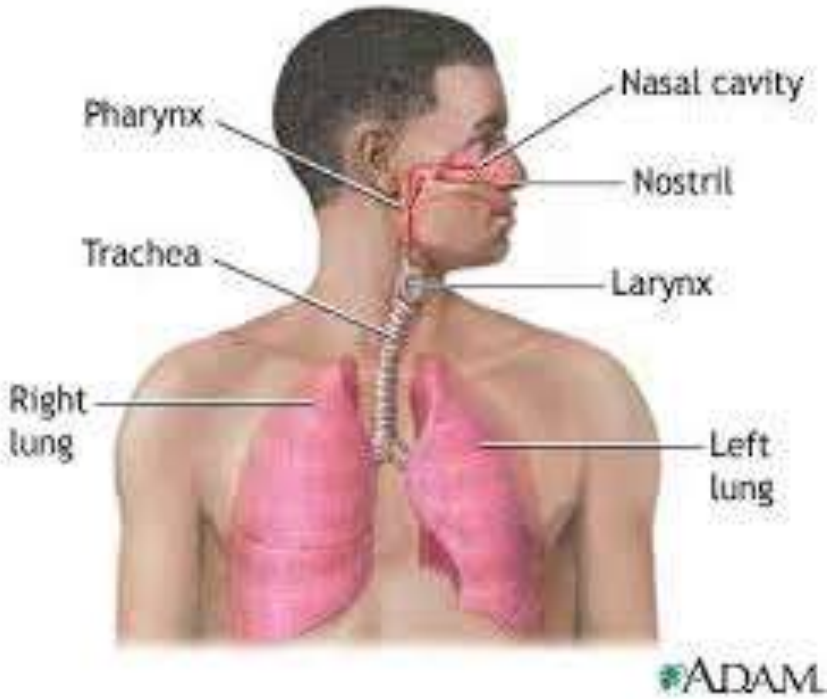
Respiratory system



Respiration divided into two meaning:

External respiration: **which include inspiration and expiration (respiratory cycle).**

Internal respiration: **utilization of o2 by mitochondria in metabolism of organic molecule.**

Inspiration:

is the movement of air from external environment through the airways to the lungs during breathing.

Expiration:

is the movement of air from the lungs through the airways to the external environment.

Function of respiratory system:

1.provide o2 and eliminate co2.

2.regulate the blood hydrogen ion concentration.

3.forms speech sound(phonation).

4.defence against microbes by cilia or mucus or by phagocytosis.

Organization of respiratory system:

1. airways.
2. lungs.
3. thorasic cage.

Airways: specialized structure for passage of o2 and co2 during respiratory cycle.

Include: nostril, nasal cavity, pharynx, larynx, trachea, bronchus, many bronchioles, terminal bronchioles, alveolar duct, alveolar sac, alveoli.

Functions of airways:

1. pass the air from external environment to alveolus and in opposite direction.
2. moisture the air.
3. clear the air from particles by mucus and cilia.
4. regulate the temperature of inspiratory air.

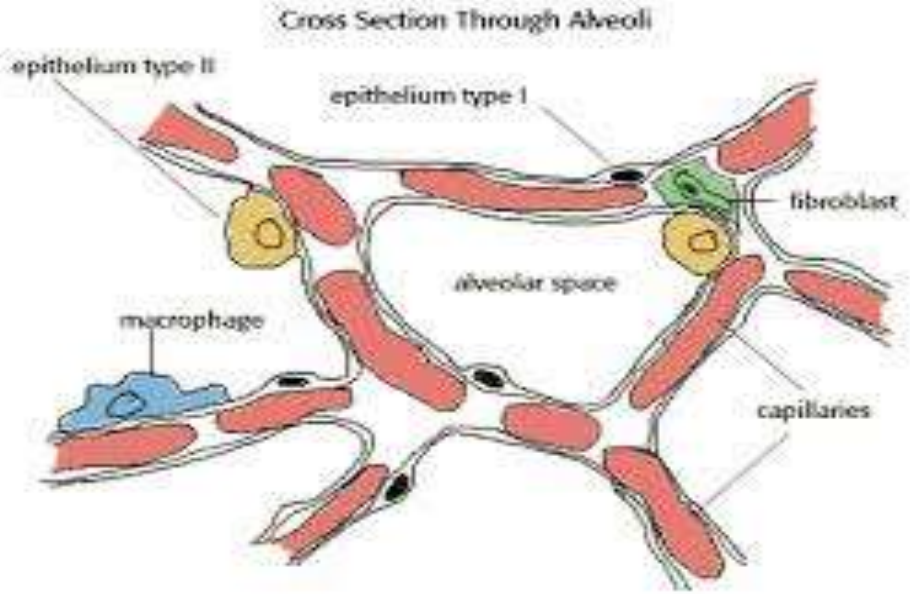
Lungs :

