

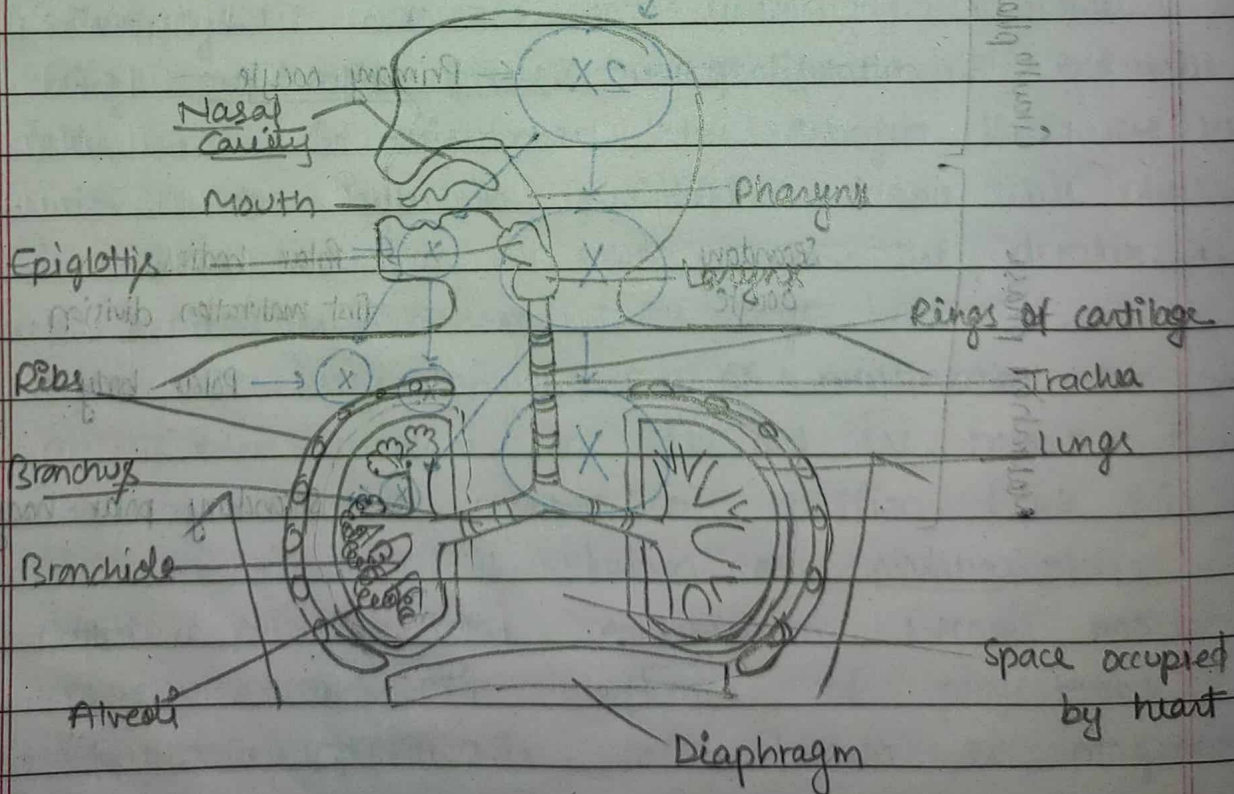
Respiratory System

The respiratory system is most important and significant system that play vital role in biological system. Some specific organs are used for the process of intake and exchange of atmospheric oxygen and carbon dioxide between an organism and the environment. Lungs are the most important organ of an respiration.

