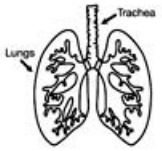
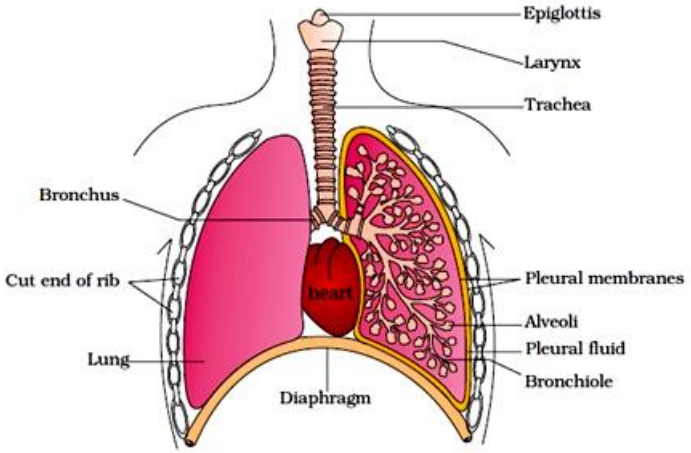
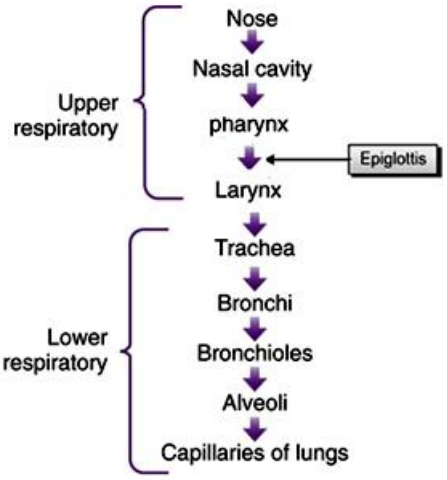
Breathing System

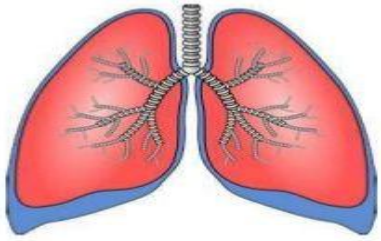
FORM 3 Biology







THE RESPIRATORY SYSTEM

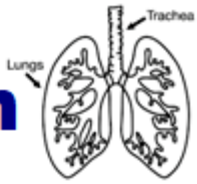


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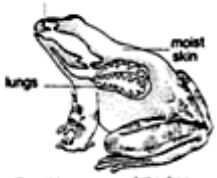
Breathing System



⇒ Respiratory system (breathing system) is a group of organs responsible for taking in oxygen and taking out carbon dioxide.

⇒ **Breathing** is the process of taking oxygen into the body cells and giving off carbon dioxide as a waste product.

⇒ Animals and human need to breathe to supply the cells with oxygen and remove the waste product carbon dioxide.

Organ for breathing or gaseous exchange in some organisms	
Organism	**Organ for breathing or gaseous exchange** (Respiratory surface)
Mammals such as **human**, **birds** and **reptiles**	**Lungs** 
Frogs  Breathing organs of the frog	Frogs breathe through two organs 1. In water, frogs breathe through their **skin** 2. On land, frogs breathe through **lungs**
Unicellular organisms such as **amoeba** and **paramecium**	**Cell membrane**  Amoeba  Paramecium
Earthworm	**Skin** 
Fish ©Ombiology4u	**Gills**  Breathing organs in fish

The Structures of the Respiratory System

- The organs of the respiratory system can be divided into two main parts;
  1. Upper respiratory tract
  2. Lower respiratory tract