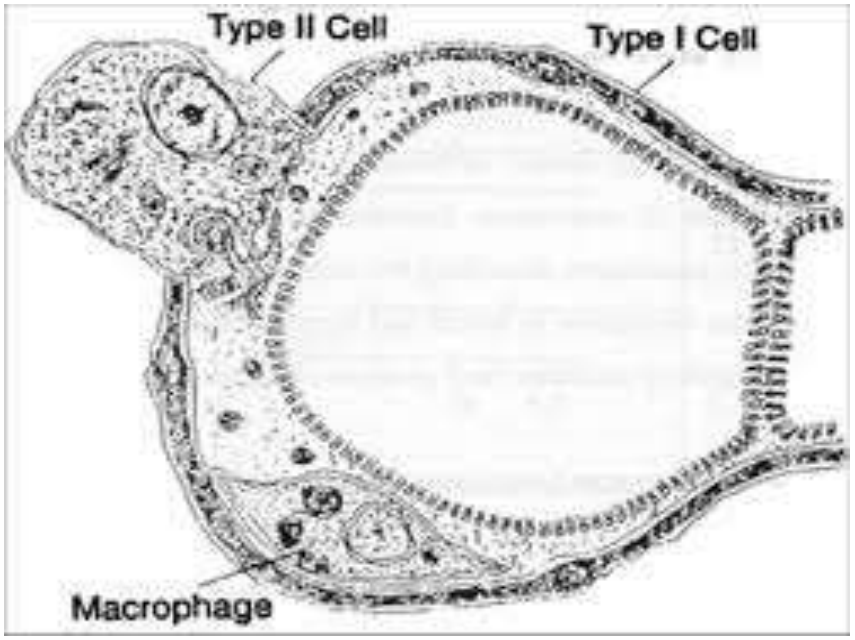
composed mainly from many of alveoli reach to 300,000,000.

Alveoli:(site of gas exchange) tiny hollow sac whose open ends are continuous with lumen of airways.

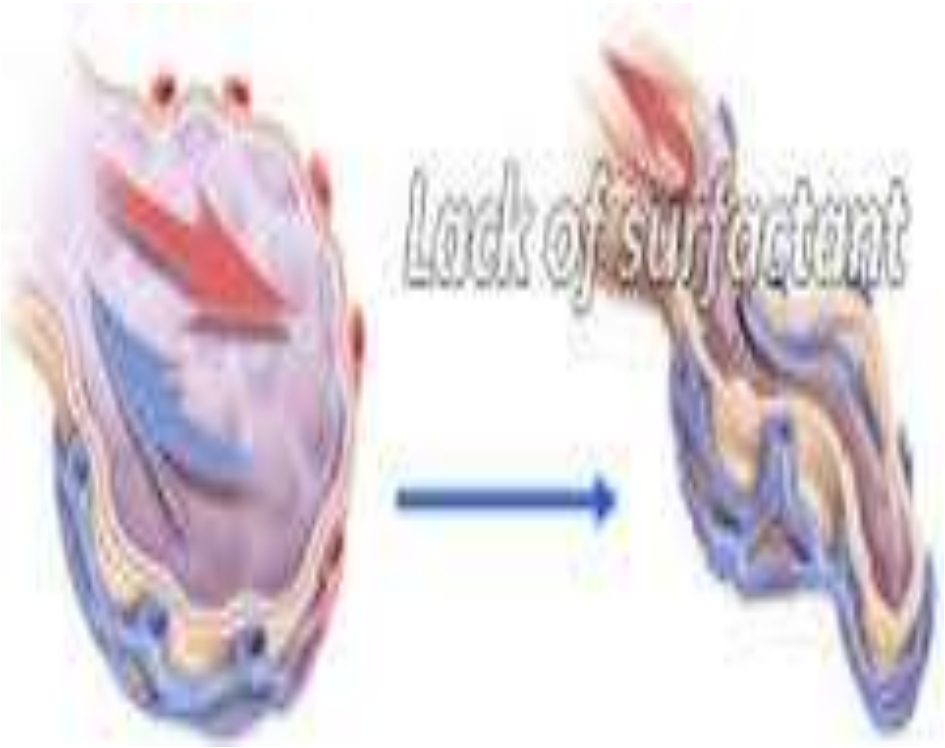
Structure of alveoli:

1.the alveolus wall lined by a continuous layer of flat epithelial cells called type I (main cell of alveolus has large cytoplasmic extension), and type II cell or granular pneumocyte which are thick cell located between type I cell.

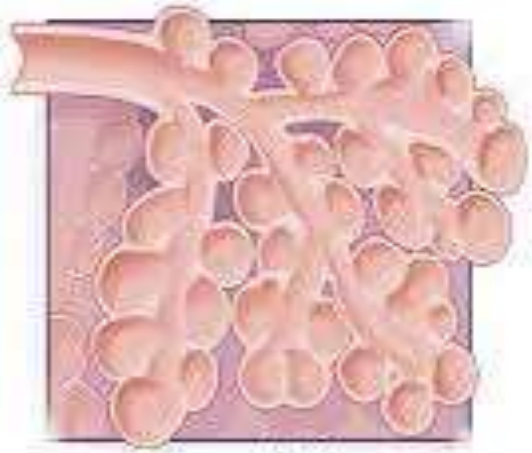

Cross Section Through Alveoli
epithelium type II
epithelium type I
fibroblast
alveolar space
macrophage
capillaries


Type II Cell
Type I Cell
Macrophage

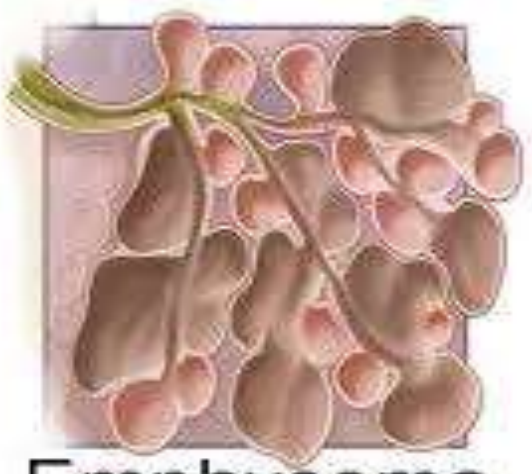
Surfactant: lipoprotein in nature its function to reduce surface tension of alveoli during expiration and prevent suffocation, stabilize the size of alveoli.


Lack of surfactant

2.alveolar wall contain capillaries which composed from one endothelial cell. This extensive area and thinness of barrier permit the rapid exchange of large quantity of O2 andCO2 by diffusion.



Healthy



Emphysema

Thoracic cage:

The wall of thoracic is formed by the spinal column, ribs,breast bone (sternum), neck, diaphragm and group of muscle called intercostals muscle.

Each lung surrounded by closed sac called pleural sac or pleural membrane, between these two layer there is pleural fluid which make these two layer sliding over each other i.e make lubricant.

Pleural pressure: sub atmospheric pressure or negative pressure.
This make the lung follow the thoracic cage expansion and return to normal position.

