

Atmospheric Pollution

AP Environmental Science ■ Unit 7

AP Environmental Science



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

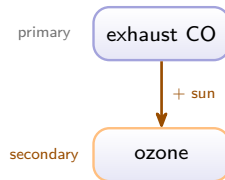


Types of pollutants

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.



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.



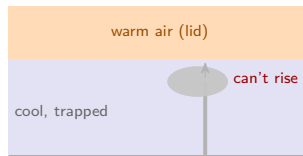
Photochemical smog over a traffic-filled city

Thermal inversion

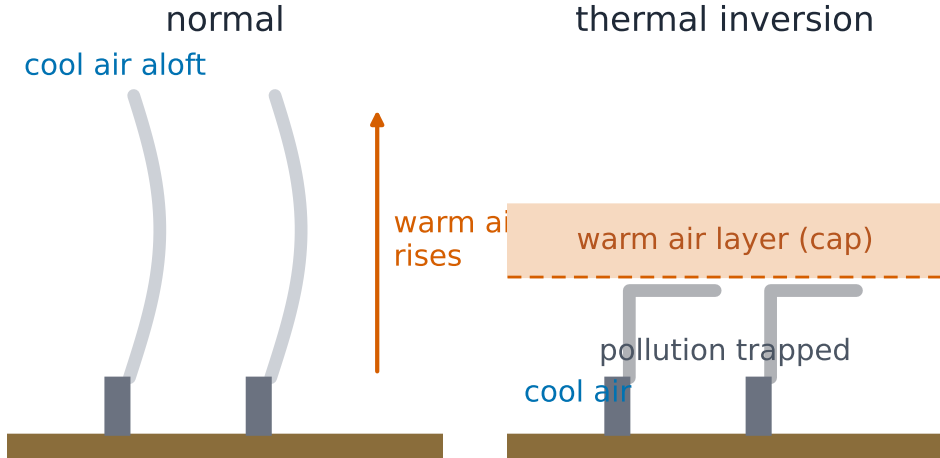
Normally warm air rises and carries pollution up. A **thermal inversion** 逆温现象 puts a warm layer *on top*, like a lid.

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

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



Thermal inversion



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

Acid rain

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

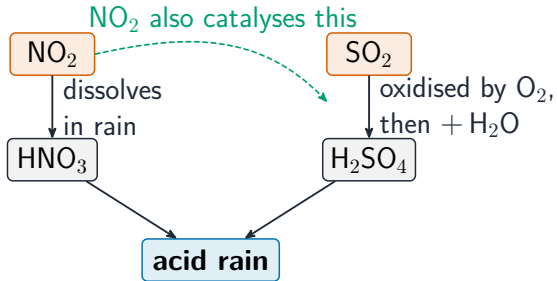
- drops **pH** 酸碱度 of soil and lakes below 4
- kills **forests** 森林 and fish, eats stone

Cut it at the source: **scrubbers** 洗滌器 and cleaner fuels.



Acid rain damages forests, lakes, and stone

Acid rain



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 SO₂ 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.

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.

Unit 7 – key takeaways

1

Pollutant types

primary released; secondary forms in air (ozone)

2

Smog & inversion

$\text{NO}_x + \text{VOC} + \text{sun}$; a warm lid traps it

3

Acid rain

$\text{SO}_2 + \text{NO}_x \rightarrow \text{acids}$; lowers pH, kills life

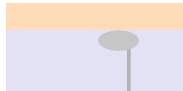
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Reduce

converters, scrubbers, laws, cleaner fuel

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