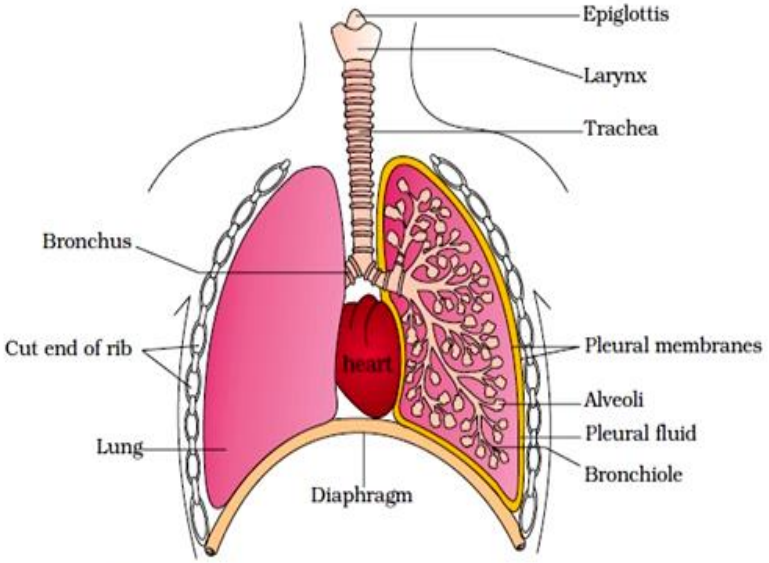
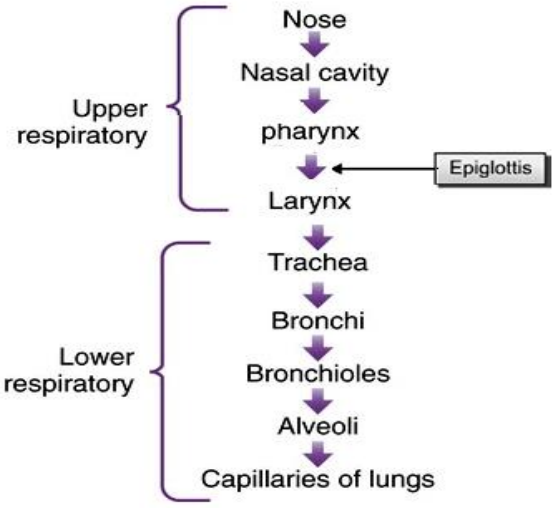


Figure Diagrammatic view of human respiratory system



- Air enters the respiratory tract from the atmosphere through the below pathway of air passages;

Nose → Nasal cavity → Pharynx → Larynx → Trachea → Bronchi → Bronchioles → Alveoli (air sac)

Nasal Cavity

- Air is a mixture of gases, which enters the nasal cavity through the two openings of the nose called **nostrils.**
- The nasal cavity contains hairs, mucus secreting cells and rich supply of blood vessels.

  What happens to the air in the nasal cavity?
  1. **Filtered** (cleaned) by the nasal hairs
  2. **Moistened** (humidified) by the mucus secreting cells
  3. **Warmed** by the blood vessels in nasal cavity

- **Olfactory cells** present in the roof of the posterior part of the nasal cavity are sensitive to **smell** by detecting the **odors** of the incoming air.

Pharynx

- **Pharynx**, also called the **throat** is where the mouth cavity and nasal cavity meet.
- **Pharynx** is part of both digestive system and respiratory system.
- In digestive system, food and water from the mouth passes through the pharynx and gets into the digestive tract such as the esophagus (food pipe) and stomach.
- In respiratory system, air from the nasal cavity passes through the pharynx and gets into the air passages such as the larynx (voice box) and trachea (windpipe).

Structure	Function (Role)
Pharynx (Throat)	○ In respiratory system, pharynx carries air to the respiratory tract. ○ In digestive system, pharynx carries food and drinks to the digestive tract

Larynx

- **Larynx**, also called **voice box**, is found at the top of the **trachea** (windpipe).
- The larynx is made up of muscle tissues and cartilages.
- **Thyroid cartilage** is the largest cartilage of the larynx, also known as **Adam's apple**, which shows up in front of the neck.
- The top opening of the larynx is called **glottis** and air enters into the **larynx** through its top opening, the **glottis**.
- **Epiglottis** is a flap of cartilaginous tissue above the **larynx** which closes the opening of the larynx during swallowing to prevent food and drinks getting into the larynx and air passages.

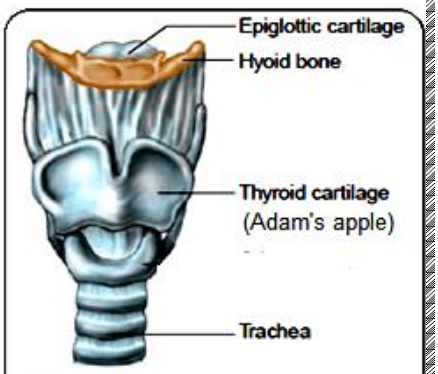


Figure: Larynx

- The larynx contains **vocal cords** and when the passing air hits the **vocal cords**, sound waves are produced by enabling one to talk.
- From the larynx, air enters into the **trachea** (windpipe).

