Mechanism of Respiration:

Entire physiology of respiration involves following steps:

1.Breathing or pulmonary ventilation

2.External respiration

3.Transport of O2 to tissue

4.Internal respiration

5.Transport of CO2 from tissue

1. Breathing or Pulmonary ventilation:

This is movement of air into and out of the lungs.

Breathing supplies oxygen to the alveoli, and eliminates carbon dioxide.

The main muscles involved in breathing are the intercostal muscles and the diaphragm.

There are 11 pairs of intercostal muscles occupying the spaces between the 12 pairs of ribs. They are arranged in two layers, the external and internal intercostal muscles.

The diaphragm is a dome-shaped muscular structure separating the thoracic and abdominal cavities.

Breathing depends upon changes in pressure and volume in the thoracic cavity. Since air flows from an area of high pressure to an area of low pressure, changing the pressure inside the lungs determines the direction of airflow.

Breathing involves two process:

i. Inspiration

It takes place when the volume of thoracic cavity is increased and the air pressure is decreased.

Simultaneous contraction of the external intercostal muscles and the diaphragm expands the thorax.

As the diaphragm + external intercostals contracts (moves downward) lung volume increases.

It involves following events:

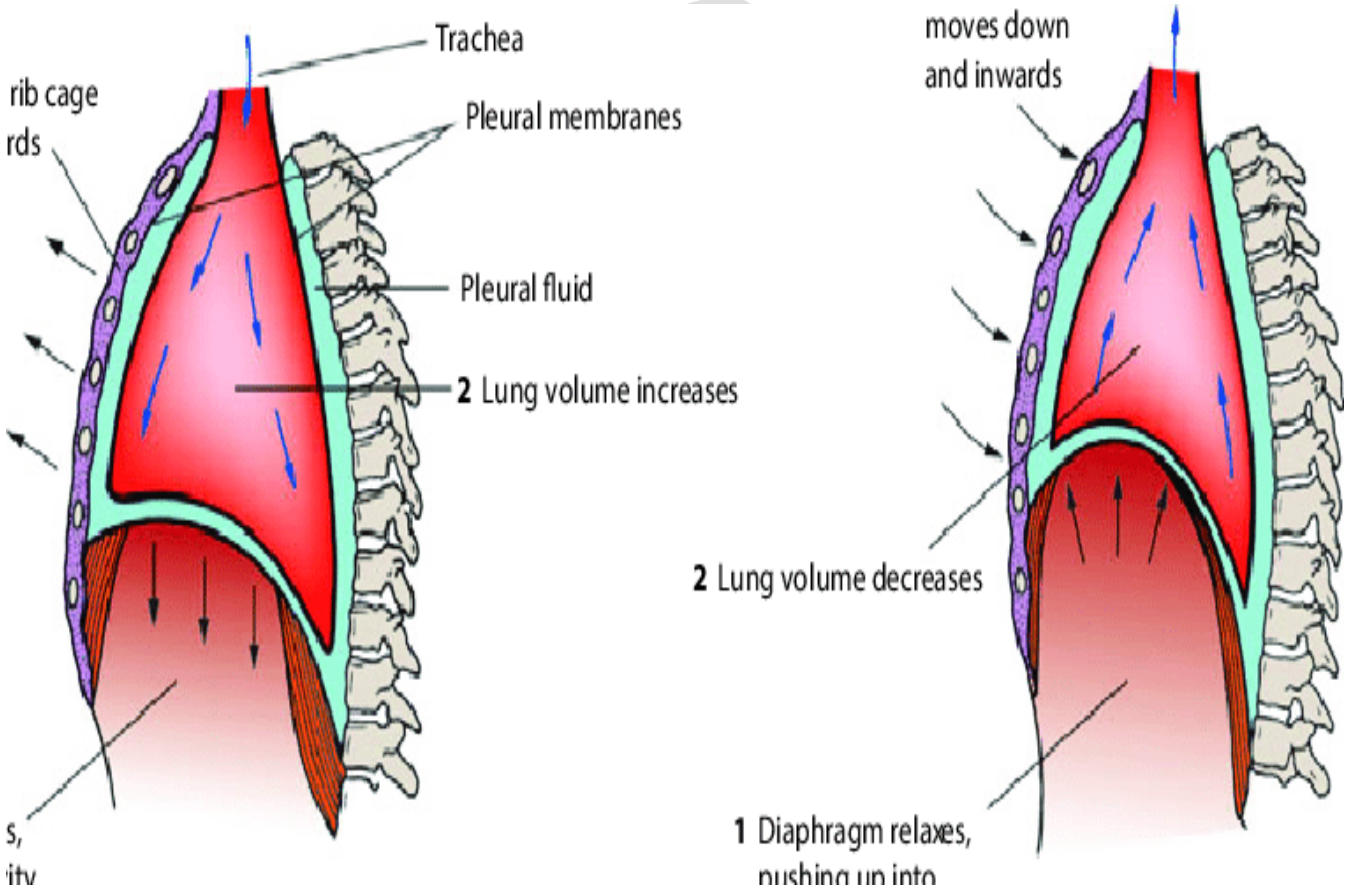
First of all, external intercoastal muscle contracts and internal intercoastal muscles relaxes.

