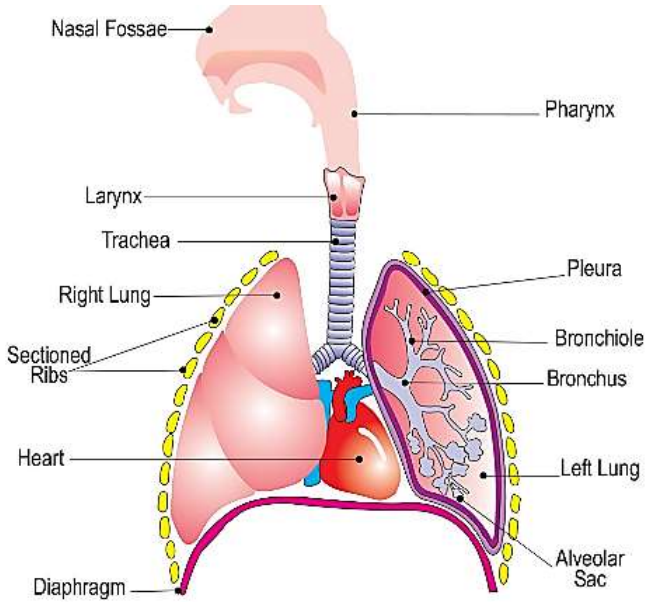
Chapter 4 :Oxygen Up-take and Carbon Dioxide Release: RESPIRATION

Activity 2: Respiratory System and Gas Exchange (p. 66 - 67)

1. Respiratory Movements

The respiratory movement consists of : inhalation (inspiration) or exhalation (expiration)

Inhalation	When air enters the lungs
Exhalation	When air is released from the lungs, by the nose



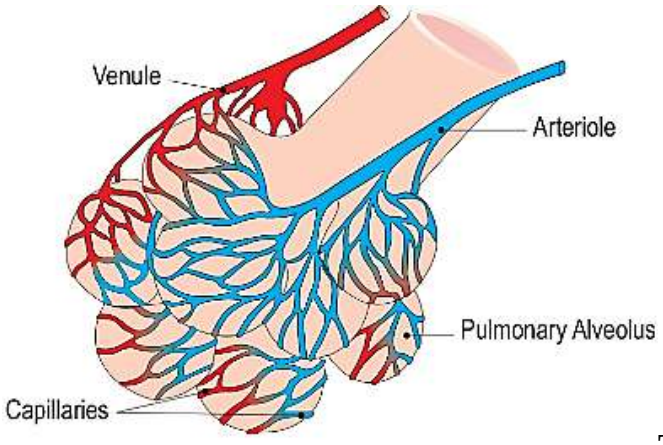
Title: Respiratory System

- **Pharynx** = crossroads of the respiratory and digestive tracts.
- **Ribs** = bones of the thoracic cage.
- **Diaphragm** = respiratory muscle.
- **Pleura** = a membrane surrounding the lungs.
- **Lungs** = spongy and elastic organs.

RESPIRATORY SYSTEM *= Set of respiratory organs*		
Respiratory Tract	**Two Lungs** *(located in the thoracic cage)*	
- Nasal cavity (fossae) - Pharynx - Larynx - Trachea - Bronchus	**Right lung**	**Left lung**
	Bigger than the left lung	Smaller than the right lung because of the heart

- Path of the **inhaled air**: nose→ pharynx → larynx → trachea → bronchus→ bronchioles →alveoli
- Path of the **exhaled air**: opposite direction of the path of the inhaled air.

