

Biology

NTSE Foundation

Respiration

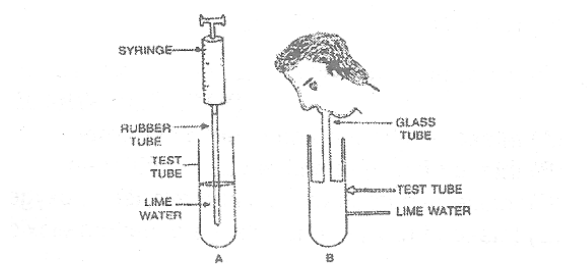
Respiration

The sum total of all vital activities is called as metabolism. Vital activities refer to all the physiochemical activities of a cell. It has two aspects (i) Anabolism: It includes metabolic processes by which complex cellular compounds are synthesized from simple compounds, e.g. Photosynthesis.

(ii) Catabolism: It includes metabolic processes by which larger molecules are broken down into simpler molecules, e.g. Respiration. Respiration is an important catabolic process responsible for the production of energy.

(a) Definition:

The process by which assimilated food is oxidized and energy is released is called as respiration. This energy is stored in the form of ATP molecules inside the cell for further use and the waste products i.e. CO_2 and H_2O are eliminated out of the body.



(A) Air being forced into lime water with a syringe ; B. Air exhaled into lime water.

(i) Take a test tube and pour some freshly prepared lime water into it.

(ii) Blow (exhale) air into lime water with the help of glass tube. Note the time to turn into milky lime water.

(iii) Now take a syringe. Pass fresh air through this syringe into lime water. Again note the time to turn into milky lime water.

(i) It is observed that exhaled air makes the lime water milky earlier than fresh air, indication the presence of more CO_2 in exhaled air.

(b) Types of Respiration:

(i) Aerobic: It is oxidation of food which takes place in presence of molecular oxygen.

Food

Glycolysis

Pyruvic acid

In presence of O_2 Krebs cycle in Mitochondria



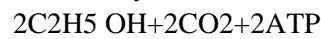
It is called as aerobic respiration.

(ii) Anaerobic respiration: When oxidation of food material does not require molecular oxygen or it occurs in absence of molecular oxygen, it is called as anaerobic respiration.

Food

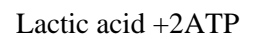
Pyruvic acid

In yeast



(During fermentation)

In muscle



(During vigorous exercise)

- **Fermentation:** This process is used for preparation of alcoholic beverages in presence of yeast in the absence of oxygen. It is called as fermentation. Glucose and fructose are converted into ethanol by this process. It is a type of anaerobic respiration.

Differences between Aerobic and Anaerobic Respiration:

AEROBIC	ANAEROBIC
It occurs in all living cells of plants & Animals.	It occurs in bacteria, certain fungi, germinating seeds, fleshy fruits, & muscles.
It requires oxygen.	Oxygen is not required.
The end products are CO_2 and H_2O	The end products are alcohol and CO_2 or lactic acid.
Produces 38 ATP molecules.	Produces 2 ATP molecules.
Organic compounds are completely oxidized.	Organic compounds are incompletely oxidized.
High amount of energy is released.	Very small amount of energy is released.

Differences Between Respiration & Photosynthesis

RESPIRATION	PHOTOSYNTHESIS
It is a catabolic process.	It is an anabolic process.
Carbohydrates are oxidized.	Carbohydrates are synthesized.
It takes Place in all the living cells,	It takes place only in chlorophyllous cells.
O_2 is utilized and CO_2 & H_2O are formed.	CO_2 and H_2O are used while O_2 is evolved.
$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$	$6\text{CO}_2 + 12\text{H}_2\text{O} + \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$

- **Differences Between Respiration & Breathing**

Respiration	Breathing
Biochemical process in which glucose is oxidized to carbon dioxide and water.	Physical process in which oxygen is taken in & carbon dioxide is given out.
Occurs inside the cell.	Occurs outside the cell.
Gradual and stepwise release of energy.	No release of energy.
Enzymes are involved in the process.	No enzymes are involved in the process.

- **Differences Between Respiration & Combustion**

Respiration	Combustion
It is a biological process	It is a chemical process.
It takes place at normal temperature.	It takes place at higher temperature.
Respiration is a slow process completed in several steps.	Combustion is fast process completed only in one step.

(a) Respiration in plants.

- In plants exchange of gases takes place from leaves, stems and roots individually.
- Exchange of gases in plants occurs by simple diffusion.

(i) Respiration in roots:

- In young roots, the epidermal cells are extended to form root hair. The oxygen from soil enters into the root hairs by simple diffusion and reaches to other cells of root for respiration.

(ii) Respiration in stems:

- In woody plants, stem have small openings in their epidermal cells called as lenticles the oxygen from air enters through stomata and carbon dioxide is released from the same.

(iii) Respiration in leaves:

- Surface of leaves possess numerous tiny pores called as stomata in their epidermal cells, exchange of gases takes place through stomata and when CO₂ concentration in cell increases stomata open and CO₂ is released out.

