

Earth Systems, Structures and Processes

Date:

6.E.2 Understand the structure of the earth and how interactions of constructive and destructive forces have resulted in changes in the surface of the Earth over time and the effects of the lithosphere on humans.

6.E.2.1 Summarize the structure of the earth, including the layers, the mantle and core based on the relative position, composition and density.

6.E.2.2 Explain how crustal plates and ocean basins are formed, move and interact using earthquakes, heat flow and volcanoes to reflect forces within the earth.

6.E.2.3 Explain how the formation of soil is related to the parent rock type and the environment in which it develops.

6.E.2.4 Conclude that the good health of humans requires: monitoring the lithosphere, maintaining soil quality and stewardship.

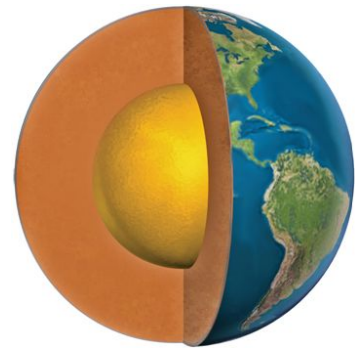
Peeling the Layers

What is inside Earth?

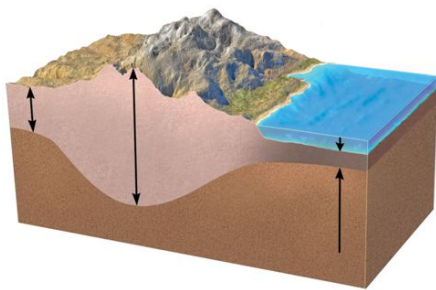
- _____ is made of several layers.
- Each layer has its own _____ properties.
- Scientists think about Earth's layers in two ways—in terms of _____ composition and in terms of _____ properties.

What are Earth's compositional layers?

- Earth can be divided into ____ layers based on chemical composition: the *crust*, the *mantle*, and the *core*.

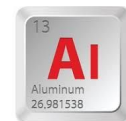


- The outermost solid layer of Earth is the _____.

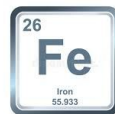
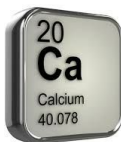


- There are two types of crust: _____ and _____.

- Both types of crust are made mostly of _____, _____, and _____.



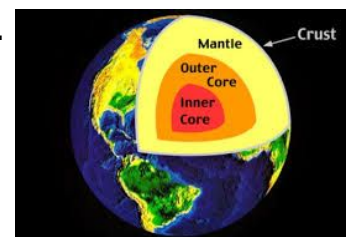
- _____ crust is _____ than continental crust because it contains almost twice as much iron, calcium, and magnesium.



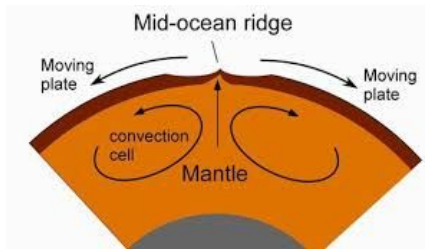
- The _____ is located between the crust and the core.

- The mantle is a region of _____, slow-flowing solid rock.

- The mantle contains more _____ and less aluminum and silicon than the crust.

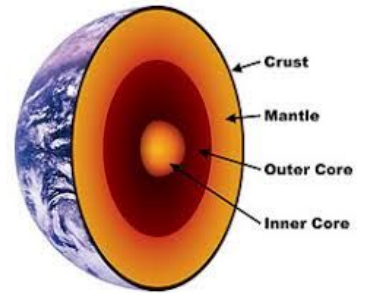


• _____ is the movement of matter that results from differences in density caused by variations in temperature.



• Convection in the mantle causes _____ rock to _____ and _____ rock to _____.

• The _____ extends from below the mantle to the center of Earth.



