



NEET Biology

Short Notes

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BREATHING AND EXCHANGE OF GASES

Introduction

Every living organism needs to obtain energy from the organic food either prepared by it (autotrophic organisms) or consumed by it (heterotrophic organisms). The process of oxidizing food to obtain the energy by using the oxygen and releasing the carbon dioxide is called the respiration. It is a physico-chemical process that includes the following:

1. Breathing: It is the physical intake of oxygen through the process of inhalation and giving out of carbon dioxide through the process of exhalation.
2. Cellular respiration: It is the chemical process of using the inhaled oxygen to oxidize the food and release carbon dioxide.

Respiratory organs

There are the following categories of organs involved in respiration:

1. Conducting parts: They clean, humidify and transport the air to the inside of the body.
2. Exchanging parts: These allow the exchange of oxygen and carbon dioxide between the blood and air.

Human Respiratory System

The human respiratory system is the tract that allows the air to move in from the nose to the lungs and also expel it through same way. There are following organs in the human respiratory system:

S. No.	Upper respiratory tract	Lower respiratory Tract
1.	Nostrils	Trachea
2.	Nasal Cavity	Lungs
3.	Pharynx	Bronchi
4.	Epiglottis	Bronchioles
5.	Larynx	Alveoli

Upper respiratory tract:

1. Nostrils: These are the openings through which the air enters and leaves the respiratory system.
2. Nasal cavity: The nostrils lead to the nasal cavity which has hair cells and mucus. The air is cleaned, moistened and warmed and allowed to move further in the respiratory tract.
3. Pharynx: It is a space that begins from the superior of the uvula and continues till the hyoid bone. It is shared by both the food coming from the buccal cavity and air coming from the nasal cavity. It is composed of ciliated epithelium that further traps the impurities in the air.
4. Epiglottis: It is muscular flap the cover the trachea while swallowing occurs to prevent the entry of food into the trachea.
5. Larynx: The air moves through the larynx to the trachea. The vocal cords present in larynx vibrate with air to produce sounds.

Lower respiratory tract:

1. Trachea: It is the windpipe that leads air into the lungs. It is lined by ciliated epithelium. On the outer surface, the C-shaped cartilaginous rings prevent the trachea from collapsing during breathing.



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2. Bronchi: The trachea branches into right and the left bronchus that enter into right and left lung respectively.
3. Bronchioles: Each bronchus in the respective lung divide to form bronchioles.
4. Alveoli: The bronchioles end up in sac-like structures called alveoli, which are supplied with blood vessels and act as the sites of exchange of gases.
5. Lungs: Each lung is surrounded by the double-layered serous pleural membranes that have pleural fluid present between them. These provide protection to the lungs and reduce friction. The upper part is called apex and lower is called base. The Left lung is smaller and has two lobes. The Right lung is bigger with three lobes.

Diaphragm: It is a muscular organ that separates the thoracic cavity from the abdominal cavity and plays an important role in the mechanism of breathing.

Mechanism of breathing

Breathing process is a sum of inhalation of air from outside to the lungs and exhalation of the air from the lungs to the inside. These occur in the following manner:

1. Inhalation:
 - a) Diaphragm contracts and pushes itself towards the abdominal cavity. This increases the volume in the thoracic cavity.
 - b) The external intercostal muscles contract and the ribs, as well as the sternum, move outwards.
 - c) The increased thoracic cavity and outwardly moved bones provide essential volume to the lungs, due to which the pressure inside lungs decreases.
 - d) Due to the pressure gradient, the atmospheric air is drawn in from outside (pressure is high) to the lungs (pressure is low)
2. Exhalation:
 - a) Diaphragm relaxes and moves towards the thoracic cavity, decreasing the volume.
 - b) Inter-costal muscles also relax and the bones move back inward. This reduces volume of the lungs.
 - c) The pressure of the lungs become more than atmospheric, so the air is expelled out.

Respiratory volumes

Tidal Volume (TV)	Volume of air inhaled or exhaled during normal breathing	500 mL
Inspiratory Reserve Volume (IRV)	Additional volume of air that can be inhaled by forceful inspiration	2500-3000 mL
Expiratory Reserve Volume (ERV)	Additional volume of air that can be exhaled by forceful exhalation	1000-1100 mL

Pulmonary Capacities

Residual Volume	Volume of air in lungs after forceful expiration	1100-1200 mL
Inspiratory Capacity (IC)	$IC = TV + IRV$	3000-3500 mL
Expiratory Capacity (EC)	$EC = TV + ERV$	1500 mL
Vital Capacity (VC)	Maximum amount of air that be breathed in or out	TV, IRV, ERV
Total Lung Capacity	Total volume of air in lungs after forceful inspiration	RV, TV, IRV, ERV



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Exchange of Gases

External exchange	Occurs between alveoli and blood	The partial pressure of oxygen (pO_2) is more in alveoli than in blood, so it diffuses in the blood while pCO_2 is more in blood than in alveoli, so it diffuses out of blood.
Internal Exchange	Occurs at the level of body tissues	In tissues, the pCO_2 is more due to respiration, so CO_2 moves in the blood and O_2 moves in the tissues because pO_2 is low in tissues.

Transport of Gases


Transport of Oxygen	98.5% of O_2 is transported via haemoglobin as oxyhaemoglobin. Rest is transported as dissolved in plasma. It is affected by the pH and partial pressure of the oxygen.
Transport of Carbon dioxide	5-7% through plasma; 10% through binding with haemoglobin; 85% as bicarbonate ions.

Disorders of Respiratory System

1. Asthma: Inflammation of bronchi and bronchioles resulting in difficulty of breathing and wheezing.
2. Emphysema: Damage to the walls of alveoli affecting transport of gases. Major cause is smoking.
3. Occupational Disorders: These are caused due to exposure to fine dust, smoke, chemical fumes in industries. Silicosis and asbestosis are common occupational disorders caused due to continuous exposure to silica and asbestos dust at work place.

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