Due to contraction of external intercoastal muscles, ribs is pulled upward, resulting in increase in thoracic cavity size

The thoracic cavity further enlarges due to contraction of diaphragm, lowering the diaphragm and increases the size of thoracic cavity.

With increase in size of thorax, lungs expand simultaneously.

As lungs expands, the air pressure is reduced inside, so equalize the pressure, atmospheric air rushes inside the lungs



ii. Expiration

It takes place when the size of thoracic cavity is reduced and air pressure is increased.

involves following events:

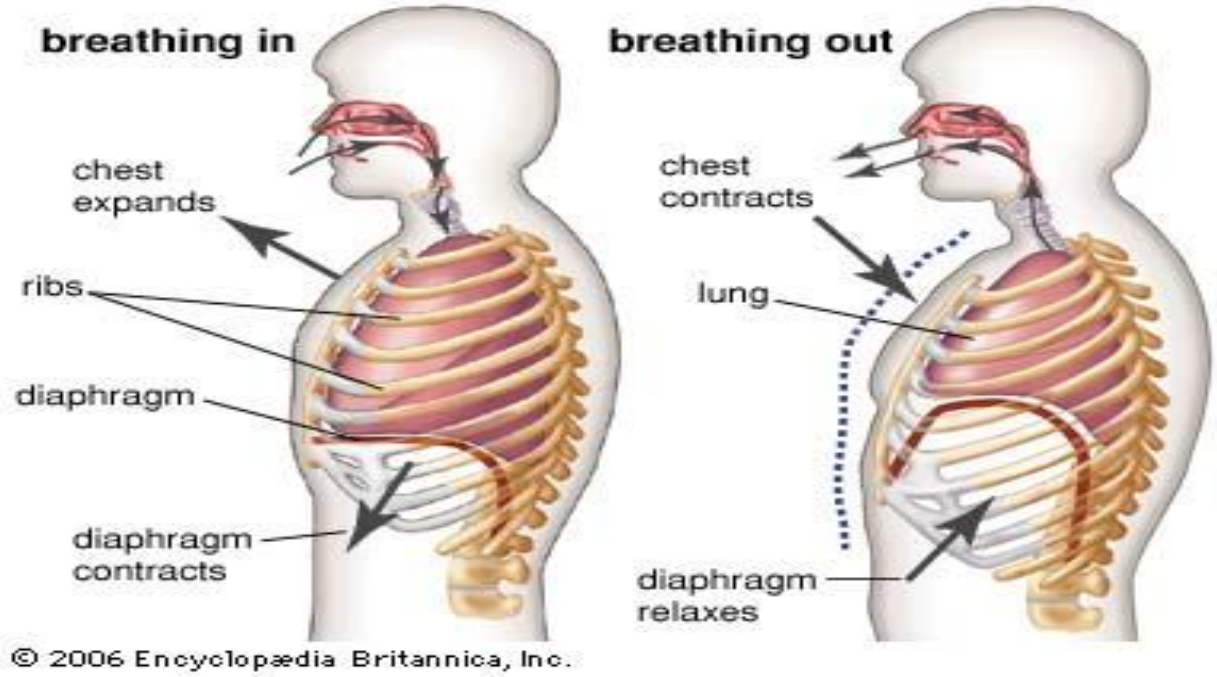
The internal intercoastal muscle contracts and external intercoastal muscles relaxes.