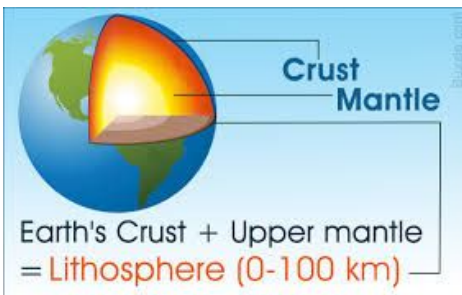
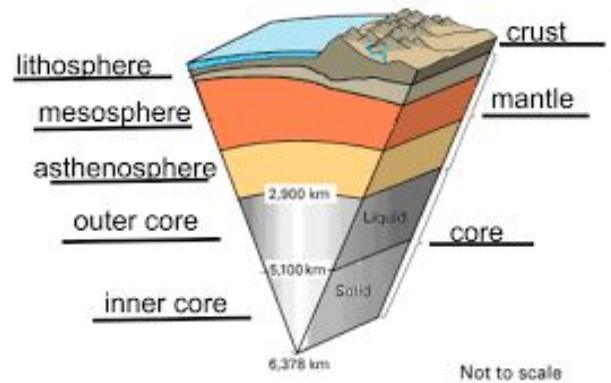
• Scientists think the core is made mostly of _____ and some _____.

• The _____ is the _____ layer and makes up about _____ of Earth's mass.

What are Earth's physical layers?

• Earth is also divided into layers based on _____ properties, such as whether the layer is _____ or _____.

• The _____ physical layers are the *lithosphere*, *asthenosphere*, *mesosphere*, *outer core*, and *inner core*.



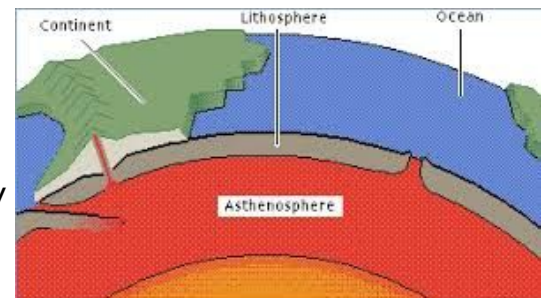
• The outermost, rigid layer of Earth is the _____.

• The lithosphere is made of the _____ and the rigid, _____ part of the _____.

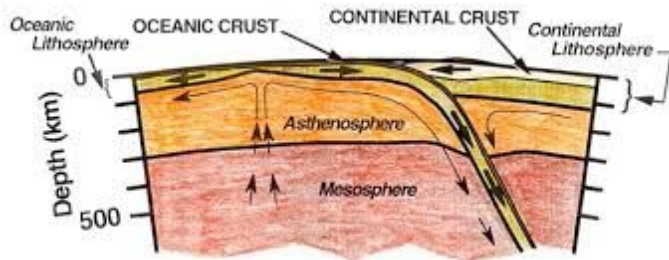
• The lithosphere is divided into pieces called _____.

• The _____ is the layer of weak or soft mantle made of solid rock that moves very slowly.

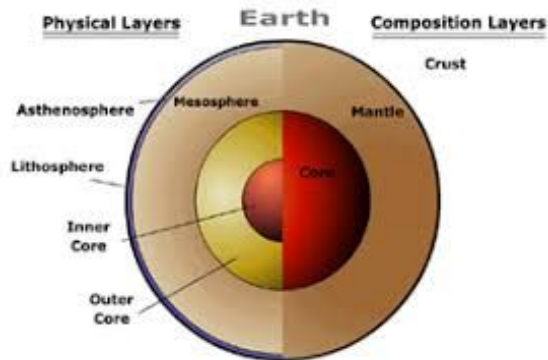
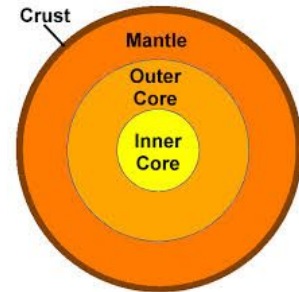
• The asthenosphere is located _____ the



- Tectonic plates _____ on _____ of the asthenosphere.
- The strong, lower part of the mantle is called the _____.
- _____ in the mesosphere _____ more _____ than rock in the asthenosphere.



- The _____ core is the _____ layer of Earth's core.
- The outer core lies _____ the mantle and _____ the inner core.
- The _____ core is the _____, dense center of our planet.
- The inner core _____ from the bottom of the outer core to the _____ of Earth.



Earth Structure

Earth Structure		Seismic wave velocities	
Crust	Lithosphere	6km/s	Continental crust
	Asthenosphere	7km/s	Oceanic crust
Mantle	Mesosphere	8km/s	Upper mantle
	Outer Core	7.8km/s	Upper mantle
Core	Outer Core	13km/s	Mantle
	Inner Core	8km/s	Outer core
		11km/s	Inner core

Compositional Mechanical

Plate Tectonics

Earthquakes, Volcanoes & Soil Formation

Puzzling Evidence

What evidence suggests that continents move?

