

BIOLOGY -

CLASS - 9

THROAT

ESOPHAGUS

TRACHEA

HUMAN

RESPIRATORY

SYSTEM

RIGHT LUNG

BRONCHI

DIAPHRAGM

NASAL CAVITY

NOSE

MOUTH

LARYNX

LEFT LUNG

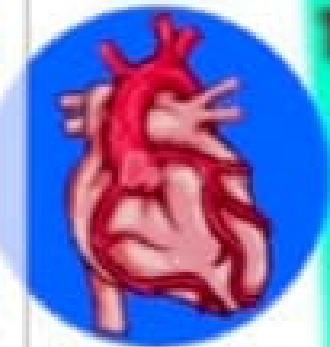
ALVEOLI

CAPILLARY NETWORK

VENA

ARTERIA

BRONCHIA

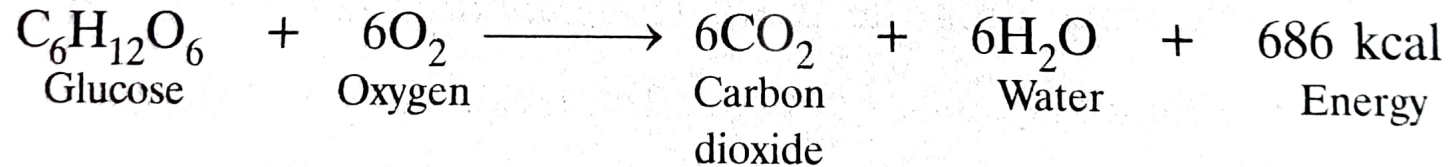


1. **Respiration** is the stepwise oxidation of glucose to release energy in the body cells. The energy produced by respiration is stored in ATP molecules.

- Respiration is of two types:

- (i) aerobic and (ii) anaerobic.

- **Aerobic respiration** requires oxygen. The glucose is completely broken down.



- **Anaerobic respiration** takes place in the absence of oxygen. The glucose is incompletely broken down.



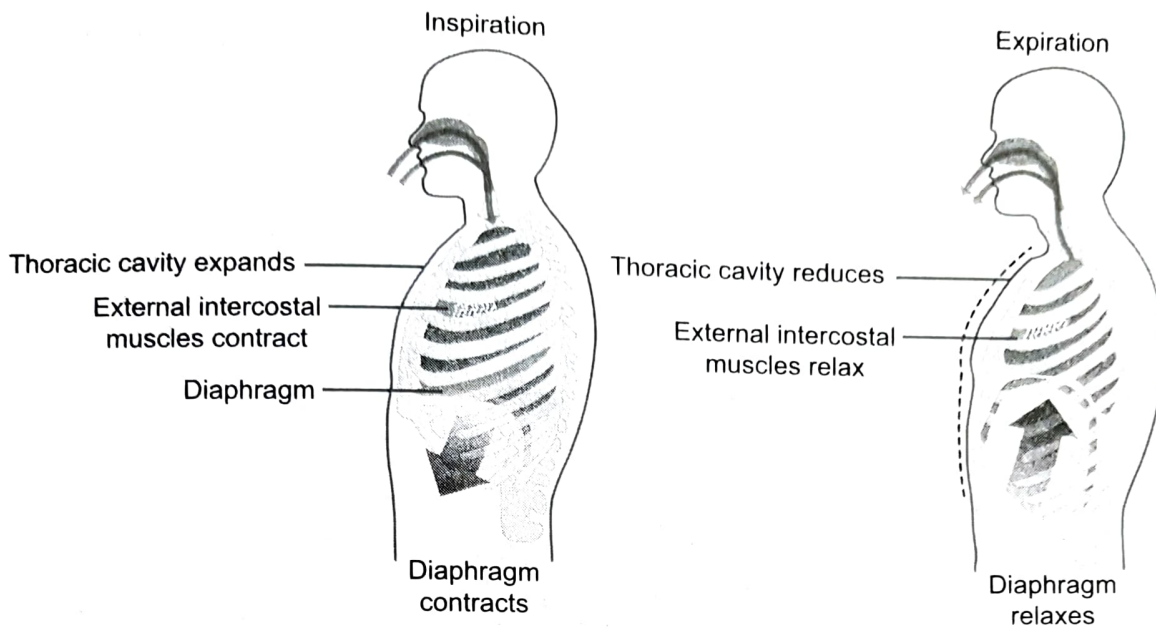
In humans gaseous exchange is completed in the following ways:

- (a) External respiration (or breathing)
- (b) Transport of gases
- (c) Tissue respiration.
- (d) Cellular respiration.

