Environmental Management
Key Terms:

The Atmosphere and Human Activities

Noble Gas	A gas that rarely reacts with other elements because it is stable, previously referred to as inert gases.	Water Vapour (H2O)	Changes in its atmospheric concentrations are linked to the warming that *results* from the other greenhouse gases we emit. - Warmer air holds more water. - Water absorbs heat - Inducing even greater warming and perpetuating a positive feedback loop. (It's worth noting, however, that the net impact of this feedback loop is still uncertain, as increased water vapour also increases cloud cover that reflects the sun's energy away from the earth.)
Aerosols	Sprays containing fine particles and/or droplets that become suspended in the atmosphere.	Methane (CH4)	It persists in the atmosphere for far less time than CO2, but is much more potent in terms of the greenhouse effect - global warming impact is 25X greater than that of CO2 over a 100-year period. Globally it accounts for approximately 16% of human-generated greenhouse gas emissions. Added by: - Cattle, rice production, coal mine ventilation, deforestation and decomposition of waste (landfill)
The Atmosphere 1	A layer of gases held to the Earth by gravitational force. 50% is within 5.6km of the Earth surface. It comprises of: 78.1% Nitrogen and 21% Oxygen, as well as water vapour, CO2, O3, Ar, He, Ne, Kr, dust and pollutants - SO2, NO2, CH4 (methane)	Nitrous Oxide (N2O)	It has a global warming potential 300X of CO2 on a 100-year time scale, and it remains in the atmosphere, on average, a little more than a century. It accounts for about 6% of human-caused greenhouse gas emissions worldwide. Added by: - Nitrogen heavy chemical fertilisers, vehicle exhausts.
Green House Gases (GHGs) (https://www.nrdc.org/stories/greenhouse-effect-101)	Earth's greenhouse gases trap heat in the atmosphere and warm the planet. The main ones are: - Water vapour. - Carbon dioxide - 200yrs - Methane - 12 yrs - Ozone - Nitrous oxide - 114 yrs - Chlorofluorocarbons (synthetic) - 1000 years They stay in the atmosphere for differing amounts of time.	Fluorinated Gases	HFCs are used as a replacement for ozone-depleting chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). Added by: - air conditioners and refrigerators, but some are being phased out because of their high global warming potential (GWP). Replacing these HFCs and properly disposing of them is considered to be one of the most important climate actions the world can take. (**CFCs:** UV light breaks them down, releasing chlorine which depletes the ozone layer.)
Carbon Dioxide (CO2)	It occurs in the atmosphere naturally, but accounting for about 76% of global human-caused GHGs, CO2 sticks around for quite a while. Added by: - Burning of fossil fuels, deforestation Removed by: - Carbon sinks - plants, soils, oceans - reforestation, afforestation	Carbon Sinks	Carbon sinks are natural systems that suck up and store carbon dioxide from the atmosphere. The main natural carbon sinks are plants, the ocean and soil.

Ozone (O3)

Occurring naturally in the stratosphere (O2 + sun's UV rays = O3) as 'the ozone layer', it protects the Earth from too much and too little heat.

Cl, in CFCs (used in fridges, aerosol spray, air cooling systems and plastics manufacturing), reacts with O2, **depleting the ozone layer**.

At ground-level, in the troposphere, ozone is known as **photochemical smog**. Made by chemicals being released - burning fossil fuels, when some chemicals, like solvents, evaporate - and reacting with sunlight.

Smog

Smoke + Fog
Added by: burning fossil fuels.
Fog forms round particles in air. Associated with industrial and urban areas. More frequent in winter, when more people are using heating.
It can occur both during the day and at night but photochemical smog only happens in the presence of sunlight.

