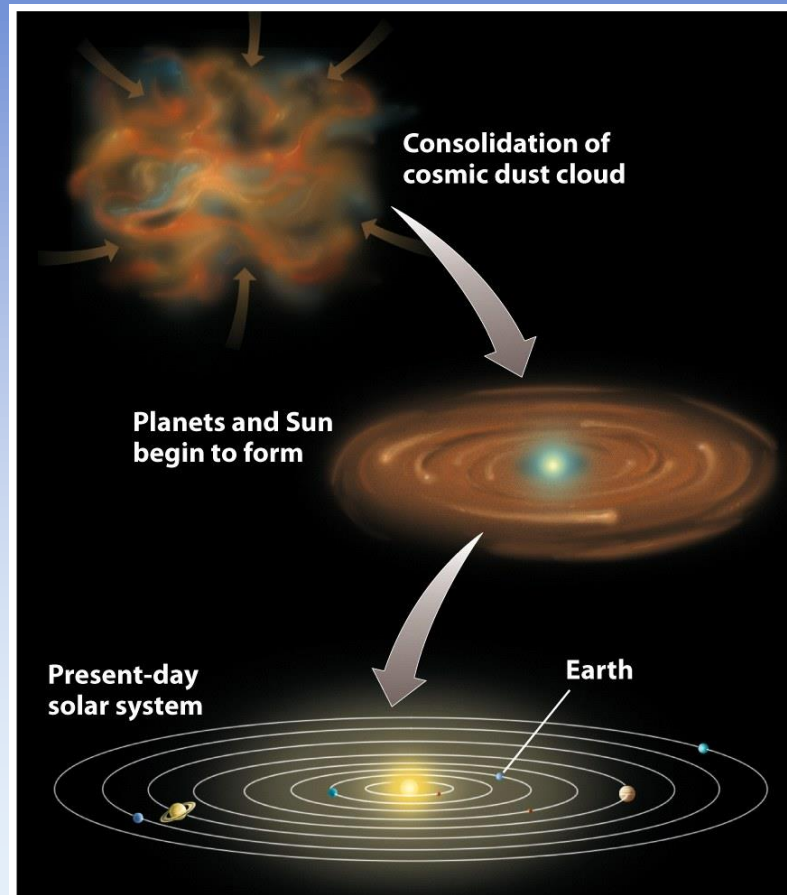




# Chapter 8

## Earth Systems and Resources

# The Earth's resources were determined when the planet formed.



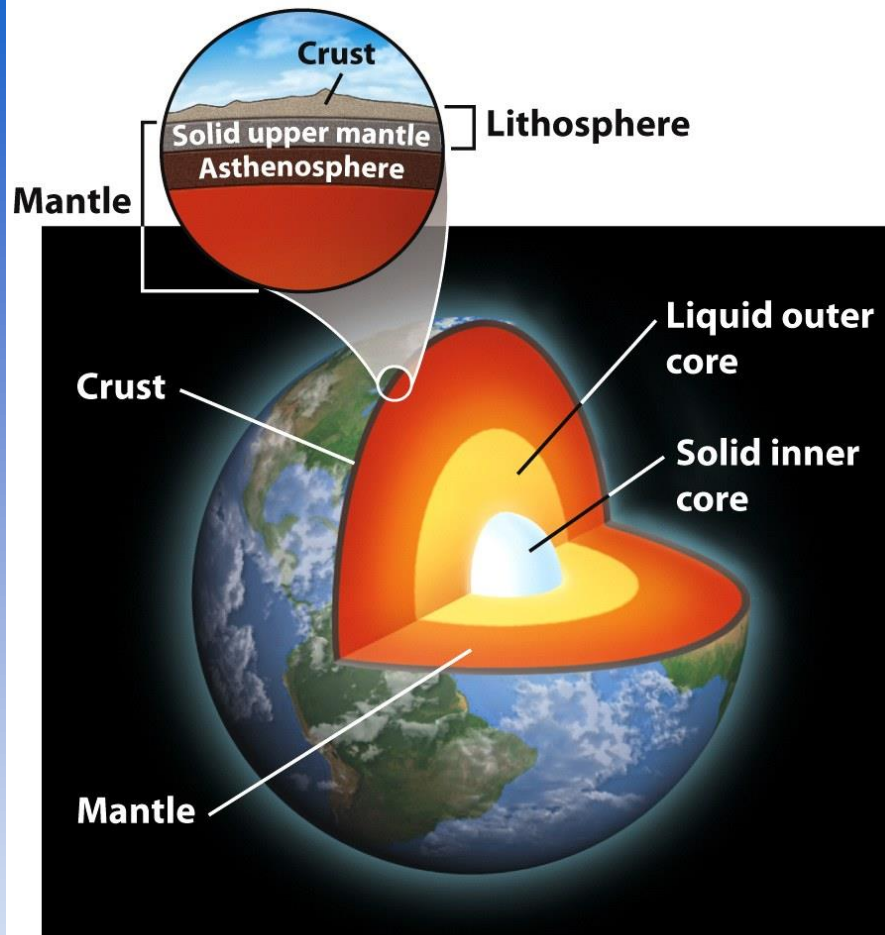
**Figure 8.1**

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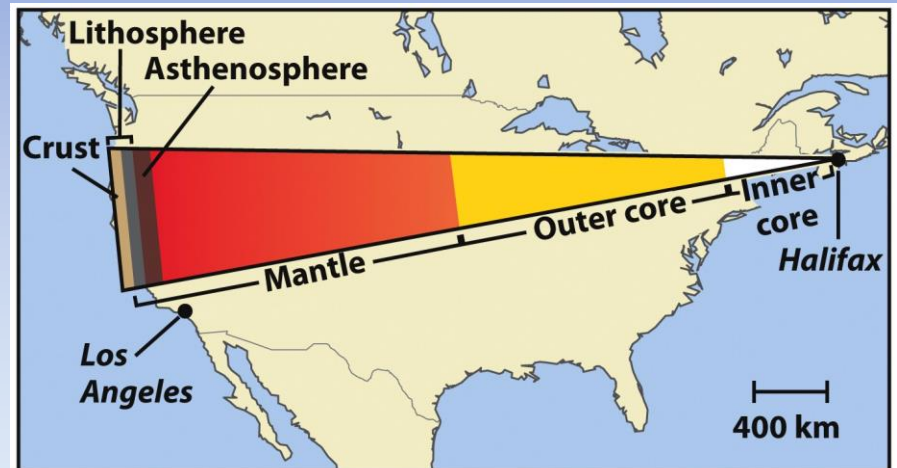
# The Earth's Layers

- ▣ Core- the innermost zone of the planet made of nickel and iron.
- ▣ Mantle- above the core containing magma
- ▣ Crust- the outermost layer of the planet.



