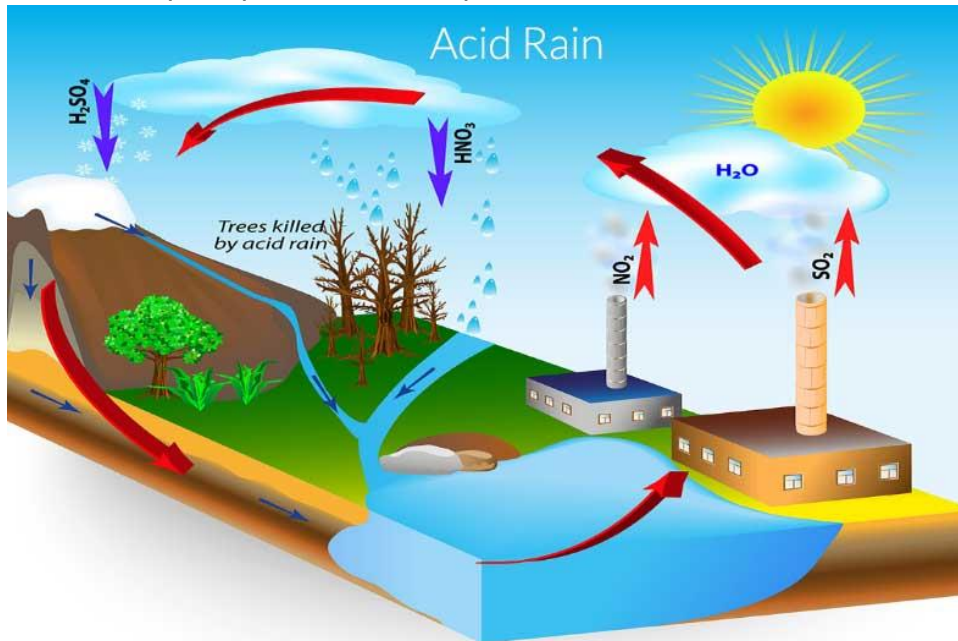


# The Atmosphere and Human Activities

## Atmospheric Pollution and its Causes

- **Acid rain:** precipitation with a pH value of less than 7.

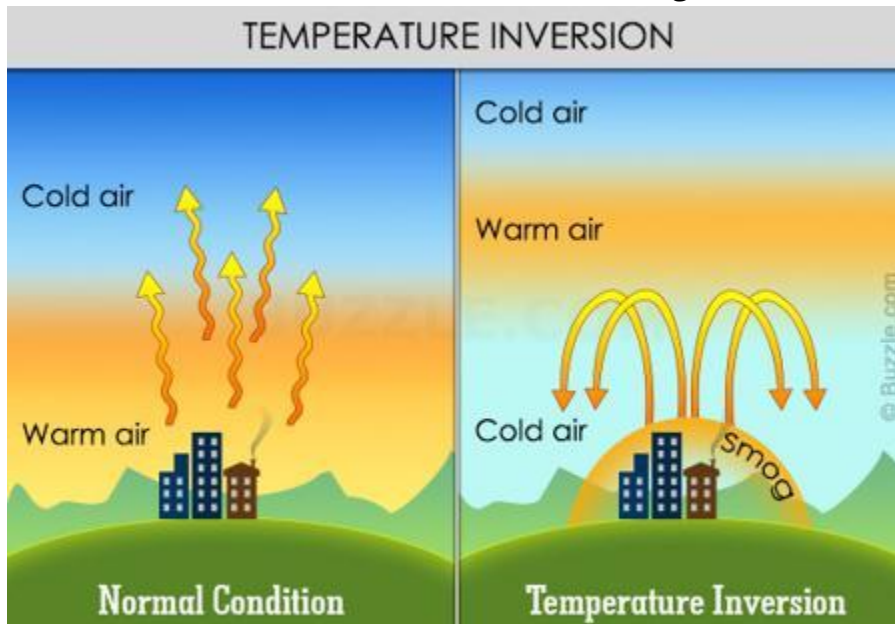


- Burning of fossil fuels in factories and power stations release sulfur dioxide and nitrogen oxides.
- Vehicle emissions add further nitrogen oxides.
- When these gases mix and react with the water vapour in the atmosphere, they form weak solutions of nitric and sulfuric acid.
- Prevailing winds carry them.
- They eventually fall to Earth as acid rain.