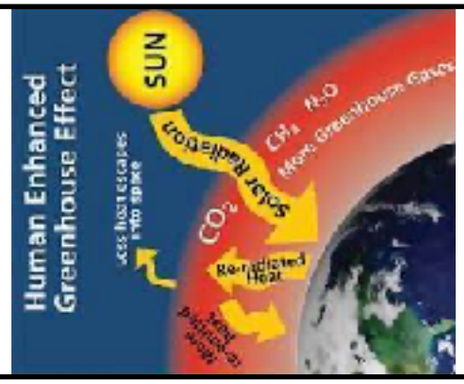
Stratospheric Ozone

(https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics)

Called stratospheric ozone, good ozone occurs naturally in the upper atmosphere, where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. This beneficial ozone has been partially destroyed by manmade chemicals, causing what is sometimes called a "hole in the ozone."
People: increased UV=sun burn/skin cancer, retina damage/cataracts, suppressed immune systems
Environment: inhibits reproductive cycle of phytoplankton, melted ice/glaciers/permafrost = raised sea levels/loss of habitats

The Human Enhanced Greenhouse Effect

(https://www.zsl.org/sites/default/files/KS3-4%20-%20Home%20Learning%20-%20Climate%20Change%20and%20Animals_0.pdf)



The Atmosphere 2: Structure

Troposphere: temp goes down with height (lower pressure, less heat from Earth)
Tropopause: temp fairly consistent (the upper limit of the Earth's weather and climate - Approx. 8km at poles, 17km in the tropics)
Stratosphere: temp up with height (ozone)
Stratopause: temp fairly consistent
Mesosphere: temp falls rapidly (very low pressure, no H2O, dust or O3)
Mesopause: temp fairly consistent
Thermosphere: very hot. (UV rays)
Thermopause: temp fairly consistent

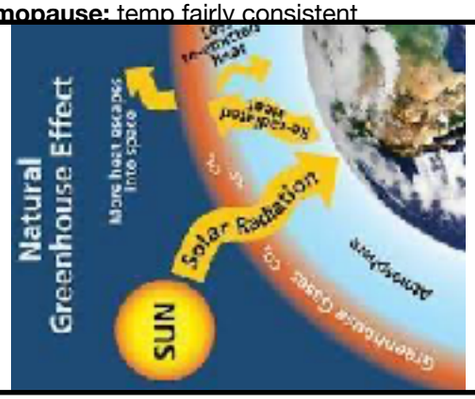
The Greenhouse Effect

Natural: A process that helps keep the world warm.
- Incoming radiation emitted by sun
- Some passes through layer of greenhouse gases
- Earth absorbs 50%, atmosphere absorbs 20%, 30% reflected (clouds) back into space
- Heated Earth emits out-going radiation back, some back into space, some heats up atmosphere, which bounces back at Earth.

Human enhanced:
- Extra greenhouse gases keep more heat in the atmosphere, return more radiation back to the Earth's surface, and so increase the Earth's temp.

The Natural Greenhouse Effect

(https://www.zsl.org/sites/default/files/KS3-4%20-%20Home%20Learning%20-%20Climate%20Change%20and%20Animals_0.pdf)



Short-wave Radiation

Incoming or short-wave solar radiation. Visible light and ultraviolet radiation are commonly called shortwave radiation

Temperature Inversion 1: Smog

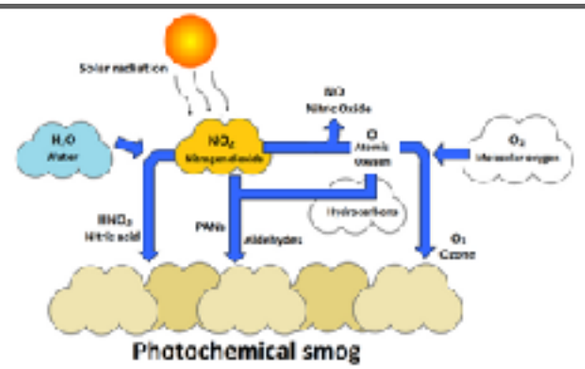
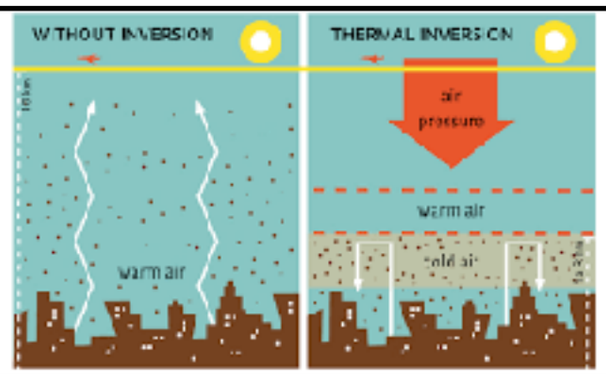
When temperature increases with altitude.

