

Air Pollution and Human Respiratory System in the Course of Study Related to the Biological Science at Various Levels

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Abstract - The Earth is the only one living planet of Solar System. The Earth is surrounded by ozone layer which forms the sky around the Earth. Between Sky & Earth the biosphere is present. In biosphere the gaseous mixture (the air) is present, the air is essential for lives due to presence of oxygen. Day by day the air or atmosphere is polluting continuously with increasing of several pollutants in air. The respiratory system of living organisms is directly communicated with atmosphere. During the processes of respiration the air pollutants also enter with oxygen in the respiratory system and then also enter the body and create various diseases. This paper advocates the study of human respiratory system with the studies of air pollution & caused diseases should be know at every learning & Communicating Stages of day by day life.

Keywords: Air Pollution, Aerosole, Respiration, Diseases.

Introduction

Our planet Earth is the only living planet of solar system and has a dynamic atmosphere, which sustain Earth's surface Conditions and protects it from most materials and UV-light at entry. It has a composition of primarily nitrogen and oxygen. Water vapor is widely present in the atmosphere, forming clouds that cover most of the planet. The water vapour acts as a green-house gas and, together with other greenhouse gases In the atmosphere, particularly carbon dioxide (CO₂), creates the conditions for both liquid surface water and water vapour to persist via the capturing the of energy from the sun's light. This process maintains the current average surface temperature of 14.76°C, at which water is liquid under atmospheric pressure. Differences in the amount of captured energy between geographic region drive atmospheric and ocean currents, producing a global climate system with different climate regions, and a range of weather phenomena such as precipitation, allowing competent such as nitrogen to cycle.

Human activities generate a tremendous amount of waste materials; these are discharged in various components of the environment in which they bring about undesirable changes.

This process is called environmental pollution which has been defined as an undesirable change in physical, chemical, or biological characteristics of air, water land that will be or may be harmful to human and other life, industrial process, living conditions and cultural assets or cause wastage of our raw material resources.

Air Pollution

The atmosphere is an insulating blanket around the Earth. It is source of essential gases, maintains a narrow difference of day and night temperatures and provides a medium for long-distance radio communication. It also acts as shield around the Earth against lethal UV radiations and meteors. Without atmosphere, there will be no lightning no wind, no clouds, no rains, no snow and no fire.

Living beings inhale quantity of air. About 90% of man's total daily intake of materials good, water and air- is contributed by air. An average human being breathes about 22,000 times a inhales about 16 kg of oxygen. The pollution of air, therefore, may have a profound influence on living organisms. Unfortunately, an alarming quantity of gases, particulate material, fumes, vapours and smoke is discharged daily into the atmosphere. Some of it sold settles down or is brought down by precipitation but much of the injourus material stays back in the atmosphere. On for global scale the pollutants which account almost 98% of the total pollution are:

(i)	Carbon monoxide	52%
(ii)	Sulphur dioxide.	18%
(iii)	Hydrocarbons	12%
(iv)	Particulates	10%
(v)	Oxides of Nitrogen	6%
Total		98%

Aerosol Accumulation and its cause's problems in atmosphere

Particulate material present in the atmosphere air most include very fine and large particles, having dust particles, various types of fumes, various, pollen grains, fungal spores, algae, bacteria etc. Very small particles which are so light that turbulence of air keeps them almost permanently are known as

aerosols. Much of the smoke derived from the combustion of organic matter, coal, petroleum and natural gas, forest fires, volcanic emissions etc. comes under the category of very fine particles or aerosols.

Problems caused as a consequence of accumulation of aerosols in the atmosphere are of diverse nature which depends chiefly on the size of particles, their chemical nature, whether toxic or nontoxic and whether the particles are viable or non-viable, these are the following problems:

- (i) A dense layer of aerosols in the atmosphere blocks a considerable portion of solar radiation.
- (ii) Aerosols provide a suitable nucleus or locus on which vapours in the atmosphere condense and this accelerates precipitation.
- (iii) Air currents are able to disperse aerosols far and wide. Thus aerosols composed of toxic metals and trace elements are also transported to great distances and deposited at places far removed from the place of their origin.
- (iv) Viable particulate material in the atmosphere is responsible for the dissemination of many pathogenic diseases and allergenic agents of various types.
- (v) The fine particles are capable of penetrating deep inside the lungs of organisms and cause various respiratory ailments. Some of the aerosols are potential carcinogenic agents. Inhalation of these particles irritates lungs and exposure for long duration causes or fibrosis in the alveolar lining.