2. Pulmomary alveoli

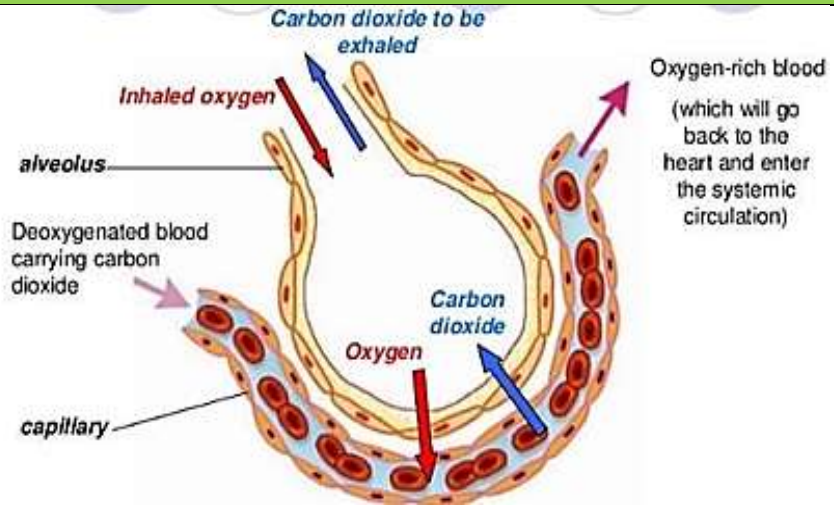


Title: Pulmonary alveoli

- **Role:** the alveoli ensure the respiratory gas exchange.
- **Characteristics of alveoli:**
  - Thin alveolar wall
  - Large surface area
  - Rich in blood vessels

Gaseous Exchange in the Alveolus:

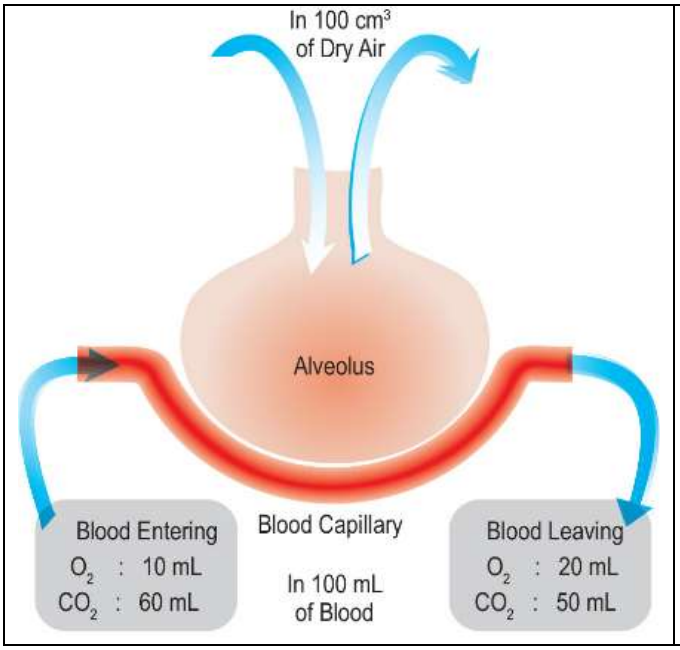
Doc.1 : Gaseous exchange at the level of the lungs



Inhaled air: rich in O_2 and poor in CO_2.

Exhaled air: rich in CO_2 and poor in O_2.

- **Doc. 2: Volume of gases in the blood entering and leaving the lungs.**

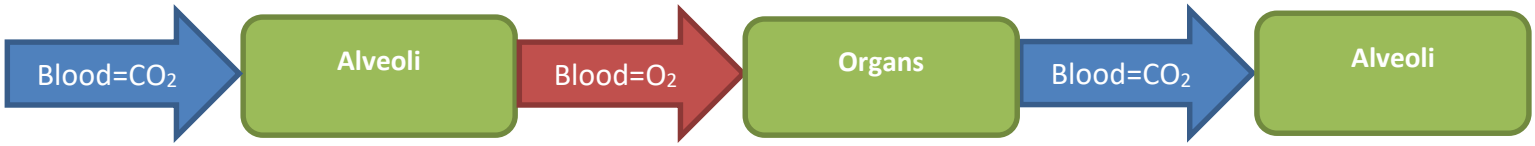


Gaseous exchange at the level of the alveoli:

1. The blood arriving to the alveolus is **rich** in CO_2 and **poor** in O_2.
2. A gaseous exchange takes place between the blood and the inhaled air in the alveolus.
3. The blood gives CO_2 to the alveolus which will be eliminated by the exhaled air and the alveolus gives O_2 to the blood.

