Gaseous Exchange and Ventilation

- Breathing draws fresh air into the lungs and forces stale air out. This is called ventilation. Ventilation ensures that there is always a good supply of 'fresh air' inside the lungs. This maintains large diffusion gradien ts for oxygen and carbon dioxide between air and blood. Large diffusion gradients mean efficient gas exchange.

- Respiration and ventilation are different. Respiration occurs in a series of oxidation reactions that occur in cells

- The organs of gaseous exchange in the mammal are lungs.

- Lungs are housed in the thorax, a chamber formed by the rib cage and its muscles (intercostal muscles), with a domed floor, the diaphragm.

- Lungs are connected to the pharynx at the rear of the mouth by the trachea. The trachea, supported by incomplete rings of cartilage, runs beside the oesophagus before dividing into bronchi, one to each lung

- Within the lung the bronchus divides into smaller bronchioles. The walls of bronchi and larger bronchioles are also supported by ring s or tiny plates of cartilage, preventing collapse.

- Breathing in is called inspiration. The volumes in the lungs increase. The intercostal muscles contract. The ribcage moves upwards and outwards. The diaphragm contracts and moves them downwards. The volu me in the thorax increases. The pressure in the lungs is less than in the thorax. Therefore, the air moves into the lungs until it reaches atmospheric pressure.

- Breathing is called expiration. The volumes in the lungs decrease. The intercostal muscles relax. The ribcage moves downwards. The diaphragm relaxes and moves upwards. The volume in the thorax decrease. The pressure in the thorax is less than in the lungs. Therefore, the air moves out the lungs.

Fish

- Water is pumped over the gills. Inside the gills, there are lamellae. This gives the gills a large surface area.
- The diffusion path for oxygen is short. Blood flows within the lamellae is separated from the water by a very thin layer of cells
- There are many problems for fish as oxygen is not very soluble in water; almost a thirtieth of water is oxygen.
- Because of this, fish have evolved the strategy of counter flow. The gills act as a counter current multiplier.
- The current multiplier involves water flowing one way and blood flowing the other way.
- So when there is a high concentration of water, there is a high concentration of oxygen. Therefore there is a higher diffusion gradient.
- When there is a low concentration of water there is a low concentration of oxygen, but the blood is flowing past and the next part of the blood has no oxygen. Therefore the concentration gradient is still high.
- This system is effective; almost 80% of the oxygen in the water diffuses into the bloodstream.
- For the countercurrent method to work, the ventilation current moves in one direction only.
- The ventilation occurs because the muscles in the floor of the mouth of a fish allow it to pump water into its mouth.
- The fish uses its mouth and opercula as valves to make sure that the water flows in one direction and it helps to maintain the diffusion gradient.
- As the fish opens its mouth, it lowers the floor of its mouth cavity. Pressure in the mouth drops an water enters the mouth.
- As the fish closes its mouth, it raises the floor of its mouth cavity. This causes a high pressure in the mouth and the water moves over the gills where the pressure is lower.
- The diffusion of carbon dioxide from the blood into the water is also helped by countercurrent flow. The countercurrent mechanism works only when the ventilation current moves in one direction only; the ventilation in fish is not tidal.

Plants

- Plants do not move from place to place and therefore they don't need as much oxygen as active animals
- But, they do need surfaces for gas exchange as the process of cell respiration and photosynthesis both involve gaseous exchange with the atmosphere.
- The main gaseous exchange surface in dicotyledonous plants is inside the leaves. Root and stem cells obtain most of their oxygen as dissolved oxygen in the water that comes through the water coming through the roots.
- Leaf has a large surface area compared to S.A.
- Oxygen and carbon dioxide enter and leave a leaf via the stomata. There are several thousand stomata per centimetre of leaf.
- Gases that enter the stomata diffuse through intracellular spaces in the mesophyll.
- The surface of the mesophyll acts as the gaseous exchange surface.
- The cell walls are thin and permeable to gases.
- There is less loss of water because the gaseous exchange occurs inside the leaf.
- The gaseous exchange is controlled by two guard cells that can vary the width of the stomata, allowing less or more gas to enter or leave.