1.2 Nature: Power and hazards - Volcanoes and earthquakes

Fachliche Inhalte

Raum und Ressourcen	**Mensch und Raum**	**Raum und Zukunft**
endogene Kräfte, Erdbeben, Vulkanismus	Naturkräfte und Naturereignisse und ihre Auswirkungen auf Lebensraum und Mensch; Schutz vor Naturgewalten; Nutzung der Naturkräfte	Auseinandersetzung mit den Naturbedingungen; Bedeutung von Vorhersagemöglichkeiten

Kommunikative Tätigkeiten/Arbeitsformen

- Geographische Einordnung von Erdbeben- und Vulkangebieten (Mark the volcanic areas in a map);
- Erklärung und Beschreibung naturgeographischer Phänomene und ihrer Auswirkungen auf den Menschen;
- Bau von Modellen (e.g.: Build a model of a volcanic island!);
- Zeichnerische Darstellung (e.g.: Show in a graph how the shapes of volcanoes look like!);
- Auswertung von Filmen, Bildern, Sachtexten, Zeitungsartikeln;
- Entwicklung von eigenen Texten zu Ursachen und Auswirkungen von Erdbeben und Vulkanausbrüchen;

Eigenständiges Heraussuchen (fächerübergreifend mit Geschichte) weiterer themenspezifischer Informationen (e.g.: Try to get more information about Pompeii!)

Gestalten einer informativen Wandzeitung (e.g.: In newspapers and magazines there are fairly often articles and pictures about volcanic eruptions. Collect them and make a wallchart.)

Materialien

LEHRWERKE

Jennings, T.: Islands : p. 9: Volcanic islands
Jennings, T.: Mountains: p. 8: Volcanoes
Jennings, T.: The Earth: p. 5: Inside the Earth; Faults and Folds; p. 10: Earthquakes; p. 11: Volcanoes
Jennings, T.: Volcanoes and Earthquakes: p. 4: The restless Earth; p. 9: How earthquakes are caused; p. 10: Where earthquakes happen; p. 11: The San Andreas Fault; p. 12: Tsunamis; p. 13: Earthquake disasters; p. 14: The San Francisco earthquake; p. 15: Preventing earthquake damage; p. 16: Volcanoes; p. 18: Dormant and extict volcanoes; p. 24: The shapes of volcanoes; p. 25: Volcanoes in the sea; p. 26: Geysers and hot springs; p. 27: Krakatoa; p. 28: Vesuvius; p. 29: Mount Etna; p. 30: Tristan de Cunha; p. 31: Mount Erebus; p. 32: The birth of a volcano; p. 33: Surtsey - a new island; p. 34: What happened to Atlantis?; p. 35: New rocks from volcanoes; p. 36: Volcanoes and the landscape; p. 37: Craters and crater lakes; p: 38: Useful volcanoes

Ladybird Picture Atlas

Beddis, R.: A Sense of Place. Workbook 2: p. 29: Volcanoes

Beddis, R. u.a.: A Sense of Place. Alternative Workbook 2A: p. 2: Earthquakes; p. 28: There are many active volcanoes

Lambert, D.: Jigsaw Pieces: p. 103: Living on the Edge

Landesinstitut für Schule und Weiterbildung Soest - Otten, E./Thürmann, E (Hg.): Californiæ p. 16: A safe place to live; p. 18: California earthquakes

Wiegand, P.: The New Oxford School Atlas

Beddis, R.: A Sense of Place 2. Places, Resources and People: p. 62: Volcanoes

Rose, D.: Basic Skills in Geography. Book 3: p. 16: The Countryside

Watt, F.: The Usborne Book of the Earth: p. 10: Earth movements and earthquakes; p. 12: Volcanoes

AUDIOVISUELLE MEDIEN

Dia-Sammlungen
Klett: Pictures of New Zealand

Filme
(auch deutschsprachige) der Bildstellen
National Geographic: The Forces of Nature