Gaseous exchange at the level of the organs/tissu:

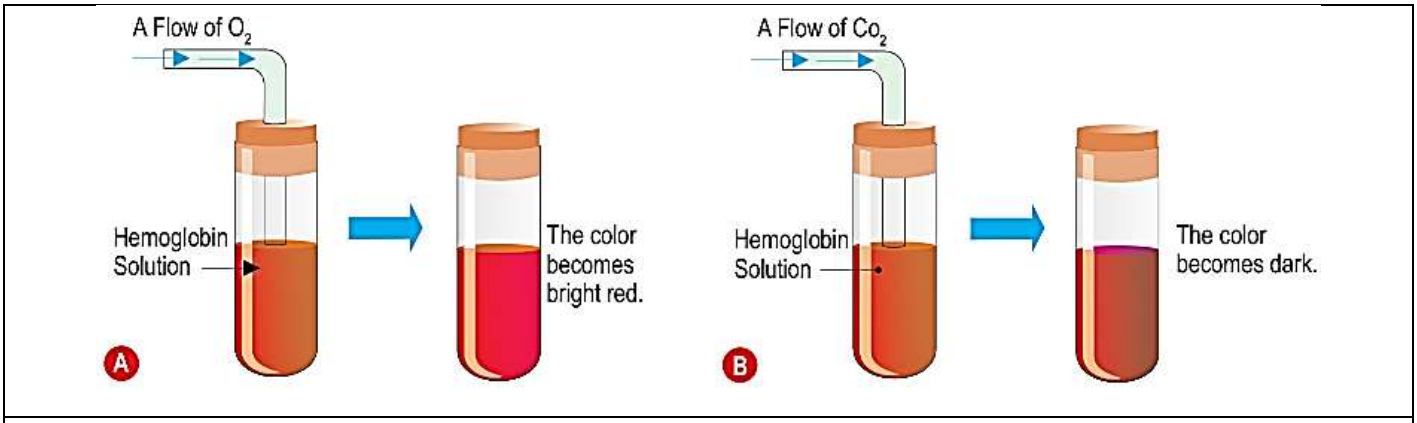
1. The blood **rich** in O_2 arrives at the level of the organ.
2. The blood gives O_2 to the organ and takes CO_2.
3. The blood returns to the alveoli to get rid of the CO_2 and become rich in O_2.



□**Activity 3: Transport of the Respiratory Gases (p. 68 - 69)**□

<table>
<tr><th colspan="3">**Blood**
Is made of :</th></tr>
<tr><th colspan="2">**Blood Cells**</th><th>**Platelets**</th><th>**Plasma** (≅ 55% of the blood)</th></tr>
<tr><td>**Leucocytes**
(= White Blood Cells)</td><td>**Red Blood Cells**
(≅ 45% of the blood)</td><td>Have role in the blood coagulation</td><td rowspan="2">• After getting out of the vessels, the blood coagulates.
• The blood constituents are separated by **Centrifugation**.</td></tr>
<tr><td>Cells **with nucleus**</td><td>▪ Cells **without nucleus**
▪ Contain proteins rich in iron = **Hemoglobin** (Hb) (responsible of the red color of RBC)</td><td></td></tr>
</table>

■ Transport of gases by Hemoglobin:



Title: Hemoglobin, Protein Present in Red Blood Cells

Transport of Oxygen:

At the level of the lungs (medium rich in O_2)	Hb + O_2	⟶	HbO_2 (= Oxyhemoglobin) *(bright red color)*
At the level of the cells (medium poor in O_2)	HbO_2	⟶	Hb + O_2 *(red dark color)*
Hb + O_2	⟵⟶		**HbO_2** *Reversible Reaction*

