents. These eruptions are so severe that the volumes of ash and gas released could cause global cooling.

Section 3: Volcanoes and People

- Why do people live close to volcanoes?

DIAGRAM 03:



Volcanic rocks are rich in minerals which, when weathered, add nutrients to the soil. This makes the soil around volcanoes very fertile and good for farming. Volcanoes are accompanied by geothermal activity, for example, geysers, which provide a source of renewable energy. Tourism is another economic opportunity, with money to be made by guides and souvenir sellers. Some people even enter the craters of active volcanoes to mine the sulphur which can accumulate around gaps in the ground called 'fumaroles'.

• Suggested Films

- Danger: Volcanic Ash
- The Last Day of Pompeii



The land around a volcano is often very good for farming, such as here in Mount Fuji, Japan

- What are the effects of volcanoes on people?

• Suggested Films

- Danger: Volcanic Ash
- The Last Day of Pompeii

Aside from the direct and immediate impacts of a volcanic eruption, there are many associated processes that affect the people in the volcano's vicinity. Earthquakes often occur in association with volcanic activity. As well as lava, volcanoes eject substances such as carbon dioxide, sulphur dioxide, hydrogen chloride and water vapour into the air. These products form other compounds that affect the temperature of the atmosphere or fall to Earth as acid rain. Ash from volcanoes can be hazardous to aircraft, as seen with the eruption of the Eyjafjallajökull volcano in Iceland in 2010.

• Why are responses to volcanoes different in LEDCs and MEDCs?

Having the resources available to invest in monitoring equipment and communication networks is crucial to providing early warning of an impending volcanic eruption. In Democratic Republic of the Congo (an LEDC) in 2002, the lack of an early warning system and failure of the government to prepare for a potential eruption led to widespread devastation. Several weeks before Mt Nyiragongo erupted, a series of small tremors and quakes were ignored by the local community, leaving over 300,000 people little time to evacuate the area. Lava, pumice and ash engulfed the area, devastating the city of Goma. Undeveloped infrastructure and communication links led to thousands of refugees fleeing into neighbouring LEDC Rwanda and difficulties in providing essential aid to the 120,000 Congolese who were left homeless.

The events that followed Mt Nyiragongo's eruption demonstrated how important communication links are in minimising the effects of volcanic eruptions. In MEDCs, such as the USA and Japan, early communication and warnings to the public ensure minimum casualties and panic. In 1980, scientists in Washington State were able to monitor Mt St Helens and predict the eruption weeks before, allowing 2000 people to evacuate the area. The State Governor used television networks to issue a state of emergency and US Congress released a billion dollar relief fund to deal with the short-term and long-term effects of the eruption.



Popocatepetl volcano is an active volcano very near to the busy Mexico City

• Suggested Films

- Volcanoes: LEDC Response
- Volcanoes: MEDC Response

Extension Question

Q4. Can volcanic eruptions be predicted?

It is possible to predict that a volcano is about to erupt, but difficult to provide any predictions as to when it may erupt. Predictions can be made by monitoring volcanoes for seismic activity (earthquakes and tremors), escaping volcanic gases and changes in the surface of the volcano, as all of these may occur before an eruption. These warning signs are caused by the mounting pressure from the magma chamber rising towards the surface.

• Quizzes

What Is a Volcano?

Basic

• Volcanoes mostly occur

- A – in the sea
- B – on plate boundaries
- C – at conservative fault lines
- D – in the middle of plates

• Magma at the Earth's surface is known as

- A – fossil
- B – graphite
- C – lava
- D – lahar

• Magma is stored beneath the volcano in the

- A – magma chamber
- B – crater
- C – caldera
- D – focus

• The collapsed top of the volcano cone is known as the

- A – crater
- B – main vent
- C – secondary vent
- D – magma chamber

Advanced

• Volcanoes occur mostly

- A – at hot spots
- B – along conservative and destructive plate boundaries
- C – along conservative and constructive plate boundaries
- D – along constructive and destructive plate boundaries

• Which is NOT part of a volcano?

- A – epicentre
- B – main vent
- C – secondary vent
- D – magma chamber

• Volcanoes contribute to the carbon cycle by releasing

- A – water vapour
- B – nitrogen dioxide
- C – carbon dioxide
- D – sulphur

• Volcanoes that have not erupted for hundreds or thousands of years are said to be

- A – pyroclastic
- B – extinct
- C – dormant
- D – semi-active

• Answers

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