VOLCANOES

Teacher Guide

including

Lesson Plans, Student Readers, and More Information

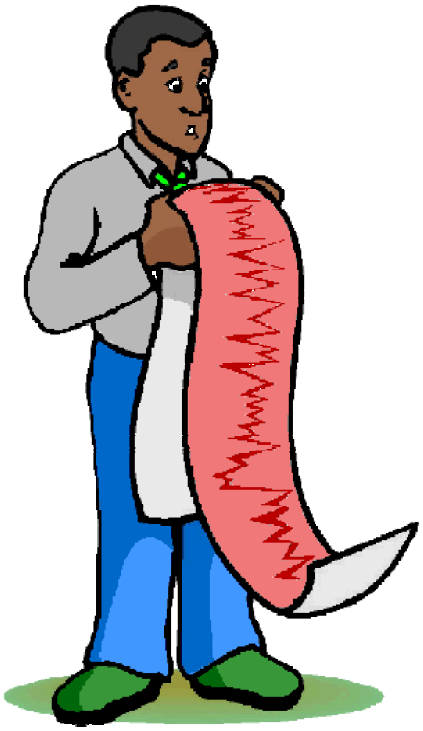
Lesson 1 - Types of Volcanoes

Lesson 2 - Volcanic Rock Lab

Lesson 3 - Virtual Volcanic Tour

Lesson 4 - Pompeii - A forgotten lesson

Lesson 5 - Volcanic Myths and Stories



designed to be used as an Electronic Textbook
in class or at home

materials can be obtained from the Math/Science Nucleus

EARTH SCIENCES - VOLCANOES

Lesson 1 - TYPES OF VOLCANOES

MATERIALS:

reader
world map placemat
inflatable world globe (optional)

Objective: Students compare the different type of volcanoes.

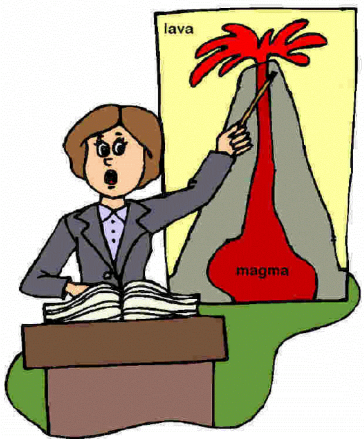
Teacher note

Volcanoes provide the structural evidence needed to look at patterns throughout the Earth's record. The volcanic rocks leave clues to compare the present distribution of volcanoes with the past. Unfortunately earthquakes leave little evidence throughout geologic time.

Students will learn the different ways to classify volcanoes. Dormant, active, and sleeping volcanoes tell about the possibility of eruptions in an area. The shape and types of rocks can help classify volcanoes into shield, composite, and cinder. Students also look at where volcanoes occur today and how they help to define plate boundaries. Make sure students can locate each of these areas on a world

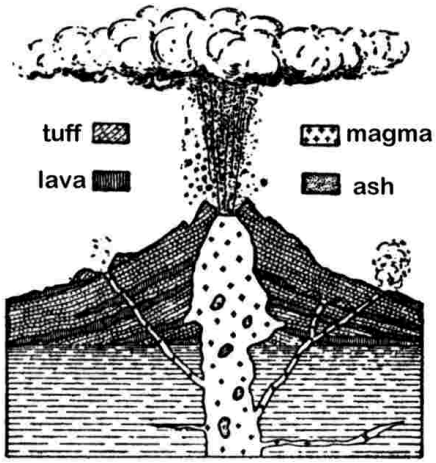
In this 1943 drawing, the Little Prince is trying to prevent a volcano from erupting. Unfortunately his intentions were noble, but no human can prevent a volcanic explosion. The forces behind an erupting volcano are greater than any type of bomb humans have created.

Volcanoes are found throughout the world, but in defined zones. Some volcanoes are active, some dormant, and some extinct. An active volcano includes Mt. Etna, located in southern Italy. Activity includes lava movements and little "hiccups" of gas spirting from its top vent. An example of a dormant volcano is Mt. Lassen, in northern California. Its last eruption was in 1915, with only quiet murmuring since then. An extinct volcano may not even look like a volcano, but the rocks it left behind are unmistakable. An example would be some of the small islands in the Pacific. Even the northwestern islands of Hawaii are extinct!



A volcano is molten magma from the upper mantle or crust that has reached the surface. The liquid rock is referred to as lava when it refers to volcanoes. Lava will cool down and become a fine grained igneous rock (volcanic) and magma when cooled with be a large grained igneous rock (plutonic).