- In the late 1800s, Alfred _____ proposed his _____ of continental drift.
- According to this hypothesis, the _____ once formed a _____ landmass, broke up, and drifted.
- Several lines of _____ support Wegener's hypothesis.
- _____ of the _____ species are found on continents on _____ sides of the Atlantic Ocean.
- The locations of _____ ranges and _____ formations and evidence of ancient climatic conditions also support Wegener's hypothesis.

What is Pangaea?



- About _____ million years ago, the continents were joined in a single large landmass called _____.
- About _____ million years ago, a large rift formed and Pangaea began to break into two continents, _____ and _____.
- Then, Laurasia began to drift northward, and a new rift separated Laurasia into the continents of _____ America and _____.
- At the same time, Gondwana also broke into _____ continents.
- One continent contained land that is now the continents of _____ America and _____.

- The other continent contained land that is now _____, _____, and _____.

What discoveries support the idea of continental drift?

- For many years, scientists did not accept Wegener's ideas because they could not determine how continents moved.
- In the _____, scientists began _____ the sea floor and discovered huge, underwater mountain ranges called _____.
- The discovery of mid-ocean ridges eventually led to the _____ of plate tectonics, which built on some of Wegener's ideas.
- _____ samples from the sea floor revealed that the _____ rock is _____ to the ridge, while the oldest rock is farthest away.
- Even the _____ oceanic crust is _____ compared to _____ crust.
- Also, sea-floor rock contains _____ patterns.
- To explain the age and magnetic patterns of sea-floor rocks, scientists proposed a process called _____.
- In this process, _____ rock from inside Earth _____ at the ridges and forms _____ oceanic crust.
- _____ crust is _____ away from the ridge, and the sea floor slowly _____ apart.
- Scientists also discovered huge _____ in the sea floor where oceanic crust _____ into the _____.
- _____ crust is thus being _____ at the ocean trenches at the same rate as new crust is forming at the ridges.
- In this manner, _____ remains the _____ size.

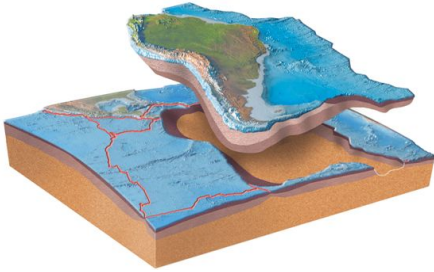
A Giant Jigsaw

What is the theory of plate tectonics?

- Scientists began to form a new _____ to explain _____ drift, mid-ocean ridges, and sea-floor spreading.
- _____ is a theory that describes large-scale movements of Earth's lithosphere.
- It _____ how and why features in Earth's crust form and continents move.

What is a tectonic plate?

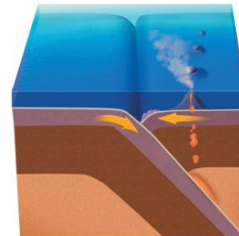
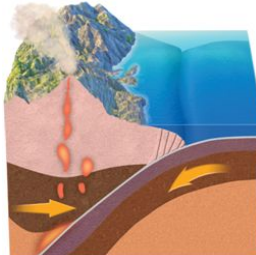
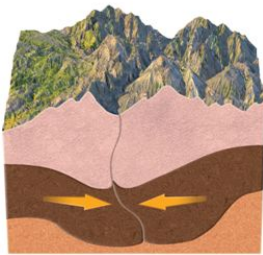
- The lithosphere is divided into pieces called _____, which move around on top of the asthenosphere.



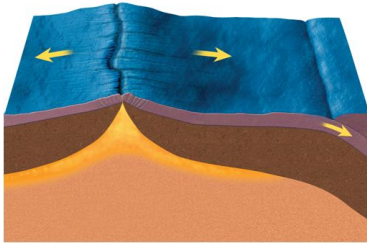
Boundaries

What are the three types of plate boundaries?

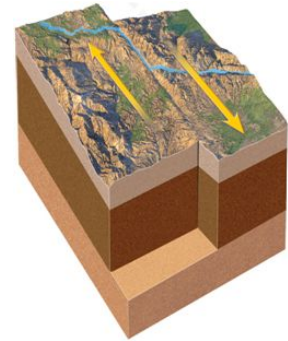
- Plate _____ may be on the ocean floor, around the edges of continents, or even within continents.
- The _____ types of plate boundaries are convergent boundaries, divergent boundaries, and transform boundaries.
- Each type is associated with characteristic _____.
- _____ **boundaries** form where two plates collide. This can happen in three ways, depending on the types of crust involved.