**Earth's vertical zonation**

**Figure 8.2a**  
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**Scale of Earth's layers**

**Figure 8.2b**  
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# The Earth's Layers

- ▣ Asthenosphere- the outer part of the mantle, composed of semi-molten rock.
- ▣ Lithosphere- the brittle outermost layer of the planet that is approximately 100 km thick.

# Convection and Hot Spots

- ▣ The Earth is very hot at the center.
- ▣ This heat causes plumes of hot magma to well upward from the mantle.
- ▣ Hotspots- places where molten material from the mantle reach the lithosphere.

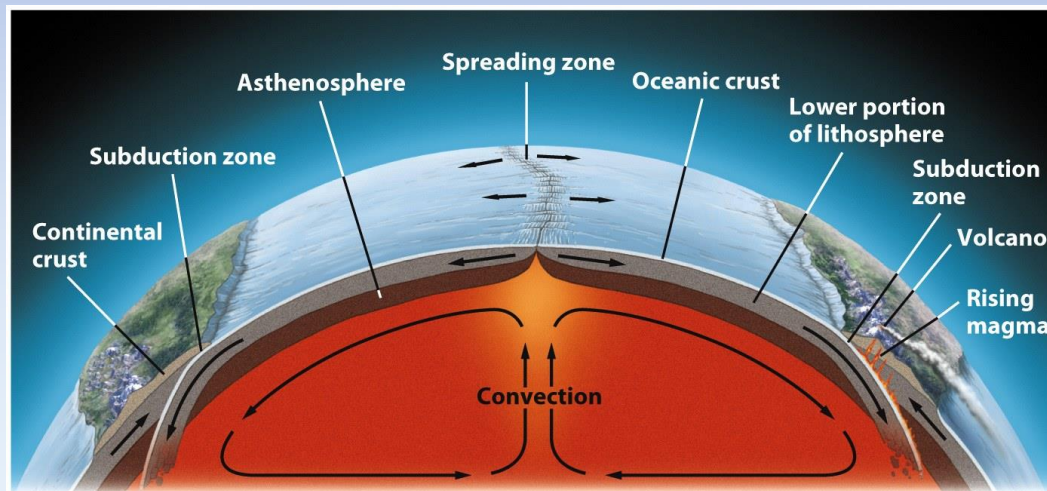
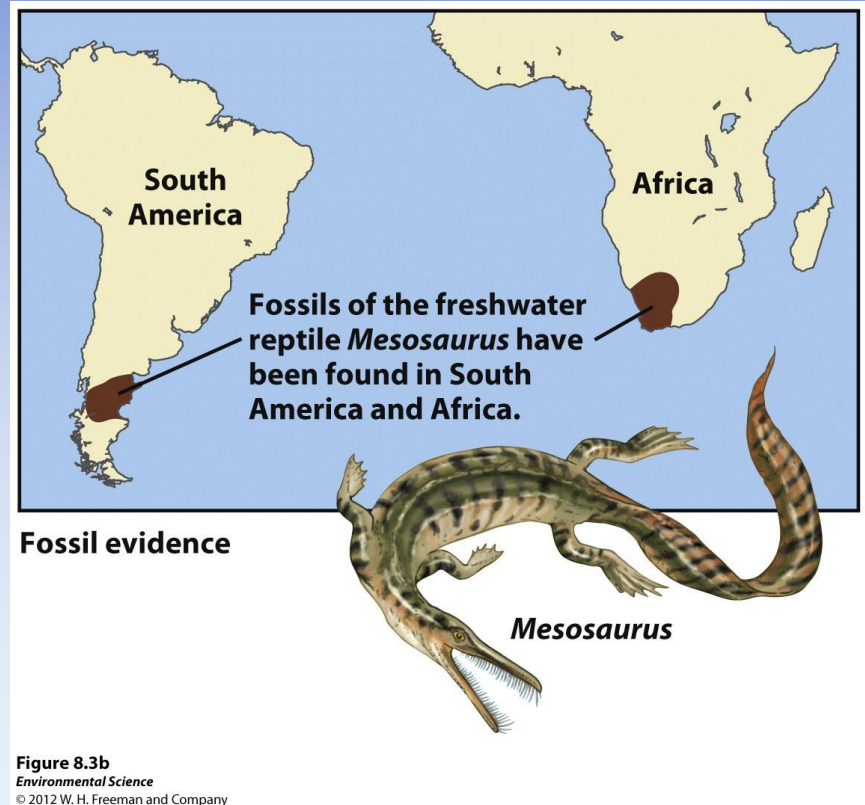


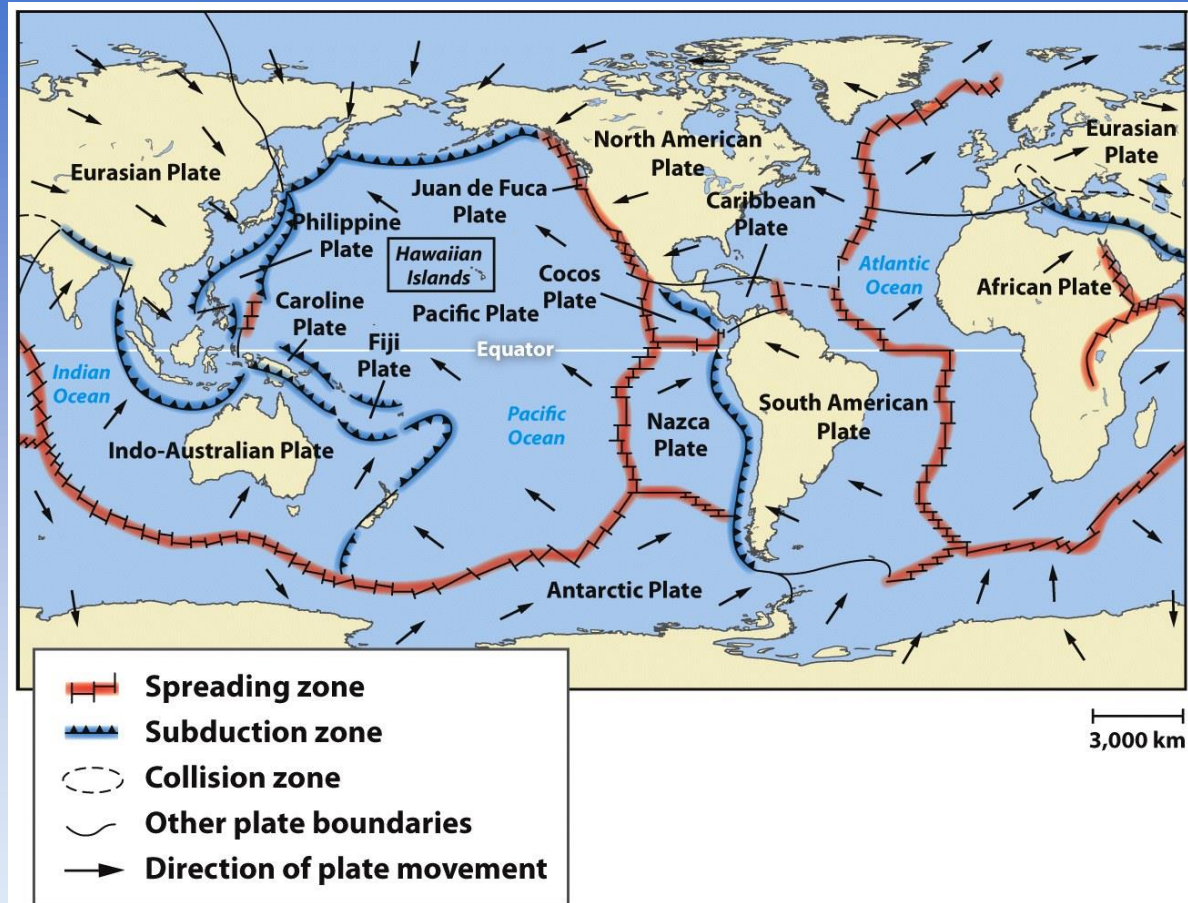
Figure 8.5  
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# Theory of Plate Tectonics