Volcanoes have different styles of eruption. They can be violent or they can be quiet. Violent eruptions are usually charged with "bottled" up gases. Just like a can of carbonated soda that you shake and then quickly open. Ash and volcanic bombs rain down after a violent eruption.



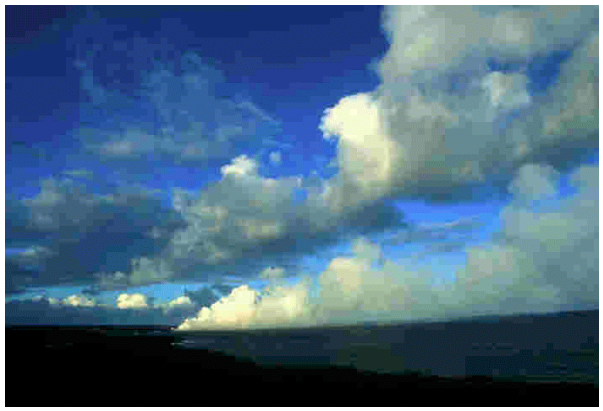
Volcanoes are also classified by the general shape and the type of rocks. There are many different type of classifications that vulcanologists use depending on the depth of your research. Basically there are three types of volcanoes based on composition including composite, shield, and cinder.


Pahoehoe lava

The main island of Hawaii is very active. The volcanoes of Hawaii extrude very thick lava, which creates a "shield-like" shape. The Hawaiian volcanoes are classic examples of shield volcanoes. The eruption is not always in one large vent, but in can occur in fissures. The lava that is emitted from Hawaii begins to cool as it reaches the surface of the Earth. The cooling lava causes many wonderful appearances.

It can create spectacular rivers of lava that race down the sides of the volcano. Lava may continue to flow as the crust thickens, causing internal tubes where the lava once flowed.

Flows of lava when cooled form pahoehoe lava, which is a Hawaiian word for "ropey," can be seen throughout the islands. Lava when it reaches the ocean, creates a glassy coating over it and forms "pillow lavas."


Hawaiian volcano as the lava flows into the ocean.

Before the eruption

Mt St Helens, in the state of Washington was dormant until it woke up on May 18, 1980. This volcano blew its top and the once calm and beautiful mountain became a catastrophe. The rocks that caps the caldera, were turned into ash by the force of the volcanic explosion. Ash blew into the atmosphere that was carried for thousands of miles. The ash mixed with the melting snow and caused walls of muds to flows down the mountainside. Burying trees, houses, and animals in a wall of fast moving wall of mud.

Lava has slowly built the mountain again, but the lava was much thicker than the Hawaiian volcanoes. Layers of ash, lava, mud, and other volcanic rocks produce what is called a composite volcano. Sixty-four people lost their lives in this eruption, including a scientist who studied the volcano (vulcanologist). He was incinerated by a pulse of hot, dry gas.

During the eruption, May, 1980.

Lassen Volcano was declared a national park in 1916 after it began erupting in 1914. Both composite and cinder cone volcanoes were found during its eruptive stage. Activity stopped in 1921, and is now considered a dormant volcano.

There are still signs of a hot magma chamber below. In an area called Bumpus' Hell, you can find bubbling mud and sulfur smelling steam. Even when the weather is cold, this area is always warm. Mr. Bumpus, was an early pioneer who decided to have a warm bath. To his horror, when he jumped in the water it was so hot, he lost his legs! He survived his own personal hell.

Paricutin in 1946 showing the pyroclastic materials being ejected from the vent. (USGS)

Paricutin, Mexico is a volcano that grew from a farmer's cornfield. Farmers had been experiencing earthquakes prior to the eruption. The eruption was a spectacular event that created a initial cinder cone that grow to 36 m (1,100 feet) to a volcano with extensive lava flows.

The eruption began in 1943 and ended in 1952. Pyroclastic fragments of spheroidal bombs, lapilli, glassy cinders, and ash were the main components of the cinder cone.

March, 1944 the cinder cone was a prominent part of what was once a cornfield.

Ponza is an island in the Tyrrehenian Sea, in Italy. It is located west of Naples. The island is now part of the Italian Park system, but was once part of a violent undersea volcano in the Pliocene and early Pleistocene. The rocks tell the story of a storm of ash and other pyroclastic materials being spurred from fractures on the sea bottom. This volcanic eruption has stopped, and is considered extinct. Howerver, not far from Ponza is Mount Vesuvius, which has the potential of erupting.