Due to contraction of internal intercoastal muscle, ribs are pulled inward, resulting in decrease in size of thoracic cavity

Furthermore the diaphragm is pushed upward due to its relaxation

With the decrease in size of thoracic cavity, lungs is compressed

As lungs is compressed, pressure increases, so the air is forced outside.



2. External respiration:

This is the exchange of gases by diffusion between alveoli and blood in the alveolar capillaries, across respiratory membrane.

Diffusion of oxygen and carbon dioxide depends on pressure differences, e.g. between atmospheric air and the blood, or blood and the tissues.

Gas exchange during the respiration process takes place in the alveolus at its surface that separates the alveolus with the capillary.

The exchange of O2 and CO2 occurs through diffusion which is the net movement of gas molecules from a region that has a higher partial pressure to another region that has a lower partial pressure.
Pp of O2 in alveoli is104mmHg. And pp of O2 in blood 40mmHg.

Pp of Co2 in alveoli is 40mmHg.and Pp of CO2 in blood is 45mmHg.

The venous blood in alveolar capillaries contains high level of CO2 and low level of O2.

Co2 then diffuses from higher level (venous blood) to lower level (alveoli) until equilibrium is maintained. By the same process O2 diffuses from alveoli to venous blood until equilibrium.

Pulmonary air volume and capacities:

In normal quiet breathing there are about 12-16 complete respiratory cycles per minute. The amount of air exchanged during breathing is measured by an instrument called Spirometer or Resprometer.

The amount of air present in lung under different condition is known as pulmonary air volume and the capacities of lungs to hold air varies according to conditions.

some of the pulmonary air volume are:

1. Tidal volume (TV):

This is the amount of air passing into and out of the lungs during each cycle of breathing.

It is about 500 mL at rest.

2. Inspiratory reserve volume (IRV):

This is the volume of air that can be inhaled into the lungs during normal inspiration above the tidal volume.

It is about 1500 ml.

3. Expiratory reserve volume (ERV):

This is the total volume of air which can be expelled from the lungs forcefully during normal expiration above the tidal volume.

It is about 1100ml.

4. Inspiratory capacity (IC):

This is the amount of air that can be inspired with maximum effort.

It consists of the tidal volume (500 ml) plus the inspiratory reserve volume. IC = TV + IRV

It is about 2000ml

5. Functional residual capacity (FRC):

This is the amount of air remaining in the lungs after normal expiration.

It is equal to ERV+ RV= 1100+1200= 2300ml.ue the pr ocess of respiration. this means that exchange of gases is not interrupted between breath.

The functional residual volume also prevents collapse of the alveoli on expiration.

6. Residual volume (RV):

This is the volume of air remaining in the lungs after forceful expiration.

It is about 1200ml.

7. Vital capacity (VC):

This is the maximum volume of air which can be expired after forceful inspiration in single breath.

VC= TV+IRV+ERV= 500+1500+1100

VC of athletes is more than normal person.

8. Total lung capacity (TLC):

This is the maximum amount of air the lungs can hold after forceful inspiration.

It is normally about 5000-6000 ml in adult.

TLC=VC + RV.

9. Dead space:

The lungs and the air passages are never empty.

Out of 500ml of air inspired during normal respiration, 350ml are exchanged across the walls of the alveolar ducts.

About 150ml of air always remains in the respiratory passage called as dead space.