- At a _____ **boundary**, two plates move away from each other, and magma rises to form new lithosphere at mid-ocean ridges.



- A boundary at which two plates move past each other horizontally is called a _____ **boundary**. At transform boundaries, the motion of the two plates often produces earthquakes.



Hot Plates

What causes tectonic plates to move?

- Scientists have _____ three _____ to explain how tectonic plates _____: mantle convection, ridge push, and slab pull.
- Hotter parts of the mantle rise as cooler, denser parts sink. This kind of movement of material due to differences in density is called _____.
- _____ convection _____ the overlying tectonic plates.
- The mechanism called _____ push moves plates _____ from mid-ocean ridges as rock cools and becomes more dense.
- _____ formed rock at a mid-ocean ridge is warm and less _____ than older, adjacent rock, which slopes downward away from the ridge.
- As the newer rock cools and becomes denser, it moves down the slope, _____ the rest of the plate away from the mid-ocean ridge.
- In the mechanism called _____, a plate moves because it is pulled along when its denser edge sinks beneath Earth's surface.
- The leading edge of a sinking plate is colder and denser than the mantle, so it sinks. The rest of the plate follows.

- Many scientists think slab pull is the most _____ mechanism driving plate motion.

Earthquake

Let's Focus

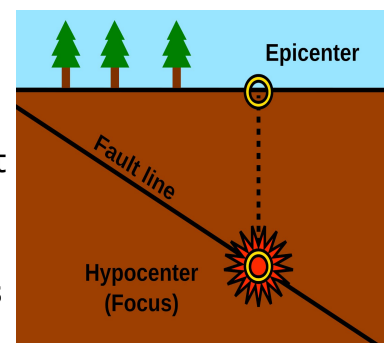
What is an earthquake?

- _____ are ground movements that occur when blocks of rock in Earth move suddenly and release energy.

- The _____ is released as _____ waves that cause the ground to move.

- The _____ is a place within Earth along a fault where the first motion of an earthquake occurs.

- The place on Earth's surface directly above the focus is called the _____.



- Seismic waves flow _____ from the focus in _____ directions.

What causes earthquakes?

- Most earthquakes occur near a _____ **boundary**, which is where two or more tectonic plates meet.

- The movement of tectonic plates breaks Earth's crust into a series of _____, which are breaks in Earth's crust along which blocks of rocks move.

- The release of _____ that accompanies the movement of rock along a fault causes an earthquake.

- Stress on the rock causes _____, which is the process by which the rock becomes deformed and changes shape.

- As the _____ on rock _____, the energy _____ in it increases.

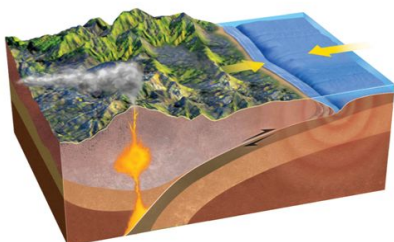
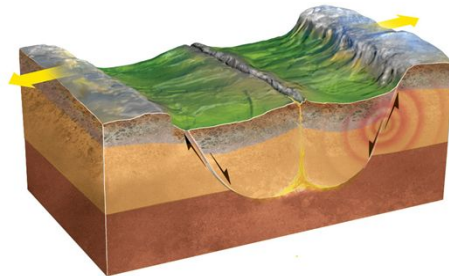
- When the stress is _____, the rock may return to its _____ shape.
- When rock _____ to nearly the _____ shape after the stress is removed, the process is called _____ *deformation*.
- The return of rock to its original shape after elastic deformation is called _____.

Unstable Ground

Where do earthquakes happen?

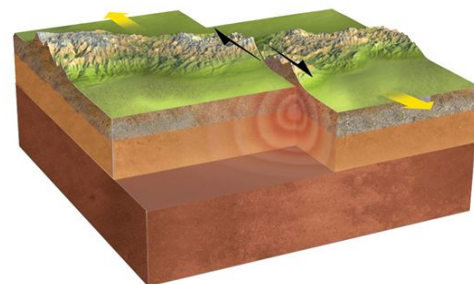
- Most earthquakes happen at or _____ tectonic plate boundaries.
- ____ tectonic plate boundaries, _____ builds up from tectonic plates _____, _____, or _____ past each other.
- There are ____ main types of tectonic plate boundaries: divergent, convergent, and transform.