(a) Breathing involves taking in of oxygen and giving out carbon dioxide.

Mechanism of breathing:

- (i) **Inspiration:** Intercostal muscles contract, allowing the ribs to move upward and outward. The diaphragm contracts and flattens, chest cavity increases. Pressure decreases and air is drawn in.
- (ii) **Expiration:** During expiration intercostal muscles relax, ribs move downward and inward. The diaphragm relaxes and becomes dome shaped. Chest cavity decreases and pressure increases. The air is expelled out.

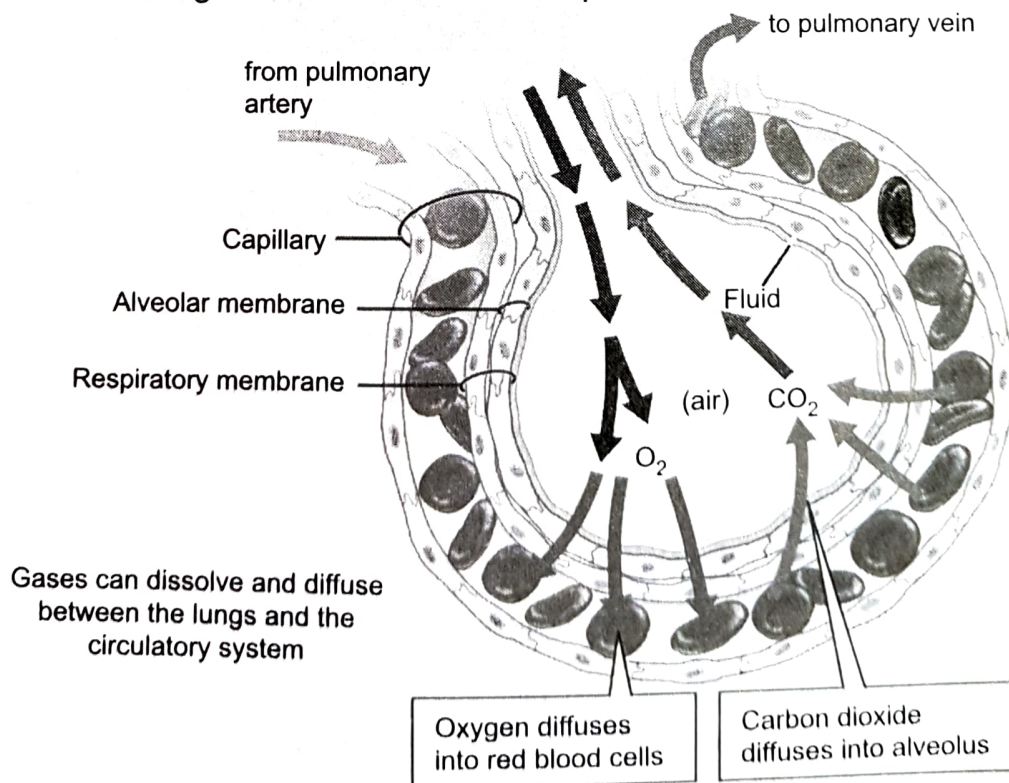


(b) **Gaseous transport:** The walls of alveoli in the lungs are covered by blood capillaries. Oxygen is absorbed by the RBCs present in the blood (in blood capillaries) from alveoli. RBCs contain haemoglobin that combines with oxygen to form oxyhaemoglobin. Thus, oxygen is transported to all parts of the body by arteries.