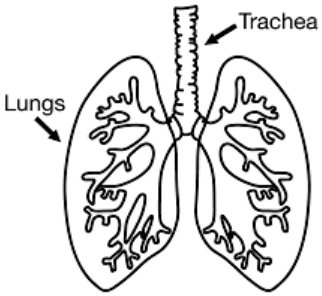
Structure	Function (Role)
Larynx (voice box)	Produces sound
Epiglottis	Prevents food and drinks entering into the air passages

Trachea

- Trachea is a straight tube that lies in front of the esophagus (food pipe).
- Trachea is surrounded by incomplete (**C-shaped**) rings of cartilage.

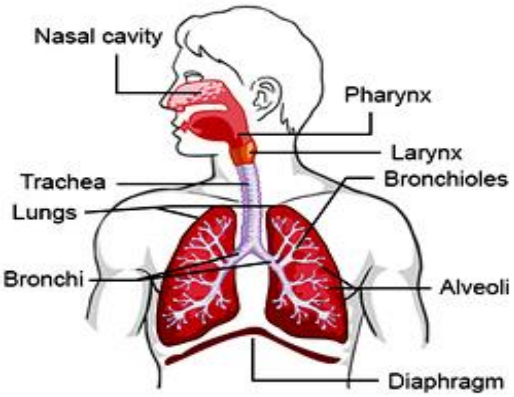
Functions of the C-shaped cartilage:

1. Helps to keep the trachea open even when the neck bends
2. Protects the trachea
3. Prevents the trachea from collapsing during breathing or coughing



- The inner wall of the **trachea** is lined with **cilia** and **mucus secreting cells**. The **mucus** traps any inhaled dust and microbes, while **cilia** move them upward to the pharynx.
- Trachea carries air to and from the lungs.
- Trachea divides into two narrowed air passages called **bronchi**.
- Each **bronchus** enters into right and left lung.
- The structure of the **bronchi** is similar to the **trachea,** except that they are narrower.
- In the lungs, the **bronchi** branch into smaller narrowed tubes called **bronchioles**
- The smallest bronchioles are called **respiratory bronchioles** which carry air to small sacs in the lungs called **alveoli**, where the exchange of oxygen and carbon dioxide takes place.

Structure	Function (Role)
Trachea (windpipe)	Carries air in and out of the lungs
Bronchi and bronchioles	Carry air in and out of the alveoli in the lungs



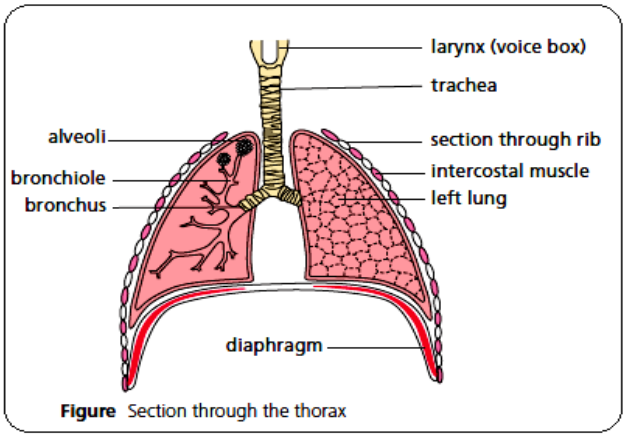


Figure Section through the thorax

Lungs

- Lungs are pair of spongy and elastic organs in the thorax (chest cavity).
- The right lung is divided into three lobes (sections), while the left lung is divided into two lobes (sections) to make a room for the heart.

- Each lung is surrounded by membranes called **pleura** (pleural membrane or parietal pleura).
- **Pleura membrane** protects the lungs and also secretes a fluid called **pleural fluid** which lubricates and reduce friction of the lungs during breathing.

Thorax

- Thorax or the rib cage protects the lungs and heart.
- The ribs help in taking air into and out of the lungs (Ribs play an important role in breathing)

- There are two groups muscles which involve and help in breathing;
  1. **Intercostal muscles**:
     - Intercostal muscles are group of muscles between the ribs, which move the ribs during breathing.

