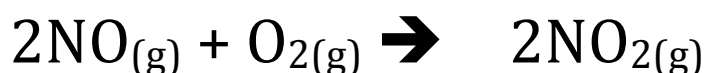
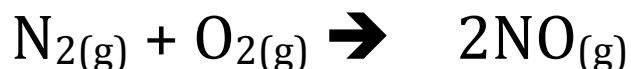


Ground-Level Ozone

Ozone, O_3 , near the surface of the Earth, is a component of smog and one of the most important health concerns of polluted air. Ozone is produced near the surface when nitrogen oxides and other organic compounds react in the presence of sunlight.

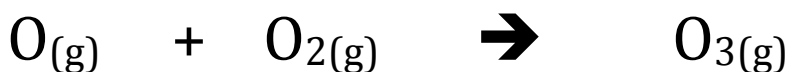


$NO_{2(g)}$ nitrogen dioxide

✓ is a reddish-brown gas with an irritating odour.

✓ This is a major component of smog.

uv radiation



$O_{3(g)}$ OZONE

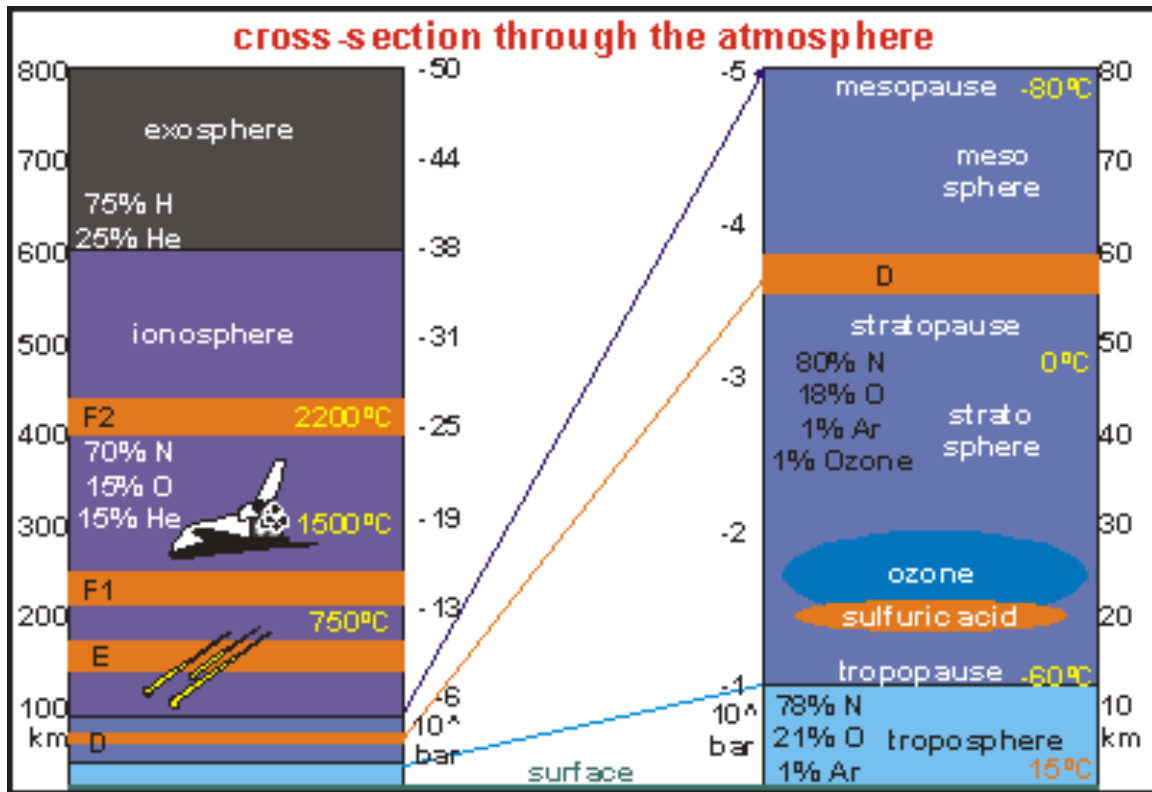
✓ irritates the respiratory tract and eyes