- ▣ Plate tectonics- the theory that states that Earth's lithosphere is divided into plates, most of which are in constant motion.



# Tectonic Plates



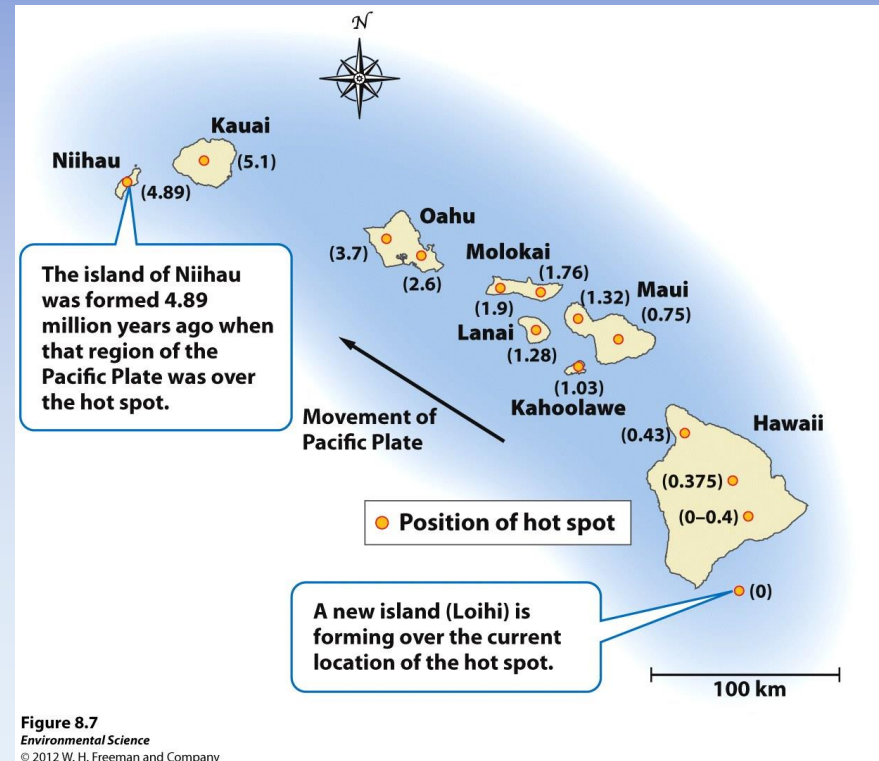
**Figure 8.4**

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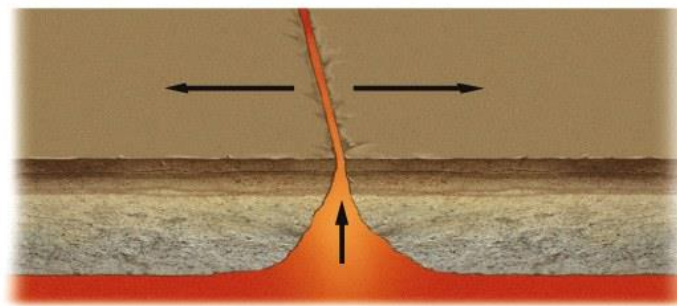
# Consequences of Plate Movement

- ▣ Volcanoes- as a plate moves over a hot spot, rising magma forms a volcano.

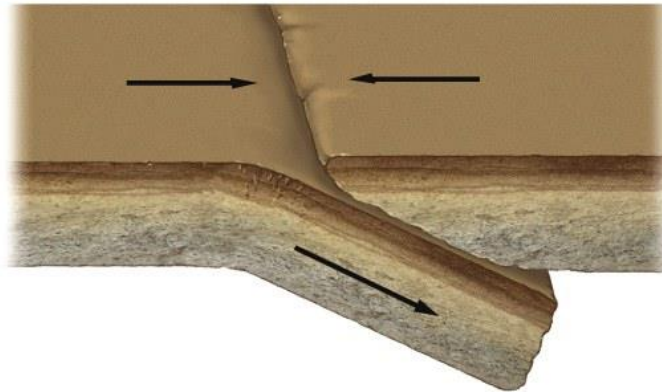


# Types of Plate Contact

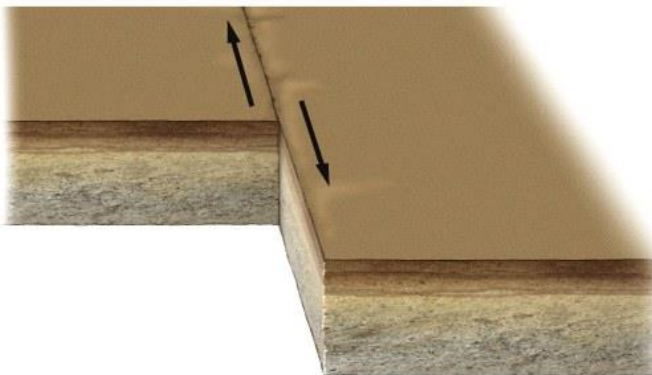
- ▣ Divergent plate boundaries- when plates move apart from one another.
- ▣ Convergent plate boundaries- when plates move toward one another and collide.
- ▣ Transform fault boundaries- then plates move sideways past each other.



