

BIOLOGY NOTES GRADE 12

Uploaded October 13, 2006

Topic: Breathing and Gaseous Exchange

Objectives

At the end of this topic, the students should be able to:

1. Define the terms *breathing and gaseous exchange*.
2. Describe the structure and function of the human breathing system.
3. Describe the structure and function of the alveoli.
4. List the special features of gaseous exchange surfaces.
5. Describe the effects of cigarette smoke and air pollution on gaseous exchange surfaces.
6. Compare inspired air with expired air.
7. Describe the role of the ribs, intercostal muscles and diaphragm in lung ventilation.
8. Describe the effects of physical activity on the rate and depth of breathing.

What is breathing?

Breathing is the inhalation and exhalation of air

Inhalation is also called: inspiration, taking in of air

Exhalation is also called: expiration, letting out of air

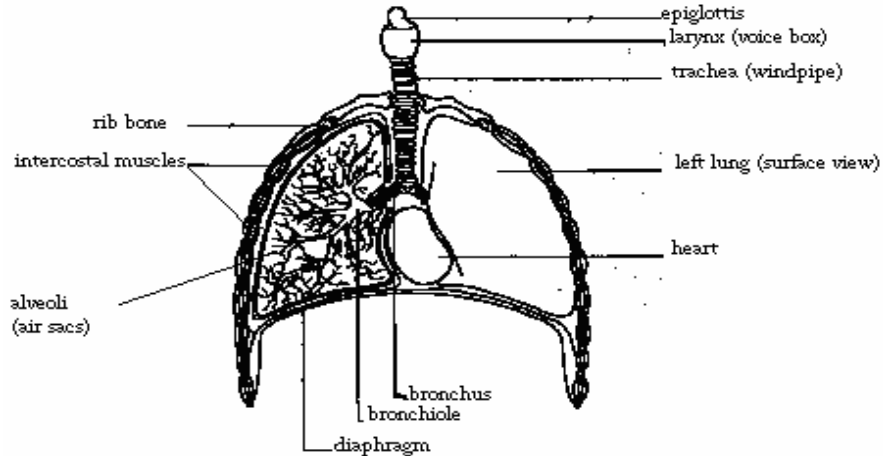
Comparison of inspired air with expired air

Component of air	Inspired air	Expired air
Nitrogen	78%	78%
Oxygen	21%	16%
Carbon Dioxide	0.03%	4%
Water Vapour	Small amount	Larger amount

* The body uses the difference in oxygen (5%) for respiration.

* Carbon dioxide and water are produced as waste products of respiration hence the increase in expired air.

Structure of the human breathing system



Descriptions/functions of the human breathing system

Epiglottis – a flap which covers the opening of the trachea and prevents food from entering.

Larynx – contains the vocal cords for speech, singing etc.

Trachea – carries air to the bronchi

The trachea is made up of rings of cartilage to keep it open. This can be felt by rubbing the fingers along the neck.

Bronchi – branches from the trachea which carries air into the lungs.

Bronchioles – smaller branches from the bronchi.

Alveoli – (singular: alveolus) small balloon-like structures located at the end of each bronchiole.

The alveoli are responsible for gaseous exchange.

Rib bone – helps to make up the rib cage

Intercostals muscles – contract or relax to help in the breathing process.

Diaphragm – a thin sheet of muscular tissue which separates the thoracic cavity from the abdominal cavity. It plays an important role in deep breathing (diaphragm breathing)

Lung ventilation

Breathing in	Breathing out
Intercostal muscles <i>contract</i>	Intercostal muscles <i>relax</i>
Rib cage moves <i>up and out</i>	Rib cage moves <i>down and in</i>
Diaphragm muscle <i>contracts</i>	Diaphragm muscle <i>relaxes</i>
Diaphragm <i>flattens</i>	Diaphragm <i>becomes dome-shaped</i>
Volume of thorax <i>increases</i>	Volume of thorax <i>decreases</i>
Pressure inside the thorax <i>decreases</i>	Pressure inside the thorax <i>increases</i>
Air is <i>drawn into</i> the lungs	Air is <i>expelled from</i> the lungs

The **normal breathing rate** at rest is approximately 18 – 20 breaths per minute. Normal breathing is usually shallow (rib breathing).

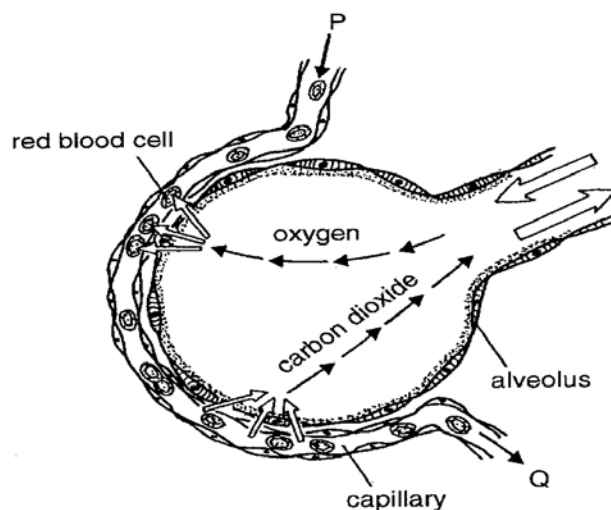
Physical activities e.g. exercises, will increase the rate and depth of breathing. The rate of breathing may even double and the breathing is usually deep (diaphragm breathing). The deeper the breathing, the more air is taken in.

Note: The breathing rate is controlled by the brain and it depends on the level of carbon dioxide in the blood.

Gaseous exchange

This is the process in which oxygen is exchanged for carbon dioxide in the lungs. The alveoli are the structures of the lungs that are involved in gaseous exchange.

Structure of an alveolus



Features of the alveoli which make them efficient in gaseous exchange

*numerous * moist membrane *thin membrane * supplied with lots of blood vessels
*large surface area

Description of gaseous exchange

Oxygen in the air sacs dissolves in the moisture of the alveolar membrane. The oxygen then diffuses across the thin membrane of the alveoli and then across the thin membrane of the capillary and into the blood stream. In the blood stream, the oxygen combines with haemoglobin of the red blood cells to form oxyhaemoglobin, and is carried around the body in this form. In the tissues, the oxygen is released and the haemoglobin is now made available to transport more oxygen.

At the same time that oxygen was diffusing into the bloodstream of the capillary, carbon dioxide was diffusing out of the capillary and into the alveoli. The carbon dioxide is removed from the alveoli in the exhaled air.

Both processes above occur simultaneously and is called **gaseous exchange**.

The effects of cigarette smoke and air pollution on gaseous exchange surfaces.

Tiny particles of carbon from cigarette smoke and from the air pollutant smoke, if breathed in, may affect the alveoli and cut down on the ability of the gaseous exchange surface to efficiently exchange gases. This will lead to frequent coughing resulting in the breakdown of the walls of the alveoli. The disease **emphysema** results. A person with emphysema has difficulty in breathing.

Assignment Question**(Answer each part in complete sentences)**

1. (a) (i) What are TWO differences between the blood entering the alveoli and the blood leaving the alveoli?(2)
 - (ii) What is the advantage of a large number of alveoli in the lungs? (1)
 - (iii) How is the structure of the capillaries adapted for the diffusion of gases? (2)
- (b) (i) Describe what happens to the diaphragm, intercostals muscles and the ribs during expiration.(3)
 - (ii) Describe what happens to the volume and pressure in the thorax during inspiration.(2)