### Smog:

- Burning of fossil fuels in industry, homes and vehicles provides particles like smoke and dust for fog to form around.
- **Photochemical smog:**
  - Involves chemical reactions induced by sunlight on certain pollutants.
  - These reactions convert them into harmful substances like ground-level or tropospheric ozone ('bad' ozone).
- **Volatile Organic Compounds (VOCs):**

- Chemicals that easily enter the atmosphere as gases, mainly from evaporation.
- **Examples:** hydrocarbons (like methane), ammonium nitrate, carbon monoxide (incomplete combustion), etc.
- **Temperature inversion:** a weather condition when the air temperature increases with altitude rather than decreasing.



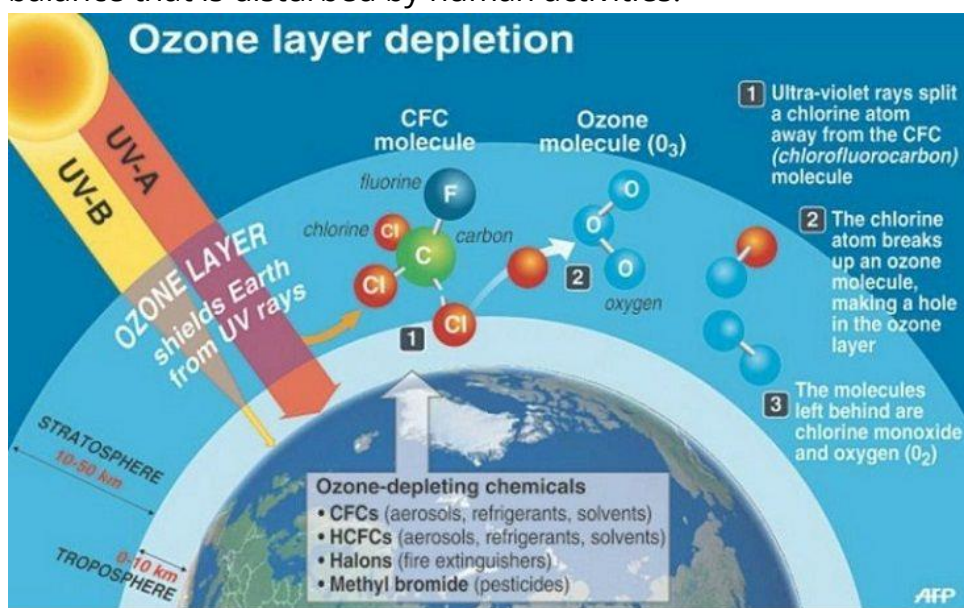
- During the day, the surfaces are heated due to longwave radiation.
- On calm and clear nights, the Earth's surface cools very quickly, emitting radiation and cooling the air above it.
- At higher altitudes, the air doesn't cool as quickly, so this air becomes warmer than the air below it.
- This layer of warm air is the inversion layer that disrupts the regular convection currents.
- The concentration of smog (pollutants) increases, often in valleys surrounded by steep-sided hills.
- **Enhanced greenhouse effect:** created by the addition of greenhouse gases to the atmosphere through human activities.
- More heat is retained in the atmosphere.
- Increased temperature of the Earth's surface leads to global warming and climate change.

<b>Greenhouse gas</b>	<b>Human activities that increase their abundance</b>
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of carbon dioxide	Burning of fossil fuels; Deforestation.
methane	Cattle and rice production; Coal mine ventilation; Deforestation; Decomposition of waste (landfill sites).
CFCs	Aerosol sprays; Fire extinguishers; Refrigeration; Air conditioning.
Nitrogen Oxides	Vehicle exhausts; Chemical fertilisers.
Tropospheric ozone	Chemical reactions involving nitrogen oxides and unburnt fuel vapours.