**(a) Divergent plate boundary**



**(b) Convergent plate boundary**



**(c) Transform fault boundary**

**Figure 8.8**

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# Faults and Earthquakes

- ▣ Faults- a fracture in rock across which there is movement.
- ▣ Earthquakes- occur when the rocks of the lithosphere rupture unexpectedly along a fault.



Figure 8.10  
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# Faults and Earthquakes

- ▣ Fault zone- large expanses of rock where movement has occurred.
- ▣ Epicenter- the exact point on the surface of Earth directly above the location where the rock ruptures.
- ▣ Richter scale- a measure of the largest ground movement that occurs during an earthquake. The scale increases by a factor of 10, so an earthquake of 7 is 10 times greater than an earthquake of 6.

# The Rock Cycle

- Rock cycle- the constant formation and destruction of rock.

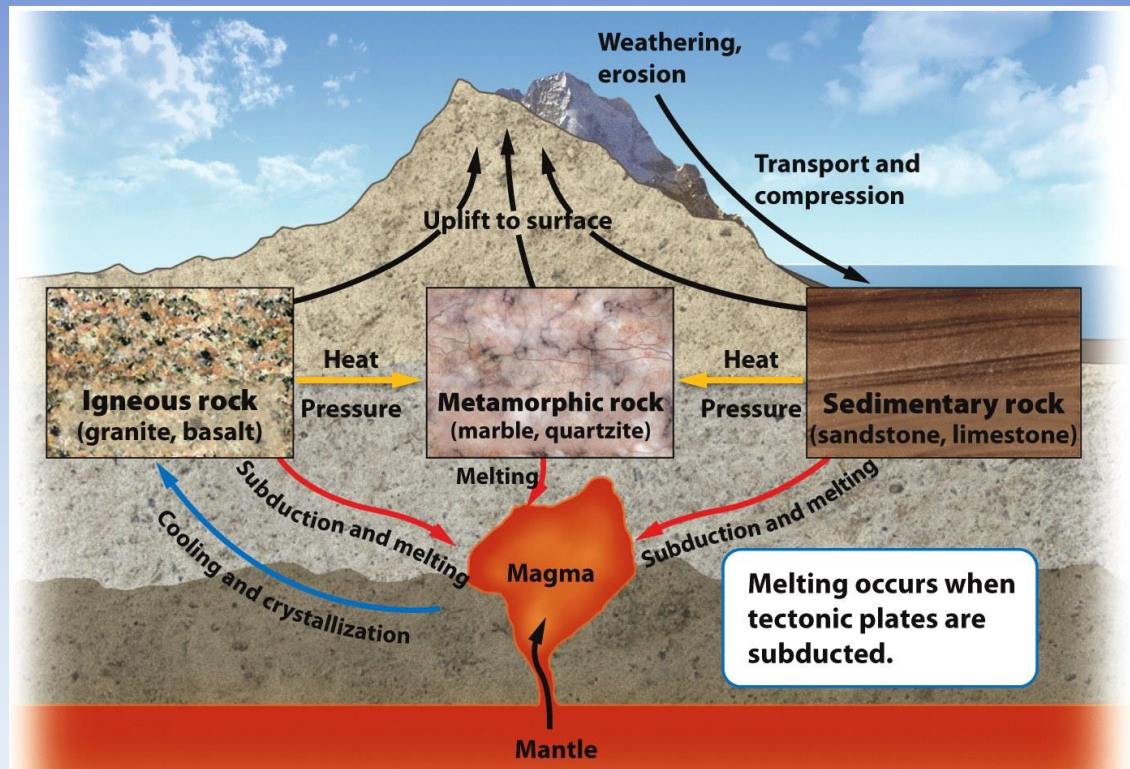


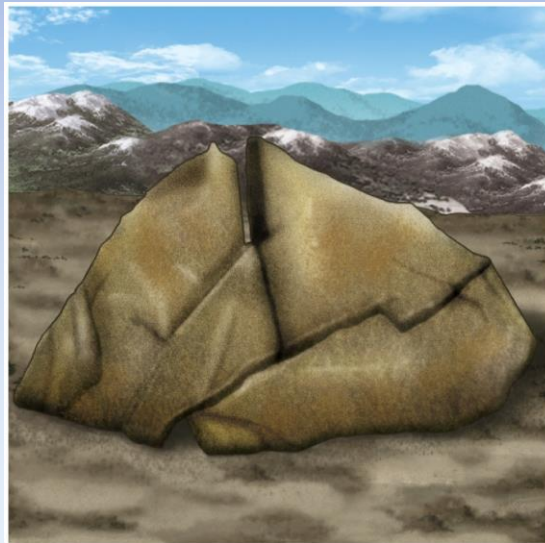
Figure 8.15  
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# The Rock Cycle

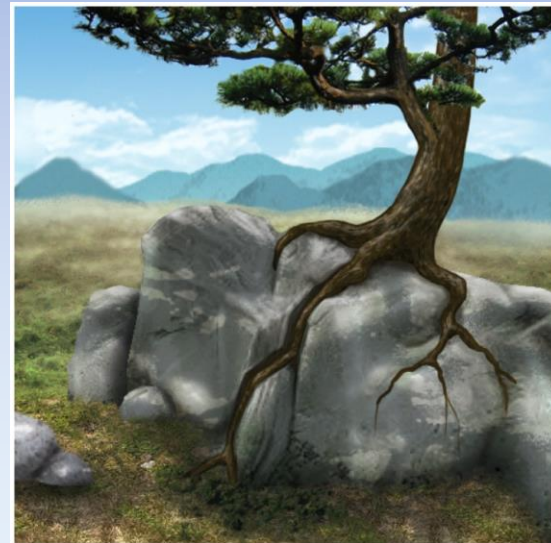
- ▣ Igneous rocks- rocks that form directly from magma.
  - ▣ Intrusive igneous- form from within Earth as magma cools.
  - ▣ Extrusive igneous- form when magma cools above Earth. (ex. A volcano that ejects magma out will form this)
- ▣ Sedimentary rocks- form when sediment such as mud, sands, or gravels are compressed by overlying sediments.
- ▣ Metamorphic rocks- form when sedimentary, igneous or other metamorphic rocks are subjected to high temperatures and pressures.

# Weathering and Erosion

- ▣ Weathering- when rocks are exposed to air, water, certain chemicals or biological agents that degrade the rock.
  - ▣ Physical weathering- the mechanical breakdown of rocks and minerals.