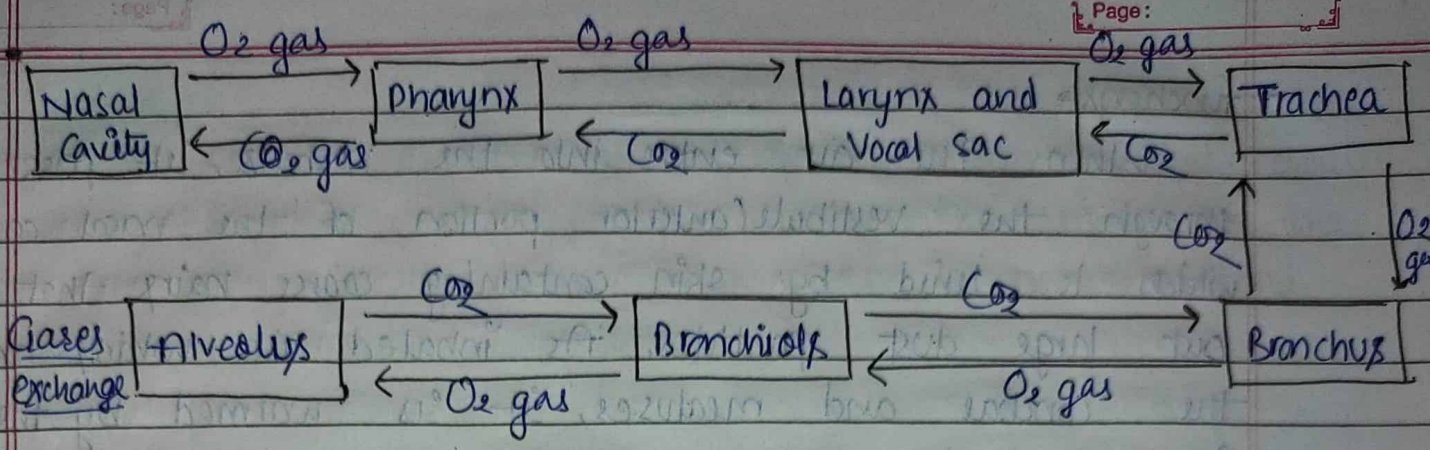
Two Basic mechanism are involved in respiration method via :-

- i) Inhalation → It is defined as the environments fresh air enter into the lungs through various organs and supplies to the blood (body) whereas,
- ii) Exhalation → It indicates equal out of unwanted CO_2 from the lungs to outside.

These two method are collectively known as breathing.



• HUMAN RESPIRATORY SYSTEM



• Respiration pathway

Breathing → A physical process in which the oxygen rich air is taken into the body and the foul air rich in carbon dioxide is released from the body.

Respiration → A chemical process of gaseous exchange between aquatic or atmospheric oxygen and tissue with simultaneous removal of carbon dioxide.

Diaphragm → A dome-shaped muscular sheet that forms a partition between the thoracic and abdominal cavities and helps in respiration.

Nose

- The external portion of the nose is made of cartilage and skin and is lined with a mucous membrane. Opening of external nares (nostrils).
- The internal portion of the nose communicates with the paranasal sinuses and nasopharynx through the internal nares.
- The nasal cavity is divided by a septum. The anterior part of the cavity is called the vestibule.
- The nose warms, moistens, and filters air and functions in olfaction and speech.

— functions —

When the air enters into the nostrils, it passes first through the vestibule (anterior portion of the nasal cavity), which is lined by skin containing coarse hairs that filter out large dust particles. As inhaled air whirled around the conchae and meatuses, it is warmed by the blood in capillaries. Mucus secreted by the goblet cells moistens the air and traps dust particles. The cilia move the mucus and trapped dust particles towards the pharynx, at which point they can be swallowed or spit out. Nose also function in olfaction and speech.