Respiration in Animals:

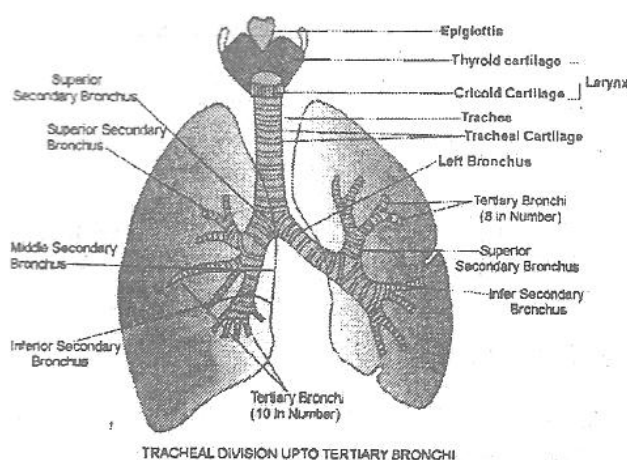
- Animals have different types of organs for respiration due to which mode of respiration also

varies according to the organism but the basic mechanism is same.

Type of respiration	Organs Involved	Example
Cell surface respiration	General body surface	Amoeba, Paramecium
Tracheal respiration	Trachea & tracheoles	Insects
Branchial respiration	Gills	Aquatic animals (Fishes)
Cutaneous respiration	Skin	Frog
Pulmonary respiration	Lungs	Amphibians, reptiles, birds & mammals
Buccal respiration	Buccal cavity	Frog

(b) Respiration in Humans:

- Human respiratory tract
 - (i) External nostrils: First part of respiratory system. It opens into nasal cavity and is meant for inhalation of air from outside.
 - (ii) Nasal Cavity: This cavity is separated from oral cavity by means of a hard and bony palate. It is lined by ciliated columnar epithelial cells which are rich in mucus. It brings about warming, moistening and sterilization of air. It contains hair and mucus which entrap the dust particles.



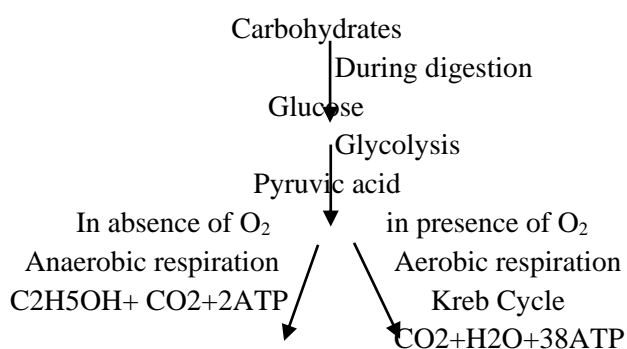
- (iii) Internal nares: Nasal cavity opens into it and it leads to pharynx.

- (iv) Pharynx: It is a common part between alimentary canal and respiratory system.

- (ii) Larynx: It is an enlarged part of trachea which is also called as 'voice box', It produces voice by passage of air between vocal cords. It contains four different types of cartilages among them a 'c' shaped thyroid cartilage protruding out in neck region is called adam's apple.
- (iii) Trachea: It is also called pipe. It is 10-12 cm long tube. Its walls are supported by 16-20 'c' shaped cartilaginous rings which prevent them to collapse when air is absent in them.
- (iv) Bronchi : Trachea is branched into two bronchi left and right each of which enters into the lungs.
- (v) Lungs: These are two light weight spongy pouches covered by a membrane called pleura. Bronchi are further branched into several bronchioles, at the end of bronchioles alveolar sacs or alveoli are present which are rich in blood capillaries and thin walled.
- (vi) Diaphragm: It is a sheet of muscles that lies below the lungs and separates thoracic cavity from abdominal cavity.
- Mechanism of breathing: It includes.
 - (i) Inhalation: The oxygen present in air diffuses into the blood and CO_2 from blood diffuses out into alveolar sac.
 - (ii) Exhalation: CO_2 is pushed out from lungs into the air through trachea and nostrils.
- (c) Cellular Respiration:

It refers to the oxidation of food taking place inside the cell. So it is called cellular respiration. It takes place in three steps:

 - (i) Glycolysis
 - (ii) Krebs Cycle
 - (iii) Electron Transport System



(a) Glycolysis:

Glycolysis also called EMP (Embden, Meyerhof, Parnas pathway. Site-cytoplasm of cell.)

- (i) In this cycle glucose is converted into pyruvic acid in presence of many enzymes and co-enzymes.
- (ii) Oxygen is not required during glycolysis.
- (iii) 1 molecule of glucose gives rise to 2 molecules of pyruvic acid.
- (iv) In this process 4 molecules of ATP are formed among them 2 ATP molecules are utilized thus net gain of two ATP molecules.
- (v) 2 NADP molecules are reduced to 2 NADPH_2 , which later produces 6 ATP molecules 3 each from.
- (vi) Net production ATP in glycolysis is $2\text{ATP} + 6\text{ATP} = 8\text{ATP}$.
- (i) There is no production of CO_2 during this process.
- (b) Krebs Cycle:

Site: Matrix of Mitochondria.

