

FORMATION OF USABLE ENERGY-ATP

6.3 RESPIRATION

ENERGY RELEASING PROCESS

- All living organisms requires constant supply of ENERGY to perform various life processes.
- This energy is derived from the stored food which is obtained by the process of Nutrition.
- Energy is stored in the complex organic molecules like carbohydrate, protein and fats cannot be used directly.
- This is potential energy which needs to be converted into usable chemical energy – called ATP.

◉ THUS THE PROCESS BY WHICH ENERGY IS RELEASED IN THE FORM OF ATP IS CALLED RESPIRATION. ◉

RESPIRATION :- Biochemical process in which complex organic material is oxidized (broken down) in a stepwise manner to release energy in the form of ATP + heat.

• THIS PROCESS OCCURS IN EVERY LIVING CELL.

• REACTION :
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 12\text{H}_2\text{O} + 38\text{ATP}$$

(Glucose) (usable energy)

: RESPIRATION OCCURS IN TWO WAYS:

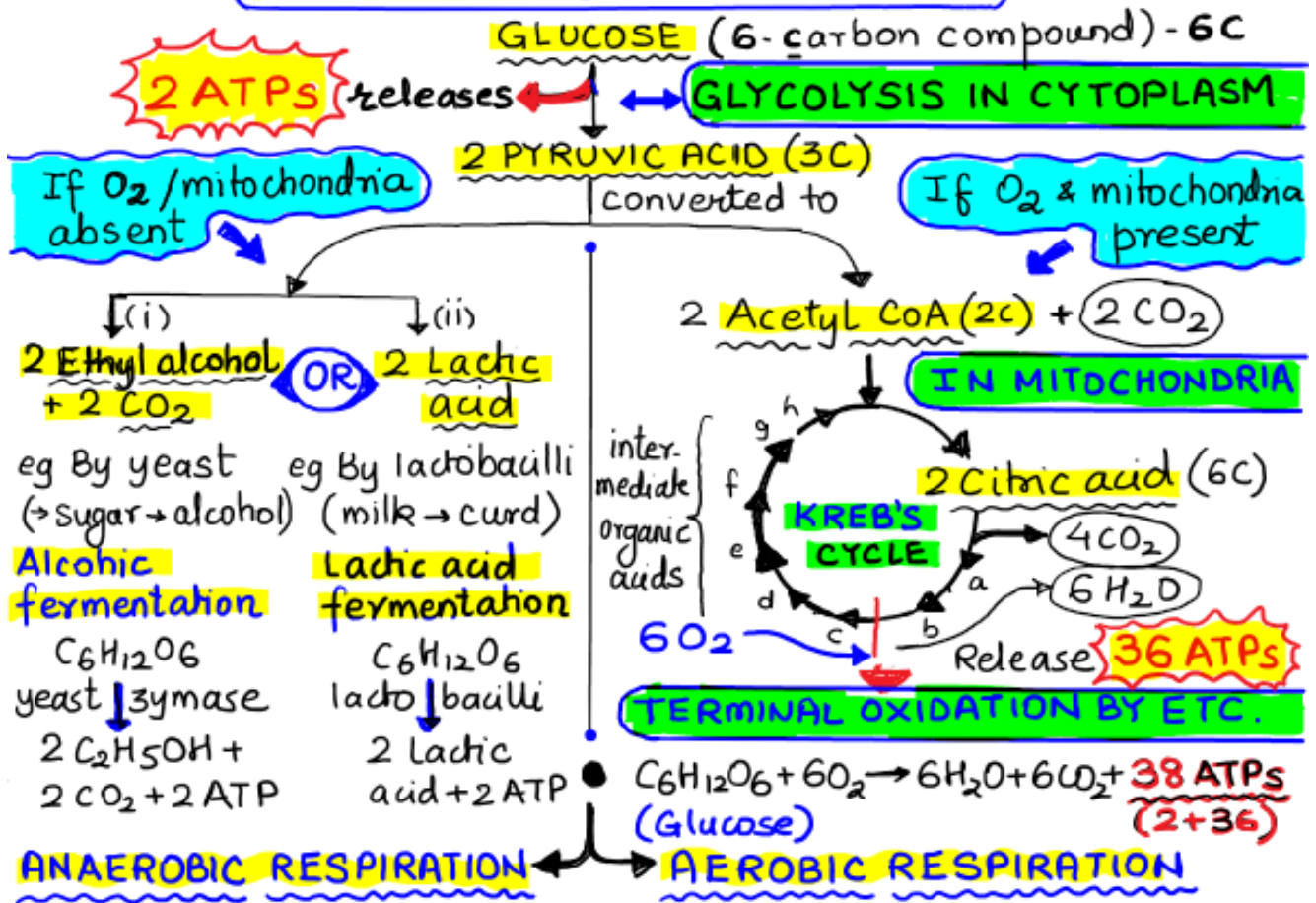
TYPE A AEROBIC RESPIRATION

1. Respiration in PRESENCE of O_2
2. Complete oxidation of glucose
3. End product = $\text{CO}_2 + \text{H}_2\text{O}$
4. Energy = 38 ATP (more)
5. Occurs in cytoplasm + mitochondria
6. Occurs in all aerobic organism, most bacteria, fungi, all algae, plants & animals.
(However in absence of O_2 show anaerobic respiration)
7. Steps :-
 - a) GLYCOLYSIS
 - b) KREB'S CYCLE