  2. **Diaphragm**:
     - Diaphragm is a sheet of muscle below the lungs and heart.
     - Diaphragm is dome-shaped (curved) muscle which separates the chest cavity from the abdomen.

Structure	Function (Role)
Rib cage (Ribs)	○ Protect the lungs and heart ○ Help breathing in and out
Intercostal muscles	Move the ribs during breathing in and out
Diaphragm	Helps breathing in and out (Contracts during breathing in and relaxes during breathing out)

Alveoli

- **Alveoli** (singular: alveolus) are small, balloon-shaped air sacs in the lungs.
- **Alveoli** are where exchange of oxygen and carbon dioxide between the blood and lungs take place during the process of breathing in and breathing out.
- Alveoli are surrounded by blood capillaries, where gaseous exchange between the lungs and blood take place by **diffusion.**
- In order oxygen rapidly diffuses into the blood, there is a large **concentration gradient** of oxygen and carbon dioxide between the alveoli and blood.
- The alveoli contain the highest oxygen concentration compared to the blood.
- An oxygen molecule passes through two cells on its way from the alveoli in the lungs to red blood cells in the blood; which are
  1. The walls of the alveoli which are one cell thick.
  2. The walls of blood capillary is one cell thick

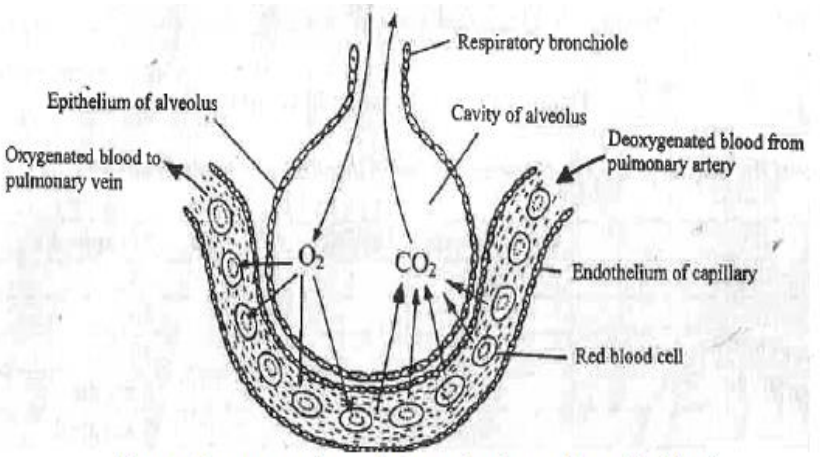


Figure: Gaseous exchange between alveolar cavity and the blood.

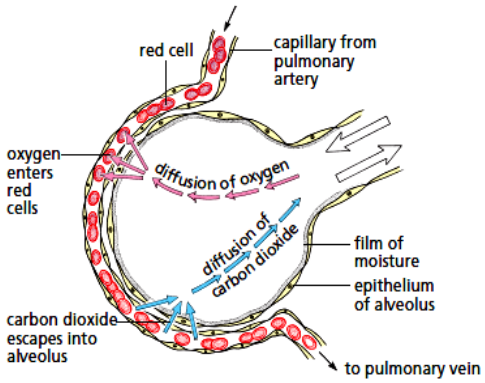


Figure Gaseous exchange in the alveolus

Properties of the Alveoli

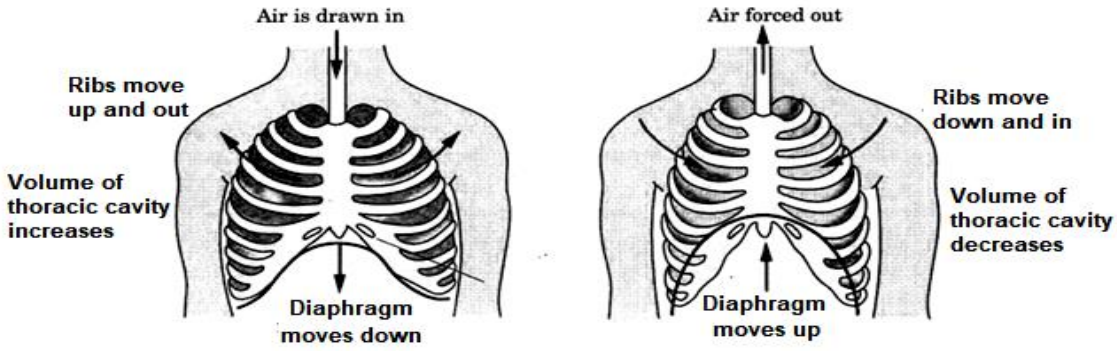
Properties or adaptations of alveoli	Importance
Alveoli have large surface area	Provides large surface are for diffusion of gases
One cell thick (Alveoli have thin walls)	Increases the rate of diffusion (creates short diffusion distance for gases)
Moist inner layer	○ Increases the rate of diffusion by dissolving the gases ○ Prevents alveoli from sticking together.
Surrounded by blood capillaries	Increases the rate of diffusion of gases between the lungs and blood.
Concentration gradient of gases	To ensure faster diffusion of gases between alveoli and blood.