Temperature inversion causing smog, e.g. LA need:
- high air pressure (anticyclone) (causes upper air to sink)
- calm conditions (due to high pressure)
- valleys surrounded by steep-sided hills (traps smog)

Smog can be thick enough to block out sun - 'dustbin lid' effect.

Long-wave Radiation

Outgoing or terrestrial radiation. As the Earth produces very little visible light or ultraviolet radiation, all radiation from the Earth is infrared.

Primary Pollutant	A pollutant that is emitted directly from the source, e.g. NOx from burning fossil fuels.	Photochemical Smog 2 (https://steemit.com/science/@shairanada/air-pollution-photochemical-smog-and-its-adverse-effects)	
Secondary Pollutant	A pollutant that forms through chemical reactions with primary pollutants, e.g. NOx & sunlight = O3	Photochemical Smog 1	Forms when nitrogen oxides and VOCs react with sunlight to form secondary pollutants, such as ozone and peroxyacetyl nitrate (PAN), creating a brown haze above cities. (Leads to acid rain.) Usually occurs when warm & sunny. - NOx = power plants, motor vehicles and other sources of high-heat combustion. - VOCs = motor vehicles, fertilisers, chemical plants, refineries, factories, gas stations, paint etc **People**: irritated eyes, heart/respiratory problems. **Environment:** photosynthesis reduced, plant health declines = susceptible to pests/disease/drought
Particle Matter (PM)	A mixture of very small particles and liquid droplets suspended in the air.	Acid Rain	**Precipitation with a pH of less than 6** • Factories/power stations/cars burn fossil fuels • Releases SO2 and NOx into atmosphere • Gases mix with water vapour and oxygen • Weak solutions of nitric acid/sulphuric acid made • They are blown far away by wind to other places • Condense, and fall as acid rain. **People:** water undrinkable (diarrhoea/stomach upset), crop yield drops, buildings weathered **Environment:** foliage dies, acid groundwater damages roots, nutrients (e.g. calcium) leached out of soil, aquatic life/plants poisoned
Volatile Organic Compounds (VOC)	Chemicals that easily enter the atmosphere as gases, mainly from evaporation. Human sources: fuel combustion, engine emissions, tyre wear, mining, quarrying and construction Natural sources: sea spray, soil and dust	Depletion	A reduction or loss
Temperature Inversion 2: Smog (https://steemit.com/science/@shairanada/air-pollution-photochemical-smog-and-its-adverse-effects)		Polar Vortex	A circulation of strong upper winds that surround Antarctica and keep cold air locked in above the continent.

Climate Change	The enhanced greenhouse effect is leading to climate change. **People:** raised sea levels (damage to low-lying countries), droughts, desertification, famine, loss of tourist attractions, unpredictable weather events, mass migration, war, spread of diseases, e.g. malaria **Environment:** loss of coastal land/erosion, plants/ animals not able to adapt fast enough (loss of biodiversity, habitats, extinction), extreme weather, changes to fisheries (warmer waters), migration of plants/animals (invasive species)		
The Atmosphere 3: Managing Pollution	• **International agreements** (e.g. Kyoto protocol 1997 - CO2 emissions, Paris climate conference 2015 - aim to limit global temp rise to 2 degrees C) • **Governments** (low-sulphur coal, catalytic converters, solar panel subsidies, ban CFCs, public transport policies, reforestation/ afforestation etc.) • **Individuals** (reduce, reuse, recycle, choose energy efficient products, monitor personal carbon footprint, farmers can use organic fertilisers etc.) Hard for industrialising LEDCs, poorer people		