Interaktive Materialien/CD-Roms
Internet
Volcano World: Volcanoes of the World
Building Volcano Models
Volcano Lesson Plans
Earth Science Hyper Studio Stacks
Exploring Earth's Volcanoes
Update on Current Volcanic Activity

Microsoft: Encarta 96 Encyclopedia

National Geographic: Restless Earth

OHP – Folien
Klett: The British Isles and the United States
National Geographic: Geography of Australia, Antarctica and Oceania/of Asia/of Europe/of North America

Poster
Klett: Australia and New Zealand
Videos
The Eruption of Mount St. Helens
Hawaiian Vulcanoes

National Geographic:
Born of Fire
Our Dynamic Earth
Natural disasters
Physical Geography of North America Series

Physical Geography of the Continents Series
The Living Earth/United States Geography Series

WEITERE MATERIALIEN

Landesinstitut Schleswig-Holstein für Praxis und Theorie der Schule (IPTS) (Hrsg.): Band 4: Materialien zum Bilingualen Unterricht Erdkunde. 7. Jahrgang/Gymnasium: p. 44: Volcanoes; p. 52: Plate Tectonics; p. 56: Earthquakes in Mediterranean Countries

Brookes, G. u.a.: Geography today: p. 56: Prepare for a shock
Crandall, H.: Yellowstone. The Story behind the Scenery
Davidson, K.Williams, A.R.: Under our skin. Hot theories on the center of the earth
Decker, R./Decker, B. Vulcano Watching
Dineen, J.: Natural Disasters. Volcanoes
Gore, R.: Living with California's faults.
Grove, N.: Volcanoes: Crucibles of Creation
Kaye, G.: Hawaiian Volcanoes. The Story behind the Scenery
Koenninger, T.: Mount St. Helens. Holocaust. A diary of destruction
Macdonald, G. u.a.: Volcanoes in the Sea
Mayhew, S.: A Dictionary of Geography
Yandell, M: National Parkways. Yellowstone National Park
Watt, F.: Earthquakes and Volcanoes
Williams, A.R.: Monserrat: Under the Volcano
Winter, S.: Iceland's Trial by Fire

Planungsskizze: Nature: Power and hazards - Volcanoes and earthquakes

Themenaspekte	**Kommunikative Tätigkeiten/Aufgaben**	**Materialien**
endogene Kräfte: Erdbeben Vulkanismus Naturkräfte und Naturereignisse und ihre Auswirkungen auf Lebensraum und Mensch Schutz vor Naturgewalten Nutzung der Naturkräfte Auseinandersetzung mit den Naturbedingungen Bedeutung von Vorhersagemöglichkeiten Earthquakes The San Andreas Fault Tsunamis Preventing earthquake damage Volcanoes Dormant and extinct volcanoes The shapes of volcanoes Volcanoes in the sea Famous volcanoes (Krakatoa, Vesuvius, Mount Etna) Useful volcanoes Geysers and hot springs	Geographische Einordnung von Erdbeben- und Vulkangebieten Erklärung und Beschreibung naturgeographischer Phänomene und ihrer Auswirkungen auf den Menschen; zeichnerische Darstellung Auswertung von Filmen, Bildern, Sachtexten, Zeitungsartikeln Entwicklung von eigenen Texten zu Ursachen und Auswirkungen von Erdbeben und Vulkan-ausbrüchen Mark the volcanic areas in a map Show in a graph how the shapes of volcanoes look like! Build a model of a volcanic island! Try to get more information about Pompeii! In newspapers and magazines there are fairly often articles and pictures about volcanic eruptions. Collect them and make a wallchart!	Earthquakes (Jennings: Volcanoes and Earthquakes, p. 4f.) The San Andreas Fault (Jennings: Volcanoes and Earthquakes, p. 11) Tsunamis (Jennings: Volcanoes and Earthquakes, p. 12) Preventing earthquake damage (Jennings: Volcanoes and Earthquakes, p. 15) Volcanoes (Jennings: Mountains, p. 8; Volcanoes and Earthquakes, p. 16) Volcanoes (Beddis: A Sense of Place 2, p. 62) Dormant and extinct volcanoes (Jennings: Volcanoes and Earthquakes, p. 18) The shapes of volcanoes (Jennings: Volcanoes and Earthquakes, p. 24) Volcanoes in the sea (Jennings: Islands, p. 9; Volcanoes and Earthquakes, p. 25) Famous volcanoes (Jennings: Volcanoes and Earthquakes, p. 27ff.) Useful volcanoes (Jennings: Volcanoes and Earthquakes, p. 38) Geysers and hot springs (Jennings: Volcanoes and Earthquakes, S 26)

