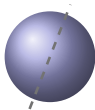


Earth Systems and Resources

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

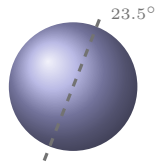




Plate tectonics

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

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



Volcanoes mark plate boundaries and hot spots



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

the mix of **sand, silt and clay** – coarse to fine

horizons

the layers soil builds as it ages: O (litter), A (topsoil), B (subsoil), C (weathered rock)

porosity

how much pore space the soil holds – how much water it can *store*

permeability

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.



The atmosphere

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

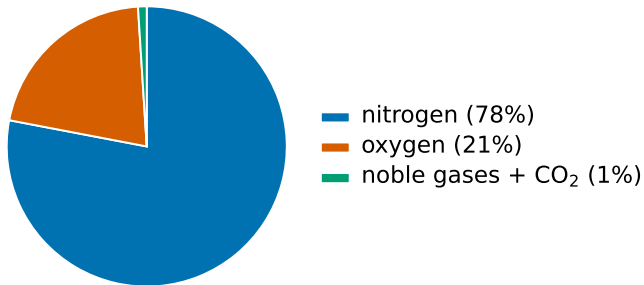
- **troposphere** : weather; cools with height
- **stratosphere** : holds the **ozone layer**

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



Climate desert

Clean dry air is about 78% nitrogen



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



Global wind patterns

Uneven heating drives air in giant **convection cells** (3 per hemisphere).

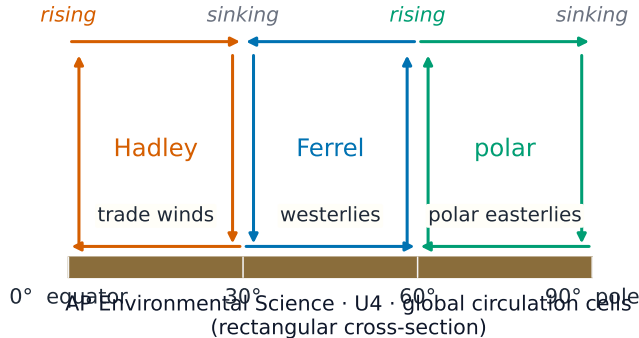
- rise & rain at the **equator**
- sink & dry at 30° (deserts)

The **Coriolis effect** bends winds side-ways into the **prevailing winds** .



Soil formation

Three circulation cells per hemisphere set the rainfall belts



Three circulation cells per hemisphere set the prevailing surface winds



Watersheds and seasons

A **watershed** 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

rock **weathers** and organic matter builds up – a process measured in **centuries**

erosion

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.

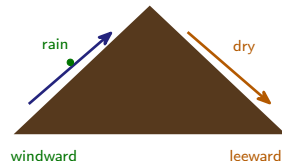


Climate and El Niño

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

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

In **El Niño** , weak **trade winds** stop **upwelling** – fisheries collapse.



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.

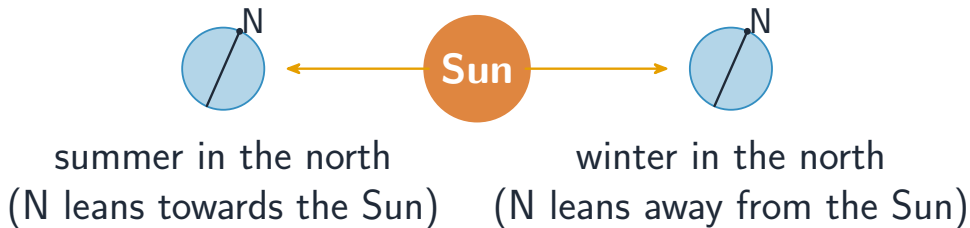
Worked example – a tectonic plate over geological time

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

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

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



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% N₂, 21% O₂).
- **El Niño / La Niña** are Pacific temperature shifts that change rainfall worldwide.



Worked example – a water budget

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

- Water in = water out + storage:
precipitation =
evaporation + runoff + infiltration.
- $80 = 50 + 10 + \text{infiltration}$
- $\text{Infiltration} = 80 - 60 = 20 \text{ cm yr}^{-1}$
- 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

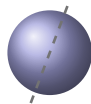
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Climate

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