Aerosols and the Respiratory Systems

Air passage in higher animals, including man, is lined internally with small ciliated cells which are covered by a layer of watery, gummy like substance- the mucus. Particles above 5 μm in diameter are trapped in the mucous lining, propelled up by coordinated movement of cilia to the throat from where they are coughed out or swallowed. Within about twenty minutes of inhalation they are cleared from the respiratory track. However, in spite of such an efficient filtering mechanism some particles do reach alveolar chambers of lungs where actual gaseous exchange takes place. These particles are those which have a diameter usually less than 5 μm .

Toxic particulate materials like coal, mica, talc and some of crystalline forms of silica, may injure or kill alveolar macrophages. Elongate asbestos fibers which are less in cross section may also reach the alveolar lumen. These fibers are many times longer than the actual diameter of the macrophage and hence are incompletely covered. In such cases a cytoplasmic sleeve forms covering the entire fiber and a number of macrophages may have to fuse together to engulf

these fibers. Particles released from dead macrophages are engulfed again by newly formed macrophages. As these macrophages tend to adhere to alveolar wall they are covered by newly formed epithelial cells. The cyclic engulfment of aerosols by macrophages, their release and epithelialization results in the formation of nodules which may grow large enough to block the alveolar lumen, making it completely defunct. With aging of nodules collagen fibers are laid down and a developed nodule resembles a ball of gummy wood. The phenomenon is known as fibrosis,

Human Respiratory system

The main functions of respiration are to provide oxygen to the tissues and remove as most tissues carbon dioxide. In the body survives oxygen to produce energy, there is a requirement for a continuous supply of oxygen and removal of carbon dioxide. The four major components of respiration are as follows:

- (i) Pulmonary ventilation, which means the inflows & out flow of air between the atmosphere and the lung alveoli.
- (ii) Diffusion of oxygen and carbon-dioxide between the alveoli and blood.
- (iii) Transport of oxygen and carbon dioxide in the blood and body fluids to and from the body's tissue cells.
- (iv) Regulation of ventilation and other facets of respiration.

The respiratory System in humans has evolved to include the following structures:

- (i) The lungs.
- (ii) The conducting airways, including the oral and nasal cavities.
- (iii) The nerves that control respiration and the respiratory centers in the central nervous system.
- (iv) The structures involved in moving air in and out of the lungs such as:
 - a) Rib cage.
 - b) Intercostal Muscles.
 - c) Diaphragm
 - d) Abdominal Muscles.

The organs for respiration are in two numbers, the left and right and they are divided into lobes. The right lung is divided into three lobes (upper, middle and lower lobes) and the left lung is divided into two lobes (upper and lower lobes). The lungs are covered by thin membranous layers called pleura. The visceral pleura line the lungs and are separated from the parietal pleura by pleural space or cavity, which is filled by pleural fluid. This interface helps the lungs to glide smoothly during inspiration and expiration.

The air is distributed to the lungs by way of the trachea, bronchi and bronchioles.

The trachea branched out into two main bronchi, which further branch out into lobar bronchi that connect each lobe. These lobar bronchi further branch out into Segmental bronchi and into smaller branches until they reach the terminal bronchioles, which are the smallest airways without alveoli attached. All these airways do not participate in any gas exchange and are referred to as the "conducting zone".

The terminal bronchioles are further divided into respiratory bronchioles. These bronchioles differ from the terminal bronchioles because they have alveoli occasionally attached to their wall. The respiratory bronchioles lead to the alveolar ducts and finally to the alveoli. This region where alveoli are present in the lungs and where gas exchange takes place is called the "respiratory zone".

The respiratory unit is the terminal portion of respiratory tract. The exchange of gases occurs only in this part of the respiratory system. The respiratory unit starts from the respiratory bronchioles. Each respiratory bronchiole divides into alveolar ducts. Each alveolar duct enters the enlarged structure alveolar sac. The space inside the alveolar sac contains the alveoli. Few alveoli are present in the wall of alveolar duct also.

