

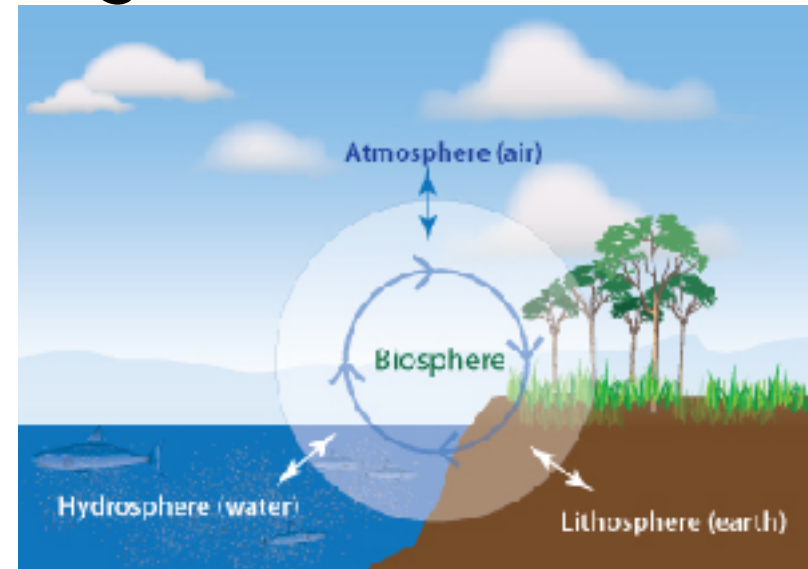
The Earth System

The Earth System

- A **system** - a group of parts that work together as a whole

The Earth system has **4 main spheres**:

- Atmosphere (air, ozone)
 - hydrosphere, (water)
 - geosphere, (land) - Lithosphere
 - and the biosphere (living)
- **Energy** - the ability to do work
 - As a major source of energy for Earth's processes - the SUN can be considered part of the Earth's system as well.



Atmosphere

OUTERMOST LAYER Mixture of gases (Nitrogen and Oxygen) and particles

Gases move freely transporting matter AND energy among the other systems

Hydrosphere

Contains ALL the water
oceans, glaciers, lakes, ice sheets, ponds, rivers &
UNDERGROUND

Water VAPOR (GAS) IN Atmosphere
Universal Solvent (Dissolver) - carries particles
Weathering/Erosion

