Global Change

AP Environmental Science

Stratospheric Ozone Depletion

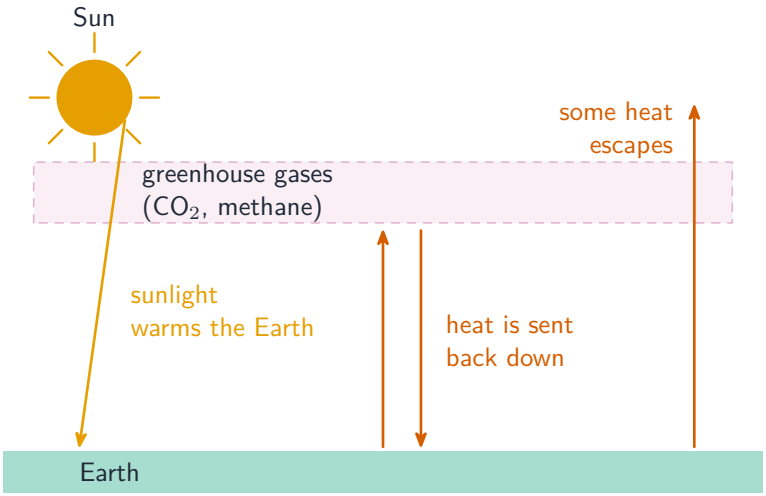
The **ozone layer** 臭氧层 high in the stratosphere absorbs harmful **ultraviolet** 紫外线 radiation. **CFCs** 氯氟烃 (chlorofluorocarbons, once used in coolants and sprays) drift up and release chlorine that destroys ozone, thinning it (the Antarctic "**ozone hole**"). More UV reaching the surface raises skin cancer, cataracts, and crop damage.

Reducing Ozone Depletion

The **Montreal Protocol** 蒙特利尔议定书 (1987) phased out CFCs worldwide and is a rare environmental success –the ozone layer is slowly recovering. Substitutes (like HFCs and HCFCs) replaced CFCs, though some are themselves greenhouse gases.

The Greenhouse Effect

The **greenhouse effect** 温室效应 keeps Earth warm: **greenhouse gases** 温室气体 let sunlight in but trap outgoing infrared heat. This natural effect makes Earth livable. The problem is the **enhanced** greenhouse effect –humans adding extra gases that trap more heat.



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

Greenhouse gases absorb the heat the Earth gives off and send some back

Increases in the Greenhouse Gases

Human activities raise greenhouse gases: **CO_2** from burning fossil fuels and deforestation, **methane** 甲烷 from livestock, landfills, and rice paddies, and **nitrous oxide** from fertilizers. Methane traps far more heat per molecule than CO_2 but is less abundant.

Global Climate Change

Global climate change 气候变化 is the long-term shift in climate from the enhanced greenhouse effect: rising average temperatures, melting ice, rising **sea levels** 海平面, more extreme weather, and shifting rainfall. It disrupts ecosystems, agriculture, and human communities worldwide.

Ocean Warming

As the climate warms, oceans absorb most of the extra heat. **Ocean warming** causes **coral bleaching** 珊瑚白化 (corals expel their algae and can die), shifts species ranges, reduces dissolved oxygen, and –with melting ice –raises sea level through **thermal expansion**.

Ocean Acidification

The ocean absorbs about a quarter of our CO_2, which forms carbonic acid –**ocean acidification** 海洋酸化. Lower pH makes it harder for corals, shellfish, and plankton to build **calcium carbonate** 碳酸钙 shells and skeletons, threatening marine food webs.

Invasive Species

An **invasive species** 入侵物种 is a non-native species that spreads and harms its new ecosystem. With no natural predators, it outcompetes natives, spreads disease, and reduces biodiversity (kudzu, zebra mussels, Burmese pythons). Human trade and travel move them around.

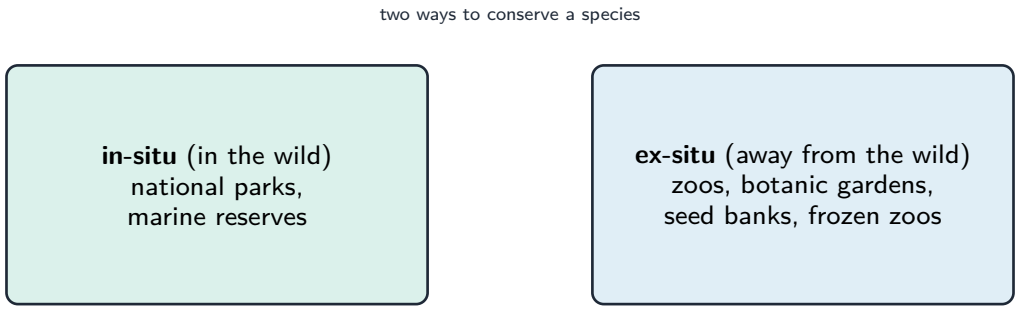
Endangered Species

An **endangered species** 濒危物种 is at risk of extinction. Causes are summarized as **HIPPO**: **Habitat** loss, **Invasive** species, **Pollution**, **Population** (human) growth, and **Overharvesting**. Protection includes laws (the Endangered Species Act), protected areas, and captive breeding.

Human Impacts on Biodiversity

Together, habitat loss, climate change, pollution, invasive species, and overexploitation are driving a rapid loss of biodiversity –some call it a sixth mass extinction. Reducing

these pressures, conserving habitat, and sustainable practices are the ways to slow it and protect the ecosystem services all life depends on.



In-situ and ex-situ conservation protect species

Exam tips

- Keep **ozone depletion** (CFCs let in more UV) and **climate change** (greenhouse gases trap more heat) as **two different problems**.
- Explain the natural greenhouse effect and the **enhanced** version from extra CO and methane.
- Connect ocean warming (coral bleaching) and **ocean acidification** (CO $\rightarrow$ carbonic acid $\rightarrow$ weaker shells).
- An **invasive species** is dangerous because it has no natural predators in its new home.
- Summarise threats to biodiversity with **HIPPO** (Habitat loss, Invasive species, Pollution, Population, Overharvesting).