- At divergent boundaries, _____ stress causes normal faults to form. Earthquakes tend to be shallow because the crust is thin.



- At convergent boundaries, rock is _____, and the stress is called _____. Reverse faults are formed, and earthquakes can be strong and deep.

- At transform boundaries, _____ stress pushes tectonic plates in _____ directions. Earthquakes tend to be relatively shallow.



What are some effects of earthquakes?

- _____ earthquakes do not cause damage, but some strong earthquakes can cause _____ damage and loss of life, especially in areas closest to the

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- When the _____ of an earthquake is more than structures can withstand, major destruction can occur.
 - Much of the _____ and loss of life after an earthquake is caused by _____ that collapse.
 - An earthquake under the _____ can cause a _____ movement of the sea floor, displacing an enormous amount of water and generating a tsunami.
 - A _____ is a series of extremely long waves that can travel across the ocean at speeds of up to 800 km/h.
 - As the waves reach the shoreline, the _____ of the waves _____. The huge waves can cause major destruction.

Killer Quake

- In _____, an earthquake generated a _____ that wiped out half the population of Banda Aceh, Indonesia.
- The tsunami traveled outward from the epicenter in the _____ Ocean. Banda Aceh was very close to the epicenter.
- The _____ to parts of Asia was so massive that geographers had to redraw the maps of some countries.

Volcanoes

Magma Magic

What is a volcano?

- A _____ is any place where gas, ash, or melted rock come out of the ground.

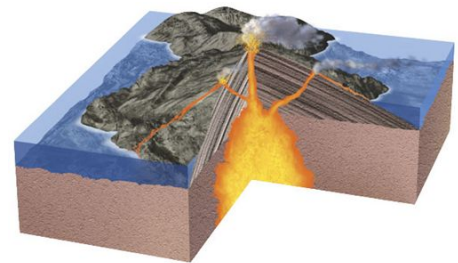


- Many volcanoes are _____, meaning an eruption has not occurred in a long period of time.

- Volcanoes form as rock below Earth's surface melts. The melted rock, called _____, is less dense than solid rock, so it rises to the surface.
- _____ is magma that has reached Earth's surface. Lava and ash erupt from a _____, or an opening of a volcano.

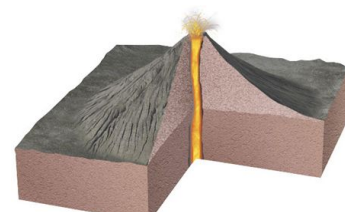
What are the kinds of volcanic landforms?

- The _____ of a volcano and _____ of magma determine the _____ of volcanic landforms created.
- Volcanic landforms include _____ volcanoes, _____ cones, _____ volcanoes, lava plateaus, craters, and _____.
- Volcanic mountains are _____ from materials _____ from a volcano.
- The _____ and _____ of a volcano depend on the lava's _____, or resistance to flow.
- _____ material, or hot ash and bits of rock, may also be ejected into the atmosphere.
- _____ volcanoes are volcanoes with broad bases and gently sloping sides.
- They are the result of _____ eruptions.