Geosphere

LARGEST system

Thin layer of soil and rocks

Mainly solid

Slowest moving

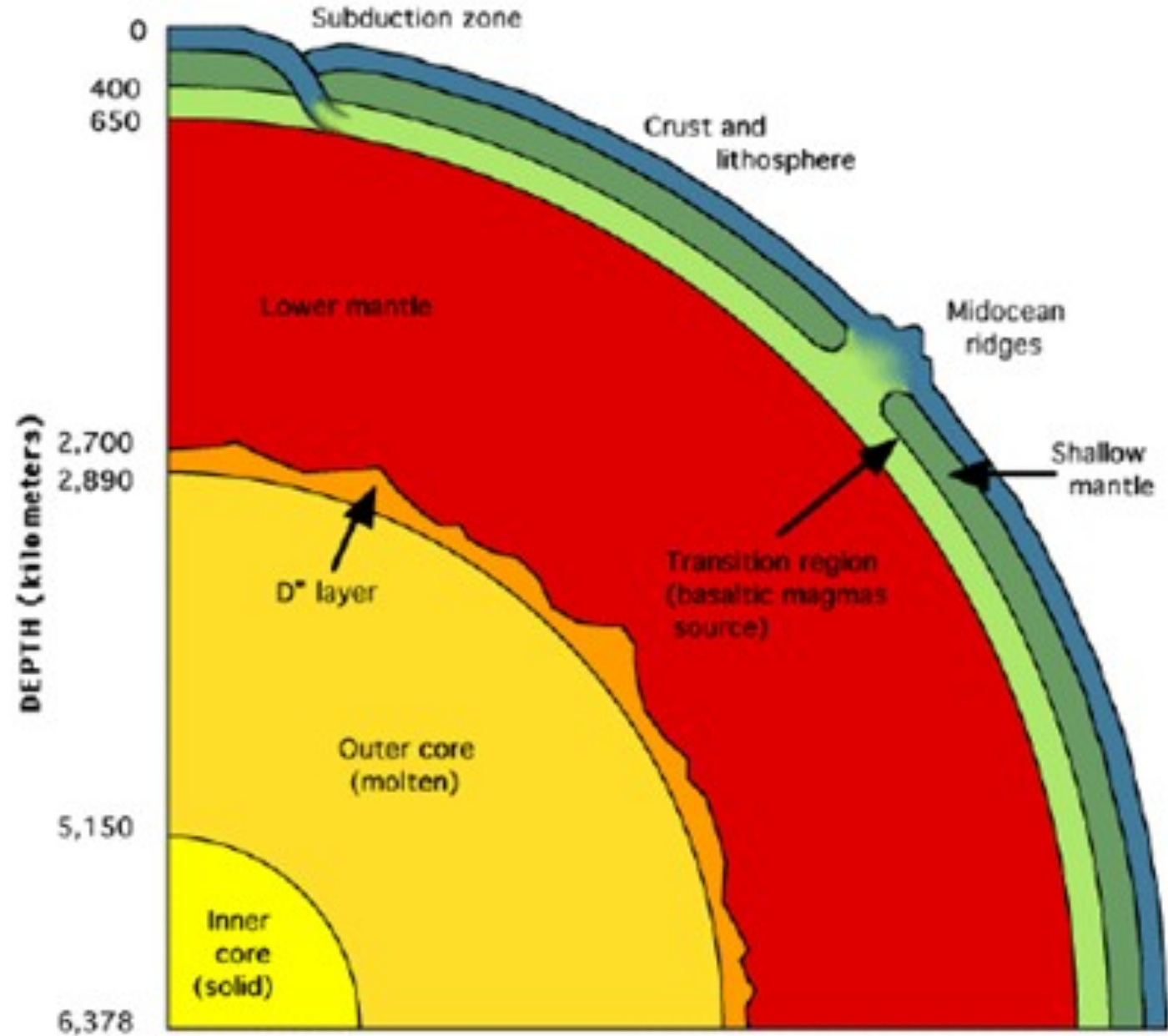
Earth's Interior

Crust - solid (the ground we walk on)

Mantle - liquid magma

Outer Core - molten iron and nickel

Inner Core - solid iron and nickel



Biosphere

All living things

Use gases from the atmosphere

Water from the hydrosphere

Nutrients found in soil and rocks

Interactions Among Earth Systems

	Biosphere	Geosphere	Hydrosphere
Atmosphere	• The ozone layer helps protect organisms from harmful solar radiation. • Plants use carbon dioxide during photosynthesis.	• Wind causes weathering and erosion. • Volcanic eruptions eject gas and debris into the air.	• The water cycle influences weather and climate. • Increasing global temperatures lead to melting polar ice caps.
Hydrosphere	• All organisms need water for life functions. • Rising sea levels change habitats.	• Water and ice cause weathering, erosion, and deposition. • Hurricanes and tsunamis change coastal landforms.	
Geosphere	• Materials in the geosphere provide nutrients for life functions. • Organisms contribute to weathering, erosion, and fossil fuel formation.		