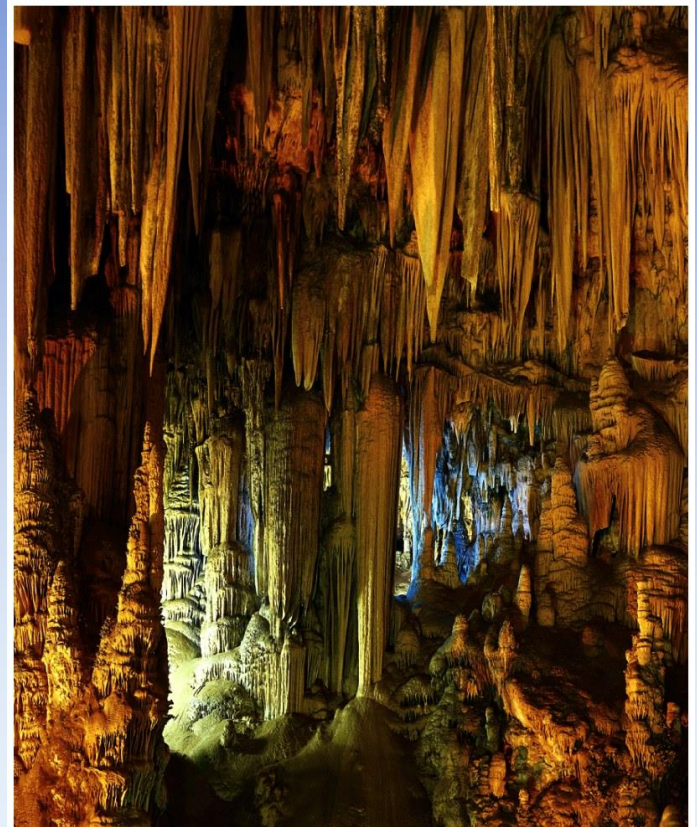
**Figure 8.16a**  
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**Figure 8.16b**  
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# Weathering and Erosion

- ▣ Chemical weathering- the breakdown of rocks and minerals by chemical reactions.



**Figure 8.17**  
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# Erosion

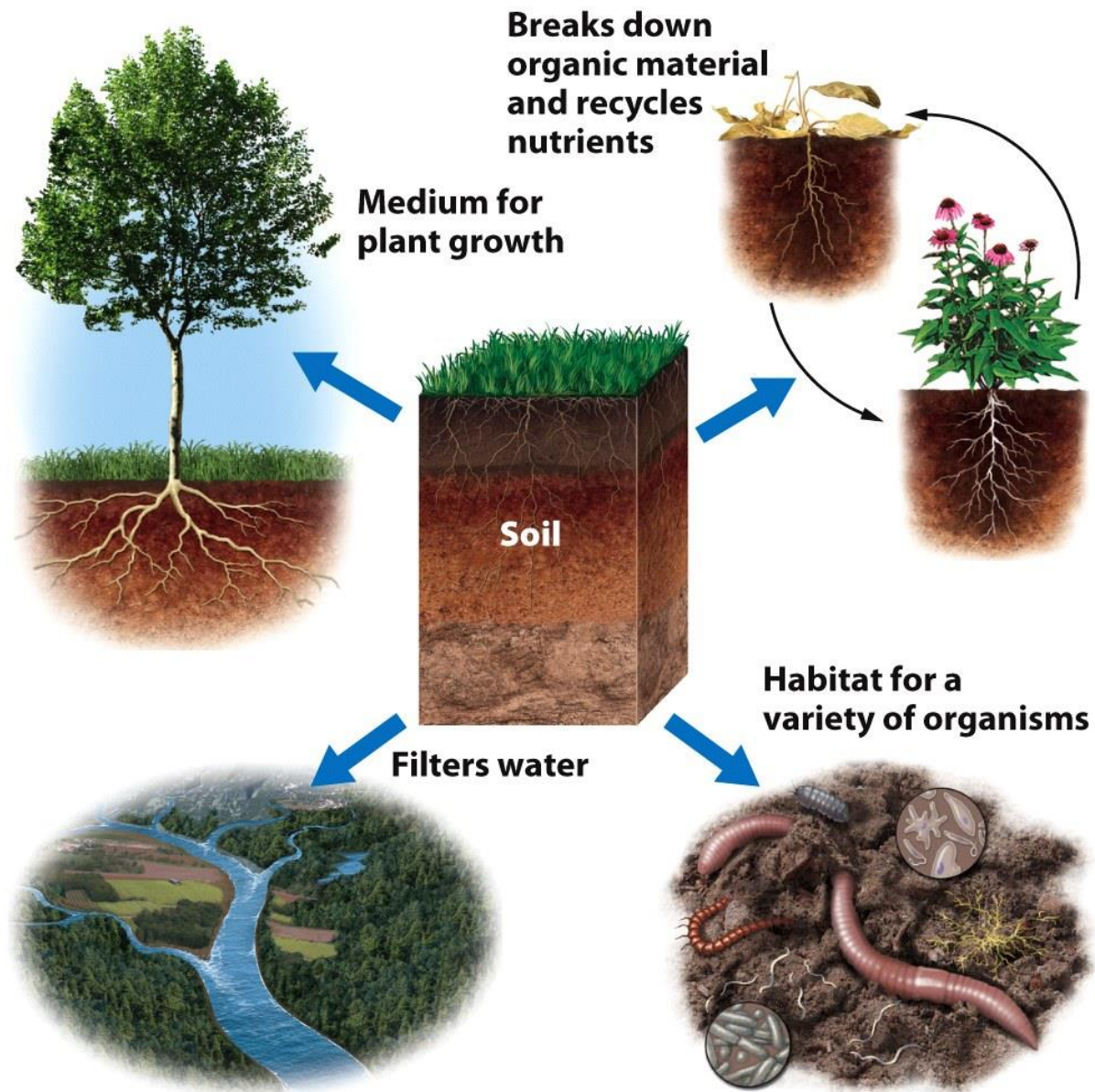
- ▣ Erosion- the physical removal of rock fragments from a landscape or ecosystem. Wind, water, ice transport and living organisms can erode materials.
- ▣ Deposition- the accumulation or depositing of eroded material such as sediment, rock fragments or soil.



