Breathing Rate: The number of times a person breathes in one minute is known as his breathing rate. A normal human being breathes in 15-20 times per minute. While running or doing heavy physical work, the breathing may increase up to 26 breaths per minute. This is because we require extra energy.

How Do We Breathe? We breathe with our nose. It has two nostrils. It has tiny hairs and contains sticky liquid known as mucus so that it can filter and clean the inhaled air. The dust particles, bacteria and other foreign particles stick to the mucus and get entangled in the hair present in the nostrils thus clean air reaches into our lungs. Just behind the nostrils, there is a passage known as nasal cavity, the air after passing through the nostrils (where it is cleaned and becomes moist) then passes through the nasal cavity. From the nasal cavity, the moist and warm air reaches through the pharynx into also the trachea also known as wind pipe. The trachea is a tube that runs from the larynx also known as voice box down the neck region into the thorax. This tube is about 12 cm long and gets divided into two smaller tubes known as bronchi (singular-bronchus) which enter into the two lungs as shown. After reaching the lungs, every bronchus divide to form a large number of yet smaller tubes known as bronchioles. These bronchioles comprise of minute air-sacs at their ends known as alveoli (singular - alveolus). The walls of each alveolus have very large number of very thin tubes or blood capillaries. The oxygen combines with the hemoglobin presents in the blood to form oxyhaemoglobin and this is then carried by the blood to the different tissues of the body. Oxygen diffuses into the cells of the body as blood passes through different tissues. From each tissue, blood picks up carbon dioxide and its compounds together with water. These waste products are then transported by the blood to alveoli and from there they are breathed out or eliminated.

Mechanism of Breathing: Breathing is a physical process that involves intercostal muscles which lies between the ribs and the diaphragm and helps in breathing.

Inhaling: During inhaling, the intercostals muscles contract, the ribs are pushed upward and outward and the diaphragm contracts and moves downward. This upward and outward movement of the ribs and the descending movement of the diaphragm add to the space in the chest cavity. This increases the volume of the air-tight chest cavity and creates pressure inside the lungs. Air rushes from outside through the trachea to the air sacs and alveoli.

Exhaling: During exhaling, the intercostals muscles relax and simultaneously two movements takes place, i.e., the ribs move downward and inward, the diaphragm relaxes and moves upward to take up its original position. The downward and inner movement of the diaphragm reduce the space in the chest cavity. The capacity of the chest becomes smaller and the air rushes out of the lungs. The lungs get vacant and then contracts. This happens because the exhaled air contains carbon dioxide and carbon dioxide turns lime water milky. Hence, this activity shows that we exhale carbon dioxide during breathing.

Take one mirror and exhale air from your mouth on a mirror. We see some moisture on the mirror. This shows that the exhaled air contains water vapours which condense on the mirror to form tiny water droplets.

Respiratory system in animals: Through skin- In earthworm and leeches, exchange of gases takes place through the moist and slimy surface of the skin.

Through air holes - In animals like insects, there are several holes called spiracles. Air enters through spiracles and carried through tubes called tracheal tubes.

Through gills - Most aquatic animals kike fish use special organs called gills. These gills are made up of a large number of threads like structures called filaments. The blood in the capillaries absorbs oxygen from the water and gives out carbon dioxide.

Through lungs- Most mammals such as dogs, monkeys, horses, etc. respire through special sac like spongy organs called lungs. Tadpoles breathe through gills, though they breathe through skin and lungs when they became frogs.

Respiratory system in humans: Lungs are present inside our chest. They protected by the ribcage. The ribs also support the lungs and help to pump air in and out when we breathe. Just beneath the lungs is a dome shaped muscle called diaphragm. When the diaphragm contracts, oxygen rich air is pulled into the lungs. When the diaphragm relaxes, carbon dioxide rich air is pumped out of the lungs.

Lung Capacity and Breathing Rate: Tidal volume is the amount of air inhaled and exhaled in a single stroke. The total volume of the lungs when fully inflated is about 5 litres in an adult. However, during sleep or at rest, the exchange is only about 500 cm3. During exercise, one can take in and expel an extra 3 litres. There is a residual volume of 1.5 litres which cannot be expelled no matter how hard one breath out. At rest, normally the inhale and exhale are about 16 times per minute During exercise, the breathing rate may rise up to 20 or 30 breaths per minute. A small aby breathes about 25 times per minute. The increased rate and depth of breathing during exercise allows more oxygen to dissolve in the blood and be supplied to the active muscles. The extra carbon dioxide which the muscles put into the blood will be removed by the faster, deeper breathing. It is mainly the extra carbon dioxide in the blood reaching the brain which stimulates the increased rate of breathing. The rate of breathing varies with age too.

Take Care

1. We should always breathe through nose and not from mouth. The air around us contains dust particles, smoke, pollen, etc. When we inhale, the dust particles get stuck in the hair present in the nose, which act as filters. However, sometimes, these particles irritate the lining of the nasal cavity, as a result of which we sneeze the dust particles from the inhaled air.
2. Smoking damages the lungs and can cause lung cancer. It is injurious to health.

Passage of air and exchange of gases: Air enters the trachea after passing through the nose and larynx. It carries the air to the bronchus. The air then moves into the bronchioles and then into the alveoli.

Nose ---Nasal cavity --- larynx --- trachea --- bronchi --- Lungs --- Bronchioles --- Alveoli

The oxygen absorbed in the alveoli combines with haemoglobin to form oxyhaemoglobin. Oxyhaemoglobin releases the oxygen, which helps to breakdown food to generate energy. Sugar + Oxygen $\longrightarrow$ energy + Carbon Dioxide + Water

Differences between Breathing and Respiration

Breathing	Respiration
It is a physical process involving exchange of oxygen and carbon dioxide	It is a biochemical process in which glucose is oxidised.
There is no release of energy.	Energy is released in this process.
Enzymes are not involved.	Enzymes are involved.
Modes of breathing are different in different organisms.	Details of respiration are similar in every living cell whether of plants or animals.

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