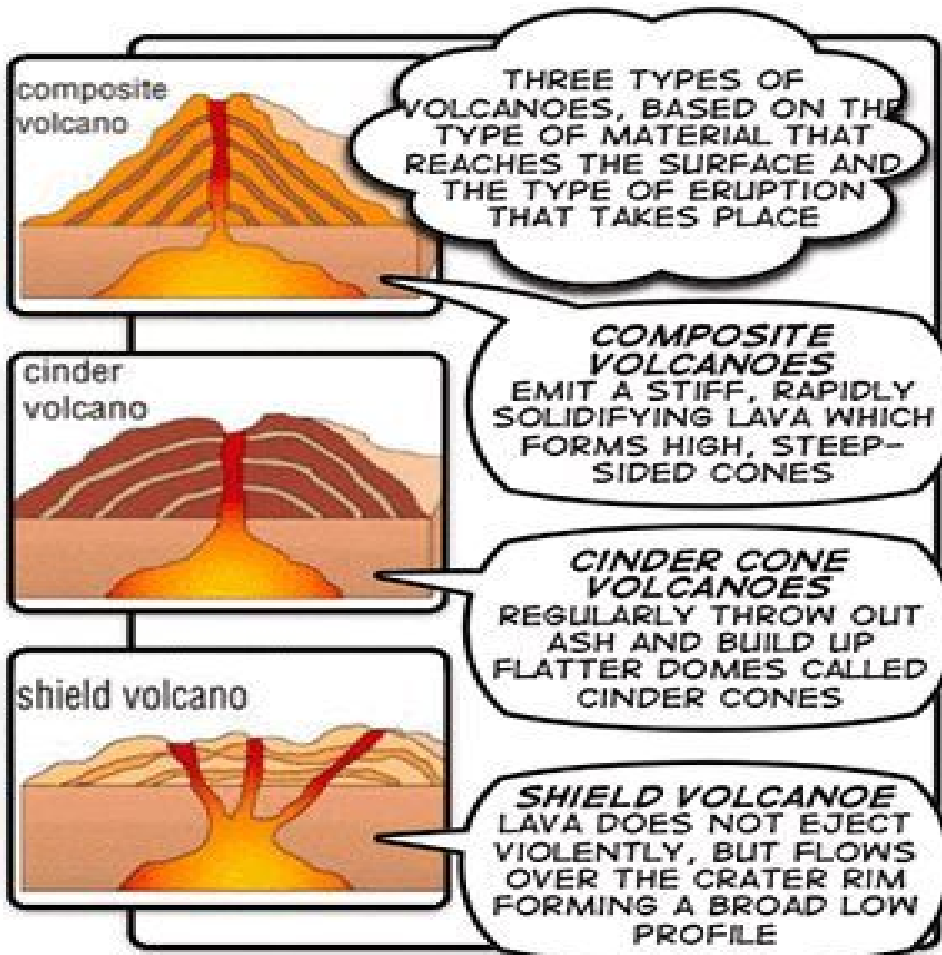
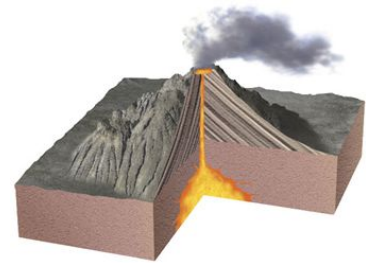
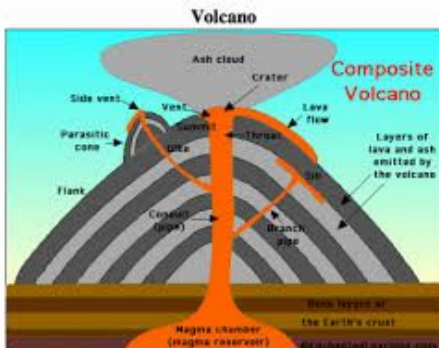
- _____ cones are small volcanoes with steep slopes.
- They form from ash and pieces of solidified lava that fall around a small vent.

2) Cinder-cone volcanoes



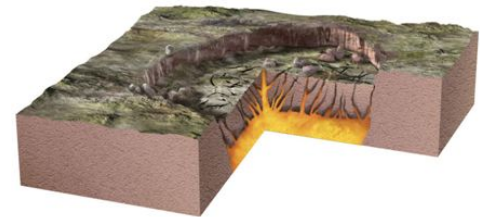
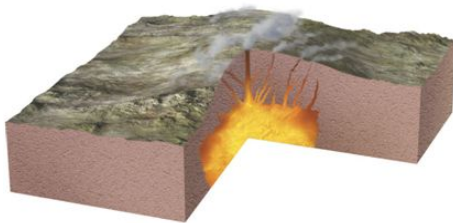
• *Composite volcanoes* are _____ from alternating layers of hardened lava flows and pyroclastic material.

• They generally develop into large, _____ mountains.



• Fissure eruptions happen when lava flows from giant cracks, or _____, in Earth's surface.