• Pharynx

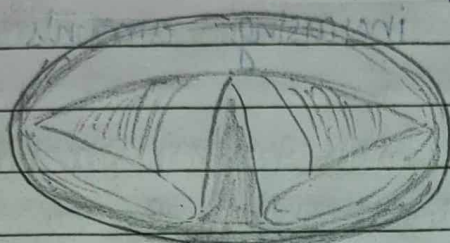
— The pharynx (throat) is a muscular tube lined by a mucous membrane. The anatomic regions are nasopharynx, oropharynx, and laryngopharynx. The nasopharynx is lined with pseudostratified columnar epithelium, and the cilia move the mucus down toward the most inferior part of the pharynx. The nasopharynx also exchanges small amounts of air with the auditory tubes to equalize air pressure between the pharynx and the middle.

— Oropharynx has both respiratory and digestive functions serving as a common passageway for air, food, and drink. It is lined with nonkeratinized stratified squamous epithelium.

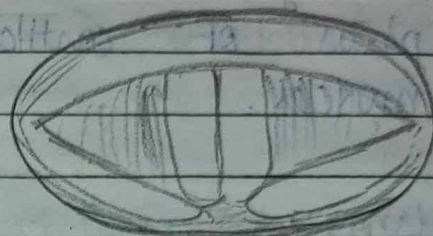
— Laryngopharynx or hypopharynx, also in both respiratory and a digestive pathway, lined by nonkeratinized stratified squamous epithelium.

Larynx

The larynx (voice box) is a short passageway that connects the laryngopharynx with the trachea. The lining of the larynx superior to the vocal folds is nonkeratinized stratified squamous epithelium.



Vocal cords open during breathing to allow air into lungs.



Vocal cords close when speaking so air from the lungs presses between them to cause the vibration that produces sound.

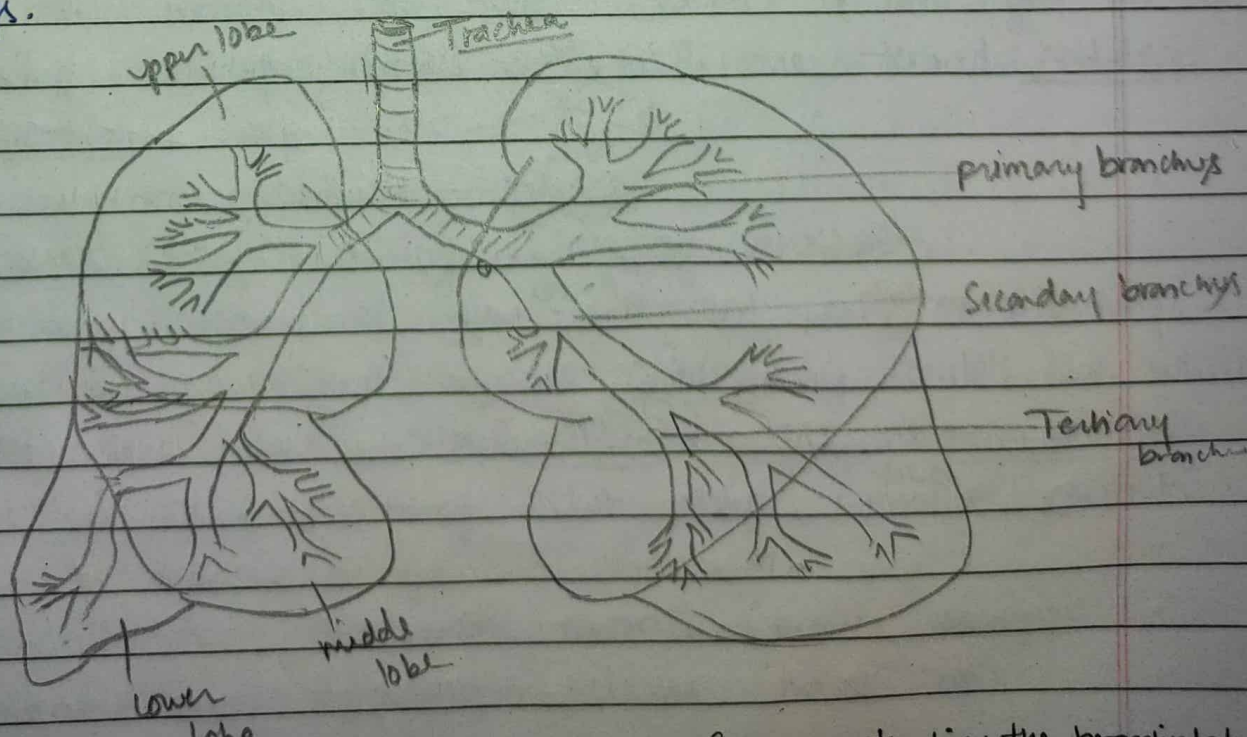
• Movement of the vocal folds.

