UNIT-3 REGULATION OF RESPIRATION

EXCHANGE OF GASES:

- **Inhaled oxygen** enters the **lungs** and reaches the **alveoli.** The layers of cells
- lining the alveoli and the surrounding capillaries are each only one cell thick
- and are in very close contact with each other.
- Oxygen passes quickly through air-blood barrier into the blood in the capillaries.
- Similarly, carbon dioxide passes from the blood into the alveoli and is then exhaled.
- Diffusion of oxygen & carbon dioxide depends on pressure differences.

DIFFUSION OF GASES:

External respiration:

- External respiration refers to gas exchange across the respiratory membrane in the lungs.
- Each alveolar wall is one cell thick and surrounded by a network of tiny capillaries.
- Carbon dioxide diffuses from venous blood down its concentration gradient into the alveoli.
- By the same process, oxygen diffuses from the alveoli into the blood.

Internal respiration:

- **Internal respiration** refers to gas exchange across the respiratory membrane in the metabolizing tissues, like your skeletal muscles, for example.

- Blood arriving at the tissues has been cleansed of it's CO_2 & saturated with O_2 during it's passage through the lungs, therefore has a higher O_2 & lower CO_2 than the tissues.
- This concentration gradients between capillary blood and the tissues lead gas exchange.
- O_2 diffuses from the bloodstream through the capillary wall into the tissues.
- CO_2 diffuses from the cells into the extracellular fluid,then into the bloodstream towards the venous end of capillary.

Transport of gases in the bloodstream:

- Transport of blood, oxygen & carbon dioxide is essential for internal respiration to occur.

Oxygen:

- Oxygen is carried in the blood in as combination with haemoglobin as **oxyhaemoglobin.**

Carbon dioxide:

- It is excreted by the lungs & transported by combined with haemoglobin as **carbaminohaemoglobin.**

REGULATION OF RESPIRATION:

- Although breathing can be controlled voluntarily for short periods, the nervous system usually controls respirations automatically to meet the body's demand without conscious effort.

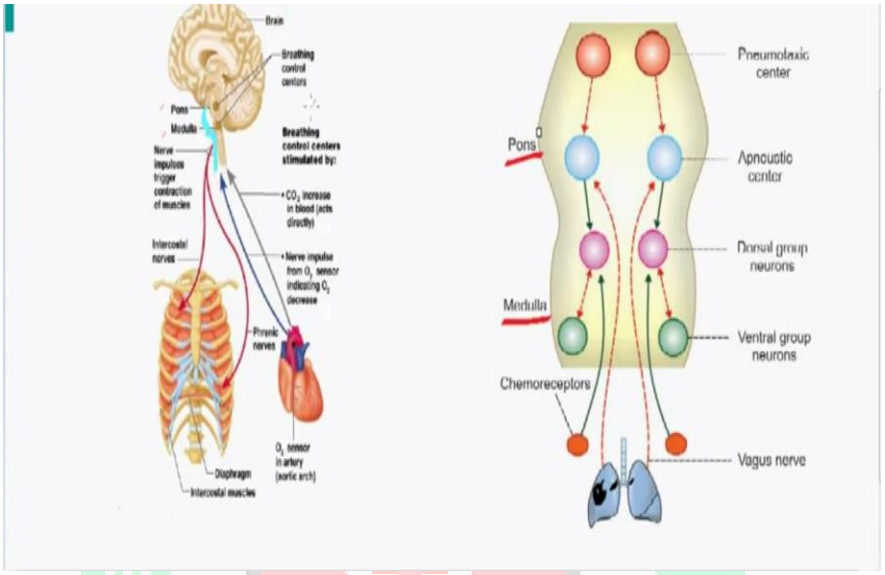
Role of the Respiratory Center:

- The area from which nerve impulses are sent to respiratory muscles consists of clusters of neurons located bilaterally in the medulla oblongata and pons of the brain stem. This area is called respiratory center.
- **Respiratory center** consists of a widely dispersed group of neurons functionally divided into three areas:

(1) the medullary rhythmicity area in the medulla oblongata;

(2) the pneumotaxic area in the pons; and

(3) the apneustic area, also in the pons



Medullary Rhythmicity Area

DORSAL GROUP OF NEURON: Present in upper part of medulla oblangata has inflence over inspiratory process

VENTRALGROUP OF NEURON: Present in upper part of medulla oblangata has inflence over inspiratory and expiratory process but its active only in forced breathing

- The function of the **medullary rhythmicity area** is to control the basic rhythm of respiration, which in the normal resting state is about 2 seconds of inhalation and 3 seconds of exhalation.
- Within the medullary rhythmicity area are inspiratory and expiratory neurons that constitute inspiratory and expiratory areas, respectively.