Factors permit inspiration and expiration:

1.alwyes the negative pressure or sub atmospheric pressure make the lung remain expand during inspiration.

2.pleural membrane (the visceral layer attach to the lung, the parietal layer attach to the ribs) make the lung follow the expanded thoracic cage during inspiration.

3.the elastic recoil of lung make lung return to its normal size during expiration.

Mechanism of inspiration:

1.during inspiration the contraction of diaphragm and intercostals muscle increase the volume of thoracic cage.

2.this make the inter pleural pressure more sub atmospheric this lead to lung expansion.
3.this expansion make pressure differences between alveoli and external environment.

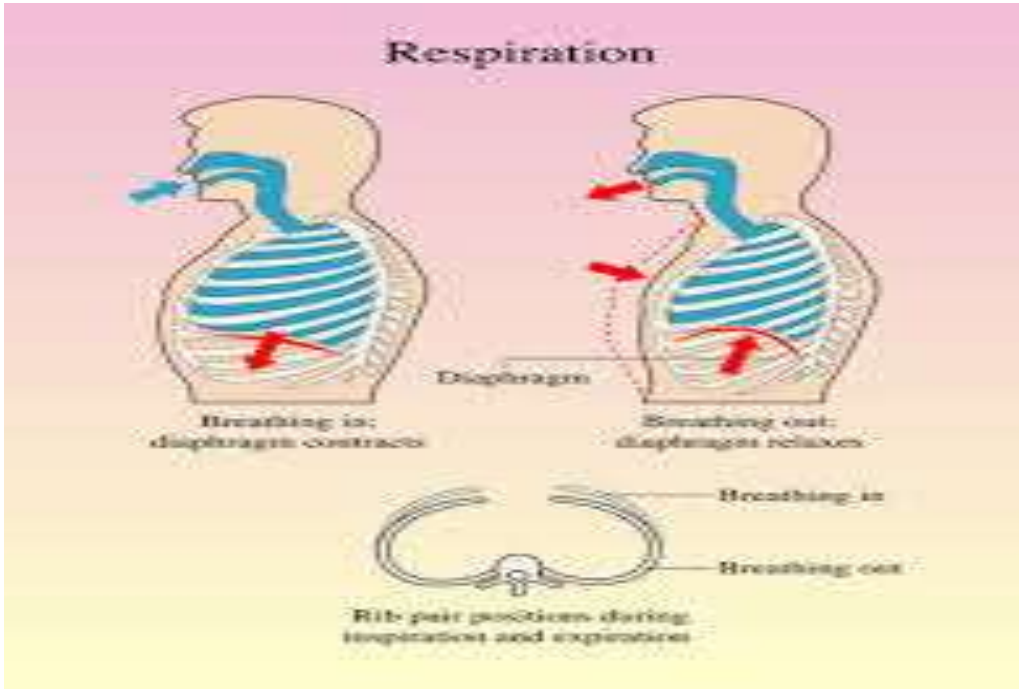
4.this differences drive air into lungs by diffusion (from area of high concentration of external environment to area of low concentration of alveoli) and as a result the inspiration occur.

Mechanism of expiration:

1.the diaphragm and intercostals muscle cease contraction allowing the thoracic cage return to its normal size.

2.the elastic recoil of lung which return lung to its normal size compressing the alveoli and lead to raising alveolar pressure.

3. the elevation of alveolar pressure make air drive out the lung by diffusion(from area of high conc. In alveoli to area of low conc. In external environment).


Respiration
Diaphragm
Breathing in:
diaphragm contracts
Breathing out:
diaphragm relaxes
Breathing in
Breathing out
Rib pair positions during
inspiration and expiration

Factors affecting the gas exchange between alveoli and blood capillaries:

1.the pressure differences between two sites. Increase pressure differences lead to increase gas diffusion.

2.surface area; increase surface area lead to increase gas diffusion.
3.thickness of alveolar wall. Increase thickness lead to decrease diffusion.

4.nature of gas. Molecular weight of gas.

Increase of molecular weight lead to increase solubility which lead to increase diffusion.