 - c) OXIDATIVE PHOSPHORYLATION

TYPE B ANAEROBIC RESPIRATION

1. Respiration in ABSENCE of O_2 .
2. Incomplete oxidation of glucose
3. End product - Lactic acid or ethyl alcohol + CO_2
4. Energy = 2 ATP (lesser)
5. Occurs in cytoplasm of cell.
6. Seen in anaerobic microbes some bacteria & fungi.
(also in aerobes in absence of O_2 or mitochondria)
Eg. RBC, Early seed germination.
7. Steps :-
 - a) GLYCOLYSIS
 - b) DECARBOXYLATION
 - c) REDUCTION

MECHANISM OF RESPIRATION



Glycolysis \rightarrow Breakdown of glucose into 2 pyruvic acid is common stage in both aerobic & anaerobic & occurs in cytoplasm.

- In RBC mitochondria is absent
 - In muscle cells during lack of O_2
- Anaerobic process occurs & lactic acid is produced.

PHASES OF AEROBIC RESPIRATION

2 Phases (Events)

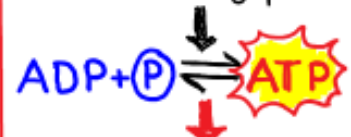
BREATHING [Exchange of O_2 & CO_2]

- A] In plants \rightarrow occurs through general body surface OR via special pores \rightarrow Stomata \rightarrow on leaf, Lenticles \rightarrow on stem, root
- B] In animals \rightarrow occurs through general body surface OR via respiratory organs \rightarrow Skin \rightarrow Frog, Gills \rightarrow Fishes, Trachea \rightarrow Insect, Lungs \rightarrow Mammals
- C] In unicellular organisms \rightarrow via cell membrane (direct diffusion).

CELLULAR RESPIRATION

(Occurs in every living cells) as given/shown above.

