

CO₂ As A Greenhouse Gas - occurs naturally in the environment, but increasing amounts that are being produced by various human activities is creating a concern globally.

The Greenhouse Effect - is a naturally occurring event, the result of greenhouse gases (water vapor, carbon dioxide, and other gases) trapping some of the outgoing energy - retaining heat in a way somewhat similar to the glass panels of a greenhouse – helping to maintain the Earth's average surface temperature of 15°C.

The Enhanced Greenhouse Effect - is causing temperatures to increase around the world. Human activities – essentially, the burning of fossil fuels is the primary reason. The enhanced greenhouse effect is depleting the ozone layer.

The Ozone Layer

Ground-level ozone can have dangerous effects. Atmospheric ozone is the chemical that occurs high in a natural formation 15 to 50 kilometers above us in the atmosphere where it maintains a shield around the Earth protecting everyone from harmful UV radiation from the Sun that is becoming thinner and has 'holes', resulting in more UV radiation getting through to the surface of the Earth and increasing the likelihood of more organisms getting skin cancer and cataracts. It is also affecting the plankton population – which is an important food supply for many animals.

Chlorofluorocarbons (CFC's)

The thinning of the atmosphere is caused by our use of chlorofluorocarbons. They get into the upper atmosphere where they are broken down into elements like chlorine – which destroys ozone. (1 chlorine atom can destroy 100,000 ozone molecules.

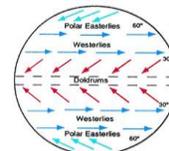
Environmental Transport

There are three stages of transport of substances in the environment:

- **Release** of chemicals at the source
- **Dispersion** of the chemical into the atmosphere
- **Deposition** of the chemical in soil or water

Transport In Air - The direction and distance that airborne chemicals travel are determined by various factors, including:

- The properties of the chemical pollutant
- The wind speed
- The direction of the prevailing winds
- The distribution of particles may also be limited by lack of wind or precipitation.



Groundwater Transport

Water soaking into the soil is collected in a zone called the **groundwater zone**. The top of the groundwater zone in the soil is called the **water table**. Groundwater moves sideways, up or down and can move very slowly (1 meter per year) or very quickly (1 meter per day). Some contaminants remain collected in the groundwater for long periods of time (because they are heavy metals), posing problems if the groundwater is used for drinking, agricultural purposes or industrial use. One factor that affects the movement of contaminants in groundwater includes the number and connection of **pores** (tiny spaces between soil grains) in the soil. When the pores are packed together very tightly and are not connected, the soil is considered **impermeable**. If the pores are connected the soil is **permeable** and water can move through easily.

Surface Water Transport - Hazardous chemicals can enter surface water from the air, the groundwater, runoff from agricultural fields and industrial sites and outflow from storm sewers and sewage treatment plants.

Soil Transport - Water is moved in one of four ways: evaporation, absorption by plants, runoff (into surface water) and soaking into soil dissolving substances (**leachate**). **Packed clay** is **impermeable** (so fluids won't pass through it). **Organic material** can absorb fluids and slow their movement through the soil. Hazardous chemicals can be changed by what other chemicals are present in the soil. (acids can be neutralized by naturally occurring bases – like limestone)

Hydrocarbons In Soil

The daily use of hydrocarbons in vehicles and industry contaminates the soil. Hydrocarbons are toxic to plants and animals.

Changing Concentration of Harmful Chemicals

Dispersion is the scattering of a substance away from its source.

Dilution reduces the concentration of a pollutant by mixing it with large quantities of air or water.

Bacteria

Some bacteria grow and reproduce only when oxygen is present. They use the oxygen for the process of **aerobic** biodegradation. When oxygen is not present – in an **anaerobic** environment (like deep in landfill sites) - some bacteria remove chlorine from harmful chlorine-containing compounds, such as **PCB's** (polychlorinated biphenyls - human made oils used in electrical equipment), by replacing them with hydrogen atoms – which can then be used as food for the bacteria.

Biodegradation

Biodegradation occurs in the environment because living things (earthworms, bacteria and fungi) are actively breaking down organic substances, including many pollutants. The existing organic molecules provide carbon atoms, which are used to build biological compounds, such as carbohydrates and proteins. This is a multi-step process - large organic molecules are broken down (hydrolyzed) either inside or outside bacteria.

Factors Affecting Biodegradation

- temperature
- soil moisture
- pH
- oxygen supply
- nutrient availability

Bioreactors speed up the rate of biodegradation by adding water to organic waste in a sanitary landfill site. Planting vegetation also encourages faster biodegradation because populations of bacteria and fungi are larger around plant roots meaning more microbial activity.

Phytoremediation

Phytoremediation is a technique that can be used to reduce the concentration of harmful chemicals in the soil or groundwater. Plants are used to clean up metals, hydrocarbons, solvents, pesticides, radioactive materials, explosives, and landfill leachate. The plants absorb and accumulate large amounts of these chemicals. When the plants have matured, they are harvested, then burned or composted. In some cases, the metal can be recycled. When most of the harmful chemicals are removed by phytoremediation from the soil, other plants can be planted.

Photolysis

Photolysis is the breakdown of compounds by sunlight. The formation of ozone and photodegradable plastic are examples of this process. These substances react when exposed to sunlight. It becomes a fine substance that is much easier to dispose of.

Biomagnification (or bioaccumulation)

This process is the increase in the concentration of a chemical or element as it moves up the food chain.