The carbon dioxide formed in the tissues is transported to the lungs by the blood (in the veins) in two ways:

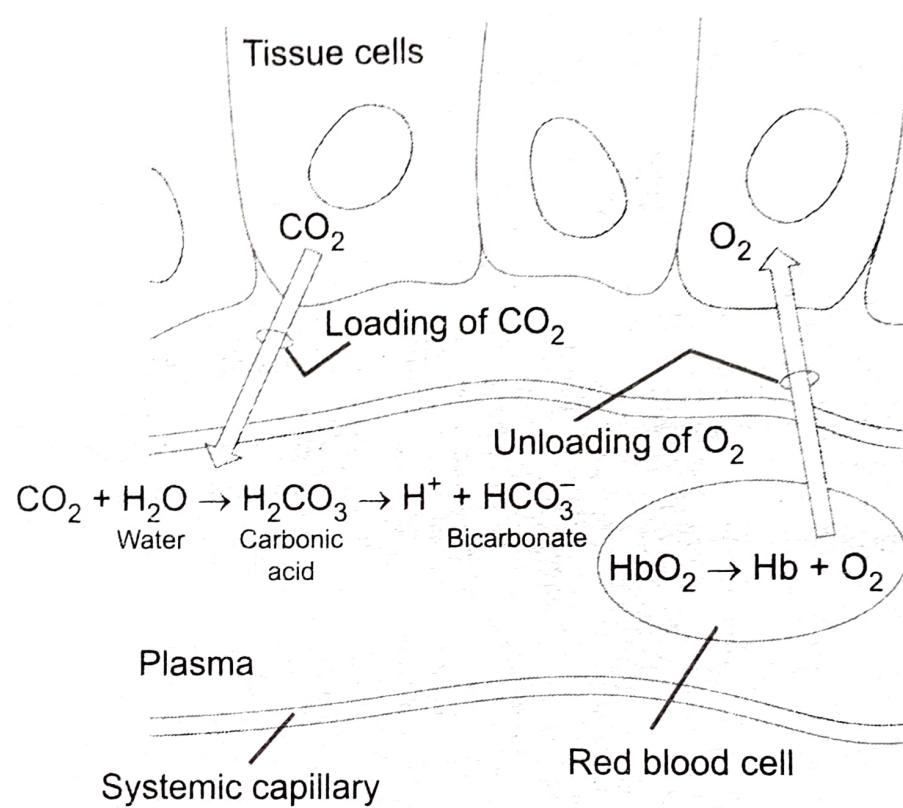
- Major portion as bicarbonates (dissolved in plasma).
- Partly in combination with haemoglobin (present in RBCs) as carbamino-haemoglobin.

Gas exchange between alveoli and capillaries



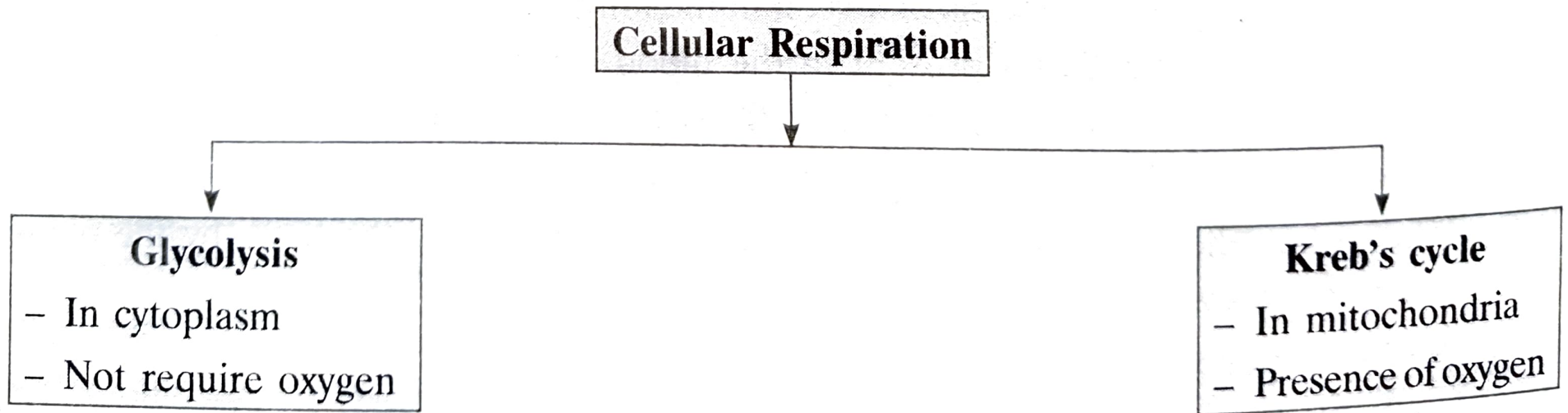
Gaseous exchange in Alveolus

(c) **Tissue respiration:** The blood capillaries transport the oxygen to all the cells in the body by the process of diffusion (through their thin walls). Also, they pick up the carbon dioxide from the cells.