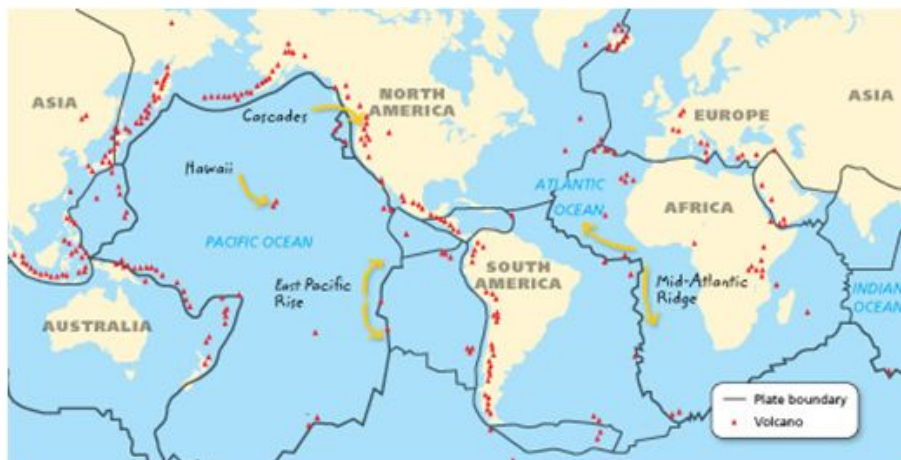
- Because fissures have ___ central opening, lava flows out the entire length of the fissure.
- _____ eruptions produce a flattened layer of cooled lava called a *lava _____*.
- A *volcanic _____* is an opening or a depression at the top of a volcano.
- A crater is caused by _____.
- Inside the volcano, molten rock can form an expanded area of magma called a _____.
- When the magma chamber empties, the roof of the chamber can collapse, leaving a large basin-shaped depression called a _____.



Eruption!

Where do volcanoes form?

- _____ are giant sections of lithosphere on Earth's surface. Volcanoes can form at plate boundaries or within the middle of a plate.

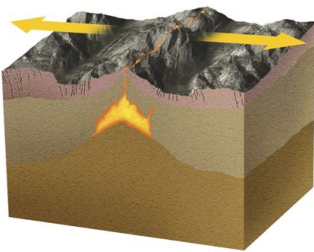


- At _____ *plate boundaries*, where two plates are moving away from each other, fissure eruptions are likely to occur.

- At _____, which are far from any plate boundaries, shield volcanoes, fissure eruptions, and cinder cones can occur.
- At _____ *plate boundaries*, _____ volcanoes can occur.
- Composite volcanoes produce the most _____ eruptions.
- The _____ is a name for the numerous explosive volcanoes that form on convergent plate boundaries surrounding the Pacific Ocean.



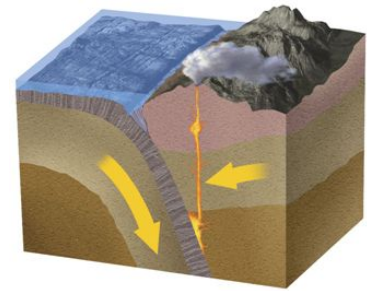
- At _____ boundaries, the crust stretches and gets thinner.
- As a result, the _____ on the mantle rock below _____, and magma rises through fissures in the lithosphere.
- _____ plate boundaries create _____ eruptions and _____ volcanoes.



- Most divergent boundaries are on the _____ floor. When eruptions occur in these areas, _____ volcanoes develop.
- These volcanoes and other processes lead to the formation of a long, underwater mountain range known as a _____.

•When a _____ boundary is located in the _____ of a continent, the crust stretches until a _____ valley is formed.

•At _____ boundaries, one plate usually _____ beneath the other. The mantle above the sinking plate can melt to form magma.

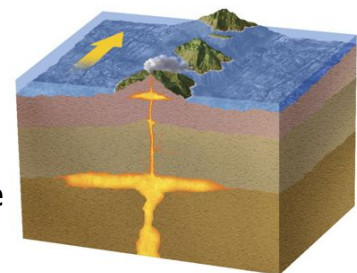


•The _____ rises to the surface and forms volcanoes.

•Magma at convergent boundaries has a _____ concentration of fluids, which form _____ bubbles.

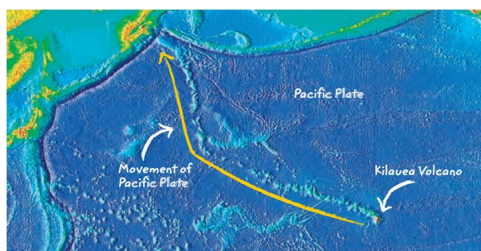
•Because the magma has a high _____, the bubbles _____ escape easily. As the bubbles expand, the magma rises _____.