Volcanoes and Earthquakes

Earthquakes

For most of us, the Earth on which we live seems safe and secure. But some parts of the Earth are far from safe. There are places where, from time to time, the Earth rocks violently as an earthquake occurs. Elsewhere, molten rock, ashes, smoke and gases pour out from volcanoes. These things may happen with little or no warning. People have always been frightened by earthquakes and volcanoes.

The earth's plates are always moving. Earthquakes are caused by movements of these plates. One plate sometimes sticks against another. Often this puts such a great strain on the rocks that they bend. The rocks may also split, forming a fault. Suddenly the two plates jerk apart. They usually give way along a fault. As the plates slip apart, the land above shudders and shakes. These jerky movements on the Earth's crust are called shocks or tremors.

In some ways an earthquake is rather like a drawer which doesn't slide smoothly on its runners. Pulling the drawer seems to have no effect. But suddenly the drawer gives way with a thump. It may even scatter the things inside.

Each year about 500,000 earthquakes are recorded. Most of these can only be recorded by delicate instruments. Stronger earthquakes may frighten people, make tree leaves shake and church bells ring. Every year about 1000 earthquakes are strong enough to cause damage. As a result of these, roads and railway tracks may buckle and twist. Sewers, gas and water pipes and electricity cables break. Buildings crack and fall down. In the worst earthquakes whole towns may be destroyed. And many people may be killed or injured.

It is not possible to say when earthquakes are going to happen. But we do know where they are most likely to occur. This is because earthquakes mainly occur in definite bands around the world. These are the places where the Earth's plates meet each other.

One of the main earthquake zones runs through the Mediterranean Sea and across Southern Asia. Another goes round the Pacific Ocean from New Zealand up to Japan. Then it passes down the west coast of North and South America. Earthquakes can occur outside these zones. But they are usually very mild. Most of the tremors are no worse than the vibrations caused by a large lorry.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 4f.)

? –

1. How are earthquakes caused?
2. Roughly how many earthquakes are recorded each year?
3. Where do most earthquakes occur?
4. What is the exact centre of an earthquake called?
5. How do vibrations from an earthquake spread out?
6. Name four countries where earthquakes often occur.

The San Andreas Fault

Most of the joints between the Earth's plates are under the oceans and seas. But along the western side of the United States one of these joints is on land. It is known as the San Andreas Fault. This huge crack in the rocks runs for nearly 965 km through California.
There are frequent slight earth tremors along the San Andreas Fault. Occasionally there are severe earthquake, like the one in 1989. All of these things happen because two of the Earth's plates are grinding against each other. One of the plates is fairly steady. But the other, the Pacific plate, is trying to move northwards. Mostly the plate moves about 5 cm a year. But during the San Francisco earthquake of 1906, the ground moved 5 m in just one minute. The earthquake not only flattened the city of San Francisco, it also caused the deaths of over 700 people.

Another big earthquake could happen along the San Andreas Fault at any time. It will happen if the fault makes another large, jerky movement. To try to stop this, scientists have been pumping millions of litres of water into old mines in the area around the fault. They hope the water will allow the rocks to slide over each other more easily.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 11)

? –

1. Where is the San Andreas Fault?
2. What are scientists doing to try to prevent earthquakes along the San Andreas Fault?

