

Last time we were talking about different groups of air pollutants, like:

1. **Methane**; and we mentioned that methane is one of the threatening gases for the whole planet, considering it dangerous not only because of its toxic effect on human beings directly but also their impact on the environment.
2. Major halogens containing compounds such as: CFCs
3. Metals as pollutants: lead; a very useful metal that has been mined for thousands of years.
4. **Particulate matter**:

We talked about PM10. We said that it is dangerous below 10 (pm <10 μ m) → **(we call it respirable fraction of dust)**

Nowadays the most dangerous particulate matter is PM2.5 (pm=2.5 microns)

***primary air pollution in the United States:** if we took a sample from the street we will find that it's composed of:

15% VOCs: kind of a high level there, because of large no. of vehicles and huge no. of forests

5% PM: we don't know if this ratio is high or not in America. But in Jordan, it is higher than that; because the amount of rainfall here is low; we spend long periods of time without rain, which allows dust to remain in the atmosphere for longer periods, but after the rain falls, the weather becomes more clear.

48% CO

16% SO₂

16% NO_x

Those percentages we don't really feel them, they are hypothetical. To show the relationship between these percentages and reality, one person brought detecting apparatus for SO₂ أجهزة رصد from different areas and monitored the SO₂ levels continuously, at the same time, he monitored the admission to hospitals in these areas. He took **respiratory tract** admissions then discovered that the levels of SO₂ and the admission to the hospital for respiratory tract problems are related.

The effects of air pollutants:

Damage to the tissue: lungs; this effect is determined by CO levels in the blood

As a doctor in the future, this is one of the tests you may do for some people that you think they have problems with CO level. You can trace the CO level in their blood and see the

increase. The difference between a smoker and a non-smoker can be known by measuring CO level.

In good smokers (those who smoke so much) the level of carboxy hemoglobin (Hb+CO) reaches 20%, we have 5 liters (in average) of blood, so as if you prevented 1 liter (20%) of the blood in your body from working and transporting oxygen, at the best you are using 80% of your blood, so, no matter how strong he was, he will get tired faster (for example upon running, or climbing the stairs) compared to non-smokers of his age with same size or weight. This is a question asked by heart specialists “when you are with your friends at your age, do you get tired faster than them when running etc.”

Pollutants were classified according to their effect on health into:

1. Irritant
2. Asphyxiant
3. Respiratory and heart problems
4. Cancer-causing pollutants
5. Sudden death

Pollutants can affect: humans, animals, plants, materials, and we can also add the total environment (even though the first 4 are part of the environment, there are effects like greenhouse phenomena and acid rain that affect the total environment).

The impact of pollutants on humans’ health is based on the following factors: (those factors are not only for air pollution but also for water pollution)

1. Host related factors: Age, health status of the receptor
2. pollutant (the toxic material) related factors; nature of the pollutant, concentration and duration of exposure
3. environment related factors (environmental conditions)

If we have a drug, and we left it for long time without using it, there is an expiry date, if we use it a period of time after the expiry date we are not going to get the same effect, what happened? It depends on Environmental conditions we left it in; it will differ if the drug was left in a cold or hot weather, dark or lightened place; that’s why most of the bottles are colored because we don’t want light to get in, because we have what are called photochemical reactions which light can start. Temperature can also affect materials. So, toxicity of materials can be affected by these conditions.

We will take this as physicians later, when we have an outbreak of a given illness, intoxication etc. Not all of us would be affected by it, for example, cancer; we all live in the same environment, some of us develop cancer while others don’t. According to the theory that states that “if we live for 120 years without dying from anything all of us would die from cancer” it’s a matter of time, but still there are factors that affect the effects on each person.

Once the doctor did a study on the impact of Dimethoate (a pesticide used in AL-Aghwar) on workers as he suspected that its toxicity level is far worse than that indicated on the label because he was seeing affects that reflect a toxicity that is worse than that on the label. The label wasn't wrong because it was written in England where they take care of these things, The doctor then discovered that this study was also done in South Africa on the workers and they found the same result, the reason for this difference is explained by the temperature of storage; England has usually low temperatures while in Jordan (since it is used in AL-Aghwar) and south Africa temperatures are higher → changes happen in the material → dimethoate's toxicity increases (dimethoate's toxicity increases with the increase in temperature)

That's how toxicity is sometimes influenced by environmental conditions; you will see later that if your patient was exposed to a certain material during day it will be different if he was exposed to it at night due to different conditions.