Trachea

Trachea or (wind pipe) is a much longer tube which extends from the larynx to the upper end of the lungs.

It is composed of C shaped rings of cartilage which provide a semirigid support so that the tracheal wall does not collapse inward (during inhalation) and obstruct the air passageway.

It gives the pathway for the air from the pharynx to lungs.



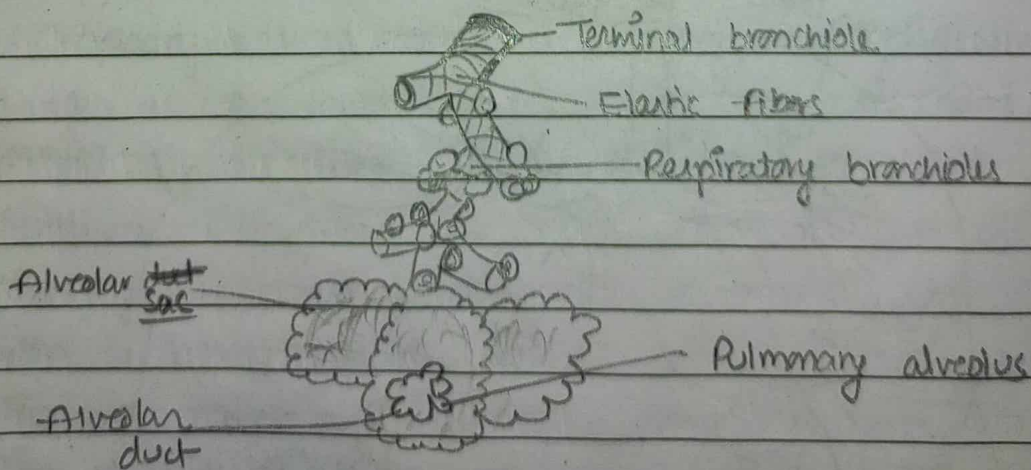
Branching of airways from the trachea: the bronchial tree.

• Branchi and Broncholes

The bronchial tree consists of trachea, primary bronchi, secondary bronchi, tertiary bronchi, bronchioles, and terminal bronchioles. Walls of bronchi contain rings of cartilage. Walls of bronchioles contain increasingly smaller plates of cartilages and increasing amounts of smooth muscles.

• Lungs →

There are two sac-like lungs which occupy the space in the thoracic cavity where they are protected by the sternum in front, ribs in front and on the sides and vertebral column at the back. From below, they are separated from the rest of the organs by a diaphragm which also closes the thoracic cavity from the lower side. Each lung has a double layered covering called pleural cavity, which consists of an outer membrane called parietal pleuron and the other close to the outer surface of lungs as visceral pleuron. The narrow space in between them is filled with pleural fluid.



• Microscopic anatomy of a lobule of the lungs.

• functions of the lungs

Lungs are paired organs in the thoracic cavity enclosed by the pleural membrane. Secondary bronchi branch into segmental bronchi, which supply segments of lung tissue called broncho-pulmonary segments.