Pneumotoxic area

- It is in upper pons and transmits the inhibitory impulses to the inspiratory area. This nerve impulses help to turn off the inspiratory area before the lungs become too full of air. When the pneumotoxic area is more active, breathing rate is more active.

Apneustic area

- This area is in lower pons. This area sends stimulatory impulses to the inspiratory area that activate it and prolong inhalation. When the pneumotoxic area is more active, it overrides the signals from apneustic area.

Regulation of the Respiratory Center

Although the basic rhythm of respiration is set and coordinated by the inspiratory area, the rhythm can be modified in response to inputs from other brain regions, receptors in the peripheral nervous system, and other factors.

Cortical Influences on Respiration

- The cerebral cortex has connections with the respiratory center, so we can voluntarily alter your pattern of breathing.
- We can even refuse to breathe at all for a short time.
- When CO2 and H concentrations increase to a certain level, the inspiratory area is strongly stimulated, nerve impulses are sent along the phrenic and intercostal nerves to inspiratory muscles, and breathing resumes, whether you want it to or not.
- It is impossible for people to kill themselves by voluntarily holding their breath.
- Even if we hold our breath for so long that we faint, breathing resumes when consciousness is lost.
- Nerve impulses from the hypothalamus and limbic system also stimulate the respiratory center, allowing emotional stimuli to alter respirations as, for example, when we laugh or cry.

Chemoreceptor Regulation of Respiration

- Certain chemical stimuli determine how quickly and how deeply we breathe.
- The respiratory system functions to maintain proper levels of CO2 and O2 and is very responsive to changes in the levels of either in body fluids.
- Sensory neurons that are responsive to chemicals are termed **chemoreceptors**.
- Chemoreceptors in two locations of the respiratory system monitor levels of CO2, H and O2 and provide input to the respiratory center.
- **Central chemoreceptors** are located in the medulla oblongata in the *central* nervous system. They respond to changes in H or CO2 concentration, or both, in cerebrospinal fluid.
- **Peripheral chemoreceptors** are located in the **aortic bodies**, clusters of chemoreceptors located in the wall of the arch of the aorta, and in the **carotid bodies**, which are oval nodules in the wall of the left and right common carotid arteries where they divide into the internal and external carotid arteries.
- These chemoreceptors are part of the *peripheral* nervous system and are sensitive to changes in O2, H, and CO2 in the blood.
- Axons of sensory neurons from the aortic bodies are part of the vagus (X) nerves, and those from the carotid bodies are part of the right and left glossopharyngeal (IX) nerves.
- If there is even a slight increase in CO2, central and peripheral chemoreceptors are stimulated.
- The chemoreceptors send nerve impulses to the brain that cause the inspiratory area to become highly active, and the rate of respiration increases.
- This allows the body to expel more CO2 until the CO2 is lowered to normal.
- If arterial CO2 is lower than normal, the chemoreceptors are not stimulated, and stimulatory impulses are not sent to the inspiratory area.

- Consequently, the rate of respiration decreases until CO2 accumulates and the CO2 level rises to normal.

The Inflation Reflex

- Located in the walls of bronchi and bronchioles are stretch sensitive receptors called **baroreceptors** or **stretch receptors**.
- When these receptors become stretched during over inflation of the lungs, nerve impulses are sent along the vagus (X) nerves to the inspiratory and apneustic areas. In response, the inspiratory area is inhibited, and the apneustic area is inhibited from activating the inspiratory area.
- As a result, expiration begins. As air leaves the lungs during expiration, the lungs deflate and the stretch receptors are no longer stimulated.
- Thus, the inspiratory and apneustic areas are no longer inhibited, and a new inspiration begins.
- Some evidence suggests that this reflex, referred to as the **inflation (Hering-Breuer) reflex**, is mainly a protective mechanism for preventing excessive inflation of the lungs rather than a key component in the normal regulation of respiration.