**CHAPTER FIVE ()**

**GLOBAL ENVIRONMENTAL PROBLEMS DUE TO AIR POLLUTION**

**5.1. Learning Objective**

After the completion of this chapter, we will be able to:

1- Describe the factors that contribute for global warming

2- Identify the different greenhouse gases.

3- Enumerate the potential adverse health effects of global warming.

4- List different international responses to ozone Depletion.

**5.2. Introduction to the chapter**

The CO2 concentration in the atmosphere is 25% higher than what it was at the beginning of the century. Large scale deforestation, burning of chemical and fossil fuel have created this increase. Climatologists believe that even a small increase atmospheric CO2 can have major effects on climate. CO2 is transparent to incoming visible sun energy, but like glass, it absorbs infrared heat reradiated from the earth's surface. This is called greenhouse effect. The earth planet has already been warmed by 0.8 to 2.5 oC and is going to get hotter by 3 to 5 oC within the next country It is feared that even a slight increase in temperature would cause the polar ice

caps to melt and rise the sea level, submerging a number of major cities of the world, because many are along the seacoast.

**5.3. Global warming**

**What is global warming?**

* The fate of solar energy when reached the earth.
* Absorption by earth and natural greenhouse gases (CO2, CH4, water vapor);
* Infrared radiation reflection by earth’s crust;
* Infrared radiation absorption by the greenhouse gases;
* Infrared radiation [retention](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AD%D8%AC%D8%B2%20%D8%A7%D9%88%20%D8%AD%D8%A8%D8%B3) by greenhouse gases;
* Resulting in an acceptable level of temperature at the earth at 15 0C
* Could have been 19 0C less if the reflected heat from the earth escaped to the space.
* IR absorption by greenhouse gases, as a function of concentration of these gases.

**Anthropogenic (man-made) “greenhouse gases” and their sources:**

1- CO2: fossil and bio-mass fuel burning, forest fire, etc.

2- NO**2**: N**2** containing [fertilizers](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D8%B3%D9%85%D8%AF%D8%A9) processing, vehicles.

3- CH4: animal [dung](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%B1%D9%88%D8%AB) decomposition, [waste landfills](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D9%85%D9%83%D8%A8%20%D8%A7%D9%88%20%D9%85%D9%82%D9%84%D8%A8%20%D8%A7%D9%84%D9%86%D9%81%D8%A7%D9%8A%D8%A7%D8%AA), wet lands, etc

4- CFCs: factories.

5- CO**2** and CFCs are main contributors to IR absorption:

1980 UNEP IR absorption contribution: 55%, 24%, 15% 6% by CO**2**, CFCs, CH**4**, Nitrous oxide, respectively.

**Potential health effects due to global warming General points:**

- Average earth’s temperature variation:

- 0.60C/past 100 years; forecasted: 1-3.50 C/next 100 years

- (an increase of 10C/700 yrs versus today 10C/35 yrs).

- An increase of 20C would result events not seen before 125 000 years ago. Variations in climatically factors: wind velocity, rainfall, etc.

- Variations in the ability to respond to the effects: economics and susceptibility.

**Effects: Direct and Indirect:**

**A/ Direct effects:**

1. Thermal extreme effect: (heat waves) the skin, CNS( Central Nervous System). and [Circulatory system](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%AF%D9%88%D8%B1%D8%A9%20%D8%A7%D9%84%D8%AF%D9%85%D9%88%D9%8A%D8%A9) the most affected: [thermoregulation disturbance](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D8%B6%D8%B7%D8%B1%D8%A7%D8%A8%20%D8%A7%D9%84%D8%AA%D9%86%D8%B8%D9%8A%D9%85%20%D8%A7%D9%84%D8%AD%D8%B1%D8%A7%D8%B1%D9%8A); [heat stroke](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%B6%D8%B1%D8%A8%D8%AA%20%D8%B4%D9%85%D8%B3) and [exhaustion](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D8%B1%D9%87%D8%A7%D9%82), decreased male fertility, [cerebro -vascular stroke](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%B3%D9%83%D8%AA%D9%87%20%D8%A7%D9%84%D8%AF%D9%85%D8%A7%D8%BA%D9%8A%D8%A9), etc.
2. Effect on the respiratory organs: persons with [chronic diseases](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%85%D8%B1%D8%A7%D8%B6%20%D9%85%D8%B2%D9%85%D9%86%D8%A9) like [asthma](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%B1%D8%A8%D9%88), [bronchitis](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%B4%D8%B9%D8%A8%20%D8%A7%D9%84%D9%87%D9%88%D8%A7%D8%A6%D9%8A%D8%A9), [cardiovascular](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D9%82%D9%84%D8%A8%20%D9%88%D8%A7%D9%84%D8%A7%D9%88%D8%B9%D9%8A%D8%A9%20%D8%A7%D9%84%D8%AF%D9%85%D9%88%D9%8A%D8%A9) are the most affected.
3. Weather instability and [natural calamities](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D9%83%D9%88%D8%A7%D8%B1%D8%AB%20%D8%A7%D9%84%D8%B7%D8%A8%D9%8A%D8%B9%D9%8A%D8%A9): cyclones, landslides, [draught](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D9%86%D9%87%D9%8A%D8%A7%D8%B1%D8%A7%D8%AA), flooding, etc.