Preventing earthquake damage

Earthquakes occur with little or no warning. But some birds and animals seem to know hours, sometimes days before, that an earthquake is going to happen. By studying these it may be possible in the future to warn people of the danger of an earthquake.

It is also possible to make buildings less liable to earthquake damage. When the Japanes earthquake struck in 1923, skyscrapers remained standing while ordinary buildings fell. This was because the skyscapers had steel frames. These were able to sway as the earthquake tremors passed them.

Nowadays in earthquake zones, new buildings are placed on solid rocks. They have a framework of strong flexible steel. There are few doors and windows. Sometimes the roofs are covered with rubber or plastic pads instead of tiles. The streets are made wide so that buildings will not block them if they fall. Open spaces are left in towns. People can go to these out of reach of falling buildings.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 15)

– ***Make a list: This can be done to make buildings safer in an earthquake***

Earthquakes in California

An aspect of California geography which has influenced the land since prehistoric times is the fact that California sits on top of one of the world's major earthquake belts. The largest and best known fault, an area where two huge plates of land come together, is the 1,100-km-long San Andreas fault. It begins in the Pacific near the Oregon border and goes through San Francisco, the San Joaquin Valley and into Southern California to Mexico. One land plate moves slowly southeast, the other north-west. As these plates pull against each other, the earth's crust is stretched like a giant rubber band and sometimes it snaps - causing an earthquake. There are hundreds of smaller faults in California. Actually, there are earthquakes every day in the state, but nearly all of them are so small that people can't feel them.

But big ones are disasters. The most famous earthquake happened on April 18th, 1906 in San Francisco. It began at 5:13 in the morning when the ground shook for two minutes. Although some buildings were destroyed by the earthquake, the greatest damage was caused by the fires which began when gas lines broke and chimneys fell down and broken water pipes made it difficult to fight the flames. In three days the fire destroyed about one-third of the buildings in San Francisco and caused 500 deaths.

San Franciscans always refer to the disaster as "the fire" - not the earthquake. That's a typical attitude in California: People always hear warnings about the "Big One", a major earthquake, that will hit the state some day, but they avoid thinking about it. It's usually tourists and newcomers to the state who worry more about earthquakes.

There are quite strict rules in California so that houses and bridges and buildings, particularly schools, are as earthquake-safe as possible. Scientists are always trying to find out how to tell when an earthquake may be coming - by studying the earth, watching the behavior of animals, and even looking to the moon and stars for clues. There are earthquake drills where everybody is told to get to a safe place (under a table or against an inside wall) and stay there until they hear the all-clear signal on the radio. And after every large earthquake, like the one in the Santa Cruz area in October 1989 which killed 67 people and caused six billion dollars worth of damage, there's always a big business selling extra bottled water and canned food and flashlights and blankets to people who want to be prepared for the next one. But the most common attitude is that there's nothing we can do about it anyway, so let's go to the beach and enjoy life.

(adapted from: Carlson-Kreibohm, K.: California Dreams)

Tsunamis

The vibrations of an earthquake are most violent near the fault which caused it. The exact spot on the Earth's surface above the place where an earthquake occurs is called its epicentre. The vibrations spread out from the epicentre of the earthquake. The vibrations rarely last for more than a minute or two. They spread out through the Earth rather like the ripples made by a stone thrown into a pond.

When an earthquake occurs under the sea, the vibrations may throw the water up into great waves. These are often called tidal waves or tsunamis. In the open sea a tsunami may be quite small. The waves are often only a metre or so high. Such waves are hardly noticeable. But tsunamis can travel huge distances. And they move at great speed. Tsunamis can reach speeds of 600 to 800 km per hour. In the shallow water around the coasts and in narrow inlets, the waves grow to be enormous. They may be 60 m high. Such large tsunamis cause serious flooding and immense damage, Tsunamis are also caused by the eruptions of volcanoes under the sea.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 12)

? – What is a tsunami?