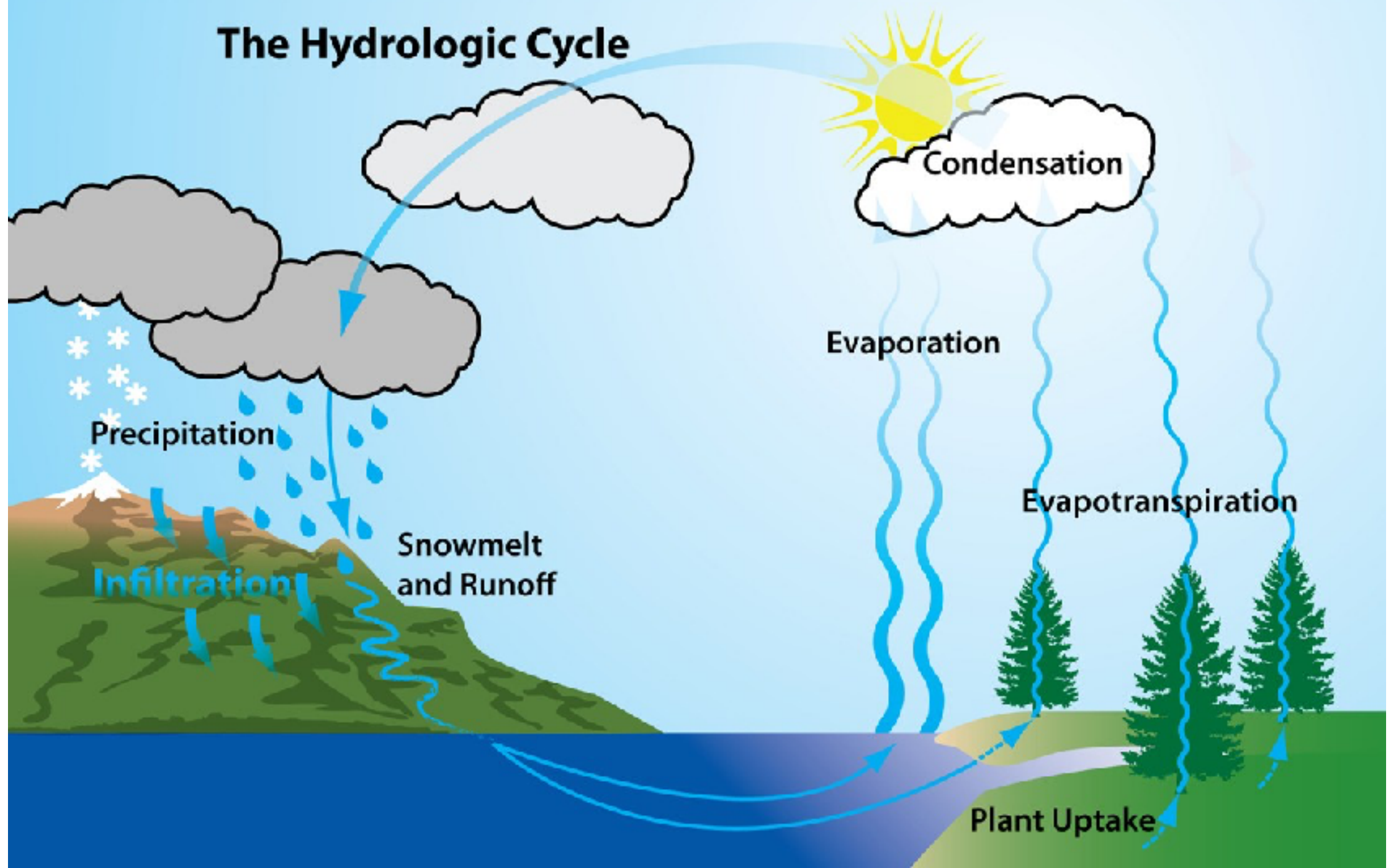
Get Animated



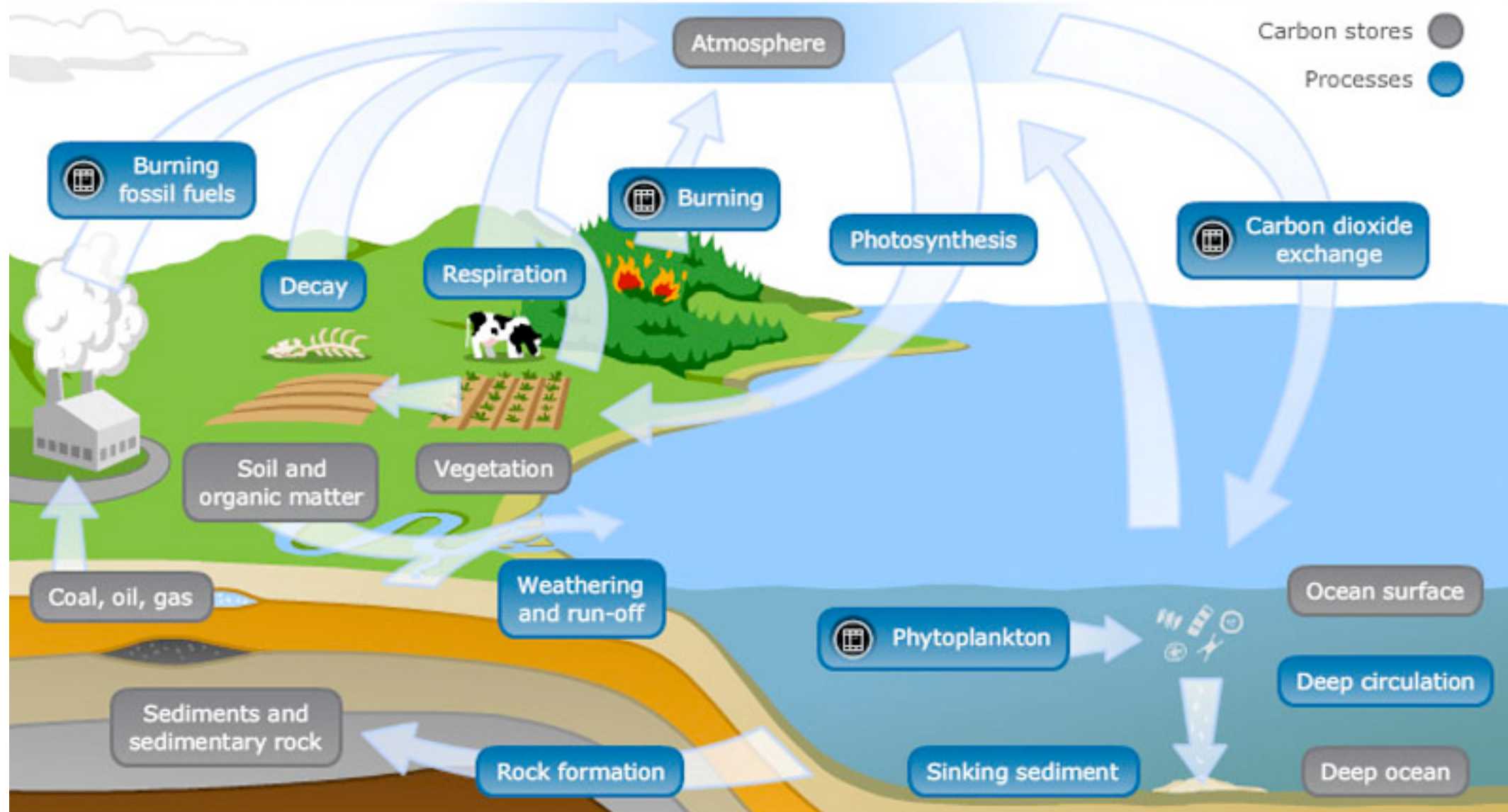
Get Connected



The Hydrologic Cycle



CARBON CYCLE



As carbon moves through Earth systems, the total amount of carbon in the carbon cycle remains about the same.

Carbon is in reservoirs, or storage places, within all Earth systems.

Carbon Reservoirs

Carbon Reservoirs	Carbon (billions of tons)	Form
Atmosphere	750	CO ₂ gas
Biosphere	3,000	organic molecules
Hydrosphere	40,000	dissolved CO ₂ gas
Geosphere (crust and upper mantle)	750,000	minerals and rocks
Geosphere (lower mantle)	750,000 +	minerals and rocks