Ventilation of the Lungs

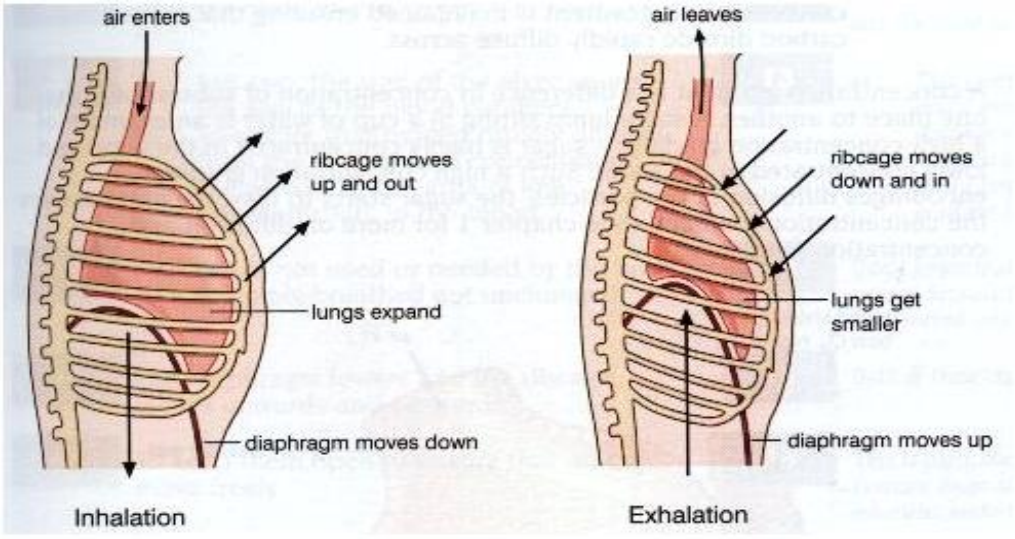
- **Ventilation** refers to the mechanism involved in bring in fresh air into the lungs and removing used air.
- **Ventilation** is the exchange of gases between the alveoli in the lungs and atmosphere.
- **External respiration**, also known as breathing is the exchange of gases between the lungs and atmosphere, and also between the alveoli in the lungs and blood.
- **The two mechanisms of breathing are**;
  1. **Inspiration** (breathing in or inhalation)
  2. **Expiration** (breathing out or exhalation)

⇒ **Inspiration** is the process of taking air into the lungs.

⇒ **Expiration** is the process of taking air out of the lungs.



Mechanism of breathing in human beings



Structure	Inspiration (Breathing in)	Expiration (Breathing out)
Intercostal muscles	External intercostals muscles contract	Internal intercostals muscles relax
Ribs	Moves upward and outward (moves up and out)	Moves downward and inward (moves down and in)
Diaphragm	Contracts Moves down (contracts and flattens)	Relaxes Moves up (relaxes and becomes dome-shaped)
Volume of thoracic cavity (chest cavity)	Increases	Decreases
Air pressure inside the lungs or thoracic cavity	Decreases	Increases
Air	Moves into the lungs (rushes into the lungs)	Moves out of the lungs (rushes out of the lungs)

Composition of inspired and expired air

Gas	Inspired air (%)	Expired air (%)	Explanation
Nitrogen	79	79	- not used/produced by body processes
Oxygen	21	16	- used up in respiration
CO_2	0.03 - 0.04	4	- produced in respiration
Water vapour	Variable	Saturated	- produced by respiration - moisture evaporates from surface of alveoli