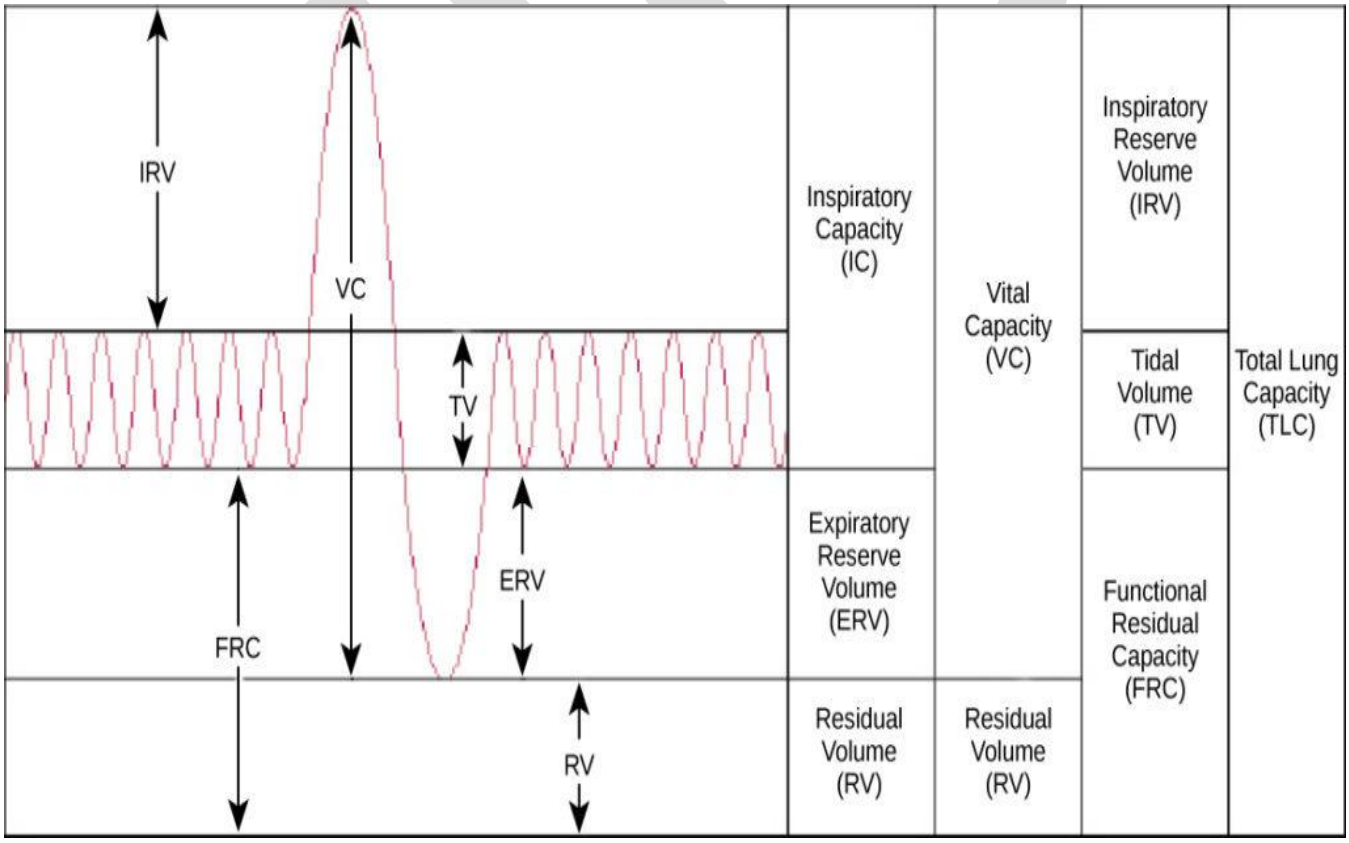


Fig: Pulmonary Air Volume(Spirogram.)

	INSPIRED AIR	EXPIRED AIR	ALVEOLAR AIR
O2……	21%	14%	15.7%
CO2……	0.04%	5.3%	3.6-4%
WATER VAPOUR…	5%	6.2%	6.2%