Volcanoes

Volcanoes occur where the Earth's crust is weak. Volcanoes are made when a crack opens in the Earth's crust. Molten rock from deep inside the Earth's mantle pour out. The molten rock is called lava. The lava cools to form solid rock. Also ashes, steam, and hot gases may come out of a volcano.

When a volcano has erupted many times it may build up a tall coneshaped mountain. Fujiyama in Japan is a volcanic mountain. So is Mount Egmont in New Zealand. Not all volcanoes form tall mountains. In some, the lava just seeps out gently from holes or cracks. It then forms thick sheets of rock.

Like earthquakes, volcanoes are among the most powerful forces in nature. A volcano is a hole in the Earth's crust. From this opening molten rock, smoke and gases escape from the Earth's mantle. The molten rock which comes from a volcano is known as lava.

When lava comes from a volcano, we say the volcano is erupting. Some kinds of lava are thick and sticky. They solidify quickly. Sometimes they solidify inside the opening of the volcano and stop it erupting. However gases in the lava build up the pressure underneath this plug of rock. Eventually the pressure may build up enough to blast away the plug with an explosion. Lumps of solid rock are hurled into the sky. Blobs of lava and cinders rain down on the surrounding countryside. And the sky may darken with clouds of smoke, ash and dust. This kind of volcanic eruption is the most violent.

Other kinds of lava are very thin and runny. They can flow for many kilometres before they solidify. This kind of volcanic eruption is much less violent.

There are about 500 active volcanoes in the world. Like earthquakes, volcanoes are found where there are weak places, or faults, in the Earth's crust. Usually this is where two of the Earth's plates crash together or separate. Volcanoes and earthquakes occur in the same general areas. But the worst earthquakes take place where there are no volcanoes. Possibly the volcanoes relieve the pressures of the molten rocks and hot gases of the Earth's mantle.

There is a band of weak places or faults around the edge of the Pacific Ocean. Most of the world's active volcanoes are found there. These volcanoes make up what is sometimes called the Pacific Ring of Fire. There is another band of volcanoes along a line of weakness in the Atlantic Ocean. They include volcanoes in Iceland, the Azores, the Canary Islands and the island of Tristan da Cunha. Four of the world's most famous volcanoes lie around the edges of the Mediterranean Sea. They are Etna, Vesuvius, Stromboli and Volcano.

(adapted from: Jennings, T.: Mountains, p. 8; Volcanoes and Earthquakes, p. 16)

☺ **Build a model of a volcanic island.**

☺ **In newspapers and magazines there are fairly often articles and pictures about volcanic eruptions. Collect them and make a wallchart**.

Volcanoes

Because of the great heat, rock at a distance below the earth's crust is molten. This molten rock, called magma, sometimes finds its way to the surface and is forced out through cracks or vents. The magma is then called lava. Lava varies a great deal in composition and the way it looks. If lava is thin and pasty, the trapped gas mixed with it explodes out, shattering the lava to fragments. The red-hot molten lava pours out of the vent while large fragments of lava, ash and fine-grained dust are hurled high into the sky to fall back on top of the vent. Because the lava is pasty it forms short, thick flows that pile up around the vent. The lava fragments and ash from the explosions collect around the vent or crater in beds that get thinner away from the centre. So steep-sided volcanic cones are formed with sloped up to about 30° leading up to the main peak. If the lava is runny it cannot form a cone but spreads like sheets over the land or ocean floor.

Volcanoes are normally active for short periods, perhaps a few months or a year at a time. Between eruptions they remain dormant or sleeping for maybe several hundred years. During this time the lava in the crater solidifies, plugging the vent or crater. Gas pressure builds up until there is an explosion that bursts open the plug and the lava flows though the vent again. A volcano is said to be extinct when it has not erupted in historic times.