Get Animated

Carbon is stored in each sphere
usually combined with other elements

BIO - living things

ATM - Smallest reserve CO₂ Gas

HYDRO - CO₂ dissolved

GEO - MOST rocks, fossil fuels

Humans and Carbon

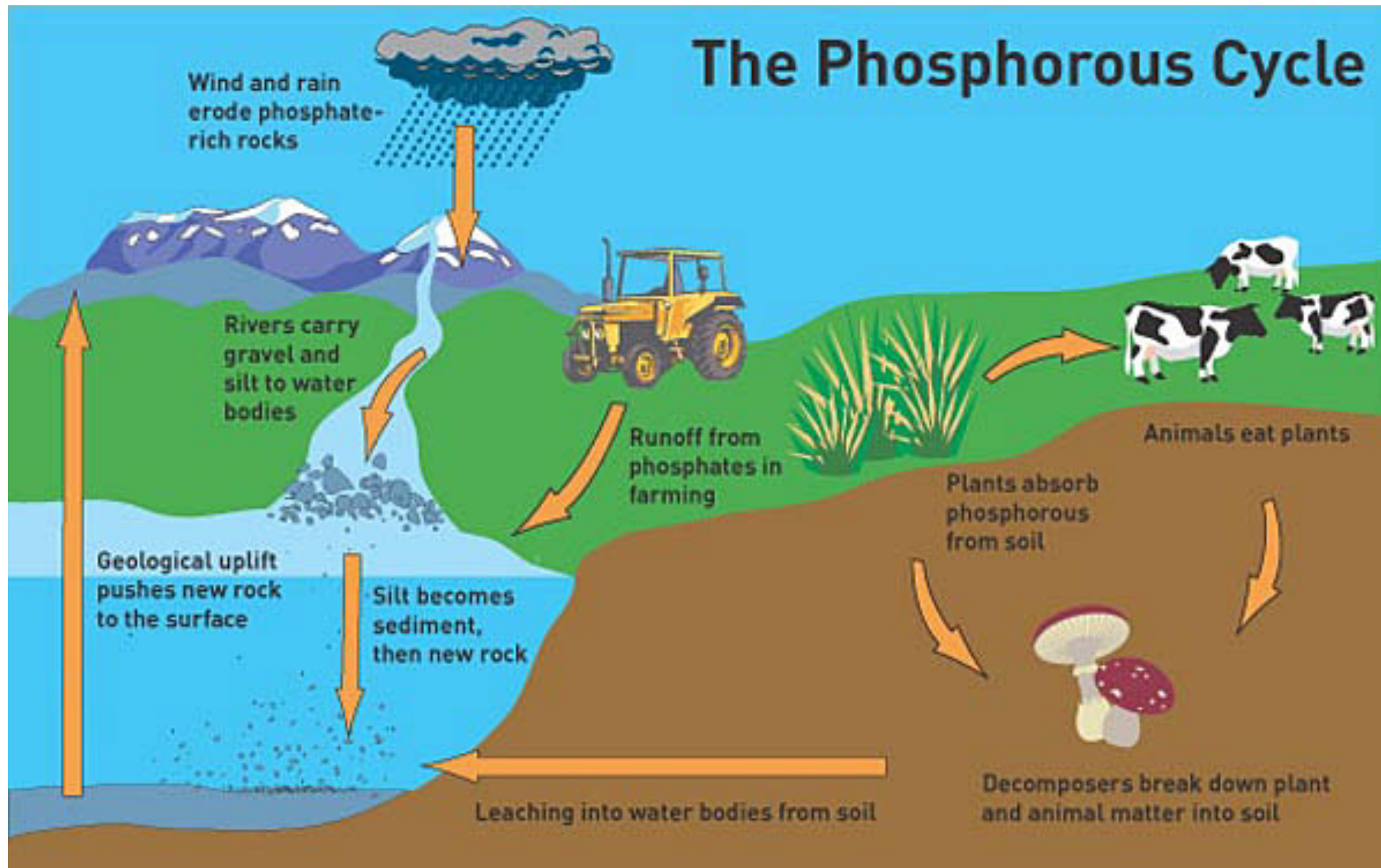
Burning fossil fuels releases CO₂ directly into the atmosphere

Cutting down trees reduces photosynthesis, leaving MORE CO₂ in the ATM

CO₂ is a GREENHOUSE gas - absorb and reradiate thermal energy

- increasing global temperature = climate change -
altering habitats and raising sea level

The Phosphorous Cycle



Phosphorus

DOES NOT exist in the ATMOSPHERE

Originates in the Geosphere as PO_4

They dissolve and enter the hydrosphere and then the soil
Absorbed by plants, eaten by animals, returned to soil in waste/
decomposition

