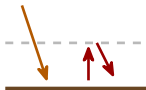


Global Change

AP Environmental Science ■ Unit 9

AP Environmental Science



What we will cover

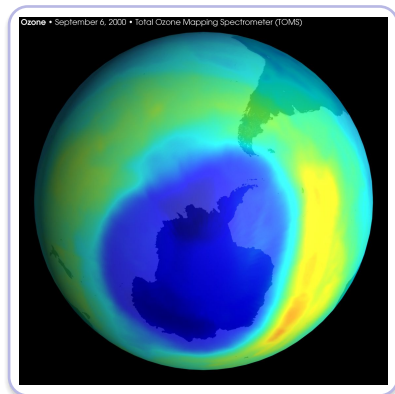
- 1 Ozone depletion
- 2 The greenhouse effect
- 3 Climate change
- 4 Ocean warming and acid
- 5 Invasive and endangered species
- 6 HIPPCO threats



Ozone depletion and the Montreal Protocol

The **ozone layer** 臭氧层 blocks UV.
CFCs 氯氟烃 release chlorine that destroys it (catalyst).

The 1987 **Montreal Protocol** 蒙特利尔议定书 phased out CFCs – international cooperation healing the layer.



Ozone

hole: CFC chlorine catalysis

The greenhouse effect

A *natural* warming: sunlight warms the ground, which radiates **infrared radiation** 红外辐射; **greenhouse gases** 温室气体 trap some heat.

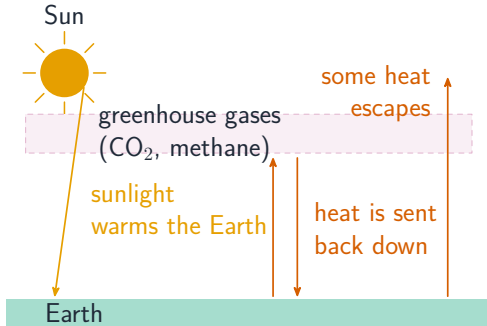
- CO₂, **methane** 甲烷, **water vapor** 水蒸气

Keeps Earth **habitable** 宜居的: +15°C, not -18°C. The problem is making it **too** strong.



endangered coral

The greenhouse effect



greenhouse gases trap some of the Earth's heat, so less escapes to space and the Earth warms up



Fossil fuels drive the enhanced greenhouse effect

Climate change

Human activities enhance the greenhouse effect. Weather is a day; climate change is decades.

- rising sea level; fiercer extremes

Feedback: melting ice bares dark water that absorbs more heat.



Glacier loss: ice-albedo feedback

Ocean warming and acidification

The ocean absorbs $>90\%$ of the extra heat and much of the CO_2 .

- heat $\Rightarrow$ coral bleaching + thermal expansion
- $\text{CO}_2 \Rightarrow$ carbonic acid, lower pH

Ocean acidification dissolves shells of calcifying organisms.



Coral bleaching from ocean heat stress

Invasive and endangered species

An **invasive species** 入侵物种 is a non-native that spreads and outcompetes natives – often via trade.

Endangered species lose habitat, face pollution, and overharvesting. Conservation can reverse it.



Invasive kudzu: spreads and outcompetes natives

HIPPCO – threats to biodiversity

The six human threats, worst first is **H**abitat loss:

Habitat destruction

Invasive species

Pollution

Population growth

Climate change

Overexploitation

No single threat is the whole story – their **combination** drives today's rapid species loss.

HIPPCO – threats to biodiversity

two ways to conserve a species

in-situ (in the wild)
national parks,
marine reserves

ex-situ (away
from the wild)
zoos, botanic gardens,
seed banks,
frozen zoos

Worked example – the greenhouse effect

Explain how CO₂ warms Earth, and why melting Arctic ice makes it worse.

- Short-wave sunlight warms the surface, which re-radiates **long-wave infrared**.
- CO₂ **absorbs and re-emits** that infrared, sending part back down $\Rightarrow$ warming.
- Ice has **high albedo** (≈ 0.9); dark ocean has **low albedo** (≈ 0.06).
- Melting exposes ocean $\Rightarrow$ more absorbed $\Rightarrow$ more melting: **positive feedback**.

Greenhouse gases are transparent to **incoming** short-wave and opaque to **outgoing** long-wave – say both. **Positive feedback amplifies**; negative feedback stabilises.

Unit 9 – key takeaways

1 Ozone

CFC chlorine catalyst; Montreal Protocol is healing it

2 Greenhouse

natural + habitable; humans enhance it → warming

3 Oceans

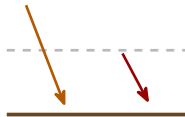
absorb heat + CO_2 : bleaching, acidification, higher seas

4 Biodiversity

invasive + endangered; the six HIPPCO threats

Check yourself

- 1 Why does one chlorine atom destroy so much ozone?
- 2 What treaty phased out CFCs?
- 3 What turns coral white in warm water?
- 4 What does the “H” in HIPPCO stand for?



Answers 1. it acts as a catalyst, freed to repeat stress (bleaching) 2. the Montreal Protocol 3. heat 4. Habitat destruction