Co2	O2
44	32

Transport of gases:

One of the most important functions of blood is transport of oxygen from lung to body cell and transport of CO2 from body cell to the lung.

Transport of O2:

O2 transported in blood by hemoglobin. The correlation relationship of O2 and Hb is called oxygen –Hb dissociation curve.

Stage of O2 –Hb dissociation curve:

Note: P is partial pressure: each gas has individual pressure which is called partial pressure.

1.initial: Hb in this stage is reduced Increase po2 lead to increase Hb-O (oxygenated Hb).

This stage is rapid and acute.

2.stepper: Hb ½ saturated Increase Po2 increase Hb-O this stage is slow and not acute.
3.flatted: Hb in this stage is complete saturated.increase po2 not lead to increase combination of O2 and Hb.
(Sigmoid shape or S shape)

Factors affecting the O2-Hb dissociation curve:

1.tempreature.

2.partial pressure.

3.2,3 diphosphoglycerides waste product of RBC.

Increase these factors lead to shift the curve to the right or down.

Effect of increase O2 in the body:

Increase O2 Lead to irritation of air ways lead to destruction of enzyme in the body lead to disturbance of body metabolism.

There are four type of oxygen decrease in the body (hypoxia):

A: hypoxic hypoxia:

Causes:

1. decrease O2 in the environment (closed places).
2. airways obstruction.
3. disfunction of alveoli.
4. high altitude.

B:anemic hypoxia:

Causes:

1.decrease RBC.

2.decrease Hb.

3.bleeding.

4.decrease Fe.

C: histotoxic hypoxia:

Causes: all external environment are normal but the utilization of O2 by the cell is abnormal due to enzyme destruction. e.g cyanide poisoning.

D:stagnant hypoxia:

Either general in all body occur in congestive heart failure.

Or local in certain area.

Transport of CO_2 in the blood:

When the arterial blood flow through tissue capillaries the Co2 diffuses from the tissue into the blood.

1.10% of Co2 remain physiologically dissolve in plasma and erythrocytes.

2.30% of Co2 react with amino group of hemoglobin to form carbamino compound

$Co_2 + Hb \longrightarrow Hbco_2$ carbamino hemoglobin

3.60% of co2 entering the blood in the tissue is converted to bicarbonate.

$Co_2 + H_2O \longrightarrow H_2Co_3 \longrightarrow HCO_3 + H$

Control of respiration:

The respiration process or breathing process is un voluntary control, but we can cease or hasted the respiratory process for short time.

There are two type of respiratory control:

1.Neural control, through centers.

2.chemical control, through receptors.

Neurol control:the respiratory centers located in medulla ablongota and pons, the removal of these centers lead to stop respiration.

The neural centers are:

1. Medullary inspiratory centers.
2. expiratory center.
3. apneustic center.
4. pnemotaxic center.

The inspiratory center send impulses to diaphragm and intercostal muscle → contraction of these muscle → inspiration. The inspiration lead to stimulation of streach receptors of lungs → activation of vagus nerve → send impulses to pneumotaxic center → stimulation of expiatory center and inhibit the inspiratory center.

Chemical control of respiration:

1.peripheral chemoreceptors;include carotid body and aortic body.

2.centeral chemoreceptors: located in brain

the peripheral chemoreceptor located at the bifurcation of common carotid arteries and in thoracic on the arch of aorta are called carotid bodies and aortic bodies.

These are stimulated mainly by decrease in arterial po2 and increase arterial H ion concentration.

The centeral chemoreceptor are located in medulla ablongata stimulated by increase co2 and H ion conc. Of the brain extracellular fluid.

Lung volumes and lung capacities during respiration: measured by spirometer.

1.tidal volume.

2.inspiratory reserve volume

3.expiratory reserve volume.

4.residual volume.

Lung capacities:

1.vital capacities.

2.total lung capacity.

3.inspiratory capacity.

4.functional residual capacity.

There are two type of dead space:

1.Anatomical dead space:the parts of respiratory system extended from nostril until terminal bronchioles (150ml).