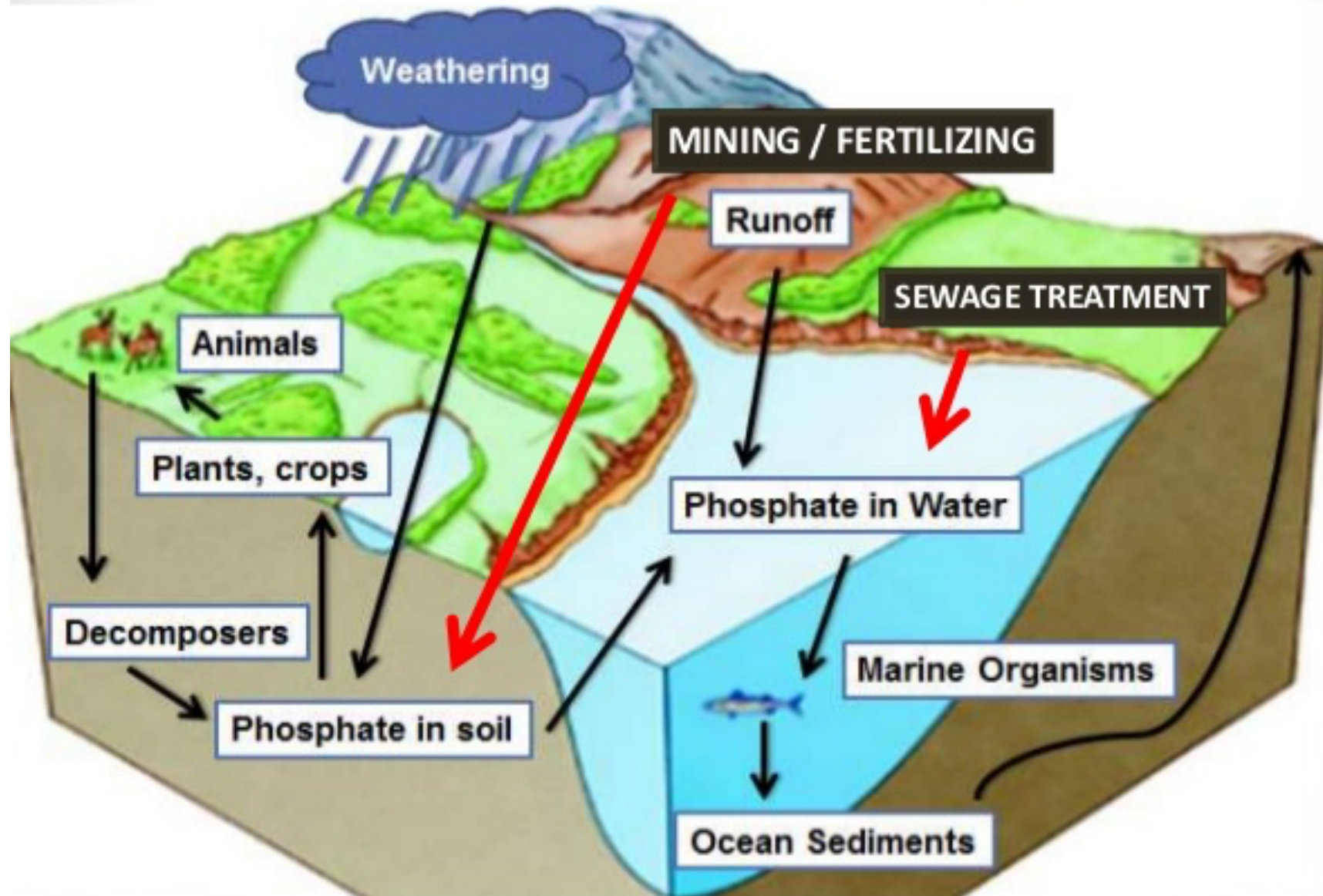
Reservoirs - ROCKS, Hydrosphere

Cycling takes a LONG time

Sedimentary rocks at the bottom of the ocean could hold it for millions of
years

In BIOSPHERE - cycling is quick - cell membranes, teeth, bones

How we intervene with the cycle?



Forces that Change Earth

- **Constructive Forces**: shape the surface of the Earth by building up mountains and other landmasses
 - Plate Tectonics (earthquakes and volcanoes)
 - Deposition (moving rocks/soil to new places)
- **Destructive Forces**: shape the surface of Earth by destroying or wearing away landmasses through erosion and weathering.
 - Weathering (wearing down surfaces due to rain or wind)
 - Erosion (removing rocks/soil from an area)



Heat Transfer

- Three types of heat transfer:
- **Radiation** (heat transfer carried in waves, like rays of light from the sun)
- **Conduction** (heat transfer by direct contact between surfaces)
- **Convection** (heat transfer by movement through a fluid like a gas or liquid)

