

Ecosystems

AP Environmental Science • Unit 1

AP Environmental Science



Ecosystems

What we will cover

- 1 Ecosystems and niches
- 2 Biomes
- 3 Biogeochemical cycles
- 4 The water cycle
- 5 Primary productivity
- 6 Energy flow and food webs



1 Ecosystems

Ecosystems

Ecosystems

Ecosystems and niches

An **ecosystem** 生态系统 = living things + their non-living surroundings.

- **biotic** 生物的 vs **abiotic** 非生物的因素
- organism → **population** 种群 → **community** 群落 → ecosystem

A **niche** 生态位 is a species' full "job." Two species can't share one – **competitive exclusion** 竞争排斥原理.



Coral reef biome

2 Biomes

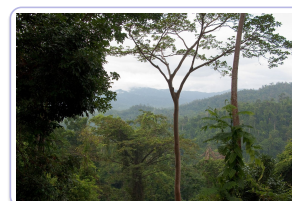
Ecosystems

Biomes

Biomes

A **biome** 生物群系 is a large region set by its climate: terrestrial by temperature & precipitation; aquatic by salinity.

Biomes band by latitude: rainforest at the equator → tundra at the poles.



Tropical rainforest: high temp and precip

3 Cycles

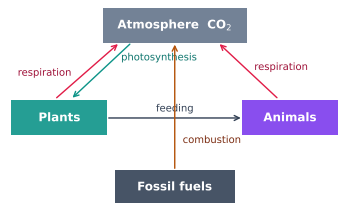
Ecosystems Cycles

The carbon cycle

Carbon 碳 moves through a **biogeochemical cycle** 生物地球化学循环:

- **photosynthesis** 光合作用 pulls CO_2 in
- **respiration** 细胞呼吸 & **combustion** 燃烧 return it

Burning **fossil fuels** 化石燃料 moves ancient carbon to the air far faster than nature removes it.



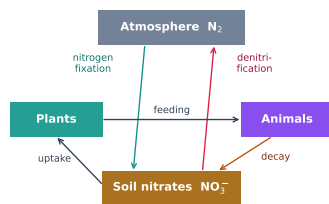
Ecosystems Cycles

Nitrogen and phosphorus

Nitrogen 氮 is a **limiting nutrient** 限制性养分: air N_2 is unusable until bacteria fix it.

- **fixation** 固氮作用 → **nitrification** 硝化作用 → **denitrification** 反硝化作用

Phosphorus 磷 has **no gas phase** – rock-based and slow. Excess of either ⇒ **eutrophication** 富营养化.



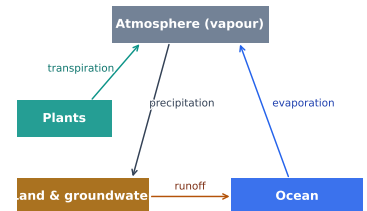
Ecosystems Cycles

The water cycle

The **hydrologic cycle** 水循环 is Sun-powered:

- **evaporation** 蒸发 + **transpiration** 蒸腾作用
- **runoff** 径流 & **infiltration** 下渗 to an **aquifer** 含水层

Paving with **impervious surfaces** 不透水面 blocks infiltration → more flooding.



4 Productivity

Ecosystems Productivity

Primary productivity

Primary productivity 初级生产力 is the rate producers store energy as **biomass** 生物量.

- **GPP** 总初级生产力: total energy captured
- **NPP** 净初级生产力: what is left after **respiration** 呼吸作用

High where sun, warmth, water & nutrients meet: rainforests, estuaries, reefs, wetlands.

The key relationship

$$\text{NPP} = \text{GPP} - R$$

NPP is the energy actually available to **consumers** 消费者 – the ecosystem's food supply.

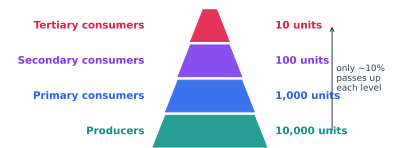
5 Energy flow

Energy flow and the 10% rule

Energy flows *one way up the trophic levels* 营养级 and is lost as heat.

- producers 生产者 → consumers 消费者 → decomposers 分解者

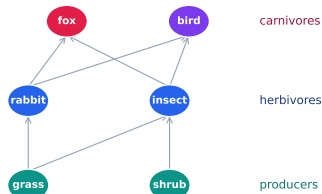
Only ~10% passes up each level (2nd law of thermodynamics) – so chains stay short.



Food chains and food webs

A **food chain** 食物链 is one path; arrows point the way energy flows (food → eater). A **food web** 食物网 links many chains.

A **keystone species** 关键种 (sea otter) shapes the whole web; an **indicator species** 指示物种 warns of stress.



6 Recap

Unit 1 – key takeaways

1 Ecosystems

biotic + abiotic; niche; competitive exclusion; symbiosis

2 Cycles

carbon, nitrogen, water recycle matter; P has no gas phase

3 Productivity

$NPP = GPP - R$ sets the food supply

4 Energy flow

~10% per level; food webs + keystone species

Check yourself

- Which two abiotic factors define a terrestrial biome?
- Which nutrient cycle has no gas phase?
- Write the equation linking NPP, GPP, and R.
- About what fraction of energy passes up one trophic level?

cycle

Answers 1. temperature and precipitation 2. phosphorus 3. $NPP = GPP - R$ 4. about 10%