**B/ Indirect effects:**

1. [Vector borne diseases](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D9%85%D8%B1%D8%A7%D8%B6%20%D8%A7%D9%84%D9%85%D9%86%D9%82%D9%88%D9%84%D8%A9%20%D8%A8%D8%A7%D9%84%D8%AD%D8%B4%D8%B1%D8%A7%D8%AA): mosquitoes (malaria, yellow fever, [rift](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AA%D8%B5%D8%AF%D8%B9) valley fever); Tsetse fly (African sleeping sickness); Fly (faecooral related diseases, [onchocerciasis](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AF%D8%A7%D8%A1%20%D9%83%D9%84%D8%A7%D8%A8%D9%8A%D8%A9%20%D8%A7%D9%84%D8%B0%D8%A6%D8%A8), [leishmaniasis](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D9%84%D8%B4%D9%85%D8%A7%D9%86%D9%8A%D8%A7), [schistosomiasis](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A8%D9%84%D9%87%D8%A7%D8%B1%D8%B2%D9%8A%D8%A7).)
2. [Waterborne diseases](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D9%85%D8%B1%D8%A7%D8%B6%D8%A7%D9%84%D9%85%D9%86%D9%82%D9%88%D9%84%D8%A9%20%D8%A8%D8%A7%D9%84%D9%85%D8%A7%D8%A1): due to water [shortage](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D9%86%D9%82%D8%B5) & [contamination](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AA%D9%84%D9%88%D8%AB).
3. Sea-level rise: damages fresh water, affects soil salinity,
4. Agricultural productivity:
* Reduced rainfall; increased [pests](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D9%88%D8%A8%D8%A6%D8%A9); decreased soil fertility; decreased farming land, etc.
* Affects both [staple foods](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%A7%D9%84%D8%A7%D8%BA%D8%B0%D9%8A%D8%A9%20%D8%A7%D9%84%D8%A7%D8%B3%D8%A7%D8%B3%D9%8A%D8%A9) & [horticulture harvesting](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AD%D8%B5%D8%A7%D8%AF%20%D8%A7%D9%84%D8%A8%D8%B3%D8%AA%D9%86%D8%A9); and animal [husbandry](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%AA%D8%B1%D8%A8%D9%8A%D8%A9).
* Food shortages and [malnutrition](file:///D%3A%5C%D9%85%D8%AD%D8%A7%D8%B6%D8%B1%D8%A7%D8%AA%5Cmsc%20class%5CAir%20pollution%5CLecutres%5C%D8%B3%D8%A4%20%D8%A7%D9%84%D8%AA%D8%BA%D8%B0%D9%8A%D8%A9);
1. Air pollution impact: increased pollen; concentration of pollutants;
2. Impacts to socio-economic development.

**5.4. OZONE DEPLETION**

**Identity**: found in stratosphere in nature as O3; its detection in troposphere (ground level) is an indicator of pollution.

**Its role**:

* Solar radiation: 55% IR; 40% visible light; 5% UV.
* Acts as a UV protective blanket (layer).
* UV radiation includes three bands: UVA (400-320nm); UVB (320-280nm); UVC (280-200nm), far UV (< 50nm).
* It blocks nearly all UVC, half UVB, and small part UVC.

**Mechanism for UV blocking:**

􀂾 Equilibrium in nature between destruction and production of O**3**.

􀂾 O**2** → O+O (energized by UVC)

􀂾 10+O**2**→ O**3** + IR (production of Ozone)

􀂾 O**3** + UV → O2+O: (destruction of Ozone as energized by UVB)

**What causes Ozone depletion?**

**•** Human activity: release of halogenated hydrocarbons: CFCs; CCI4;

**•** Are used as refrigerants, propellants, solvents, foam production, etc.

**•** Are stable under normal conditions in the troposphere.

**•** These volatile chemicals become active with the presence of UV to react with O3;

**The reaction:**

1. CCI**2**F**2** + UV → CCIF**2** + CI-

2. CI- + O**3** → CIO + O**2**

3. CIO +O→ CI- + O**2**

4. Net: O**3**+O→2O**2** (Chlorine atom acts as a catalyst).

**Potential adverse effects:**

* + UVC is absorbed by O3, (does not reach the earth);
	+ UVB and UVA reach the earth.