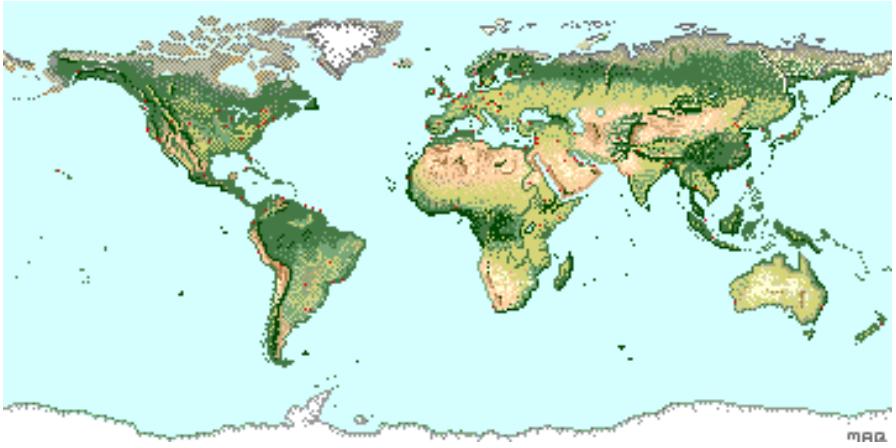
At first sight it seems odd that people should want to live near volcanoes that might erupt, but rich crops can often be grown on the lower slopes of volcanoes. The climate has to be suitable, of course, but when that is so, the volcanic lava and ash usually break down under the weather to provide very rich soils. So in many parts of the world within the tropics or in midaltitudes there are many people farming the lower slopes of extinct or sometimes even active volcanoes.

(adapted from: Beddis, R.: A Sense of Place 2, p. 62)

? –

1. What is lava?
2. What do we say is happening when lava comes from a volcano?
3. Whereabout are most of the world's active volcanoes found?
4. How does a volcano begin life?
5. What is the cone of a volcano?
6. What is the hollow in the top of a volcano called?

Mark the volcanic areas:



Dormant and extict volcanoes

Volcanoes do not go on erupting for ever. Some volcanoes may go for many years without erupting. They are said to be dormant or sleeping. Some other volcanoes have finished erupting. They are said to be extinct.

When a volcano has not erupted for a very long time, it is said to be dormant. The word dormant means 'sleeping'. Normally volcanoes erupt for a short time. Then they remain dormant for a long period. Fujiyama in Japan is a dormant volcano. It last erupted in 1707. Mount Rainier in the United States last erupted over 100 years ago.

While a volcano is dormant, steam may come from it. This is true of both Fujiyama and Mount Rainier. Lava may bubble in the crater of the volcano. Sometimes the lava hardens: This solid lava may stop the volcano from erupting any more. This happened with Mount Kenya. More often, though, it means that when the volcano does next erupt it will explode into life. Krakatoa in Indonesia was a volcano which exploded in this way.

If a volcano has shown no signs of life for thousands of years it is said to be extinct. Two famous extinct volcanoes are Mount Egmont in New Zealand and Kilimanjaro in Tanzania. There are also many extinct volcanoes in the British Isles, France and Germany.

Of course it is not easy to tell when a volcano is dormant and when it is extinct. Everyone thought that the volcano on Tristan da Cunha was extinct, until it erupted in 1961. Evidently the volcano was not extinct, it was only dormant.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 18)

? –

1. What is a dormant volcano?
2. What is an extinct volcano?

The shapes of volcanoes

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.

But not all volcanoes are the same shape. If runny lava comes from the volcano, this may flow a long way before it hardens. The volcano it forms has gently sloping sides. Such a volcano is known as a shield volcano. This is because it is shaped like an upturned shield. Diamond Head and Mauna Loa in Hawaii are good examples of shield volcanoes.

If the lava is sticky it hardens quickly. It builds up a volcano with steep sides. The cones of most volcanoes are made up of layers of ash and cinders, and layers of lava. These are known as composite cones or stratovolcanoes. Cotopaxi in Ecuador and Fujiyama in Japan are stratovolcanoes.

