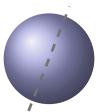
Earth Systems and Resources

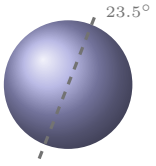
AP Environmental Science ▪ Unit 4

AP Environmental Science



What we will cover

1. Plate tectonics
2. Soil
3. The atmosphere
4. Global wind patterns
5. Seasons and radiation
6. Climate and El Niño



1 Plate tectonics

Plate tectonics

Plates 板块 drift on the mantle: divergent, convergent, transform.

> Boundaries build earthquakes, volcanoes, mountains; hot spots make island chains.



Volcanoes mark plate boundaries and hot spots

2 Soil

Soil

Soil forms slowly from weathering + decomposition, in horizons (O, A, B, C).

> Erosion strips topsoil first; vegetation roots hold it in place.



Soil horizons: litter to parent rock

What soil is made of, and why it matters

texture 质地	the mix of sand, silt and clay – coarse to fine
horizons 土层	the layers soil builds as it ages: O (litter), A (topsoil), B (subsoil), C (weathered rock)
porosity 孔隙度	how much pore space the soil holds – how much water it can *store*
permeability 渗透性	how fast water moves *through* it – sandy soil drains fast, clay holds water

Soil also holds organic matter, water and air. Texture sets porosity and permeability, and those two set what will grow.

3 Atmosphere

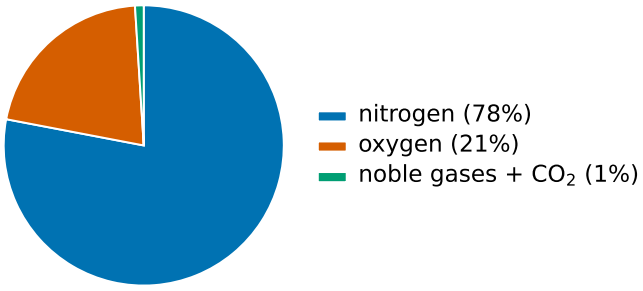
The atmosphere

The **atmosphere** 大气层 is $\sim 78\%$ N_2, 21% O_2.

- **troposphere** 对流层: weather; cools with height
- **stratosphere** 平流层: holds the **ozone layer** 臭氧层

> Ozone absorbs UV, so temperature rises again in the stratosphere – the shield for land life.

Clean dry air is about 78% nitrogen



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

4 Winds

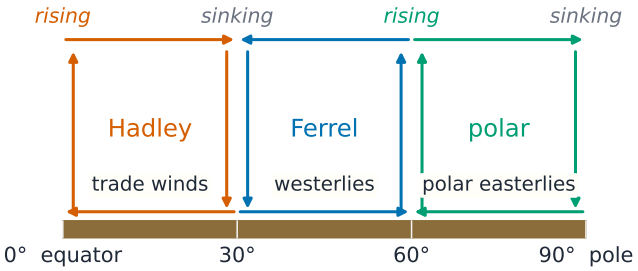
Global wind patterns

Uneven heating 不均匀加热 drives air in giant **convection cells** 对流环流 (3 per hemisphere).

- rise & rain at the **equator** 赤道
- sink & dry at 30° (deserts)

> The **Coriolis effect** 科里奥利效应 bends winds sideways into the **prevailing winds** 盛行风.

Three circulation cells per hemisphere set the rainfall belts



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

Three circulation cells per hemisphere set the prevailing surface winds

5 Watersheds

Watersheds and seasons

A **watershed** 流域 is all the land draining to one river. Slope & vegetation set water quality; upstream land use becomes a downstream problem.

> Axis tilt makes seasons; ray angle sets climate bands.



Watershed: all land draining to one river

A watershed collects everything that happens on it

definition	all the land that drains to one common body of water
why it matters	farming, paving and pollution anywhere on that land end up in the same river or lake
soil formation 成土	rock **weathers** 风化 and organic matter builds up – a process measured in centuries
erosion 侵蚀	wind and water remove soil, sped up sharply by stripping vegetation

> Soil forms far slower than it erodes. That asymmetry is the whole argument for soil conservation.

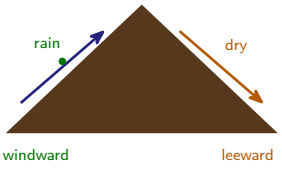
6 Climate

Climate and El Niño

Climate is set by latitude, elevation, and nearness to water.

- a mountain **rain shadow** 雨影: wet windward, dry **leeward** 背风
- **ocean currents** 洋流 move heat poleward

In **El Niño** 厄尔尼诺, weak **trade winds** 信风 stop **upwelling** 上升流 – fisheries collapse.



El Nino and La Nina

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 over geological time

A plate moves 5 cm per year. How far does it travel in 1 million years?

- 5 cm/yr $\times\ 10^6$ yr $= 5 \times 10^6$ cm
- $= 5 \times 10^4$ m $= 50$ km

A rate too small to notice becomes continent-scale over geological time. Convert the units before you interpret the number.

Solar Radiation and Earth's Seasons



summer in the north
(N leans towards the Sun)

winter in the north
(N leans away from the Sun)

The tilt of the Earth's axis causes the seasons

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.

7 Recap

Worked example – a water budget

A region gets $80\ \mathrm{cm}$ of rain a year; $50\ \mathrm{cm}$ evaporates and $10\ \mathrm{cm}$ runs off. How much recharges the groundwater?

- Water in = water out + storage: precipitation = evaporation + runoff + infiltration.
- $80 = 50 + 10 + \text{infiltration}$
- Infiltration $= 80 - 60 = 20\ \mathrm{cm\,yr^{-1}}$
- Paving the region raises runoff and cuts recharge $\Rightarrow$ wells drop and floods worsen.

Every APES budget question is in = out + change in storage. Name where the water goes; impervious surfaces shift it from infiltration to runoff.

Unit 4 – key takeaways

1 Tectonics

divergent, convergent, transform; hot spots

2 Soil & air

O/A/B/C horizons; troposphere then ozone stratosphere

3 Winds

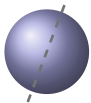
3 convection cells; equator rain, 30° desert; Coriolis

4 Climate

tilt makes seasons; rain shadow; El Niño stops upwelling

Check yourself

1. Which boundary type pulls plates apart?
2. Which soil horizon is the rich, dark topsoil?
3. Why does air sinking at 30° make deserts?
4. What causes Earth's seasons?



Answers **1.** divergent **2.** A horizon **3.** sinking air is dry **4.** the 23.5° axial tilt