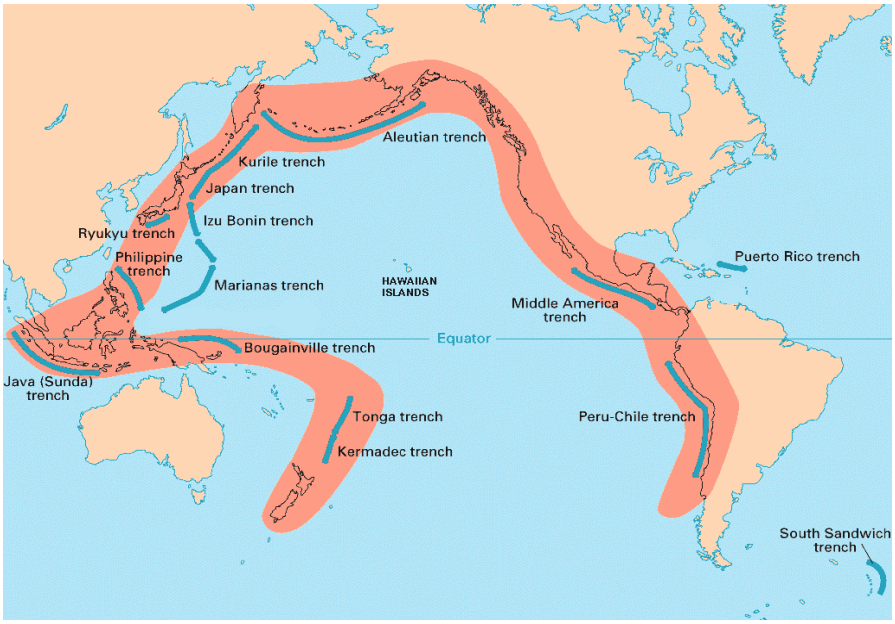
Chaia di Luna with layers of ash making up the cliff.

Ponza represent volcanic rocks deposited mainly underwater.

There are many volcanoes throughout the world that are erupting today. They are mainly found in zones where plates interact called plate boundaries. However, there are some volcanoes like the Hawaiian volcanoes that are not along a plate boundary.

There is an active area that is called the “Ring of Fire” in the Pacific. In the picture it shows a large zone of where you can find active and dormant volcanoes. These are areas where the crust of the Earth is being “subducted” or destroyed under continental rock. This causes volcanism.

There are also other areas of intense volcanism under the Atlantic Ocean. This is referred to as the Mid-Atlantic Rift, and is an area that is being rifted apart. Two plates are moving in opposite direction, and the Earth “heals” the wound by the lava of the volcanoes.



EARTH SCIENCES - VOLCANOES

Lesson 2 - VOLCANIC ROCKS - LAB

MATERIALS:

reader
Volcanic Rock Kit

Objective: Student compare violent and quiet eruptions preserved in rocks.

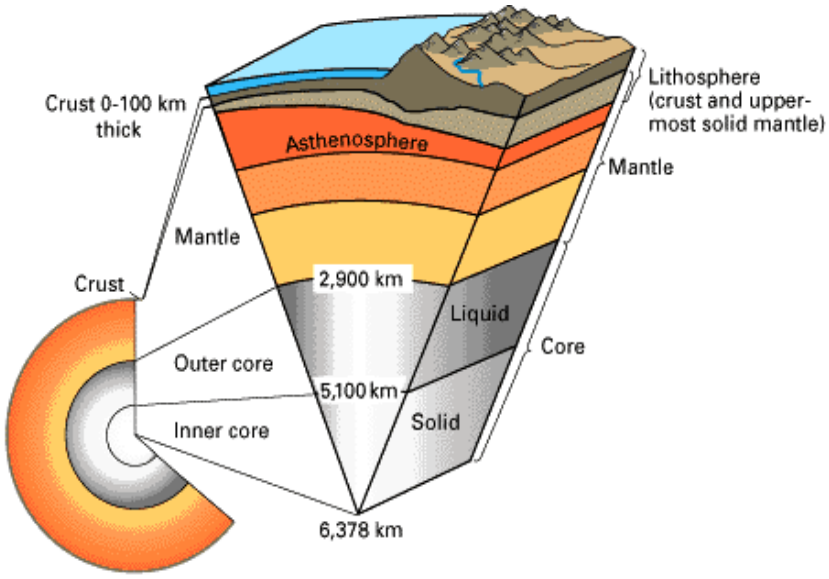
Teacher note

Volcanic rocks are a subdivision of igneous rocks, associated with forming on the surface of the Earth. Plutonic rocks are formed within the crust, and usually have larger mineral crystals. Volcanic rocks have fine-grained crystals, that usually require a microscope to observe. Volcanic rocks have many different forms. For example, obsidian a volcanic rock that cools quickly is usually black. But you can find brown, red, and even green obsidian depending on the volcano.