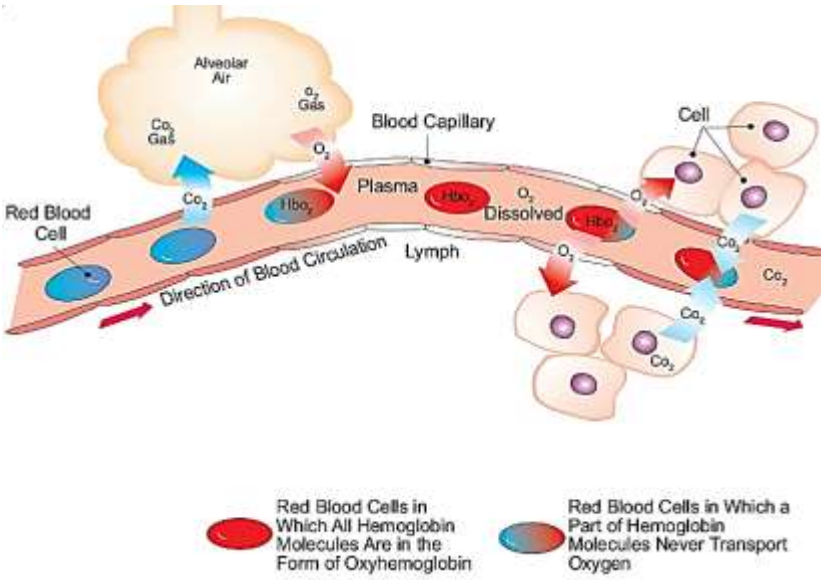
- ✓ 98 % *(large quantity)* of O_2 is carried by Hemoglobin.
- ✓ Small quantity of O_2 (≅ 2%) is carried by the plasma.

■ Transport of carbon dioxide:

At the level of the cells (medium rich in CO_2)	Hb + CO_2	⟶	$HbCO_2$ (= Carbohemoglobin)
At the level of the lungs (medium poor in CO_2)	$HbCO_2$	⟶	Hb + CO_2
Hb + CO_2	⟵⟶		**$HbCO_2$** *Reversible Reaction*

- ✓ 30% of CO_2 is carried by Hemoglobin.
- ✓ 70% of CO_2 is carried by the plasma in the dissolved form of dissolved carbonated compounds.

Sum-up scheme:



Diffusion :

- Takes place in the alveoli.
- Diffusion is the passage of gas particles from a medium of high gas pressure to a medium of low gas pressure.

Medium	Pressure (in mmHg)	
	Oxygen	Carbon Dioxide
Alveolar air	100	40
Blood entering the lungs	35 to 40	46

Table showing the pressure of two CO_2 and O_2 in two media: alveolar air and blood entering the lungs

Compare:

- The pressure of oxygen gas in the alveolar air (100 mmHg) is greater than that in the blood entering the lungs (35 à 40 mmHg).
- The pressure of carbon dioxide gas in the alveolar air (40 mmHg) is less than that in the blood entering the lungs (46 mmHg).

Conclude:

- O_2 will diffuse from the alveolus, where its pressure is **high**(100 mmHg), to the blood, where its pressure is **low** (35 à 40 mmHg).
- CO_2 will diffuse from the blood, where its pressure is **high**(46 mmHg), to the alveolus, where its pressure is **low**(40 mmHg).

Activity 4: Pollution and Respiratory Disturbances (p. 70 - 71)

- Air pollution and smoking cause the entry of many harmful substances into the respiratory system such as sulfur dioxide, nitrogen oxide and nicotine from tobacco.

- Certain substances disrupt the functioning of the respiratory system and can cause illnesses (diseases). **Ex:** Carbon monoxide (found in cigarettes) is transported by hemoglobin from the blood and forms the compound HbCO: $Hb + CO \rightarrow HbCO$

- **Toxic Gases**:

Pollutants	Effects
Carbon Monoxide	obstructs oxygen transport by the blood.
Benzene	causes lung cancer.
Sulfur Dioxide	causes coughing and respiratory disturbance.
Nitrogen Oxides	provoke asthma attacks and increase the sensitivity of a child's bronchi to infections.
Ozone	provokes a decrease in the pulmonary function.
Fine Particles: lead, asbestos…	cause infections and cancer.

- **Asthma**: a disease characterized by an excess of respiratory troubles.