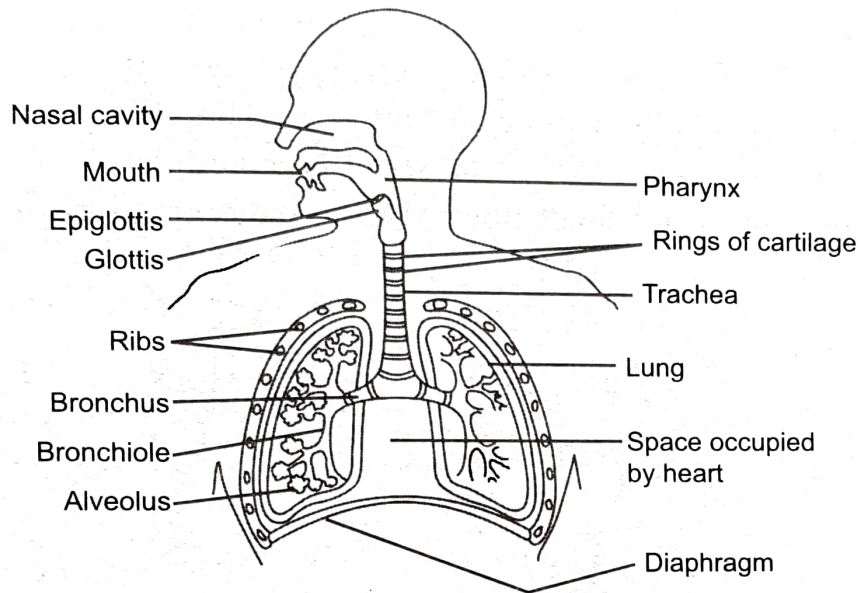
Tissue respiration

(d) Cellular respiration occurs in two phases:



3. Composition and percentage of components present in inspired and expired air:

Respiratory organs in humans:



Human respiratory system

- (a) **Nose:** Has two nostrils. It contains fine hair. Nostrils warms the air, trap harmful microbes and moistens the air.
- (b) **The pharynx:** It is a large cavity. It is a common passage for air and food.
- (c) **The Larynx (voice box):** Situated in front of the wind pipe. It has two vocal cords which when vibrated produce sound.
- (d) **The trachea (wind-pipe):** The walls of trachea are lined with C-shaped cartilaginous rings as these prevents the collapsing of trachea. At the mouth of the trachea lies epiglottis.
- (e) **The bronchi:** The immediate branches of trachea which enters into the two lungs.
- (f) **Bronchioles:** The branches of bronchi.
- (g) **Alveoli (air-sac):** The ultimate branch and the functional unit of lungs. It has a network of capillaries which aids in diffusion of oxygen.
- (h) **Lungs:** A pair of lungs is located in the thoracic cavity. The lungs are enclosed in protective double-walled sac called **pleura**.

Respiratory centre is located in the medulla oblongata.