This lab provides students a chance to look at the different types of volcanic rocks that are formed from volcanoes. Use the following U.S. Geological Survey site for more information.

The molten rock that feeds a volcano comes from the upper mantle and crust. It does not come from the core, as many people think. If the molten rock never makes it to the surface of the Earth it will take a long time to cool. When it takes a long time to cool, it will have large minerals and is referred to as a plutonic rock. Volcanic rocks have reached the surface and cool faster, with smaller minerals.

If you can see a volcano as it is erupting, you can determine if the event is violent or quiet. However, most volcanic rocks that you find are part of ancient, extinct volcanoes. Is there a way to tell about the eruption from just a rock?



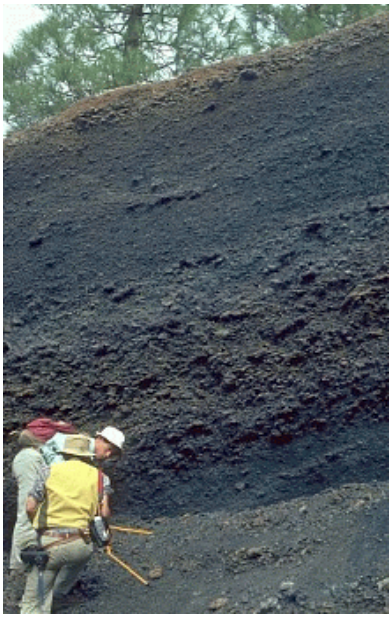
Clues of a violent eruption include ash, bombs, and gas holes. Gases trapped in the molten rock infer that there is a more violent eruption. Gas trapped in the rock gives a vesicular texture or a rock with holes in it. Just like when you shake a bottle of carbonated soda and you open the bottle cap. The gas was out! Causing a mess. A volcano is not much different.

A quiet eruption would include lava rocks that have no holes and are homogeneous throughout.

Another clue is the rock type itself. Rhyolite is associated with violent eruptions, whereas basaltic rocks are formed during quiet eruptions. This has to do with the chemistry of the rocks.

Some rocks can tell you of their strange evolution. The picture to the right shows "pillow lava" forming. The water cools the crust of the lava quickly giving it a crust that curls into itself. It looks like many pillows stacked on one another. When you see pillow lava, a geologist knows that the eruption occurred under water.

Pillow lava



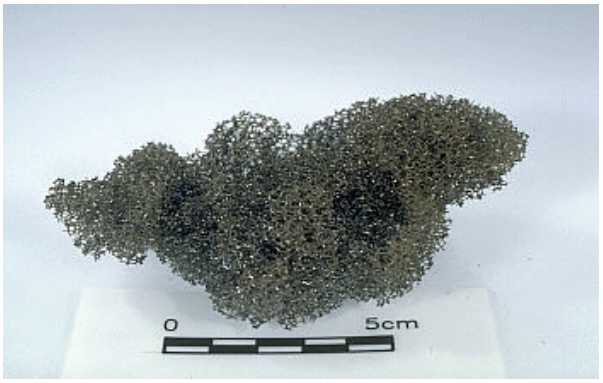
Scoria

Scoria is a vesicular rock due to the escape of volcanic gases during an eruption. Scoria is usually black with a high iron content, but also has a distinct reddish color due to a chemical reaction with oxygen in our atmosphere.

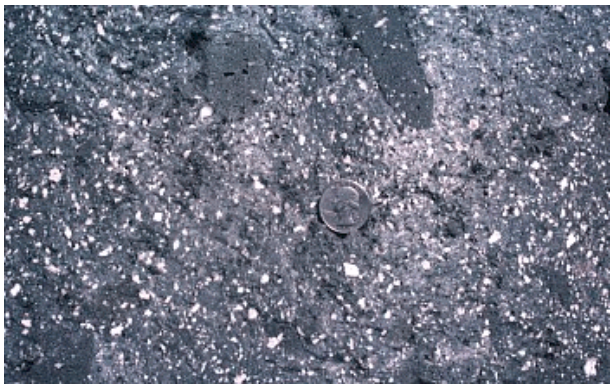
TYPES OF VOLCANIC ROCKS

Ash from Mt. St. Helens. Although it looks harmless if an animal breathes ash it can puncture their lungs.