•Eventually, the magma erupts _____, forming _____ volcanoes or _____.



•_____ are locations far from plate boundaries where a *mantle plume*, a column of extremely hot mantle rock, rises and produces volcanoes.

•_____ of volcanoes can _____ over time as a tectonic plate moves over a mantle _____.



Living Near a Volcano

•Many people around the world live near a volcano because the surrounding soils are fertile for growing a variety of crops.

•Volcanic rocks can be used in making jewelry, concrete, water filtration systems, and other applications.

•However, an eruption can produce destructive earthquakes, fire, ash, and lava flows, destroying property and taking lives.

Soil Formation

The Dirt on Soil

What causes soil to form?

- _____ is a loose mixture of rock fragments, organic matter, water, and air that can support the growth of vegetation.
- The first step in soil formation is the _____ of _____ rock into smaller pieces.
- Eventually, very small particles from parent rock are _____ in with _____ matter to form soil.
- _____ is broken down by _____ and plant root growth to form sediment.
- The type of _____ in soil depends on what rocks are in the area. This helps to explain why soils differ from place to place.
- Some _____, such as bacteria and fungi, decompose the remains of plants and animals.
- These remains are decayed organic matter called _____. It contains nutrients that plants need to grow.
- _____ animals, such as earthworms and moles, _____ and mix the soil as they burrow, _____ the air in the soil and its _____ to drain water.

Thick Tops, Rocky Bottoms

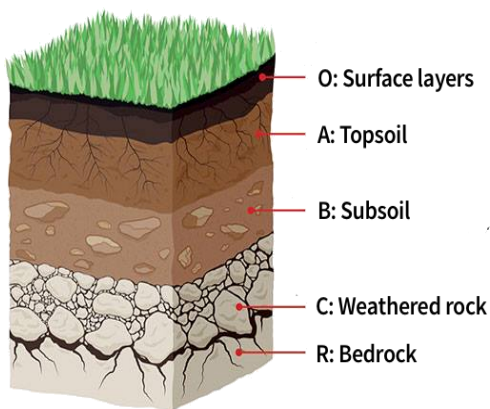
What factors determine how long it takes for soils to form?

- _____ main factors determine how long it takes for soil formation and development.
- These _____ include parent rock type, climate, topography, and plants and animals.

- _____: The rate of weathering depends on the structure of the rock and minerals that make up the rock.
- _____: Soil usually develops more quickly in warm, wet areas than in cold, dry areas.
- _____: Soils usually develop faster in flatter areas where sediments are not easily eroded.
- _____: Without a lot of plants and animals, soil tends to develop slowly.

What are the main soil horizons?

- different layers is called a _____.
- Each layer in the soil profile that has different physical properties is called a _____.



• The _____ horizons include the A horizon, B horizon, and C horizon.

• The ____ horizon is the topmost layer of soil, often referred to as _____. It contains the most humus.

• The ____ horizon lies under the A horizon and has less humus. Water carries material from the A to the B horizon, in a process

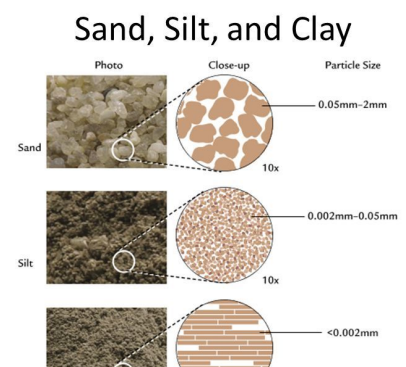
called _____.

• The ____ horizon lies below the B horizon and directly above the parent rock. It contains the _____ rock fragments and usually ____ organic matter.

All About Soil

What are some properties of soil?

• Soil _____ are used to _____ different soils. These properties include soil texture, color, chemistry, pore space, and fertility.



• Soil _____ describes the relative amounts of differently sized soil particles.

• Soil _____ are classified as _____ (largest particles), _____, or _____ (smallest particles).

• Soil _____ depends on the minerals and organic matter that make up the soil.

• Soil ____ is a measure of how acidic or basic the soil is. Soil pH _____ on the minerals, sediment, and organic matter found in the soil.



• _____ describes the spaces between soil particles. Water and air are found in the pore spaces of soils.

• _____ describes how well a soil can support plant growth.

• Soil fertility _____ on the _____ and _____ of the area, and the _____ of humus, _____, and _____ in the soil.