- Once an ill person went to one of the hospitals (an ex-hospital) and they discovered that he was poisoned by one of the pesticides, they gave him the right treatment, and because he was young, they admitted him to hospital for observation for 12 hours; he came at night, they kept him till morning (just in case), in the morning they found him dead in his bed, everybody was shocked, but the real reason was his clothes (unfortunately none of the doctors there checked them), they were contaminated with the pesticide as well, he was getting better due to the drug they gave him but during night the absorption from skin increases because the circulation becomes more active. Who to blame? (everybody there ;doctors, nurses, etc. threw the blame on the other person and so on until the case was forgotten with no one to blame).

A real life story: Once a doctor was put in prison because he was considered as the weakest ring in a team that didn't accompany an injured confused patient to the x-ray, this patient came alone, so he entered an open dark remote room in the hospital, but it wasn't officially opened, by coincidence there was a person there from maintenance, the patient found a chair and sat on it, when the maintenance guy was done with his work he left the room and locked the room behind him, when the patient woke up, he knocked on the door but no one opened it for him, they found him dead after 1 or 2 days. (When you find a confused patient you either take him by the hand to the x-ray room, or get him a nurse to accompany him).

The effects of air pollutants on the environment:

A. On the atmosphere:

1. Changing the color of the atmosphere (it is normally translucent); if it was affected by NO_x the color would change to yellow- brown, and that's because of NO_x absorption of sunlight spectrum (7 colors) and reflecting only the yellow and if you increase their amount in the air the orange will be reflected and the resulting color will be "yellow to brown". This

phenomenon can be seen in San Francisco and Los Angeles. (an indicator of high NO_x compounds).

2. It affects Precipitation (الهطول)

Dust particles can act as nuclei around which water droplets accumulate and then start to fall. That's why you see that the size of the rain is more than usual.

Once, We did experiments about synthetic rain الاستمطار (adjacent countries protested on it), what happens is that we have special air planes with special kind of crystalline materials, they go to a level above clouds and spray it, when it reaches the cloud, it acts as a nucleus, water drops accumulate, and start to drop instead of losing these clouds somewhere else, they could tell the difference by the size of rain, in synthetic, the drops are larger than usual.

3. Changing the pattern of rain: the amount of rain is constant (so if we have more rain in an area this means that another area is deprived of this rain); the middle area of America (drawing a line from north to south of America) used to have a good amount of rain for agriculture and raising cattles, all of a sudden due to changes the rain started to fall away from it, it lost rain and because there is no infrastructure البنية التحتية to bring new water for irrigation, a large problem happened that changed the agricultural map of America and the areas of raising cattles.

4. Changing the visibility of the atmosphere (the distance you can see through): air navigators; they need a certain distance of vision to be able to react if something (mountains, other airplanes) suddenly appeared (they need 7 miles; which is a large distance due to the high speed of the plane). Many countries around the world stopped navigation due to this phenomenon.

For example: Different countries stopped the air traffic when the volcano in Ireland erupted and affected the visibility of air navigators. Smoke and Suspended dust particles gave the atmosphere a black color that prevented vision.

B. on the general environment (3 phenomena):

1. **Greenhouse phenomena** (Global warming, ظاهرة الصوييا-المدفأة): warming the atmosphere by the presence of certain materials.

Greenhouse gases: NO_x , CH_4 (methane), CFCs and the most important of all CO_2 .

Carbon dioxide is the most important because of its high concentration. Even though its efficacy in warming is low (CFCs for example have a higher efficacy); it is responsible for 60-70% of the impact. Methane is starting to be of an importance because it has an efficacy that is much higher than that of CO_2 , but it has a low concentration, so, if its concentration increased rapidly, it will become very dangerous on the environment.

*note: In normal weather carbon doesn't react with oxygen, they need energy, if you increase temperature CO will form, if you increase it more it will become CO₂, but high temperatures are needed (speaking of temperatures around 400-600 degrees), not like the normal ones, or else there will be no oxygen left in the atmosphere.

These gases allow UV light to get through to the earth and warm it up, and then the ground will try to get cooler by radiating infrared which hits the gaseous compounds and reflects back to the ground raising its temperature more than usual. To end life on earth you only need a temp. That is 2 or 3 degrees higher; because of

- 1- The expansion of the water in the oceans, so it will cover the majority of earth.
- 2- It will increase the rate of ice melting in north and south poles as well as Greenland etc.
- 3- one that we are afraid of is the change of the pattern of diseases, for example African sleeping sickness, will not be African anymore, it might become European or Mediterranean, and those people are not used to these types of creatures and will die quickly from this.

It will be a famine; areas good for agriculture will be lost and people will have to leave their places and go somewhere else (emigration) and this would make wars and famines. Many crops especially cash crops will be affected easily by this extra heat and will die. Fish also can be affected. That's how this phenomenon can end life on earth.

2. Effect on the ozone layer (ozone layer depletion)

3. Acid rain