Volcanic bombs ejected from a violent eruption. Image a bomb falling 100 feet on your car! Not a pretty picture.



Reticulite is a special pumice where so much gas was trapped that the rock looks interlacing bubbles.



This volcanic rock has a vesicular texture, meaning that it is “holey.”

Tephra refers to blocks and bombs, and smaller debris like scoria, pumice, and ash. As this becomes solidified as a rock it has unique chemical characteristics.

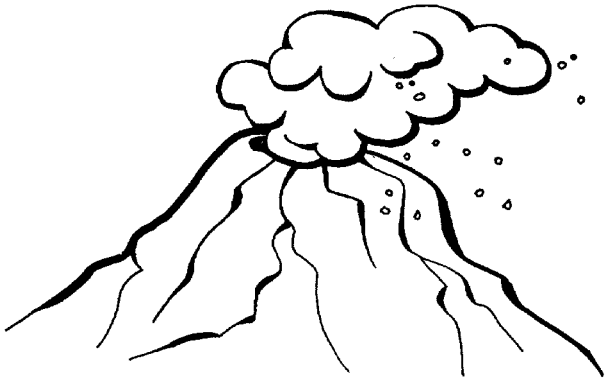
Rhyolite all swirled up with obsidian. This looks like a violent eruption.

VOLCANIC ROCK LAB

PROBLEM: Can you infer from a volcanic rock, how it was created?

HYPOTHESIS: _____

label and draw in when appropriate: ash, volcanic bombs, lava, vent, magma chamber



Look at the following rocks and describe its texture. Then predict if it came from a violent or quiet eruption.

rock	describe	violent or quiet

How can you tell from the rocks the eruption style?

EARTH SCIENCES - VOLCANOES

Lesson 3 - VIRTUAL VOLCANOES

MATERIALS:

reader
Internet

Objective: Students use the Internet to find information on erupting volcanoes.

Teacher note

Before class check your favorite search engine to locate sites about volcanoes. Give the URL's to your students to find information on a particular volcano that might interest them. Have them record the information. The websites below may be helpful.

http://www.geo.mtu.edu/volcanoes/

University of Michigan volcano sites around the world. Can also view which 10 volcanoes are most active.

http://www.learner.org/exhibits/volcanoes/

Annenberg/CPB volcano exhibit. Facts of ancient and recent volcanoes.

http://volcano.und.nodak.edu/volcanoes.html

Current volcanoes erupting around the world with links to each site. Also has links to all the Volcano Observatories.

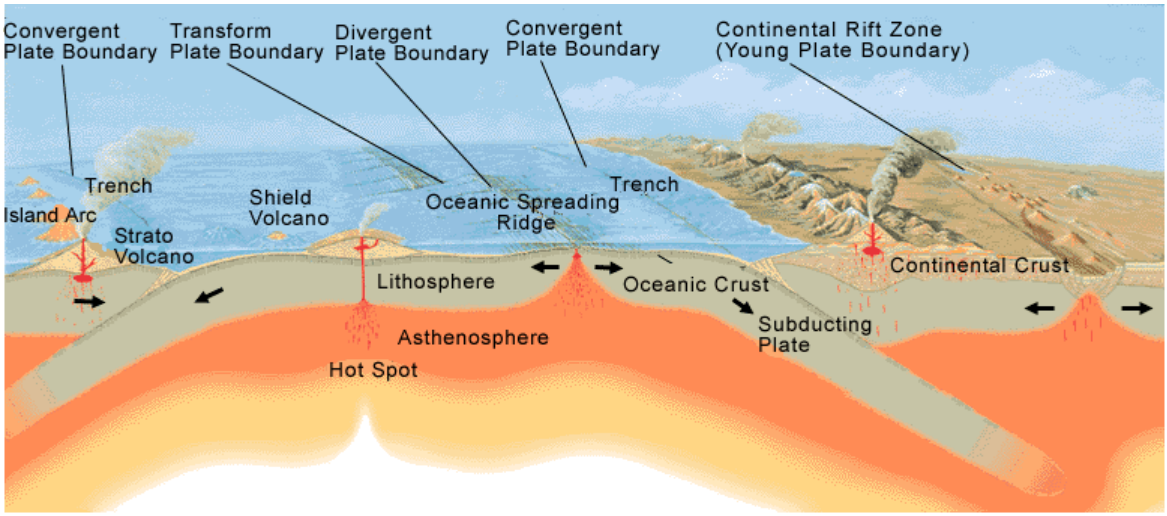
http://volcanoes.usgs.gov/

Includes basic information, booklets, glossary, and good information on volcanoes.