Figure 8.18  
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# Soil

- ▣ Soil is important because it
  - ▣ Is a medium for plant growth
  - ▣ Serves as a filter for water
  - ▣ A habitat for living organisms
  - ▣ Serves as a filter for pollutants



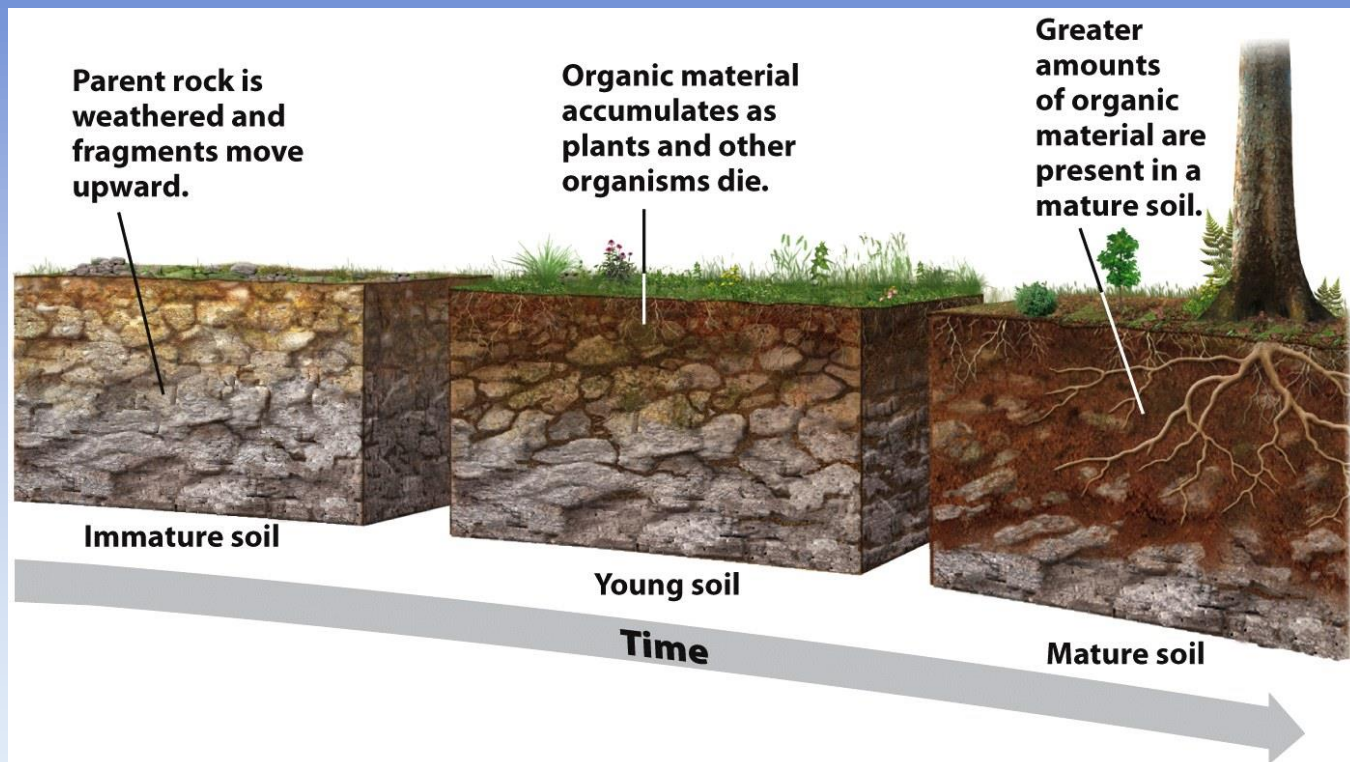
**Figure 8.19**  
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# The Formation of Soil

- ▣ Factors that determine the formation of soil:
  - ▣ Parent material- what the soil is made from influences soil formation
  - ▣ Climate- what type of climate influences soil formation
  - ▣ Topography- the surface and slope can influence soil formation
  - ▣ Organisms- plants and animals can have an effect on soil formation
  - ▣ Time- the amount of time a soil has spent developing can determine soil properties.

# The Formation of Soil

- ▣ Parent Material- the rock material from which soil is derived.



**Figure 8.20**  
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# Soil Horizons

- As soils form, they develop characteristics layers.