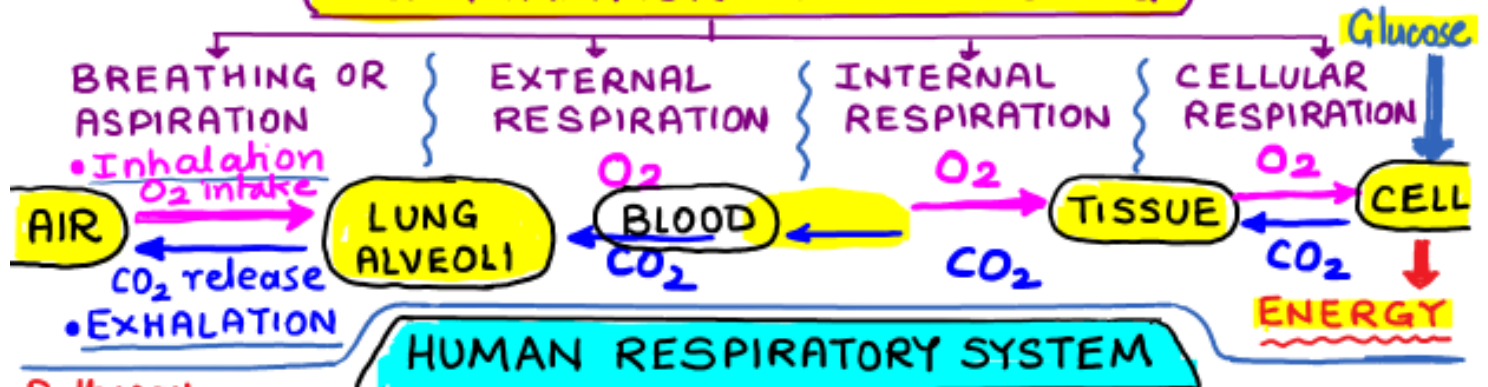
Energy obtained on oxidation of food



Energy released by ATP is used for cellular activities

ATP: Usable energy source • energy currency • Adenosine Triphosphate (with high energy PO_4 bond) \rightarrow P

RESPIRATION IN HUMAN BEING



Pathway of air

RESPIRATORY TRACT (AIR PASSAGE)

A] NOSTRILS (2 external nares)

Inlet for O₂ rich air
Outlet for CO₂ rich foul air

B] NASAL CHAMBER / Passage (3 region)

- Vestibule → filters air via hair
- Sensory part → senses smell
- Respiratory part → warms air

C] PHARYNX - throat - common passage for air & food

D] LARYNX - Sound box

- produce sound (2 vocal cord)
- opening guarded by **EPIGLOTTIS**
- closes opening during food swallowing.

E] TRACHEA - wind pipe supported

by C-shaped cartilage to prevent collapse of tube.
Divided into 2 1° BRONCHI.

F] BRONCHI - Respiratory tube

with ring cartilage.
Divide into 2° & 3° bronchi in lungs.

G] BRONCHIOLES - Terminal branch of bronchus carrying air into alveoli.

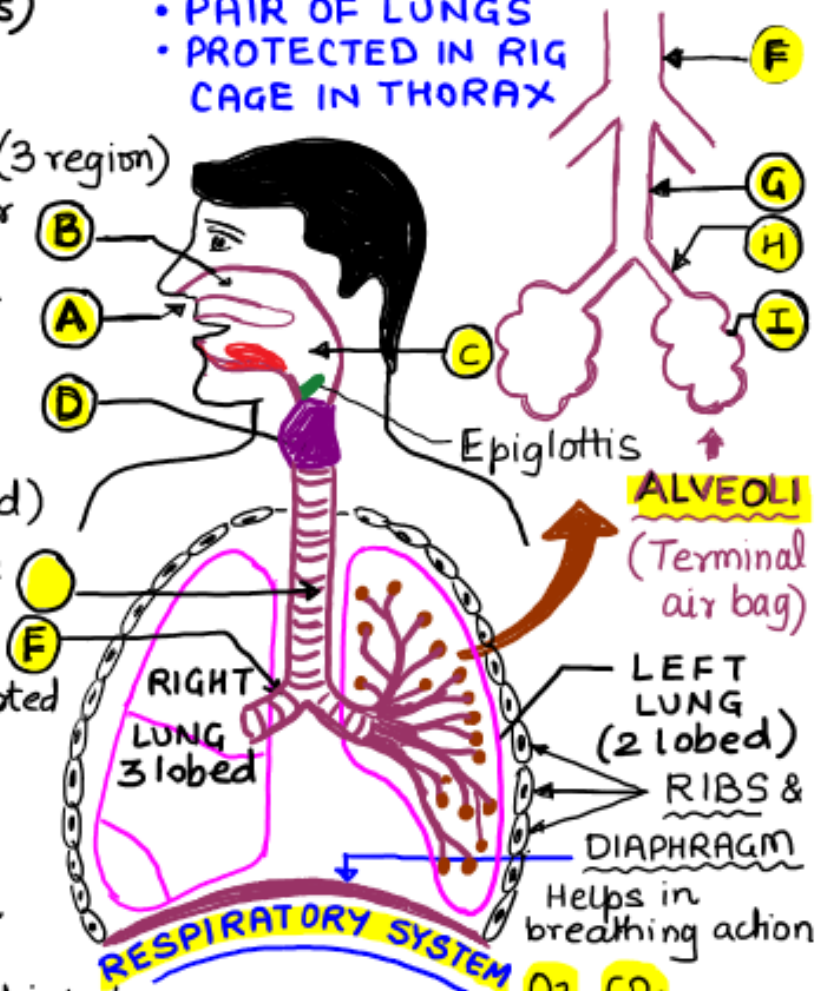
H] ALVEOLAR TUBE - Elastic tube of alveoli