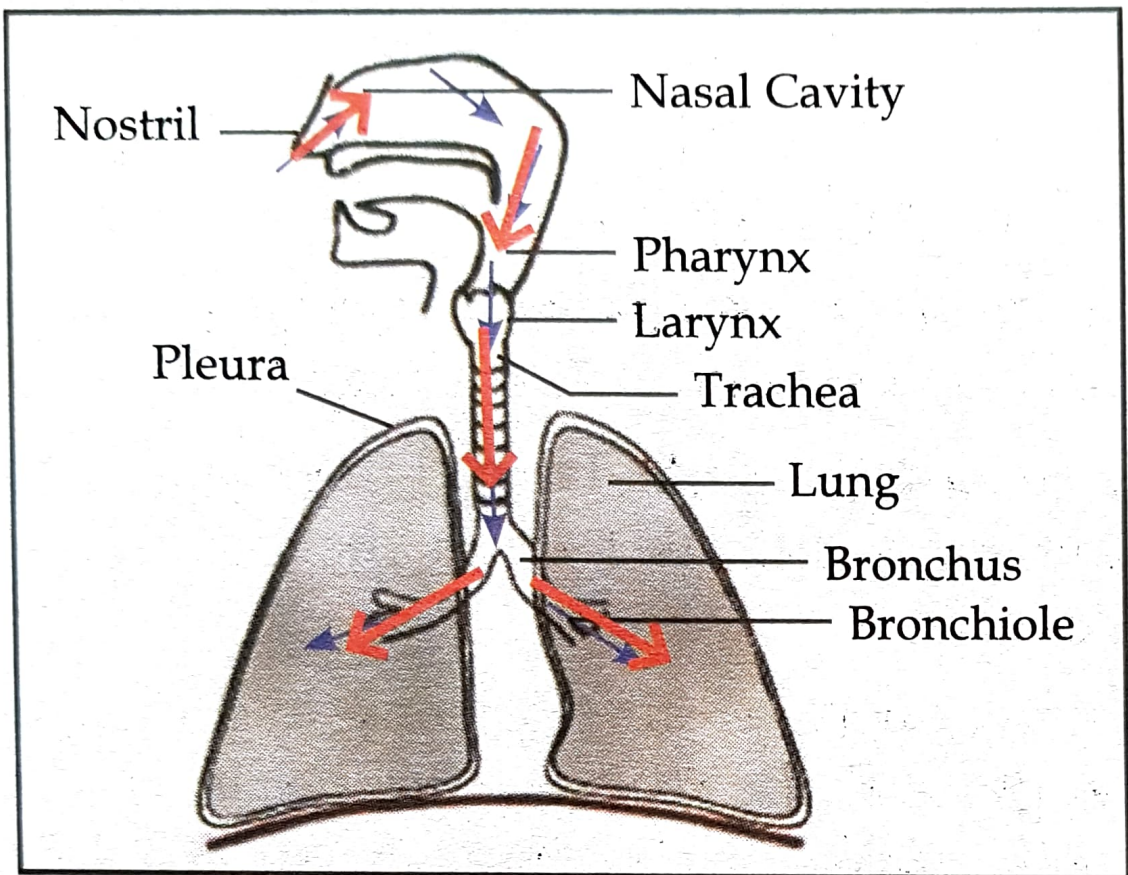


Fig. 14.3: Path of air in human respiratory system

Blood Supply to the Lungs

The lungs *receive deoxygenated blood from the heart* through the pulmonary artery.

- ❑ The **pulmonary artery** divides into two and enters the respective lungs.
- ❑ The artery then divides many times in the lungs and forms **capillaries**.
- ❑ The capillaries form a network around the alveoli, where the gaseous exchange takes place.
- ❑ These capillaries join to form **venules** and then veins, finally forming the **pulmonary vein**.
- ❑ The pulmonary vein transports *oxygenated blood to the left auricle* of the heart for systemic circulation.

MECHANISM OF BREATHING

Breathing is a cyclic and bi-directional process which involves two phases:

- **Inspiration (inhalation)** during which the atmospheric air enters the lungs, and
- **Expiration (exhalation)** during which the air is expelled from the lungs to the outside.

The movement of air from and into the lungs takes place by the *alternate expansion and contraction of the thoracic cavity*. One inhalation followed by one exhalation is called a **breath**. The number of times a person breathes in a minute is called **breathing rate**. On an average, an adult human being, at rest, breathes in and out 15 to 18 times in a minute.

Inspiration

Inspiration takes place when the thoracic cavity expands and increases in size. This occurs when:

- the muscle fibres of the **diaphragm contract** and make it flat. This presses the abdominal organs.
- the *ribs move upward and outward* because of the contraction of intercostal muscles.