Volcanoes are a hot topic! Although many people do not want to be a vulcanologist, they do love to learn more about volcanoes. The Internet is full of wonderful sites on volcanoes that students and you can find more information.

In this exercise we would like you to look at the Internet and find 5 sites on specific volcanoes. On the lab sheet write any information that is of interest to you.

Also critique the website and determine if this is a website someone your age would enjoy. State why or why not?



VIRTUAL VOLCANOES

PROBLEM: Are there any informational but entertaining websites on volcanoes for teenagers?

HOW TO SOLVE THE PROBLEM: _____

Use the following websites provided to you by your teacher, find 5 volcanoes that interest you. Look through the website and critique the site. Think of this as a movie review, and answer the question: Would I recommend this site to students my age?

SITE	DESCRIPTION	RECOMMEND

Which of the sites do you think is the best? Explain.

EARTH SCIENCES - VOLCANOES

Lesson 4 - POMPEII, ITALY

MATERIALS:

reader

Objective: Students will learn about Pompeii, in ancient Rome.

Teacher note

Volcanoes can be devastating to an entire city. Sometimes cities can be "lost" to history because volcanic debris can cover an entire area. Archaeologists, in later civilization sometimes find these cities, which uncover a frozen day of ancient life. Pompeii, in ancient Rome, is such an example.

More information can be found on the following websites.

http://www.eliki.com/ancient/civilizations/pompeii/

An excellent site on the Roman culture revealed at Pompeii

http://volcano.und.nodak.edu/vwdocs/volc_images/img_vesuvius.html/

A well written and illustrated guide to the eruption of Vesuvius. Good links to more volcano information.

http://pompeii.virginia.edu/pompeii/t-s_top.html

Translations of Roman eyewitness accounts of the eruption, plus Roman graffitti. Good teaching information.

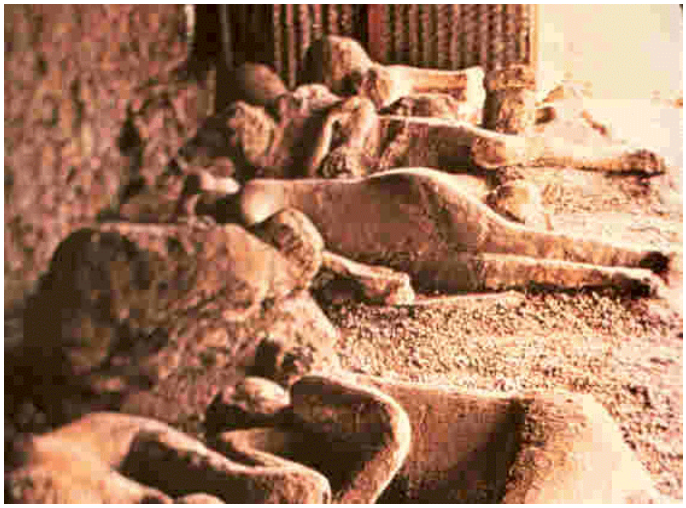
Although most molten rock cools inside the Earth, sometimes it erupts on the surface creating a volcano. Some molten rock erupts out onto the Earth's surface as a fluid lava flow. In other instances, it explodes out of the ground, making **pyroclastic** material.

Volcanic eruptions, especially explosive ones, can be dangerous. Large amounts of pyroclastic material can shoot out of the volcano with virtually no warning. When this hot rock lands on the surface, it can bury fields, crush houses and cars, and burn and suffocate people and other living things.

The destruction of the Roman town of Pompeii is a good example. Pompeii was an industrial town and seaport located on the southwestern coast of Italy. Pompeii was founded before the sixth century B.C., and quickly became a very successful city. Pompeii was also a beautiful place, in part because it was located near the foot of a local mountain, called Mt. Vesuvius. Unfortunately for the citizens of Pompeii, Vesuvius was a volcano. It is possible that the Romans knew this. Since Vesuvius was quiet during the history of Pompeii, they may have thought that Vesuvius was an extinct, or dead volcano. If so, they were wrong.