At the top of the volcano is a deep hollow. This is called the crater. When the volcano erupts, smoke, flames and lava shoot out of the crater. As time goes by, other openings may appear on the sides of the volcano. Lava and smoke may come from these openings as well and cause further hazards.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 24)

? –

1. What do we call a volcano which has gently sloping sides?
2. What is the lava like which forms volcanoes with gently sloping sides?
3. What is the cone of a stratovolcano made of?

 Show in a graph how they look like.

Strato volcano **Shield volcano**

Pasty lava form short thick flows around the vent, mixed with layer of ash

Massive outpourings of thin, running lava from central vent

Volcanoes in the sea

Many oceanic islands began life as volcanoes. One day a volcano on the sea-bed suddenly exploded or erupted. Molten rock or lava flowed out from cracks in the sea-bed. The lava piled up in the water and solidified. Eventually this new volcanic rock rose above the surface of the sea. A new island had formed. At first nothing can live on a volcanic island. But as the lava cools, plants and animals can live on it. Islands are constantly being worn away by the sea. If they are small they may last only a few years. But large volcanic islands can eventually have many plants and animals living on them. This often takes thousands of years, though.

Many of the islands of the Pacific Ocean are the tops of undersea volcanoes. They grew bigger until they appeared above the surface of the water.

Tristan da Cunha in the South Atlantic is an old volcano. So are the Galapagos Islands, the Azores, the Canary Islands and many more.

The Hawaiian Islands were formed like this. They are are a group of more than 100 islands in the Pacific Ocean. They are actually the tops of undersea volcanoes. One of the islands, Hawaii, is the top of a mountain more than 9,150m high. This is higher than Mount Everest. Hawaii is made up of several volcanoes. One of them, Mauna Loa, is the largest active volcano in the world. Mauna Loa is a shield volcano. Its top is like a huge upturned saucer. Mauna Loa erupts on average about once every 3 or 4 years. Its lava is very thin and runny. When the volcano erupts, the lava flows huge distances before it cools and hardens. That is why Mauna Loa has such gently sloping sides. At its top or summit, Mauna Loa has a huge oval crater. But as well as erupting from this, Mauna Loa often erupts from cracks in its sides. Mauna Loa and its neighbouring volcano Kilauea are visited by many tourists. Visitors can drive right to the rim of the volcanoes and look down into their craters.

(adapted from: Jennings, T.: Islands, p. 9; Volcanoes and Earthquakes, p. 25)

? –

1. How were the Hawaiian Islands formed?
2. What kind of volcano is Mauna Loa?
3. Why does Mauna Loa have gently sloping sides?

Famous volcanoes

Krakatoa
The world's greatest explosion was caused by a volcano. This volcano was Krakatoa, an island in Indonesia. Krakatoa had been quiet for more than 200 years. A plug of solid lava had blocked its opening. But unbeknown to everyone, gases were collecting beneath the plug. One day in August 1883, the pressure of these gases became so great that Krakatoa exploded. The explosion destroyed two-thirds of the island. It was so loud that it was heard 5,000km away. Rocks were thrown 55km high into the air. Clouds of dust caused darkness for days. Only a few people were killed by the explosion of Krakatoa. But it rocked the sea-bed, creating a huge wave. This giant tsunami swamped nearby islands. In places the wave was over 35m high. It destroyed a total of 163 villages. And more than 36,000 people were drowned. Great clouds of dust from Krakatoa gradually drifted around the world. For the next three years this dust scattered the sun's rays. It caused spectacular sunsets everywhere. And the world had a series of cold summers and freezing winters.

Vesuvius
Vesuvius is one of the world's most famous volcanoes. It is on the southern coast of Italy behind the city of Naples. Vesuvius is the only active volcano on the mainland of Europe. There are, however, other active volcanoes on the nearby islands.

