Earth Systems and Resources

AP Environmental Science

Plate Tectonics

Earth's crust is broken into **plates** that slowly move on the mantle – **plate tectonics**. At **divergent** boundaries plates spread apart (new crust); at **convergent** they collide (mountains, volcanoes, earthquakes); at **transform** they slide past (earthquakes). Boundaries create hazards but also volcanic soils and mineral resources.

A volcano erupting at a plate boundary in Iceland. Molten rock rising between spreading plates builds new crust

Soil Formation and Erosion

Soil forms slowly as rock **weathers** and organic matter builds up. **Erosion** is the removal of soil by wind and water, sped up by removing vegetation (farming, deforestation, overgrazing). Because soil forms so slowly, erosion faster than formation depletes a vital resource.

Soil horizons form over time as parent rock weathers; erosion can strip topsoil and reverse that progress

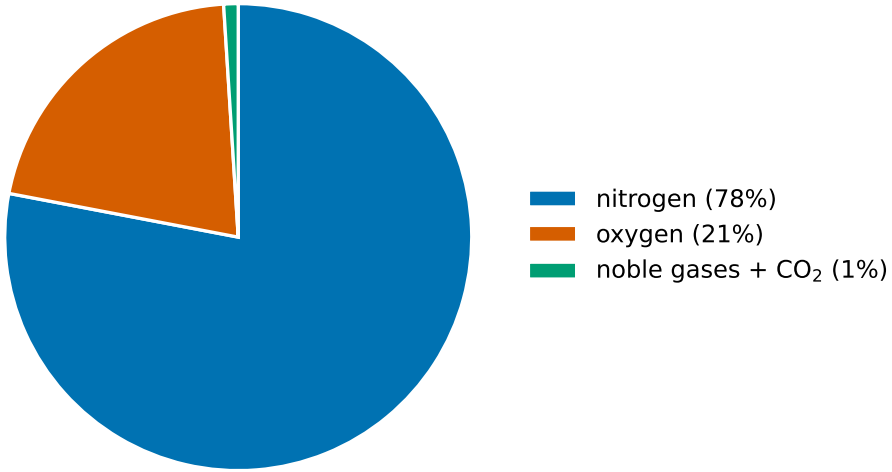
Soil Composition and Properties

Soil is a mix of sand, silt, and clay (its **texture**), plus organic matter, water, and air, layered in **horizons**. Texture controls **porosity** and **permeability** – how well soil holds water and nutrients. **Loam** (a balanced mix) is best for plants.

A pit dug through soil shows its horizons: dark organic topsoil on top, then paler mineral layers, over broken rock (tape for scale)

Earth's Atmosphere

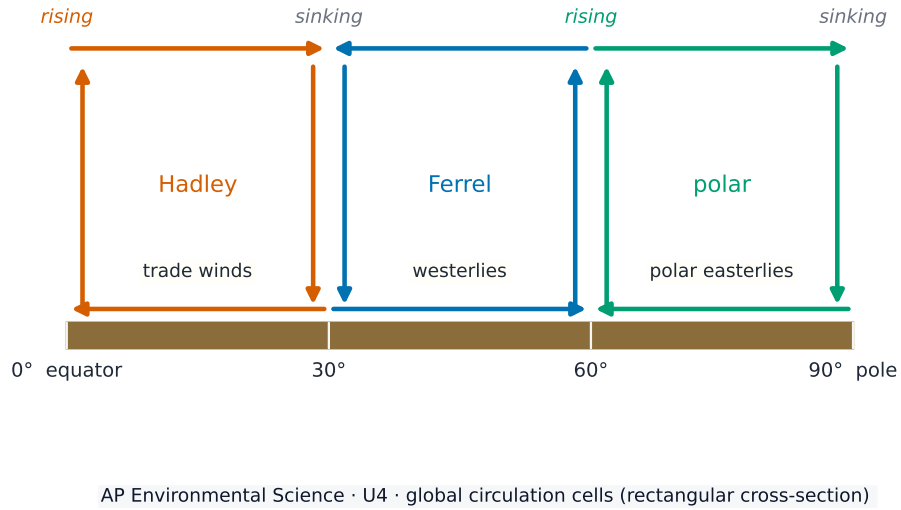
The **atmosphere** is layered: the **troposphere** (weather, where we live), the **stratosphere** (holding the ozone layer), and higher layers. It is mostly nitrogen and oxygen, with trace gases (including greenhouse gases) that regulate temperature.



Clean dry air is about 78% nitrogen, 21% oxygen, and 1% other gases

Global Wind Patterns

Uneven solar heating drives **global wind patterns**. Warm air rises at the equator and sinks at about 30°, creating **convection cells** (Hadley, Ferrel, polar) and prevailing winds (trade winds, westerlies). The spinning Earth deflects winds – the **Coriolis effect** – shaping weather and climate.



Three circulation cells per hemisphere set the prevailing surface winds

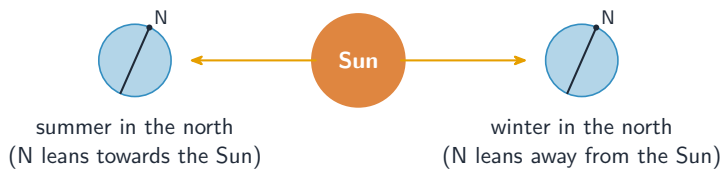
Watersheds

A **watershed** is all the land that drains to a common body of water. Everything that happens on the land – farming, paving, pollution – affects the water it drains into, so watersheds are key units for managing water quality.

A waterfall in a river basin: a watershed is the land that drains into a stream or lake

Solar Radiation and Earth's Seasons

Seasons come from Earth's **tilted axis** (about 23.5°), not its distance from the Sun. The hemisphere tilted toward the Sun gets more direct sunlight and longer days (summer). The tilt also makes the **tropics** warm year-round and the **poles** cold.



The tilt of the Earth's axis causes the seasons

Earth's Geography and Climate

Geography shapes climate: **latitude** (sunlight angle), **elevation** (cooler with height), proximity to **oceans** (moderating temperature), and mountains creating a **rain shadow** (wet windward side, dry leeward side). These factors decide which biome forms where.

Desert dunes: latitude, altitude and ocean currents shape Earth's climate regions

El Nino and La Nina

El Niño and **La Niña** are periodic shifts in Pacific Ocean temperatures and winds. El Niño (warm eastern Pacific) and La Niña (cool eastern Pacific) alter rainfall, storms, and fisheries **worldwide** – for example, floods in some regions and droughts in others.

> **Worked example.** A tectonic plate moves 5 cm per year. How far does it travel in 1 million years? $5\ \text{cm/yr} \times 10^6\ \text{yr} = 5 \times 10^6\ \text{cm} = 50\ \text{km}$. A tiny yearly motion adds up to ocean-basin-scale distances over geologic time – the same slow rate that opens oceans and builds mountain ranges.

Exam tips

- **Seasons come from the Earth's tilt**, not its distance from the Sun.
- Soil forms very slowly, so **erosion faster than formation** permanently depletes it; know soil texture (sand/silt/clay) and horizons.
- Explain global wind patterns from uneven heating + the **Coriolis effect**, and a **rain shadow** (wet windward, dry leeward).
- Name the atmospheric layers (troposphere = weather, stratosphere = ozone) and air composition (~78% N_2, 21% O_2).
- **El Niño / La Niña** are Pacific temperature shifts that change rainfall worldwide.