This not only increases the thoracic cavity but also enlarges the lungs. As a result,

- the **air pressure** in the lungs and the whole respiratory tract, **decrease**.
- the outside air which is at a greater pressure, *rushes in to equalise the air pressure* in the lungs. The alveolar sacs get filled with the atmospheric air.
- the alveoli now have a *higher concentration of oxygen and a lower concentration of carbon dioxide* as compared to the blood present in the capillaries around alveoli. Thus, the exchange of gases takes place between the alveolar air and the blood surrounding them.
- the oxygen from the alveolar air diffuses into the blood, while the carbon dioxide from the blood diffuses into the alveoli to be expelled through the lungs.
- the blood gets oxygenated and is returned to the heart that circulates it throughout the body.

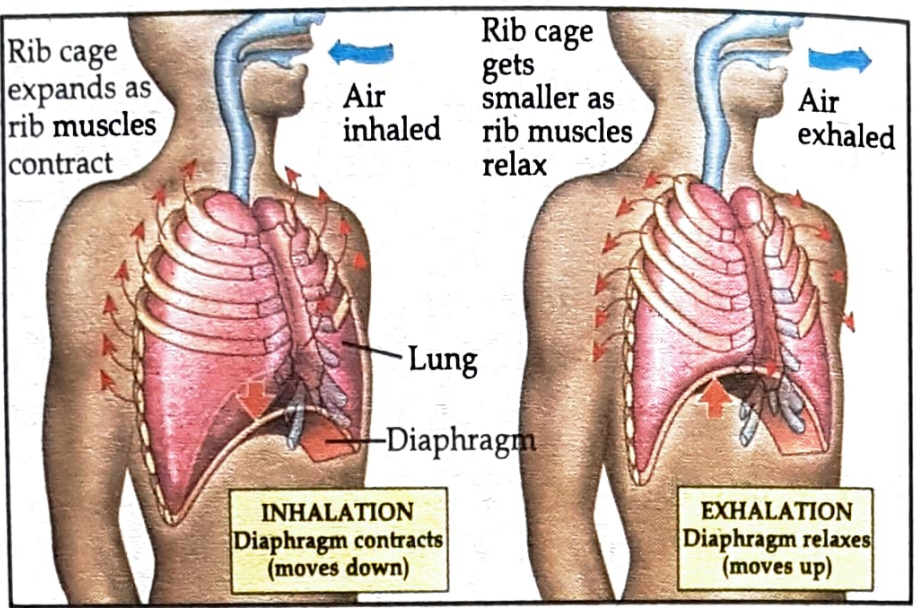


Fig. 14.4: Movement of ribs and diaphragm during breathing

Expiration

Expiration involves the reverse events that occur during inspiration. During expiration,

- the muscle fibres of the **diaphragm relax** and thus, it regains its original dome-shaped position.
- the intercostal muscles also relax and bring the **ribs inward and downward**.

This results in the following:

- The size of the **thoracic cavity decreases** resulting in an **increased pressure** inside.
- The pressure on the lungs **forces the inside air out** through the respiratory tract. The outgoing air carries away the carbon dioxide diffused into alveoli from the blood.

