

Atmospheric Pollution

AP Environmental Science • Unit 7

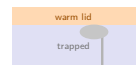
AP Environmental Science



Atmospheric Pollution

What we will cover

- 1 Types of pollutants
- 2 Photochemical smog
- 3 Thermal inversion
- 4 CO₂ and indoor air
- 5 Acid rain
- 6 Reducing pollution



1 Types

Atmospheric Pollution

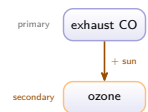
Types

Types of pollutants

Air pollution 空气污染 arrives two ways:

- **primary** 一次污染物: released already harmful (CO)
- **secondary** 二次污染物: forms *in* the air (ground-level ozone)

Burning **fossil fuels** 化石燃料 is the biggest source of **particulates** 颗粒物, **ozone** 臭氧, and **nitrogen oxides** 氮氧化物.



2 Smog

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Smog

Photochemical smog

Brown city haze forms when pollutants bake in sunlight:

- nitrogen oxides + VOCs + sunlight
- → ground-level ozone

Ozone is the classic secondary pollutant – worst on hot, sunny, traffic-filled afternoons.



Photochemical smog over a traffic-filled city

3 Inversion

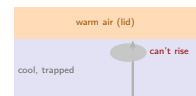
Atmospheric Pollution
└ Inversion

Thermal inversion

Normally warm air rises and carries pollution up. A **thermal inversion** 逆温现象 puts a warm layer *on top*, like a lid.

- cool air below cannot rise
- pollution cannot **disperse** 扩散

A valley or basin traps it longer – deadly smog events build over days.



4 CO2 and indoor

Atmospheric Pollution
└ CO2 and indoor

CO₂, particulates, and indoor air

Combustion 燃烧 releases **carbon dioxide** 二氧化碳 plus **particulate matter** 颗粒物.

Indoors can be worse: **radon** 氡, **carbon monoxide** 一氧化碳, **asbestos** 石棉. Fix: **ventilation** 通风.



Indoor air: cookstoves and poor ventilation

5 Acid rain

Atmospheric Pollution
└ Acid rain

Acid rain

Acid rain 酸雨: **sulfur dioxide** 二氧化硫 (coal) and nitrogen oxides (cars) form acids in cloud water.

- drops **pH** 酸碱度 of soil and lakes below 4
- kills **forests** 森林 and fish, eats stone

Cut it at the source: **scrubbers** 洗涤器 and cleaner fuels.



Acid rain damages forests, lakes, and stone

6 Reducing

Atmospheric Pollution
└ Reducing

Reducing pollution

Clean the exhaust, pass laws, switch fuels:

Catalytic converters 催化转化器
change exhaust into safer gases

Scrubbers 洗涤器
strip SO_2 from smokestacks

Legislation 立法
Clean Air Act sets limits

Cleaner energy 清洁能源
cut pollution at its root

Noise pollution 噪声污染 also harms: **hearing loss** 听力损失, **stress** 压力, and disrupted **wildlife** 野生动物.

7 Recap

Atmospheric Pollution
└ Recap

Worked example – photochemical smog

Why is photochemical smog worst on hot, sunny, windless afternoons in a city?

- Cars emit NO_x and VOCs in the morning rush hour.
- **Sunlight** drives the reaction: NO_2 splits, and the O atom makes ground-level **ozone**.
- Heat **speeds** it up, so ozone peaks in the **afternoon**, not at rush hour.
- No wind (often a **thermal inversion**) traps it $\Rightarrow$ a **brown haze that irritates lungs**.

Ground-level ozone is **secondary** – nothing emits it. Good ozone is up in the stratosphere; **bad ozone** is down here. A thermal inversion is the lid.

Atmospheric Pollution
└ Recap

Unit 7 – key takeaways

1 Pollutant types

primary released; secondary forms in air (ozone)

2 Smog & inversion

NO_x + VOC + sun; a warm lid traps it

3 Acid rain

SO_2 + $\text{NO}_x \rightarrow$ acids; lowers pH, kills life

4 Reduce

converters, scrubbers, laws, cleaner fuel

Atmospheric Pollution
└ Recap

Check yourself

- 1 Is ground-level ozone a primary or secondary pollutant?
- 2 What three ingredients make photochemical smog?
- 3 Why does a thermal inversion trap pollution?
- 4 What device cleans a car's exhaust gases?



Answers 1. secondary 2. NO_x , VOCs, sunlight 3. a warm lid stops cool air rising 4. catalytic converter