 - (i) Also called aerobic oxidation.
 - (ii) Discovered by Sir Hans Krebs.
 - (iii) Another name TCA cycle (tricarboxylic acid cycle) or Citric acid cycle.
 - (iv) It brings about the conversion of pyruvic acid, fatty acids, fats and amino acids into CO_2 and water by oxidation.
 - (v) It is the common path for oxidation of carbohydrates, fats and proteins.
 - (vi) It accounts for 24 ATP molecules.
 - (vii) It starts with acetyl Co-A which is then converted into several intermediate compounds with the release of NADPH_2 , FADH_2 , ATP_1 hydrogen atoms and then Acetyl Co-A is regenerated back.
- (c) Electron Transport System or ETS:

Site of ETS- Inner membrane of mitochondria.

 - (i) In this hydrogen atoms produced during oxidation of various intermediates during krebs cycle are first broken into protons and electrons.
 - (ii) These protons and electrons after passing through a series of coenzymes and cytochromes combine with oxygen to form water molecules.
 - (iii) During these series of events 1 NADPH_2 releases 3 ATP molecules and 1 FADH_2 gives 2 ATP molecules which were produced during krebs cycle and glycolysis.

- Note: The net gain of ATP molecules during respiration is 38 ATP molecules among them, 8 ATP from glycolysis, 6 ATP from conversion of pyruvic acid into acetyl Co.A., 24ATP from kreb cycle besides this CO_2 and H_2O are also released.

EXERCISE

- The exchange of gases between the external air and the blood occurs in the.
 - Bronchus
 - bronchiole
 - trachea
 - alveoli
- Anaerobic respiration is likely to occur in
 - Ants
 - Earthworms
 - Echinoderms
 - Tapeworms
- In humans lungs. How many lobes are
 - 2 in Left and 3 in right lungs
 - 3 in left and 2 in right lungs
 - 3 in each lung
 - 2 in each lung
- Pyruvic acid is reduced to lactic acid anaerobically in –
 - Liver
 - Muscles
 - brain
 - skin
- Oxygen is transported n vertebrates as
 - Dissolved in plasma
 - Combined with Haemoglobin
 - Dissolved in cytoplasm of erythrocytes
 - Absorbed over the RBC
- Respiration is controlled by-
 - Cerebrum
 - cerebellum
 - Medulla oblongata
 - olfactory lobe
- Respiration by lungs is called as-
 - Pulmonary respiration
 - Cutical respiration
 - Branchial respiration
 - Dutaneous respiration
- During expiration, the diaphragm becomes
 - Oblique
 - Normal
 - Flattened
 - Dome-shaped
- In human body, blood is oxygenated and purified in the-
 - Liver
 - kidneys
 - heart
 - lungs
- In mammals the body cavity is partitioned into thoracic and abdominal parts by
 - Liver
 - Lungs
 - ribs
 - diaphragm
- Which function is not performed by lungs?
 - Elimination of carbon dioxide
 - Provision of oxygen
 - Purification of blood
 - Removal of nitrogenous wast
- The end product of anaerobic respiration is –
 - CO_2
 - H_2O
 - ethyl alcohol
 - A and C both
- The process of respiration is concerned with
 - Liberation of oxygen
 - Liberation of nitrogen
 - Liberation of energy
 - Intake of oxygen
- The end product of glycolysis is –
 - Pyruvic acid
 - Rubp
 - PEP
 - ATP
- Respiration site in a cell is-
 - Chloroplast
 - ER
 - mitochondria
 - golgi body
- Respiration is a process where glucose molecules are oxidized to release energy. Mitochondria are cellular organelles which carry out aerobic respiration. Which one of the flowing santance is incorrect?
 - Green plant cells respire during day time even when they are actively undergoing photosynthesis.
 - Bacteria can not carry out aerobic respiration as they are prokaryotic cells and lack mitochondria.
 - Cells of dormant seeds respire.
 - Plant cells respire even when stomata are closed.
- Amount of which of the following components' in air does not change in process of respiration-
 - Oxygen
 - Carbon di-oxide
 - Nitrogen
 - Water Vapour
- Given below are some statements.
 - The oxygen dependent respiration is called aerobic respiration.
 - The requirement of water for photosynthesis is not essential.
 - Gymnosperms such as pines are the vascular plants which produce seeds but no fruits.

(d) Root hairs provide increased surface area for gas exchange and absorption of water in plants.

Which one of the following alternatives is correct?

(a) A is true, B is false

(b) B is true, A is false

(c) B is true, C is false

(d) D is true, A is false

ANSWER - KEY

RESPIRATION

Q.	1	2	3	4	5	6	7	8	9	10
A.	D	D	A	B	B	C	A	D	D	D
Q.	11	12	13	14	15	16	17	18		
A.	D	D	C	A	C	B	C	A		