Mt. Vesuvius from the city of Pompeii

On August 24, 79 A.D., Vesuvius suddenly returned to life. The mountain erupted violently, shooting a column of pyroclastic material, gas, and rock up to twenty miles into the sky. The tremendous cloud of material quickly spread out, blocking the sun and turning the bright summer day into night. The eruption continued for at least three days. During this whole time, pyroclastic material fell on Pompeii. The town was buried by volcanic ash and other material. In places the ash, which is called a volcanic fallout deposit, was more than ten feet thick. The city of Pompeii was buried and forgotten.



Plaster casts of people trying to protect themselves from the hot ash that incinerated their bodies.

In addition to the giant cloud of ash, Vesuvius also erupted **pyroclastic flows**. Pyroclastic flows are very hot fast-moving avalanches of ash and gas which race down the sides of volcanoes. They move almost like hot, glowing hurricanes. Pyroclastic flows from Vesuvius destroyed other towns near Pompeii, such as Herculaneum and Stabiae, which were buried by up to twenty feet of ash deposits.

After the eruption was over, the formerly bustling landscape of the Pompeii region was gone. Green fields, streams, and cities were replaced by a thick blanket of grey ash. The remains of ruined buildings stuck up in places. Thousands of people were killed. The economy of the region was ruined, and took many years to recover. Vesuvius remained active for several hundred years. This helped cause Pompeii and the other buried towns to be forgotten.

Columns that lined the large homes of Pompeii

Pompeii remained buried for almost sixteen hundred years, until it was rediscovered by archeologists. Since the city was so completely buried, it was not disturbed very much by looters and treasure seekers. Modern research at Pompeii began about one hundred and fifty years ago, and had given us an exciting and detailed portrait of life in ancient Roman. The rapid burial of the city preserved the Roman buildings, ranging from homes to workplaces to public areas. It also maintained all kinds of artifacts, such as food, medical instruments, artwork, and even graffiti. It is a fascinating place to visit.

Excavation and discoveries at Pompeii continue to this day. Vesuvius slumbers in the background, patiently waiting until it is ready to erupt once more.

Interior of a Roman House, Pompeii

EARTH SCIENCES - VOLCANOES

Lesson 5 - VOLCANO MYTHS AND STORIES

MATERIALS:

reader

Objective: Students learn about worldwide stories around volcanic eruptions.

Teacher note

Students should read the different volcano legends that have evolved over the ages. Discuss with them how the legends can evolve, through fear and creative dialog. You may want to have students research more legends on the internet or take the information that they have learned and try to craft their own modern legend.

Vitaliano, Dorothy B., 1976, Legends of the Earth: Their Geologic Origins: Secaucus, N.J.: The Citadel Press.

HAWAII

Pele, is the Hawaiian Goddess of volcanoes. Pele had frequent moments of anger, which brought about eruptions. She was both honored and feared. She could cause earthquakes by stamping her feet or volcanic eruptions and fiery lava by digging with her Pa'oa, her magic stick. Long strands of volcanic glass, have been called Pele's hair.

Many of the stories were created to explain some of the odd but beautiful structures that were formed. For instance rocks that look like tree trunks are given this story. *"Pele is a skilled rider of the holua, a wooden sled that slides down steep stone ramps. Papalauahi and and other chiefs challenged Pele to see who was the best holua rider. Papalauahi proved by far to bethe most skilled. Pele lost her temper. She produced a great flood of lava which overran many of the chiefs and onlookers and they became stone pillars."*

Pele's hair

MT. SHASTA, CALIFORNIA

The Modoc Indians of northern California have lived in the Mt. Shasta area a long time and have seen the volcano erupt. Their oral tradition explains how the volcano formed. The Chief of the Sky Spirits was cold in the Above World. One day he used a rotating stone to drill a hole in the sky. Once the hole was finished he pushed in snow and ice. The snow and ice piled up and almost reached the sky. Then, the Chief of the Sky Spirits stepped down to the Earth. He created the trees, rivers, animals, fish, and birds. He even brought his family down and they all lived in the mountains. The sparks and smoke from their fires blew out of the hole in the top of their lodge. When Chief of the Sky Spirit tossed a big log on the fire sparks flew up even higher and the Earth trembled. The Chief eventually put out the fire and returned to the Above World. From Vitaliano (1976).