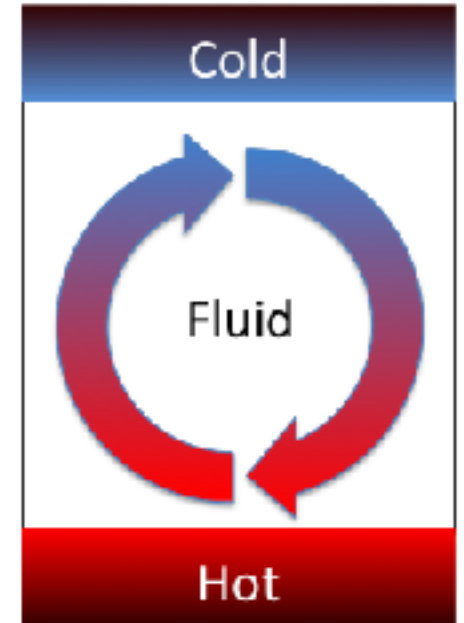


Conductors vs. Insulators

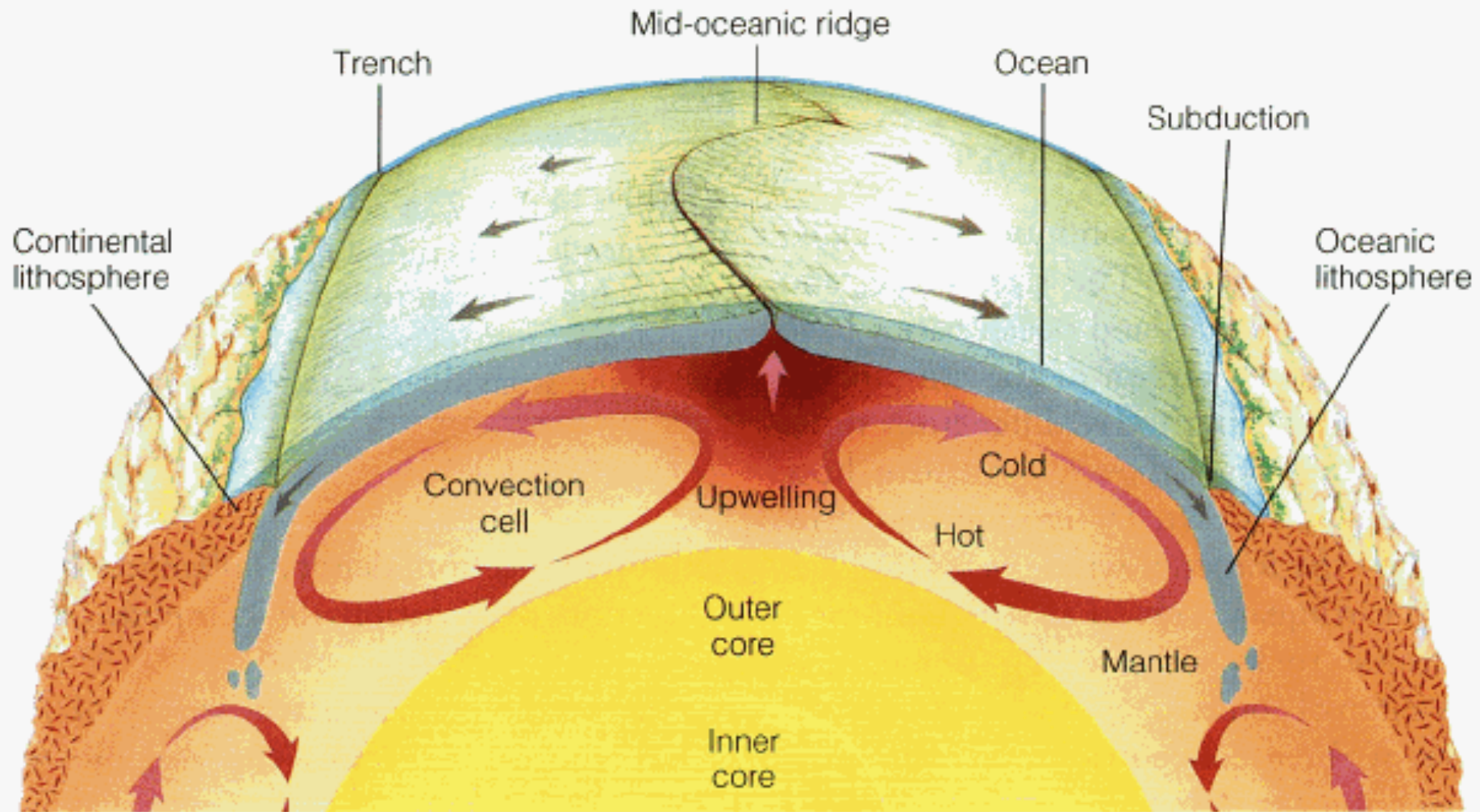
- Conductors allow thermal energy to flow easily
 - Metals - Low specific heat -takes less energy to heat it up
 - (Specific Heat -amount of thermal energy required to increase the temperature of 1kg of a material 1degree C)
 - Water has a HIGH specific heat: takes 99 degrees of C
- Insulators do not allow an easy flow of thermal energy
 - Cloth - blankets

Convection Currents

- Heating and cooling of a fluid, changes the fluid's density, and the force of gravity combine to set convection currents in motion.
- **Density** - the measure of how much mass is in a given volume of a substance
- On Earth:
 - **Heat from the core and the mantle itself cause convection currents in the mantle**



Convection in the Mantle = Moves Tectonic plates!