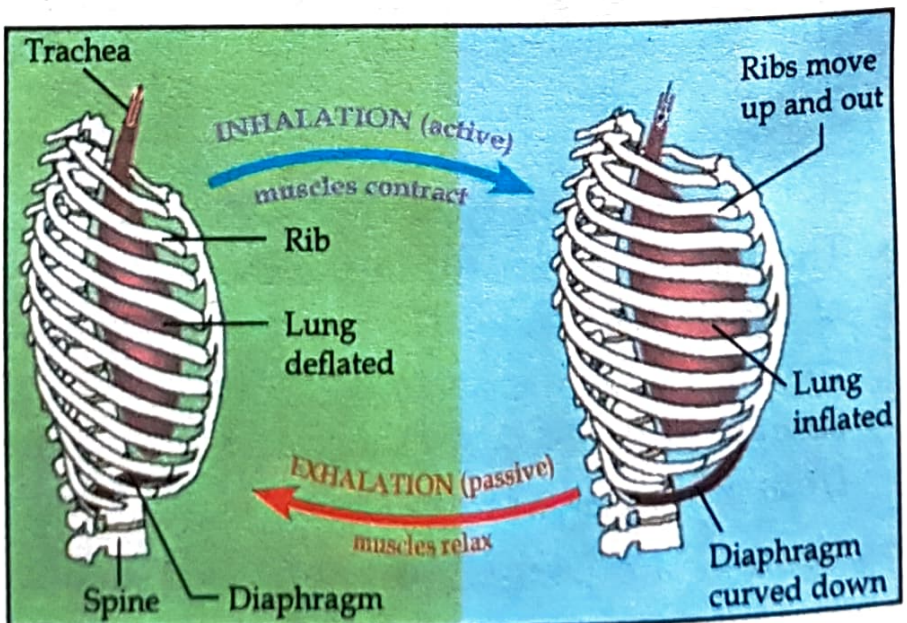


Fig. 14.5: Mechanism of breathing

The whole process of inhalation and exhalation can be described as under:

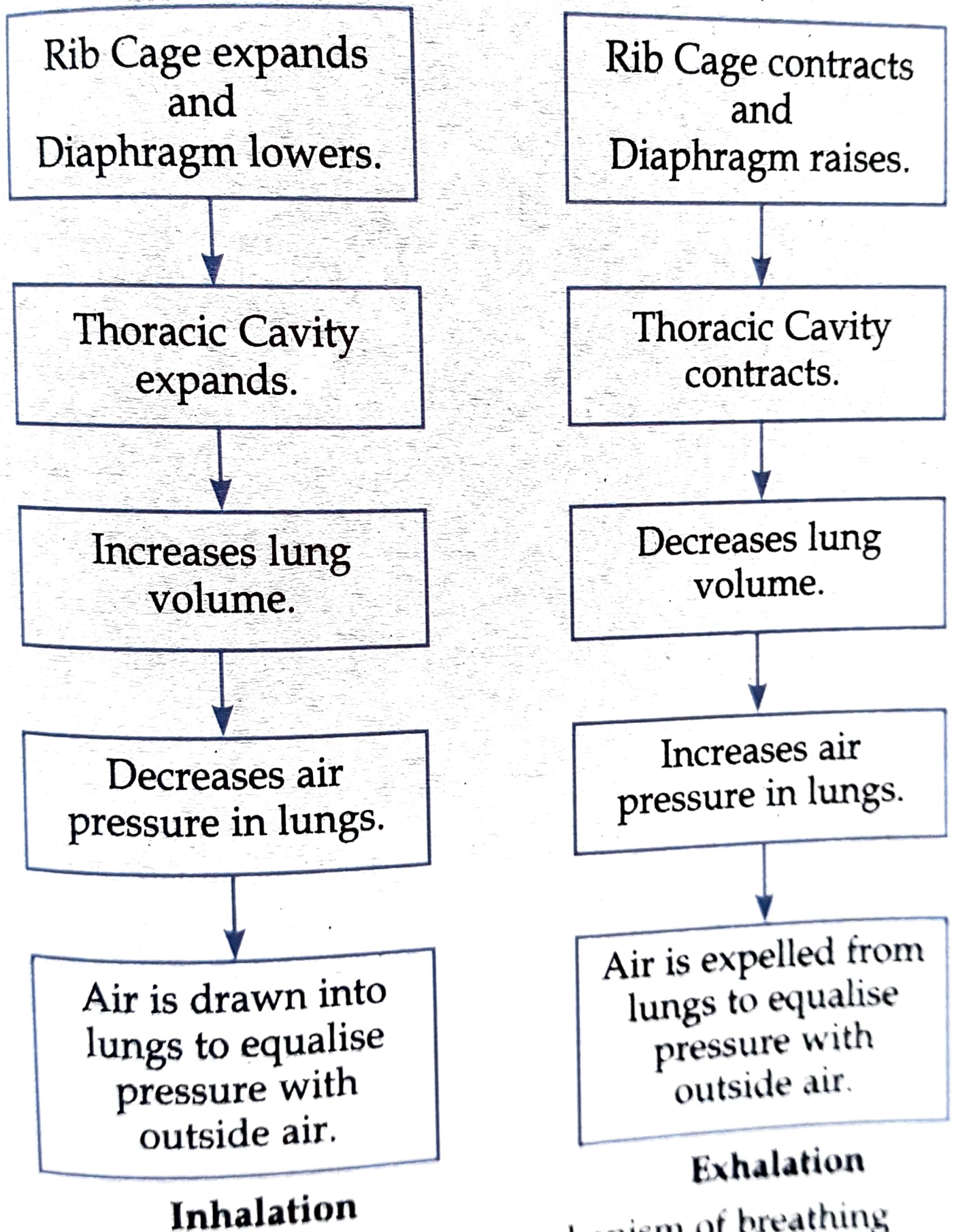
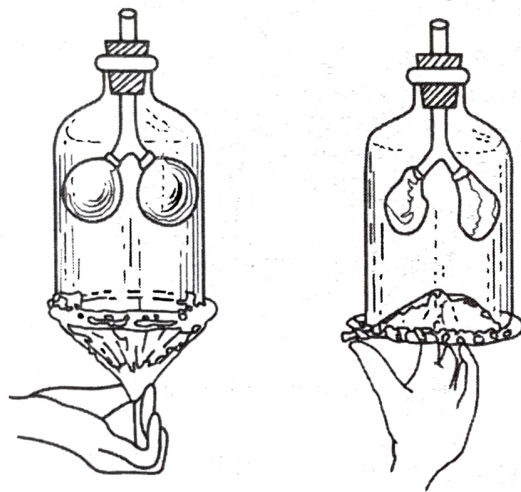