✓ lung damage for people with heart or lung problems

✓ damages plants, increases plants' susceptibility to disease

✓ bleaches colour from fabrics

✓ hardens rubber



The Ozone Layer and CFCs

Unlike ground-level ozone, ozone in the stratosphere (10-15 km above the Earth's surface) is beneficial because it protects the environment and us by preventing most of the short-wavelength, high-energy ultraviolet (UV) radiation from reaching Earth's surface.

If all the UV radiation were to reach Earth's surface, serious damage would occur.

***UV radiation has enough energy to break covalent bonds!!!!**

- sunburn
- cataracts
- skin cancer
- genetic mutation (DNA damage)
- destruction of vegetation

Scientists noticed a "hole" in the ozone layer above Antarctica and the Arctic. The "hole" is really a thinning of the layer (almost like fabric that is worn out and is so thin you can see right through it). They have researched the link between this thinning and CFCs.

CFCs

Chlorofluorocarbons (CFCs), also known by the trade name Freon, were first synthesized in the 1930s.

$\text{C}_2\text{F}_3\text{Cl}_3$ (freon-113)

CF_2Cl_2 (freon-12)

CFCl_3 (freon-11)

These compounds are readily liquefied, relatively inert, non-toxic, non-combustible and volatile, they have been used as coolants in refrigerators and air conditioners as well as in the manufacture of disposable foam products and aerosol propellants in spray cans. These chemicals are released into the atmosphere. Since they are inert, they diffuse to the stratosphere, where UV radiation decomposes them. Scientists have found that this decomposition also breaks down ozone.

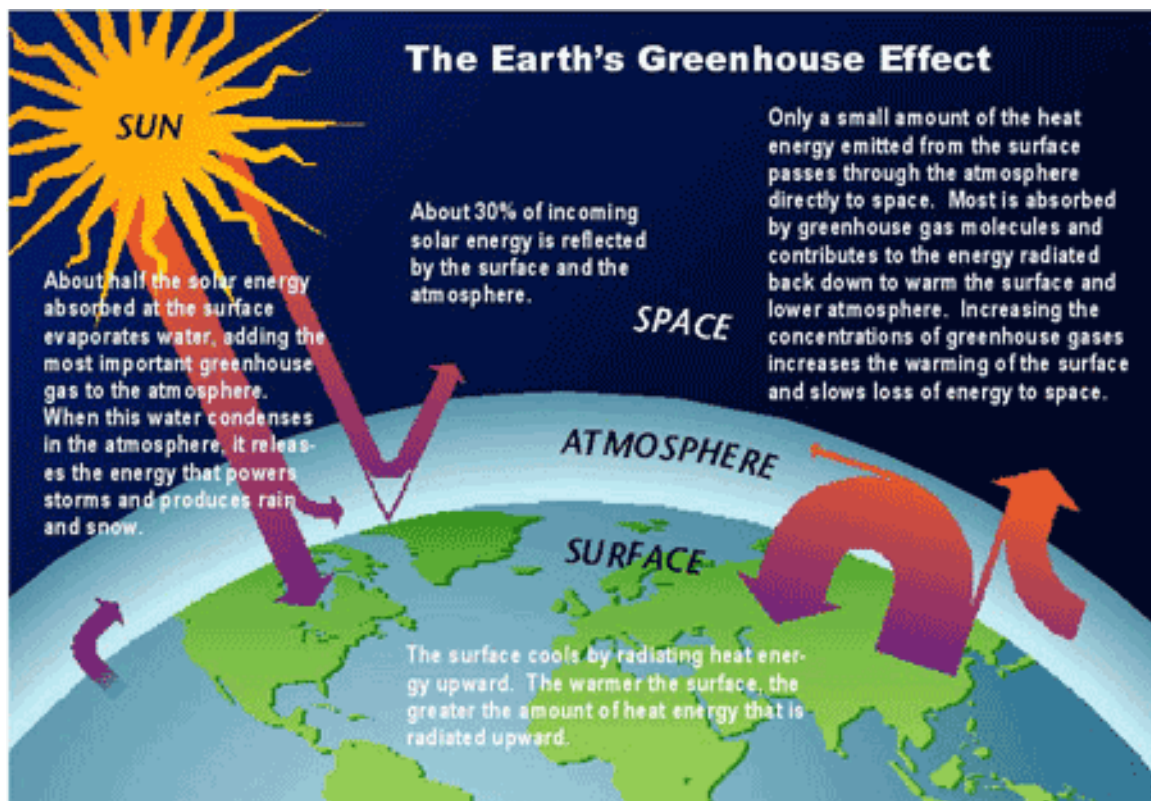
In Canada, the maximum allowable ground ozone concentration is 82 ppb over a one-hour period, although urban centers often exceed that. Los Angeles used to reach levels of 680 ppb but now is around 300 ppb, thanks in large part to catalytic converters.

