Respiration

It is a catabolic process during which glucose molecule is oxidized In the presence of specific enzymes to release energy for various metabolic processes. It is completed in two steps-External and Internal Respiration

External Respiration- It involves exchange of gases in the respiratory organ or surface. It takes place in different ways in different organisms.

1. In plants- Exchange of gases takes place through stomata, large intercellular spaces ensure that all cells are in contact with air. Exchange of CO_2 and O_2 take place by the diffusion. At night when there is no photosynthesis occurring, CO_2 is mainly given out. During the day time CO_2 generated during respiration is used up for photosynthesis, so there is no CO_2 release. Instead O_2 is released.
2. In aquatic animals- These animals use O_2 dissolved in water. Amount of dissolved O_2 is fairly low in water as compared to the amount of oxygen in the air. In order to take in maximum O_2 the rate of breathing is very fast as compared to terrestrial organisms.
3. In terrestrial organisms- These animals use the O_2 from the atmosphere. It is absorbed by different organs in different animals. E.g. In earthworm exchange of gases takes through skin. The respiratory surface shows following features-
   -The surface which is contact with oxygen rich atmosphere is large.
   - The surface where exchange of gases has to take place is very thin and delicate.
   - The surface is richly supplied with blood capillaries
   - The surface is usually placed within the body, so there has to be a passage to take the air to this area. There is mechanism for moving the air in and out of this area.
4. In Human beings- Human beings have well developed respiratory system to take in air rich in oxygen and give out air rich in CO_2. This system is formed by nostrils, nasal cavities, pharynx, trachea, bronchi, and bronchioles leading to alveoli in the lungs. The air is taken into the body through the nostrils. The nasal cavity has fine hair and mucus glands. It is filtered by the fine hair to remove dust particles and other impurities as well as made warm. From nasal cavities the air comes to pharynx and then into trachea. Trachea is lined by rings of cartilage to prevent the air passage from collapsing. Trachea divides into two branches called bronchi which enter each lung.

The lungs are located in the air tight chest cavity formed by ribs, diaphragm, chest bone and back bone. They are highly elastic and are well protected by rib cage and double walled pleura. Inside each lung the bronchi divide and re divide into brochioles; each bronchiole opens into balloon like structure called alveoli. The alveoli very thin provide large surface area and are richly supplied with blood vessels. (Fig. 6.9 page 104)

Mechanism of breathing-It is completed in two phases-

Inspiration / Inhalation- It is concerned with taking in of atmospheric air in to the lungs. During this phase rib muscles contract so the ribs move up ward and outward. Diaphragm contracts and becomes flat. The volume of chest cavity increases and pressure of the air in the thoracic cavity decreases. Air is sucked into the lungs which fills the spaces in the alveoli.

Expiration / Exhalation- It is concerned with the expelling of CO_2 from the lungs. During this phase rib muscles and diaphragm relax so volume of the chest cavity decreases. The pressure of air inside the cavity increases. Air rich in CO_2 rushes out of the chest cavity.

During breathing cycle, when air is taken and let out, the lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for carbon dioxide to be released.

Exchange of gases in alveoli-

Blood rich in CO_2 i.e. deoxygenated blood reaches the alveoli, CO_2 diffuses into the alveolar cavity because of its high concentration. O_2 diffuses into the capillaries and combines with haemoglobin of red blood cells to form

Oxy haemoglobin and then transported to all the tissues.

Transportation of gases in human beings-

In large animals like human beings, diffusion pressure alone can not carry oxygen to all parts of the body. Respiratory pigment is required to do this function. Human beings have haemoglobin in the red blood cells which has very high affinity for oxygen. CO_2 is more soluble in water than O_2 so it is transported in the dissolved form by the plasma of blood.

Internal Respiration / Cellular respiration-It is the biochemical process during which glucose molecule is oxidized in side the cell in the presence of specific enzymes at optimum temperature to release energy in the form of ATP. Various organisms carry on this process in different ways. It depends on the availability of oxygen. Some organisms use oxygen while others use some other pathways.

First step –It is a common step and involves break down of glucose (a six carbon compound) into two molecules of three carbon compound called pyruvate. The process takes place in cytoplasm. It s called glycolysis.It releases two ATP.

Second Step-Further break down of pyruvate depends upon the availability of oxygen. There are three possibilities-

-In the presence of oxygen pyruvate breaks down to form carbon dioxide and water. This process takes place in mitochondria. It is called aerobic respiration and a lot of energy is released. (In all 38 ATP)

- In the absence of oxygen pyruvate breaks down incompletely to form ethanol and carbon dioxide. It occurs in the cytoplasm in yeast cells and some bacteria during fermentation and is also called anaerobic respiration. It releases less amount of energy (2 ATP in all)
- When there is lack of oxygen pyruvate breaks down to form lactic acid in muscle cells. Accumulation of lactic acid causes muscle cramps. It releases less energy (2 ATP in all)

ATP molecules released during cellular respiration are further broken down to give rise to fixed amount of energy to carry on all endothermic reactions in the cells.

Over all reactions-

Aerobic Respiration-

$C_6H_{12}O_6 + 6O_2 \rightarrow 6\ CO_2 + 12\ H_2O + 38\ ATP$

Anaerobic Respiration/ Fermentation

$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2 + 2\ ATP$

During lack of oxygen-

$C_6H_{12}O_6 \rightarrow C_3H_6O_3 + 2\ ATP$