Fig. 14.6: Summary of mechanism of breathing

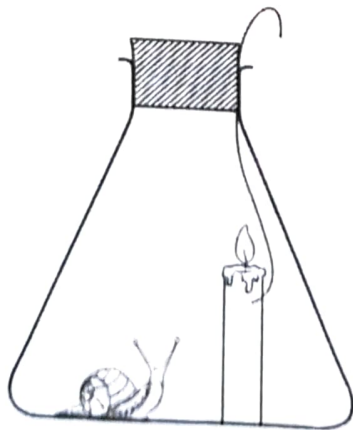
(i) To demonstrate the action of diaphragm during breathing:

Take a bell jar and insert a Y-shaped tube into the jar. Tie a rubber sheet around the bottom of the bell jar. Tie two empty balloons on either side of the Y-shaped tube. Pull the rubber sheet down. The two balloons become inflated. The rubber sheet represents the diaphragm. Two balloons are the lungs. When the sheet is pulled down the volume is increased, pressure is reduced. Now, push the sheet upwards, the balloons become empty or collapse.



(ii) To show that O_2 is used during respiration in animals:

Take two conical flasks *A* and *B*. Place alive snail in flask *A* and a dead one soaked in formalin in flask *B*. Keep the apparatus air tight and leave it for sometime. Introduce a burning candle in flask *A* and flask *B*. The flame goes out faster in flask *A* than flask *B*, showing that O_2 is used up in flask *A* by the snail.



1. Describe the **two** phases of respiration in brief.
2. Explain the complete step-wise breakdown of glucose during the process of respiration.
3. What is fermentation? Why is it important?
4. Describe the human respiratory system with the help of a well-labelled diagram.
5. Discuss the mechanism of breathing in human beings.
6. How are lungs structurally adapted for the oxygenation of blood?
7. Explain the transport of respiratory gases in the human body.
8. List some problems of the respiratory system. Write the cause of each problem.
9. With the help of an experiment demonstrate that exhaled air contains carbon dioxide.
10. Describe an experimental set up which can explain the mechanism of breathing.
11. Differentiate between the following pairs of terms on the basis of clues given in the brackets:
 - (a) Inspired air and expired air (CO_2 content).
 - (b) Breathing and respiration (organs involved).
 - (c) Anaerobic respiration in yeast and skeletal muscles (end products).
 - (d) Anatomical dead space and alveolar dead space (volume of air).
 - (e) Vital capacity and total lung capacity (volume of air).
12. What would happen if the
 - (a) diaphragm of an individual does not move,
 - (b) food enters the wind pipe of an individual,
 - (c) lungs of an individual lose elasticity,
 - (d) lungs of an individual get punctured?