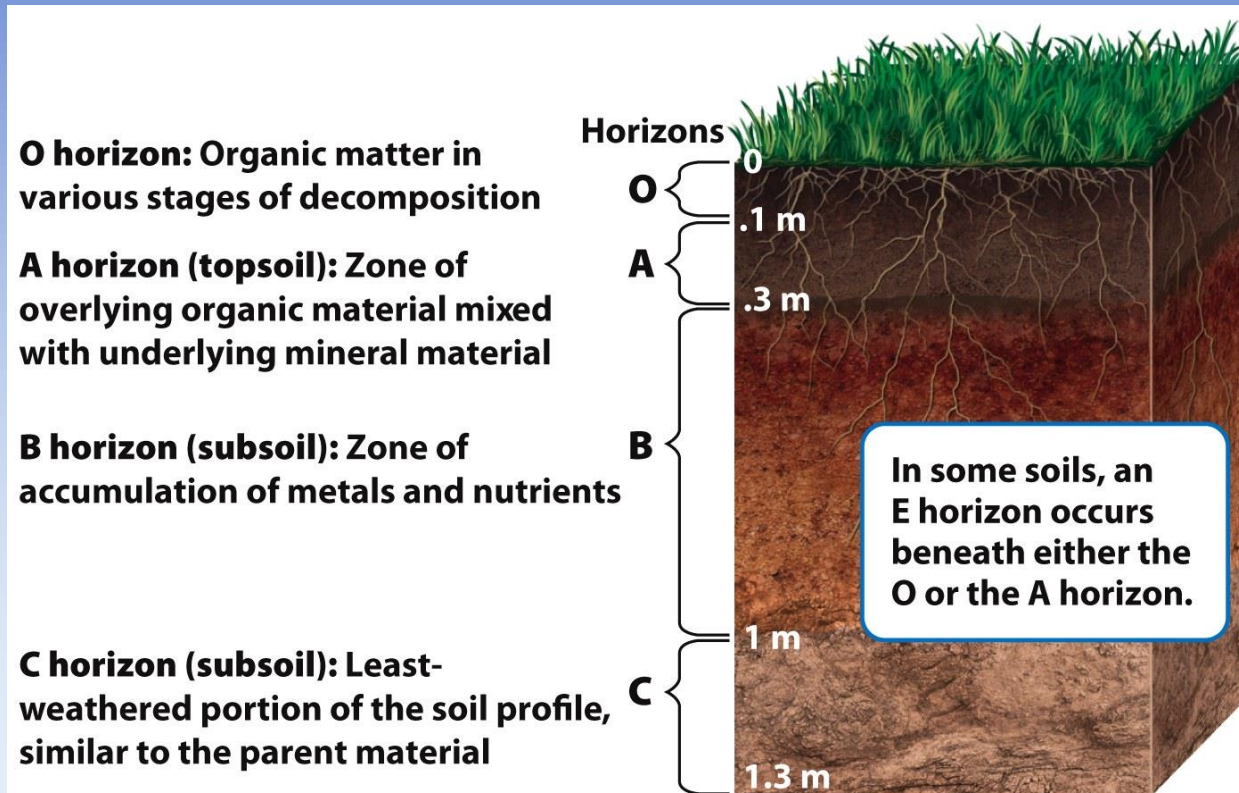


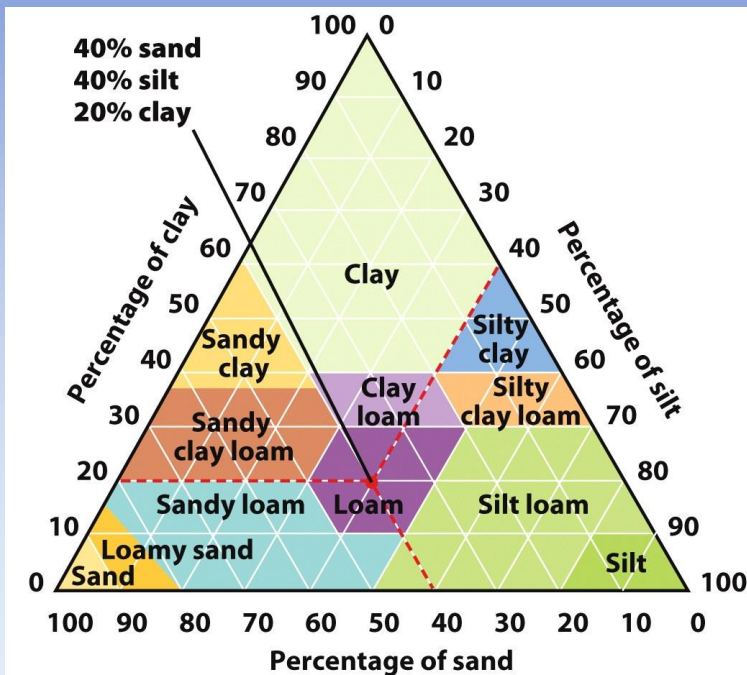
Figure 8.21  
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# Soil Horizons

- ▣ O horizon- (organic layer) composed of the leaves, needles, twigs and animal bodies on the surface.
- ▣ A horizon- (topsoil) the zone of organic material and minerals mixed together.
- ▣ B horizon- (subsoil) composed primarily of mineral material with very little organic matter
- ▣ C horizon- (parent material) the least weathered horizon and is similar to the parent material.

# Physical Properties of Soil

- Texture- the percentage of sand, silt and clay the soil contains.



Soil texture chart

Figure 8.22a  
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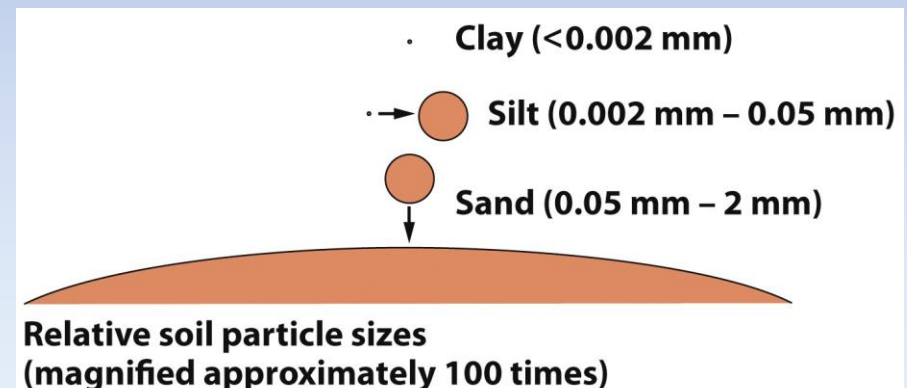
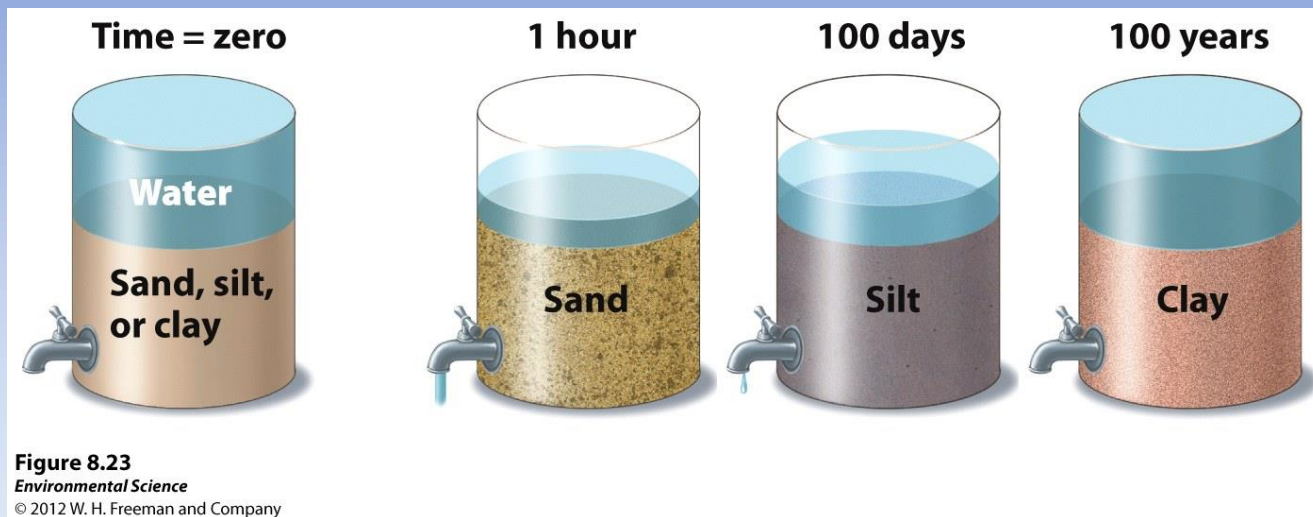


Figure 8.22b  
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# Physical Properties of Soil

- ▣ Porosity- how quickly the soil drains (which depends on its texture)



# Chemical Properties of Soil

Cation exchange capacity- the ability of a soil to adsorb and release cations, positively charged mineral ions.

Soil bases- calcium, magnesium, potassium and sodium

Soil Acids- aluminum and hydrogen

Base saturation- the proportion of soil bases to soil acids

# Biological Properties of Soil

- Many organisms are found in the soil including fungi, bacteria, protozoans, rodents and earthworms.