Structure of the Geosphere

Knowledge gained by studying earthquake wave speed and direction

Crust - thin outer layer - brittle

Continental - thickest (40km average, under mountains 70km) Made of all three types of rocks: Igneous, Sedimentary and Metamorphic, Silicon and Oxygen (less dense than Iron and Magnesium)

Oceanic - 7km thick - dense igneous rocks (Iron and Magnesium)

Mantle - Rocky middle layer - Upper layer - lithosphere, lower layer - Asthenosphere - partially melted

Core - Outer = liquid = produces the magnetic field

Inner = Solid metal - pressure

Classifying Rocks

- To study rock samples, geologists observe the rock's mineral composition, color and texture.
- About 20 minerals make up most of the rocks on Earth's crust
- Texture is the look or feel of the rock
 - Rock forming minerals can be easily seen in rocks such as granite, but not easily seen in rocks such as basalt or slate.
 - Texture varies from rock to rock depending on grain size



Properties of Minerals

Luster - the way a mineral reflects light

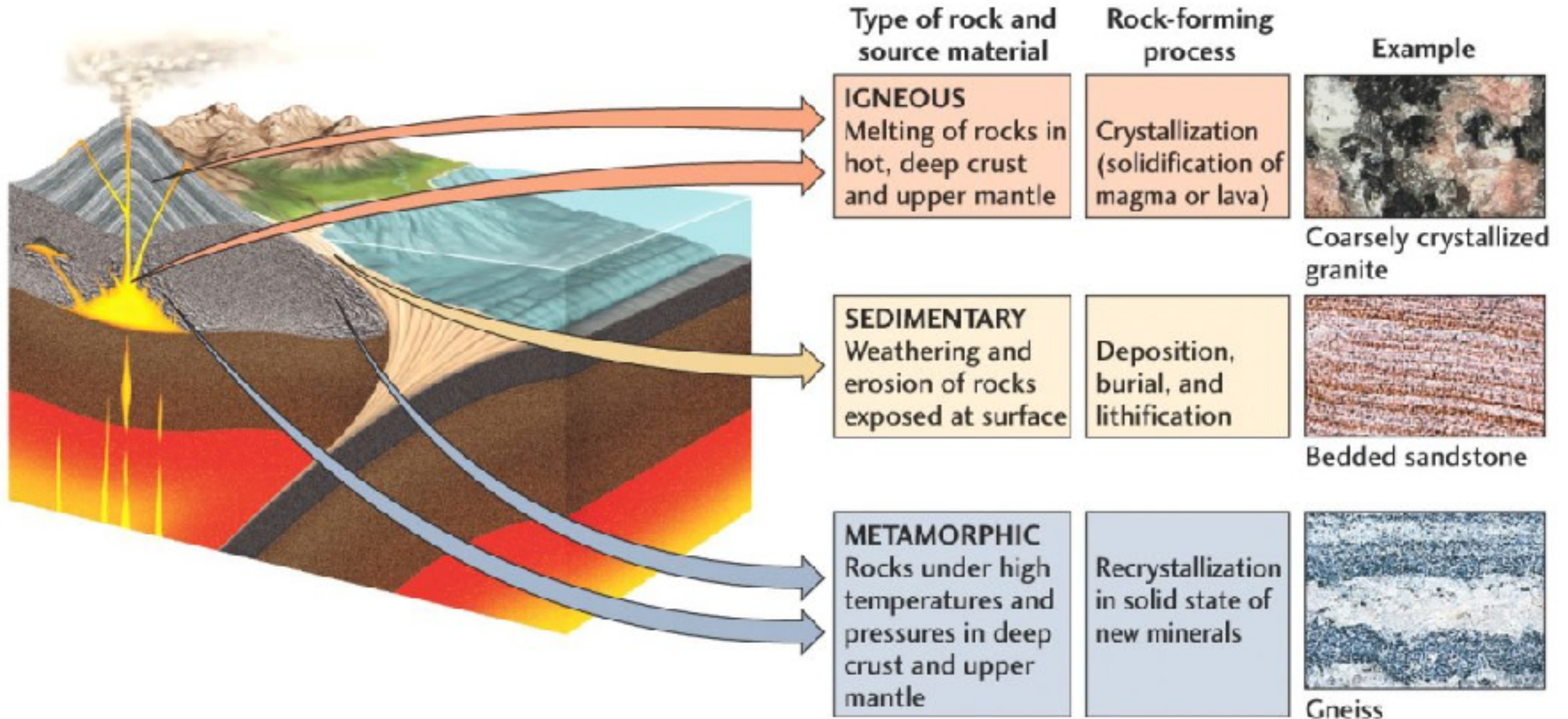
Streak - color of a mineral's powder

Cleavage - tendency to break along smooth flat surfaces

Fracture - tendency to break along an irregular surface

Hardness - Moh's Scale - relative hardness compared to other rocks

3 Major Rock Groups



The Rock Cycle

- Forces deep within Earth and at the surface produce a slow cycle that builds, destroys and changes the rocks in the crust.

