



FORCES OF NATURE

MUSICAL SPROUTS

TEACHER BACKGROUND

VOLCANOES

WHAT IS A VOLCANO?

A volcano is a place where material from the inside of the Earth is escaping to the surface. The prime material involved is molten (or melted) rock that comes from the layer of the Earth known as the mantle. Lava is magma once it reaches the earth's surface.

Volcanoes are built by the accumulation of their own eruptive products—lava, bombs (crusted over ash flows), and tephra (airborne ash and dust). A volcano is most commonly a conical hill or mountain built around a vent that connects with reservoirs of molten rock below the surface of Earth. The term volcano also refers to the opening or vent through which the molten rock and associated gases are expelled.

Driven by buoyancy and gas pressure, the molten rock, which is lighter than the surrounding solid rock, forces its way upward and may ultimately break through zones of weaknesses in Earth's crust. If so, an eruption begins, and the molten rock may pour from the vent as nonexplosive lava flows, or it may shoot violently into the air as dense clouds of lava fragments. Larger fragments fall back around the vent, and accumulations of fall-back fragments may move down slope as ash flows under the force of gravity. Some of the finer ejected materials may be carried by the wind and fall to the ground many miles away. The finest ash particles may be injected miles into the atmosphere and carried many times around the world by stratospheric winds before settling out.



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MAGMA & LAVA

Molten rock below the surface of Earth that rises in volcanic vents is known as magma, but after it erupts from a volcano it is called lava. Magma also contains many other chemical elements in trace quantities. Upon cooling, the liquid magma may precipitate crystals of various minerals until solidification is complete to form an igneous or magmatic rock. Lava is red-hot when it pours or blasts out of a vent but soon changes to dark red, gray, black, or some other color as it cools and solidifies. All magmas contain dissolved gases, and as they rise to the surface to erupt, the confining pressures are reduced and the dissolved gases are liberated either quietly or explosively. If the lava is a thin fluid (not viscous), the gases may escape easily. But if the lava is thick and pasty (highly viscous), the gases will not move freely but will build up tremendous pressure, and ultimately escape with explosive violence. Gases in lava may be compared with the gas in a bottle of a carbonated soft drink. If you put your thumb over the top of the bottle and shake it vigorously, the gas separates from the drink and forms bubbles. When you remove your thumb abruptly, there is a miniature explosion of gas and liquid. The gases in lava behave in somewhat the same way. Their sudden expansion causes the terrible explosions that throw out great masses of solid rock as well as lava, dust, and ashes. The violent separation of gas from lava may produce rock froth called pumice. Some of this froth is so light—because of the many gas bubbles—that it floats on water.



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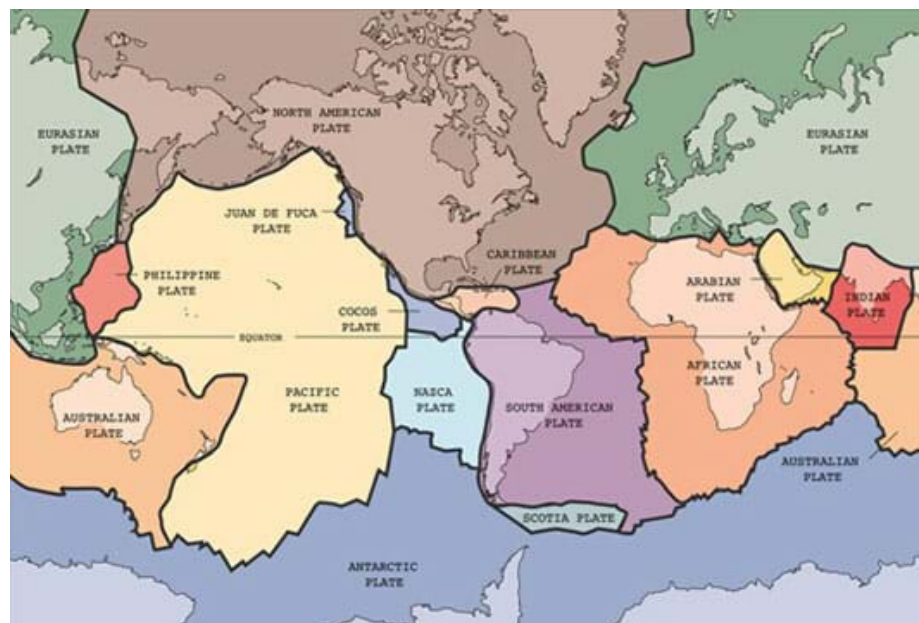
VOLCANOES

LAYERS OF THE EARTH

To understand volcanoes we must first understand what is inside the Earth. The Earth is made of three distinct layers. The innermost layer of the Earth, the core, is made mostly of iron.

The inner core is solid, while the outer core is liquid. The middle layer of the Earth is the mantle. The mantle is a semi-molten layer between the core and the outermost layer, which is known as the crust. The crust is the solid layer on which we live. The crust is much thinner than the other two layers. If you think of the Earth as an egg, the crust would be the shell, the mantle would be the egg white, and the core would be the yolk.

As we know from studying earthquakes, the crust of the Earth is not one solid piece. It is broken into about 15 pieces called tectonic plates (see figure below).





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ENGINEERING CONNECTION

Volcanoes are both a constructive force and a destructive force. Constructive forces build up land while destructive forces break down the Earth's surface. While volcanoes cannot be prevented, we can do our best to predict them so that human populations near volcanoes can be safely evacuated before an eruption. To predict eruptions, engineers design and build many different devices to detect subtle changes in a volcano that occur before it erupts. Engineers use their science and math skills to build specialized instruments that can detect gases, changes in the shape of the volcano, as well as monitor earthquakes that may signal a possible eruption.

To give people advance warning that a volcano is going to erupt, engineers and scientists are creative in designing and building devices to detect natural indicators of volcanic eruptions. Warning signs include earthquakes, gas emissions, change in magnetic field, and the swelling of the volcano itself. To monitor active volcanoes, seismometers detect the vibration of earthquakes, tilt meters detect even slight changes in the shape of the mountain, and other devices monitor and measure escaping gases. Explosive ash eruptions from volcanoes can shut down airports, disrupt air routes and temporarily stop air supply service to remote areas.