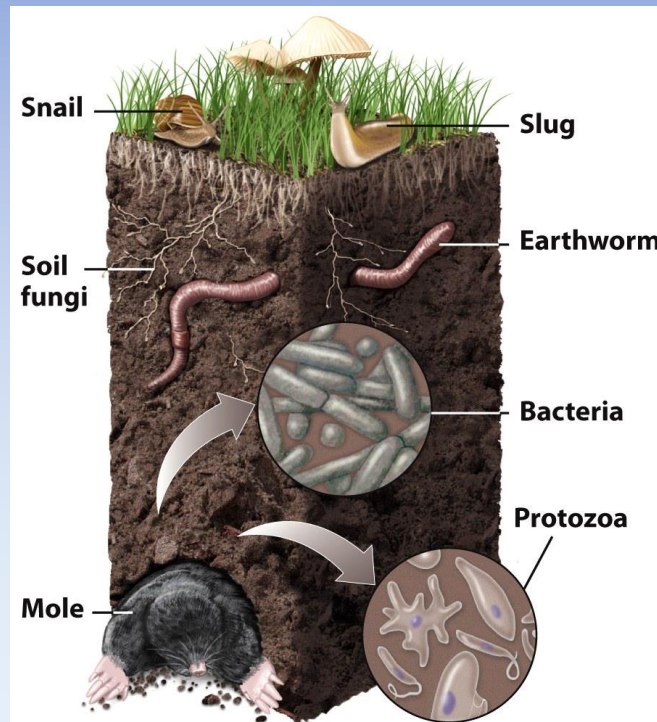
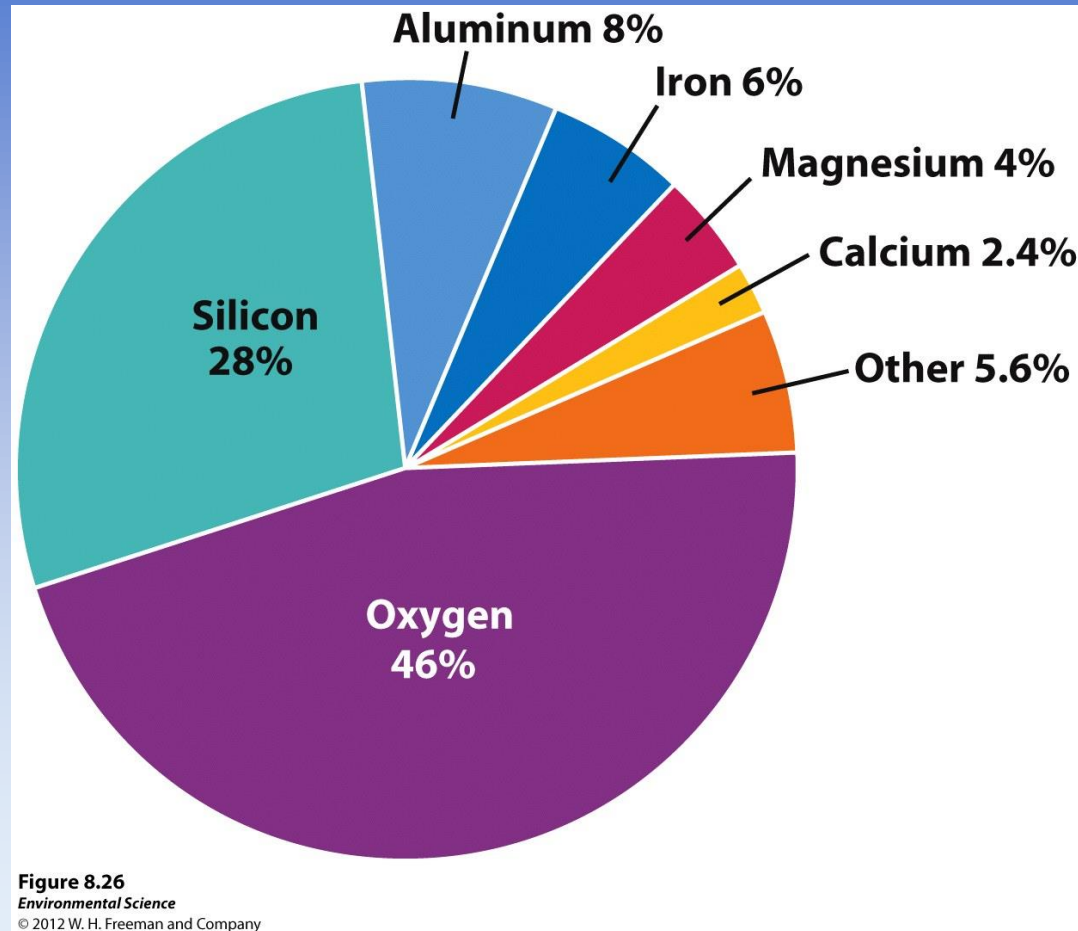


Figure 8.24  
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# Elemental Composition of the Earth's Crust



# Reserves

- Reserves- the known quantity of a resource that can be economically recovered.

<b>TABLE 8.1   Approximate supplies of metal reserves remaining</b>		
<b>Metal</b>	<b>Global reserves remaining (years)</b>	<b>U.S. reserves remaining (years)</b>
Iron (Fe)	120	40
Aluminum (Al)	330	2
Copper (Cu)	65	40
Lead (Pb)	20	40
Zinc (Zn)	30	25
Gold (Au)	30	20
Nickel (Ni)	75	0
Cobalt (Co)	50	0
Manganese (Mn)	70	0
Chromium (Cr)	75	0

*Sources:* S. Marshak, *Earth: Portrait of a Planet*, 3rd ed. (W. W. Norton, 2007); U.S. Geological Survey Mineral Commodity Summaries, <http://minerals.er.usgs.gov/minerals/pubs/mcs/>.

**Table 8.1**  
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# Types of Mining

- ▣ Surface mining- removing minerals that are close to Earth's surface.
  - ▣ Strip mining- removing strips of soil and rock to expose ore.
  - ▣ Open pit mining- the creation of a large pit or hole in the ground that is visible from the surface.
  - ▣ Mountain top removal- removing the entire top of a mountain with explosives.
  - ▣ Placer mining- looking for metals and stones in river sediments.

# Types of Mining

- ▣ Subsurface mining- mining for resources that are 100 m below Earth's surface.

<b>TABLE 8.2    Types of mining operations and their effects</b>					
<b>Type of mining operation</b>	<b>Effects on air</b>	<b>Effects on water</b>	<b>Effects on soil</b>	<b>Effects on biodiversity</b>	<b>Effects on humans</b>
<b>Surface mining</b>	Significant dust from earth-moving equipment	Contamination of water that percolates through tailings	Most soil removed from site; may be replaced if reclamation occurs	Habitat alteration and destruction over the surface areas that are mined	Minimal in the mining process, but air quality and water quality can be adversely affected near the mining operation
<b>Subsurface mining</b>	Minimal dust at the site, but emissions from fossil fuels used to power mining equipment can be significant	Acid mine drainage as well as contamination of water that percolates through tailings		Road construction to mines fragments habitat	Occupational hazards in mine; possibility of death or chronic respiratory diseases such as black lung disease

**Table 8.2**  
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