— Each bronchopulmonary segment consists of lobules,

• Pulmonary Ventilation

(i) It is the inhalation (inflow) and exhalation (outflow) of air between the atmosphere and the alveoli of the lungs.

ii) External (pulmonary) respiration → It is the exchange of gases b/w the alveoli of the lungs and the blood in pulmonary capillaries across the respiratory membrane (blood gain O_2 and loses CO_2).

iii) Internal (tissue) respiration → It is the exchange of gases b/w ~~the~~ blood in systemic capillaries and tissue cells (blood loses O_2 and gain CO_2). Metabolic reactions within cells that consume O_2 and give off CO_2 during the production of ATP are termed cellular respiration.

• Pressure Change during Pulmonary ventilation.

The movement of air into and out of the lungs depends on pressure, which is governed by Boyle's law, which states that, the volume of a gas varies inversely with pressure, assuming that temp. remains constant.

⇒ • Inhalation - diaphragm contracts (moves down)
• exhalation - diaphragm relaxes (moves up)

• Lungs Volumes and Capacities

While at rest, a healthy adult average 12 breaths a minute, with each inhalation and exhalation moving about 500 ml of air into and out of the lungs.

- Tidal volume (V_T) \Rightarrow The volume of one breath.

- The minute ventilation (MV) \Rightarrow The total volume of air inhaled and exhaled each minute (respiratory rate) multiplied by tidal volume.

$$\begin{aligned} MV &= 12 \text{ breaths/min} \times 500 \text{ ml/breath} \\ &= 6 \text{ litre/min.} \end{aligned}$$

A lower than normal MV (usually) is a sign of pulmonary malfunction.

• Spirometer / Respirometer \Rightarrow the apparatus commonly used to measure the volume of air exchanged

during breathing and the respiratory rate in a spirometer or respirometer. The record is called a spirogram.

Inhalation is recorded as an upward deflection, and exhalation is recorded as a downward deflection.

• Inspiratory Reserve Volume (IRV)

It is the amount which can be inhaled with maximum effort after the normal amount has been inhaled. In this way 2000 to 3000 ml of air can be inhaled by an adult. This is in excess of tidal volume.

• Expiratory Reserve volume (ERV)

It is reverse of IRV i.e. an amount of air

which can be expelled from the lungs with maximum effort. This is possible because some amount of air is always left behind in the lungs after expiration. About 1000ml can be pushed out in this way.

- Residual volume

As mentioned above, this is the amount of air (1000-1500ml) which always remains behind in the lungs after normal ~~ex~~ respiration. / expiration.

- Vital capacity

It is the sum total of all the air that can be taken in and exhaled out of the lungs with maximum efforts.

It is calculated as the total lungs capacity but does not include the volume of residual air.

- Inspiratory capacity

It is the sum total of tidal volume and inspiratory reserve volume.

- Total lungs capacity

It is the total amount of air that can be inhaled with maximum efforts and also include the residual volume. Therefore, it varies about 4500-6000ml or $4\frac{1}{2}$ to 6 litres.

- Functional Residual capacity

It is the amount of air calculated by adding expiratory reserve volume and residual volume.

Disorders of Respiratory System

- i) Hypoxia → The word Hypoxia is formed by 'hypo' - low and 'oxia' - oxygen. It is a disorder in which less than the required amount of oxygen is available to the alveoli and to the tissue. The reasons may include high altitude, polio (neuro muscular disorders), lower than normal amount of haemoglobin which carries oxygen to the tissue as in anaemia, and obstruction of the air passage due to some sort of growth or asthma and damage to air sacs.
- ii) Pneumonia → It is a more serious disorder of the respiratory system in which there is infection of the alveoli due to bacteria, virus, fungal spores, chemicals like pesticides or chemical air pollutants. A person suffering from it has to make considerable effort in breathing accompanied by increased rate of breathing. In acute condition, pus and fluid may also accumulate in the lungs.
- iii) Bronchitis → This disease implies to the bronchial tubes in which infection of the bronchial passages may result in the swelling of the cellular lining. Chronic bronchitis and asthma are the acute stage of bronchial disorder.