

Earth Systems and Resources

AP Environmental Science

Plate Tectonics

Earth's crust is broken into **plates** 板块 that slowly move on the mantle – **plate tectonics** 板块构造. 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 土壤 forms slowly as rock **weathers** 风化 and organic matter builds up. **Erosion** 侵蚀 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

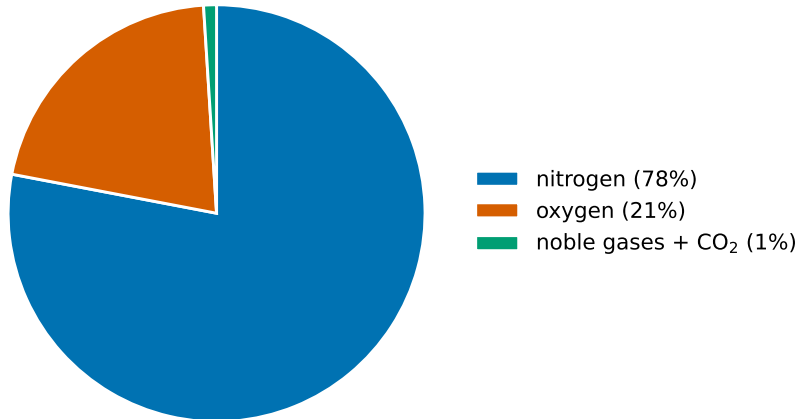
Soil is a mix of sand, silt, and clay (its **texture** 质地), plus organic matter, water, and air, layered in **horizons** 土层. Texture controls **porosity** 孔隙度 and **permeability** 渗透性 – how well soil holds water and nutrients. **Loam** (a balanced mix) is best for plants.



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

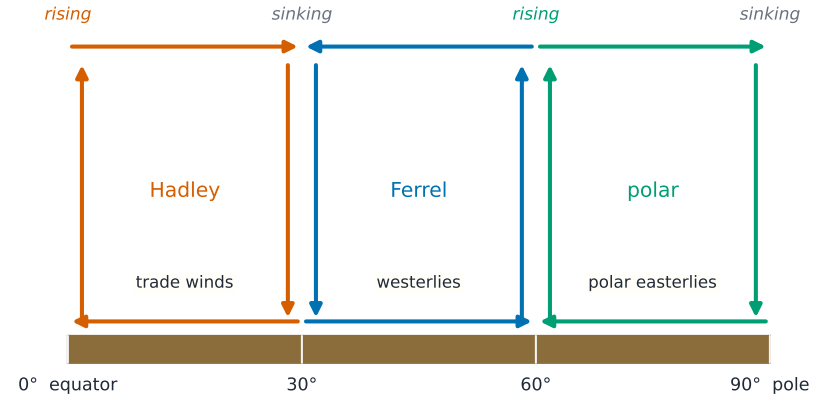
The **atmosphere** 大气层 is layered: the **troposphere** 对流层 (weather, where we live), the **stratosphere** 平流层 (holding the ozone layer), and higher layers. It is mostly nitrogen and oxygen, with trace gases (including greenhouse gases) that regulate temperature.



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

Global Wind Patterns

Uneven solar heating drives **global wind patterns** 全球风带. Warm air rises at the equator and sinks at about 30°, creating **convection cells** 对流环流 (Hadley, Ferrel, polar) and prevailing winds (trade winds, westerlies). The spinning Earth deflects winds – the **Coriolis effect** 科里奥利效应 – shaping weather and climate.



AP Environmental Science · U4 · global circulation cells (rectangular cross-section)

Three circulation cells per hemisphere set the prevailing surface winds

Watersheds

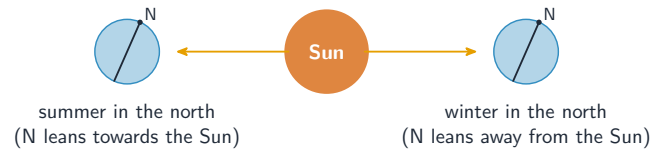
A **watershed** 流域 is all the land that drains to a common body of water. Everything that happens on the land – farming, paving, pollution – affects the water it drains into, so watersheds are key units for managing water quality.



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** 雨影 (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 Niño and La Niña

El Niño 厄尔尼诺 and **La Niña** 拉尼娜 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 ($\sim 78\% \text{ N}_2$, $21\% \text{ O}_2$).
- **El Niño / La Niña** are Pacific temperature shifts that change rainfall worldwide.