I] ALVEOLI (Single - alveolus) - Terminal air sac

The site of exchange of O₂ and CO₂ between lungs and surrounding blood capillaries by simple DIFFUSION

RESPIRATORY ORGAN

- PAIR OF LUNGS
- PROTECTED IN RIG CAGE IN THORAX



VERY SHORT ANSWER QUESTIONS:- 1 Mark

Q1. Name the intermediate and end products of glucose breakdown in aerobic respiration. (CBSE-19)

Ans: i) Intermediate product \rightarrow Pyruvic acid + 2ATP energy
ii) End product \rightarrow $\text{CO}_2 + \text{H}_2\text{O} + 36 \text{ ATP energy}$

Q2. Where is the respiratory pigment found in human body?

Ans:- Respiratory pigment \rightarrow Haemoglobin (red) (CBSE-14)
Present in \rightarrow RBC (Red blood cells)

Q3. What is breathing?

Ans. Breathing :- The physical process in which O_2 rich air is taken in (inhalation) & CO_2 rich foul air is given out (exhalation)

Q4. What is the site of aerobic respiration in a cell.

Ans. First phase - Glycolysis - occurs in cytoplasm.
2nd & 3rd phase - Krebs cycle + ETS - occurs in mitochondria

Q5. Why does trachea - wind pipe do not collapse?

Ans. Trachea is supported by C-shaped cartilage which prevents collapse of tracheal tube.

Q6. How many ATPs are produced in respiration?

Ans. In anaerobic respiration - only 2 ATPs
In aerobic respiration $\rightarrow (2 + 36) = 38 \text{ ATPs}$

Q7. What is ATP?

Ans. ATP - stands for Adenosine Tri-Phosphate, which is usable form of energy or energy currency of cell.

SHORT ANSWER QUESTIONS (I) - 2 Marks

Q1. "Respiration is an exothermic reaction". Justify the statement giving the chemical equation. (CBSE-11)

Ans. • During cellular respiration, glucose is broken down in a step wise manner to release stored energy.
• A part of this is used to form ATP (usable energy)
• Remaining part is released as heat (Exothermic process)
• Equation :- $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}$ $\rightarrow 38 \text{ ATP}$ heat

Q2. Why is the rate of breathing in aquatic organisms much faster than in terrestrial organisms. (NE)

Ans. Air has more O_2 concentration than water. Terrestrial organisms take O_2 directly, while aquatic organism obtain O_2 in dissolved form. Hence rate is more

Q3. How does anaerobic respiration occurs in our muscles and what is the effect?

Ans. • Anaerobic respiration in our muscles occurs due to lack of oxygen.

- This happens during vigorous exercise or suffocation.
- Glucose is not completely oxidized & forms lactic acid.
- Effect :- Lactic acid gets stored in muscles. This leads to muscle stiffness & cramps.