### Ozone Layer Depletion:

- The ozone layer protects the Earth from Sun's harmful radiation.
- It is formed when oxygen ( $O_2$ ) filters from the top of the troposphere and reacts under the influence of ultraviolet radiation to form ozone ( $O_3$ ).
- It is continually formed, destroyed and replaced naturally, creating a dynamic balance that is disturbed by human activities.



- When CFCs reach the stratosphere, the ultraviolet radiation breaks them down, releasing chlorine.
- Chlorine reacts with oxygen in a destructive process, breaking down the ozone molecules to chlorine monoxide and oxygen, depleting the layer and forming a hole.
- This hole allows harmful radiation to enter the Earth's atmosphere.

# Impact of Atmospheric Pollution

Pollutant	impact
Smog	Irritation of eyes and throat;
	Respiratory diseases, like asthma;
	Fine particles are carried into the lungs, leading to lung cancer, strokes and heart attacks;
	Breathing difficulties.
Acid rain	Acidification of groundwater, making the water undrinkable;
	It can cause diarrhoea and stomach
	Upset if the water is consumed;
	Aluminium leached from the soil to groundwater;
	Acidification of groundwater damages tree roots
	Crop yields decline;
	Nutrients like calcium are leached out of the soil;
	Fish die as acidity levels increase;
	Limestone buildings are chemically weathered.
Ozone Depletion	Higher levels of ultraviolet radiation cause sunburn, skin cancers, retina damage and cataracts;

	Extra ultraviolet radiation limits the reproduction of phytoplankton, affecting the entire food web;
	Changes in the biochemical composition of some plant leaves make them less attractive as food.
Climate change	Melting of ice sheets, glaciers and permafrost causes a rise in sea levels;
	Damage to low-lying countries from flooding;
	Forced migration as people lose their homes and farmland from rising sea levels;
	Loss of biodiversity, habitat or extinction if animals and plants can't adapt;
	Increased droughts could lead to desertification and famine;
	Sea-level rise leads to the loss of coastal land and increased erosion.

## Managing Atmospheric Pollution

### Reduction of carbon footprint:

- **Carbon footprint:** a measure of the impact of our activities on the environment.

### Reduced use of fossil fuels:

- Low-sulfur coal can be used;
- Increased use of renewable energy.

### Energy efficiency:

- Using energy-efficient appliances.

### Carbon capture and storage:

- Waste carbon dioxide from power stations can be transported via pipelines to storage sites.

### Transport policies:

Creation of cycle lanes, bus lanes, metro systems and trams;

- Electric or hybrid cars can be encouraged;
- Biofuels can be used;
- Vehicles can be banned from certain parts of the city by pedestrianisation;
- Public transport and residential parking can be made free.

**International agreement and policies:**

- Policies such as the Montreal Protocol, Kyoto Protocol and Paris Climate The conference can be passed on worldwide;
- International cooperation is required.

**CFC replacement:**

- Reduction in the use of CFCs;
- Hydrochlorofluorocarbons (HCFCs) can be used as an alternative;
- Safe disposal of items containing CFCs.

**Taxation:**

- Higher road tax to decrease car ownership.

**Catalytic converters:**

- Catalytic converters in vehicles reduce sulfur dioxide emissions;
- They also convert nitrogen dioxide and carbon monoxide to carbon dioxide and nitrogen;
- Low-sulfur vehicle fuels can also be used.

**Flue-gas desulfurisation:**

- Scrubbers can be used to remove 95% of sulfur dioxide emissions;
- Lining chimneys with lime also reduces emissions.

**Reforestation and afforestation:**

- **Reforestation:** replanting an area with trees;
- **Afforestation:** planting trees in a barren land.