Catalytic converters significantly reduced the amounts of nitrogen oxides emitted by cars. The hot exhaust gases pass over the surface containing beads of rhodium, platinum and palladium, which reduce NO to N_2 and CO to CO_2 .

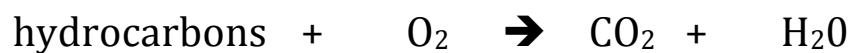
The Montreal Protocol

The Montreal Protocol is a treaty that was signed by 27 countries in 1987 (175 countries eventually signed) in Montreal. It has been amended numerous times. The original protocol stipulated that the production and consumption of compounds that depleted ozone in the stratosphere were to be phased out by 2000. These chemicals included CFCs, halons (CF_3Br in fire extinguishers), carbon tetrachloride and methylchloroform. Unfortunately it has only decreased about 60%, not the total phase out that was agreed upon.

Even when the production of these chemicals stops, it will be some time before the ozone layer is repaired. In cars, Canada has switched to hydrochlorofluorocarbons (HFCs). They are “ozone friendly” but they are potent greenhouse gases.



The Greenhouse Effect



Carbon dioxide and water are the two most important greenhouse gases. These gases absorb heat radiation from the Earth and emit some of this radiation back to Earth. The term **greenhouse effect** refers to the trapping of the thermal energy in the atmosphere, producing the same effect as the glass panels of a greenhouse. This is a natural process that makes the Earth inhabitable. The problem is that it appears that the extra gases that are produced are trapping more of the heat and resulting in an increase in the average global temperature. This is called **global warming** and is considered by some scientists to be the most crucial environmental problem in the world today.

- melting the polar ice caps
- a rise in the sea levels
- significant climate change
- significant atmospheric change

The Kyoto Protocol

In 1997, Canada was one of over 160 countries to adopt the Kyoto Protocol, which commits industrialized countries to binding targets for reduction of greenhouse gas emissions. The emissions of six gases are targeted:

CO₂ CH₄ NO and the 3 halocarbons that are being used as CFC substitutes.

Canada had committed to reducing its emissions by 6% by 2012 and did indeed do so. Countries that did not meet their target can strike a deal with nations that do better than required and buy their excess “quota”, a process known as “carbon trading”. Canada is the 8th largest greenhouse gas emitter and the 4th largest per capita.

The factors that contribute to Canada’s emissions are:

- population is widely distributed creating significant transportation needs
- northern climate causes heavy energy consumption
- large part of the economy is resource based (eg. iron smelting) which requires high energy demands

Air Quality Assignment

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What is a TAGA?

What does a gas chromatograph do?