From time to time Vesuvius erupts violently. The last time was in 1944. Vesuvius' most famous eruption was in AD 79. The volcano had been quiet for many centuries. Suddenly there was an enormous explosion. The top of Vesuvius blew off. Huge quantities of ash showered down on the surrounding plain. The city of Pompeii was buried by the ash. In places the ash was 6 m deep. A nearby town, Heraculaneum, was buried by molden lava. Thousands of people were killed. At Pompeii the shapes of their bodies were preserved in the ash.

Mount Etna
Mount Etna is the largest volcano in Europe. It lies on the island of Sicily in the Mediterranean Sea. At present Mount Etna is 3,260 m high, and ist top is often snow-covered. But Etna is not a simple volcano and its height changes from time to time. On its main cone there are hundreds of smaller cones and craters. Like Vesuvius, Etna always shows some signs of life. In the last 2,500 years, Etna has erupted more than 400 times. The last heavy outbreak was in 1983.

On the lower slopes of Mount Etna there are orange and lemon groves. Higher up, grape vines are grown. Above the farming areas there are forests. Many people live on the slopes of Etna and work on these farms and forests.

During the 1983 eruption, streams of lava threatened the towns and the villages below. To save their houses, the people dug a deep canal to carry the lava away from their homes. Then explosives were used to try to force the streams of lava into the canal. Unfortunately the results were only partly successful. And a number of houses and hotels were destroyed.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 27ff.)

? –

1. What caused the world's greatest explosion?
2. What happened when a plug of solid lava formed in the opening of Krakatoa?
3. What effect did the dust of Krakatoa have?
4. In which country is the volcano Vesuvius?
5. How was Pompeii buried?
6. Name three crops which are grown on Mount Etna.
7. What did the people of Sicily do to try to protect their homes from the lava coming from Mount Etna?

Where are the famous volcanoes?

Try to get more information about Pompeii.

Useful volcanoes

Although they are dangerous and destructive, volcanoes have their uses. There are many farms and even villages on the slopes of some volcanoes. This is because when the lava and ash turn into soil, that soil is sometimes very fertile and can be used for orchards or vineyards.

Another useful product from some volcanoes is hot water. This hot water comes from springs and geysers around volcanoes. In Iceland, the water from hot springs is used to heat swimming pools and to centrally heat houses and flats. The water from the hot springs is also used to heat greenhouses. It means tomatoes, grapes and even tropical fruits like bananas can be grown. In several countries, hot water from volcanoes is used to make electricity. Pipes take the hot water to a power station. There it is used to produce steam which turns the generators. These are the machines which make electricity.

A useful chemical called sulphur is found near some volcanoes. Sulphur is used for hardening rubber tyres, and for making sulphur acid, gunpowder and some oitments and medicines. And of course volcanoes are often a popular tourist attraction.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, p. 38)

? — In what ways can the hot water from around a volcano be useful?

Geysers and hot springs

A geyser is a spring. But unlike ordinary springs, the water which comes out of a geyser is scalding hot. The water doesn't flow continuously, it comes out in spurts. Geysers are found in many volcanic areas of the world. They are particularly common in Iceland and an New Zealand's North Island. There are also geysers in the state of Wyoming in the United States.

A geyser consists of a hole in the ground. This hole goes deep into the ground to where the rocks are hot. Rain water seeps through the ground until it touches the hot rocks. The water is heated. Eventually hot water and steam are shot up into the air through the hole. Soon more water seeps into the hole. When this is heated up, the geyser is ready for the next eruption.

Some geysers throw water and steam hundreds of metres into the air. They may erupt at regular intervals. One geyser in the Yellowstone National Park in Wyoming in the United States is called 'Old Faithful'. It erupts every hour for about 5 minutes. It has been doing this for hundreds of years.

The water in geysers usually contains a lot of dissolved chemicals. Often these collect around the opening of the geyser. Around some geysers there are also pools of bubbling, boiling mud.

(adapted from: Jennings, T.: Volcanoes and Earthquakes, S 26)

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1. What is a geyser?
2. Where are most geysers found?