The blood vessels in the lungs form a capillary network beyond the terminal bronchiole i.e., in the respiratory unit. The capillaries are formed by endothelial cells. The alveolar membrane and the capillary membrane are together called the respiratory membrane. The respiratory membrane separates air in the alveoli from blood in capillary. Respiratory membrane has a surface area of 70 sq. meters and thickness of 0.5 microns.

Non Respiratory Functions of Respiratory Tract

During expiration, through the expired air there is evaporated water and during expiration of water some amount of heat is lost from the body. During expiration, small amount of water is also lost along with the heat and some amount of water of body is reduced by the process of expiration.

Lungs play an important role in maintaining the acid base balance of the body by regulating the carbon dioxide content in blood. Carbon-dioxide is produced during various metabolic reactions in the tissues of the body. When it enters the blood, carbon-dioxide combines with water to form carbonic acid. Since carbonic acid is unstable, it splits into hydrogen and bicarbonate ions.



The entire reaction is reversed in lungs when carbon dioxide is removed from blood into the alveoli of lungs.



As carbon-dioxide is volatile, it is practically blown out by ventilation.

When metabolic activities are accelerated, more amount of carbon dioxide is produced in the tissues and the concentration of hydrogen ion is also increased leading to reduced pH. The increased hydrogen ion concentration causes increased pulmonary ventilation i.e. hyperventilation by acting through various mechanisms like chemo-receptors in aortic and carotid bodies and in medulla of the brain. Due to hyperventilation, the excess of carbon dioxide is removed from the body fluid and the pH is brought back to normal.

The dust particles entering the nostrils are prevented from entering lungs by the filtration action of the hairs of nasal mucus membrane. The alveoli are lined by the pulmonary alveolar macrophages. Those dust particles, which escape the nasal hairs and nasal mucus membrane are destroyed by the phagocytic action of the macrophages.

The particles which escape the above protective mechanisms in nose and alveoli are thrown out by cough reflex and sneezing reflex. The leukocytes, particularly the neutrophils and lymphocytes present in the alveoli of lungs play an important role in the defence mechanism against bacteria and virus. The pulmonary alveolar macrophages also play an active role in the defence mechanism of lungs. Macrophages engulf the dust particles and the pathogens entering the alveoli and thereby act as scavengers in lungs.

Lungs contain the mast cells, which secrete heparin. Heparin is an anticoagulant and it prevents the intravascular clotting.

Endothelial cells of the pulmonary capillaries secrete the angiotensin converting enzyme (ACE). This converts the angiotensin I into active angiotensin II. Lung tissues are also known to synthesize the hormonal substances - prostaglandins, acetylcholine, bradykinin and serotonin.

Respiratory Health concern

Diseases are caused by Air Pollution

- (i) Respiratory symptoms including cough, phlegm and wheeze.
- (ii) Acute, reversible decrement in pulmonary function.
- (iii) Inflammation of the airways and lung (this is acute and neutrophilic).
- (iv) Bronchial hyper-reactivity.

- (v) Acute phase reaction.
- (vi) Respiratory infections.
- (vii) Decreased lung function growth in children.
- (viii) Chronic loss of pulmonary function in adult.
- (ix) Asthama development.
- (x) Premature mortality in people with chronic lung disease.

Conclusion and Recommendations

Air pollution is one of the biggest environmental Pollution among various other types of Pollutions. Air pollution also the human respiratory System directly.

The respiration is the physiological process in which the organisms take oxygen & release carbon dioxide. During this process various kinds of air pollutants also enters in the human body with the oxygen and they cause the various diseases in human respiratory system.

Since the life sciences along with the physical sciences have received much more attention to revise and refresh course of study, there is an urgent need now to by emphasis on the protection of environment all over the world and thence to provide a better life to the living beings of this planet. In order to maintain a proper balance between the environment and human survival it becomes imperative to incorporate concepts of immediate concern that have direct implications not only to theory but practical work and their subsequent application for environmental protection and human Survival. This is also significant with the viewpoint to bring out social awareness towards the protection of environment, human survival and then to maintain the ecological balance.

Based on the present study, the following recommendations can be advanced.

- 1) Awareness towards health and hygiene through cleanliness of air and atmosphere.
- 2) It is commonly being experienced that the position is going from bad to worse when one takes into account the reduction of Ozone layer day by day since it is the Ozone layer which protects the lives of human beings from harmful radiations coming from different planets of the universe, which may create the atmospheric pollution.

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