Q4. Give the differences between aerobic & anaerobic respiration

Ans. Refer the notes - page no. 1 (write any 4 points)

Q5. Give the pathway of air flow through respiratory tract.

Ans. Nostrils → Nasal chamber → Pharynx → Larynx
Alveoli ← Bronchioles ← Bronchi ← Trachea

SHORT ANSWER QUESTIONS (II): 3 marks

Q1. List three characteristics of lungs which makes it an efficient respiratory organ. (CBSE-12)

- Ans.
1. It is highly vascular (supplied with blood vessels)
 2. Highly branched respiratory tract (large area)
 3. Inner lining is thin and moist.
 4. Terminal air sacs (alveoli) are numerous.

Q2. How are alveoli designed in human beings to maximize the exchange of gases? List three features

- Ans.
- Alveoli are terminal air sac which is balloon like
 - It is lined by thin elastic membrane.
 - It is provided by extensive network of blood capillaries.
 - This helps in rapid exchange of O_2 and CO_2 between alveoli and blood.

Q3. Differentiate between inhalation & exhalation.

Ans.

Sr	POINTS	INHALATION	EXHALATION
1	Process of ---	taking O_2 into lungs	giving out CO_2 from lungs
2	Type of process	Active	Passive
3	Diaphragm & Inter costal muscles	Contracts	Relaxes
4	Ribs	Pushed forward	Pushed backward
5	Diaphragm	Pushed downward	Pushed upward
6	Thoracic cavity	Increases	Decreases
7	Effect	Air gushes into	Air gushes out.

LONG ANSWER QUESTIONS: 5 marks

Q1. Explain the three pathways of breakdown of glucose in living organisms.

Ans. • Glucose is broken down in step wise manner during the process of RESPIRATION.
• The first common step is GLYCOLYSIS.
During this → glucose (6C) is broken into 2 pyruvate (3C)
• Glucose glycolysis → 2 pyruvic acid + 2ATP (energy)
• The pyruvic acid (pyruvate) is further broken down in 3 ways depending on presence of O_2 & mitochondria

1.	2.	3.
<u>Absence of O_2</u>	<u>Lack of O_2</u>	<u>Presence of O_2</u>
in yeast into <u>Ethanol (2C) + CO_2</u> ↑	in muscles into <u>Lactic acid (3C)</u>	in mitochondria <u>$CO_2 + H_2O + 36 ATP$</u>

Q2. Draw a well labelled diagram of human respiratory system. Mention the function of
a) Alveoli b) Trachea c) Nasal chamber

Ans. For diagram :- Refer pg no. 3 of the notes.

Functions
a) Alveoli → Site of exchange of O_2 & CO_2 between lungs & blood by diffusion.
b) Trachea → Passage of air between pharynx & lung
Traps germs & dust particles.
c) Nasal chamber → Filters air, senses smell, Warms air.

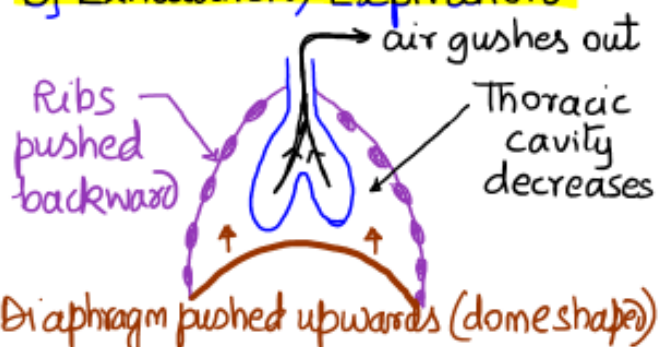
Q3. Explain the mechanism of breathing in human.

Ans. Breathing involves 2 alternate phases :-

A] Inhalation/Inspiration



B] Exhalation/Expiration



Note : Refer Q3. pg 5 for explanation.