2.Alveolar dead space: some fresh air is not used for gas exchange with blood even though it reach the alveoli; its quit small in normal person but increase in congenital and pathological cases.

The sum of anatomical dead space and alveolar dead space lead to physiological dead space.

Other functions of lungs:

In addition to their function in gas exchange the lung have a number of metabolic function.

1.Release substances that enter the systemic blood

e.g.prostogandin

2.The lungs activate the angiotensin I to angioteninII by converting enzyme in the surface of pulmonary capillaries.

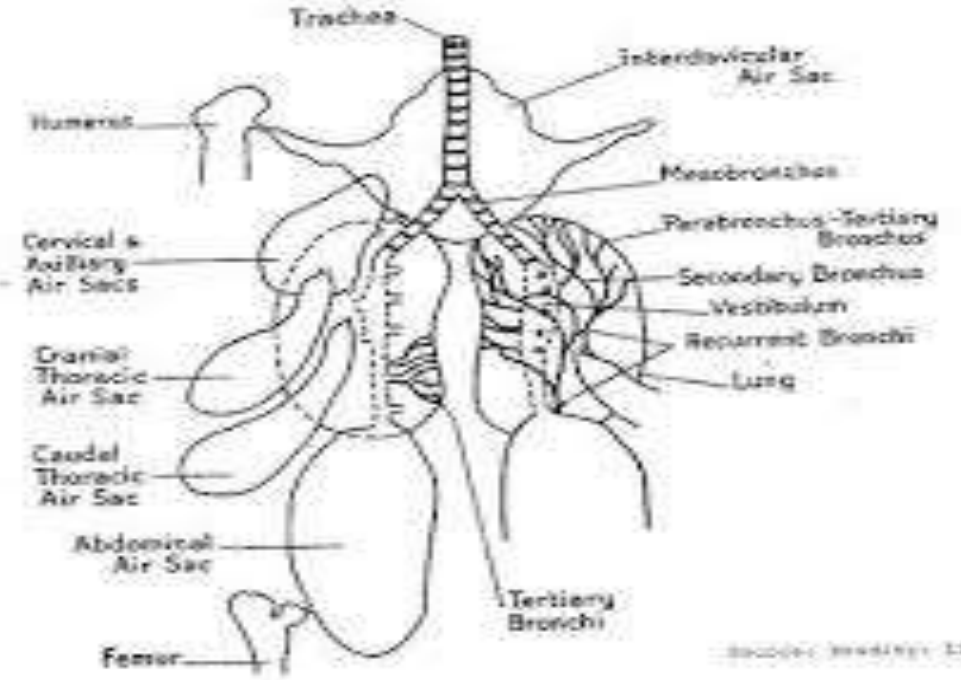
3.Contain fibrionlytic system that lyses clot in pulmonary vessels.

4.Reservoir of blood.

Avian respiratory system:

1.small lungs which do not change during breathing and has nine air sacs to ventilate lungs but not participate in gas exchange.

2Cervical sac, 1 clavicular sac, 2 cranial thoracic and 2 caudal thoracic,2abdominal sac.


Trachea
Interclavicular Air Sac
Humerus
Mesobronchus
Parabronchus - Tertiary Bronchus
Cervical & Axillary Air Sacs
Secondary Bronchus
Vestibulum
Recurrent Bronchi
Cranial Thoracic Air Sac
Lung
Caudal Thoracic Air Sac
Abdominal Air Sac
Tertiary Bronchi
Femur

2.There is no diaphragm separate thoracic and abdominal cavities.

3.the trachea has complete cartilaginous ring because the

Avian eat grains.

4.the para bronchi or tertiary bronchi is the site of gas exchange not alveoli.

5.lamellated osmophilic bodies in para bronchi secrete the trilaminar substance.

6.in contrast to mammals the lungs of birds contain intra pulmonary chemoreceptor IPC which respond to physiological changes in Pco2.

7.respiratory rate/min.

Human 12-20

Chiken 15-30