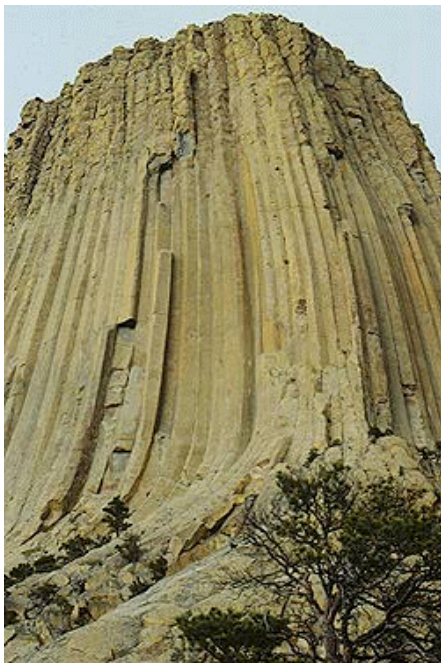
NEW ZEALAND

A man-eating demon named Tamaohoi once lived on the flank of Mount Tarawera, in New Zealand. He was imprisoned on the mountain by Ngatoro. Tamaohoi slept for many centuries. Under the influence of the white man, the morals of the local people declined until there was a call for Tamaohoi to return and punish the sinners.Tamaohoi exploded from the mountain and killed many people in the village of Te Ariki. From Vitaliano (1976).

DEVIL'S TOWER, WYOMING

This area was a lava flow that has cooled into rocks that resemble pillars. Early Indians and settlers did no realize that these were rocks from ancient volcanoes. There are many legends that use the rocks as a backdrop, with no reference to its volcanic nature.

"*Once there were seven brothers, one day the wife of the oldest brother was carried off by a huge bear to his cave. Her husband mourned her loss greatly. The youngest brother who had great power told him to make 4 arrows with a special design. Then he and the other brothers went to the cave, where they found the bear asleep with his head resting in the wife's lap. They helped her escape. When the bear awoke and found the woman gone he was so mad that he rounded up all the bears in the area, as he was the leader and set out to find the Indians.*



The youngest of the brothers (who was a holy man) saw the bears coming and he took a small rock from his pocket, sang a sacred song and made the rock grow to the size it is today. The leader bear kept jumping up the sides of the rock trying to get to the top of the rock where the Indians were seeking protection, his claws marking the sides of the tower. On his forth jump they shot an arrow into his head and that killed him. The story ends with the brothers capturing the last two bears and telling them never to bother people again. To make sure, he cut off their ears and tails. That is why to this day bears have short ears and no tails." From a tourist postcard.

Earth Science - VOLCANOES - Unit Test

Part 1. Definitions Match the number of the term or concept in Column 1 with the letter of the correct definition in Column 2.

Column 1	Column 2
1. Shield volcano	a. Mt. St. Helens, Washington, USA
2. Ring of Fire	b. fast cooling igneous rock
3. Cinder Cone	c. with holes
4. Obsidian	d. rim of Pacific Ocean
5. Vesicular texture	e. presently erupting
6. Lava	f. Hawaiian volcanoes, USA
7. Active volcano	g. particles from an erupting volcano
8. Composite	h. molten rock on the surface of Earth
9. Pyroclastic	i. Hawaiian goddess of the volcano
10. Pele	j. Paracutin, Mexico

Part 2. Multiple Choice Choose the best answer to complete each statement.

1. Pillow lava is formed when lava erupts
    a. on the surface
    b. near a bed
    c. under water
    d. none of these

2. Which is not a volcanic rock?
    a. Scoria
    b. Granite
    c. Basalt
    d. Obsidian

3. A dormant volcano
    a. will never erupt again
    b. may erupt in the near future
    c. will erupt in a week
    d. all of these

4. Magma that feeds volcanoes comes from
    a. the crust and upper mantle
    b. the inner core
    c. the outer core
    d. the lower mantle

5. Pompeii was destroyed by
    a. lava
    b. earthquakes
    c. Romans
    d. pyroclastic flows

6. The Devil's Tower in Wyoming is
    a. an ash deposit
    b. a pluton
    c a lava flow
    d. caused by the devil

7. Volcanoes can form a
    a. an island
    b. a mountain
    c. a plateau
    d. all of the above

8. Pumice is an igneous rock formed
    a. when gases get trapped in forming volcanic rocks
    b. underwater
    c. under an obsidian flow
    d. all of these

9. Basalt, rhyolite, obsidian, scoria, and pumice are all
    a. plutonic rocks
    b. dark rocks
    c. volcanic rocks
    d. heavy rocks

10. Pahoehoe refers to a rock that resembles
    a. a pahoehoe tree
    b. rope
    c. a tree
    d. a devil's toe

ANSWERS

PART I.

1. F
2. D
3. J
4. B
5. C
6. H
7. E
8. A
9. G
10. I

PART II.

1. C
2. B
3. B
4. A
5. D
6. C
7. D
8. A
9. C
10. B