

Global Change

AP Environmental Science • Unit 9

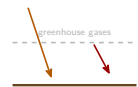
AP Environmental Science



Global Change

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



1

Ozone

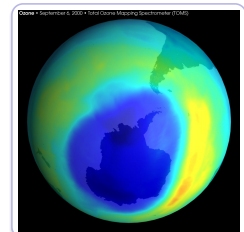
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└ Ozone

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.



hole: CFC chlorine catalysis

2

Greenhouse

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└ Greenhouse

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

3 Climate

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└ Climate

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

4 Ocean

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└ Ocean

Ocean warming and acidification

The ocean absorbs >90% of the extra heat and much of the CO₂.

- heat ⇒ coral bleaching + thermal expansion
- CO₂ ⇒ carbonic acid, lower pH

Ocean acidification dissolves shells of calcifying organisms.



Coral bleaching from ocean heat stress

5 Species

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└ Species

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

6 HIPPCO

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└─HIPPCO

HIPPCO – threats to biodiversity

The six human threats, worst first is **Habitat** 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.

7 Recap

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└─Recap

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 ⇒ warming.
- Ice has **high albedo** (≈ 0.9); dark ocean has **low albedo** (≈ 0.06).
- Melting exposes ocean ⇒ more absorbed ⇒ 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.

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└─Recap

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 + CO₂; bleaching, acidification, higher seas

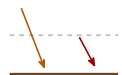
4 Biodiversity

invasive + endangered; the six HIPPCO threats

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└─Recap

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 stress (bleaching) 4. Habitat destruction