**The Respiratory System**

Introduction

Air is breathed in through the [nose](https://en.wikipedia.org/wiki/Nose) to the [nasal cavity](https://en.wikipedia.org/wiki/Nasal_cavity), where a layer of [nasal mucosa](https://en.wikipedia.org/wiki/Nasal_mucosa) acts as a filter and traps pollutants and other harmful substances found in the air. Next, air moves into the [pharynx](https://en.wikipedia.org/wiki/Pharynx), a passage that contains the intersection between the [oesophagus](https://en.wikipedia.org/wiki/Esophagus%22%20%5Co%20%22Esophagus) and the [larynx](https://en.wikipedia.org/wiki/Larynx). The opening of the larynx has a special flap of cartilage, the [epiglottis](https://en.wikipedia.org/wiki/Epiglottis), that opens to allow air to pass through but closes to prevent food from moving into the airway. This is known as **Upper Respiratory Tract**.

From the [larynx](https://en.wikipedia.org/wiki/Larynx), air moves into the [trachea](https://en.wikipedia.org/wiki/Trachea) and down to the intersection known as the [**carina**](https://en.wikipedia.org/wiki/Carina_of_trachea) that branches to form the right and left primary (main) [bronchi](https://en.wikipedia.org/wiki/Bronchus). Each of these bronchi branches into a [secondary (lobar) bronchus](https://en.wikipedia.org/wiki/Bronchus) that branches into [tertiary (segmental) bronchi](https://en.wikipedia.org/wiki/Bronchus), that branch into smaller airways called [bronchioles](https://en.wikipedia.org/wiki/Bronchiole) that eventually connect with tiny specialized structures called [alveoli](https://en.wikipedia.org/wiki/Pulmonary_alveolus) that function in [gas exchange](https://en.wikipedia.org/wiki/Gas_exchange). This is called the **Lower Respiratory Tract.**

The lungs which are located in the thoracic cavity, are protected from physical damage by the **Rib cage**. At the base of the lungs is a sheet of skeletal muscle called the **Diaphragm**. The diaphragm separates the lungs from the stomach and intestines. The diaphragm is also the main muscle of respiration involved in breathing, and is controlled by the sympathetic nervous system.

the rib cage and the sternum, together known as the **thoracic cage**, is a semi-rigid [bony](https://en.wikipedia.org/wiki/Bone) and [cartilaginous](https://en.wikipedia.org/wiki/Cartilage) structure which surrounds the [thoracic cavity](https://en.wikipedia.org/wiki/Thoracic_cavity) . A typical human thoracic cage consists of 12 pairs of ribs and the adjoining [costal cartilages](https://en.wikipedia.org/wiki/Costal_cartilage), the sternum (along with the [manubrium](https://en.wikipedia.org/wiki/Manubrium) and [xiphoid process](https://en.wikipedia.org/wiki/Xiphoid_process)), and the 12 [thoracic vertebrae](https://en.wikipedia.org/wiki/Thoracic_vertebra) articulating with the ribs. Together with the [skin](https://en.wikipedia.org/wiki/Skin) and associated [fascia](https://en.wikipedia.org/wiki/Fascia) and [muscles](https://en.wikipedia.org/wiki/Muscle), the thoracic cage makes up the [thoracic wall](https://en.wikipedia.org/wiki/Thoracic_wall) .

The rib cage intrinsically holds the [muscles of respiration](https://en.wikipedia.org/wiki/Muscles_of_respiration) ([diaphragm](https://en.wikipedia.org/wiki/Thoracic_diaphragm), [intercostal muscles](https://en.wikipedia.org/wiki/Intercostal_muscles)) that are crucial for active [inhalation](https://en.wikipedia.org/wiki/Inhalation) and forced [exhalation](https://en.wikipedia.org/wiki/Exhalation), and therefore has a major [ventilatory](https://en.wikipedia.org/wiki/Ventilation_%28physiology%29%22%20%5Co%20%22Ventilation%20%28physiology%29) function in the [respiratory system](https://en.wikipedia.org/wiki/Respiratory_system).

**The Lungs**

are the primary [organs](https://en.wikipedia.org/wiki/Organ_%28anatomy%29) of the [respiratory system](https://en.wikipedia.org/wiki/Respiratory_system) , Their function in the respiratory system is to extract [oxygen](https://en.wikipedia.org/wiki/Oxygen) from the [air](https://en.wikipedia.org/wiki/Air) and transfer it into the [bloodstream](https://en.wikipedia.org/wiki/Bloodstream), and to release [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide) from the bloodstream into the [atmosphere](https://en.wikipedia.org/wiki/Atmosphere_of_Earth), in a process of [**Gas Exchange**](https://en.wikipedia.org/wiki/Gas_exchange). Humans have two lungs, a right lung, and a left lung. They are situated within the [thoracic cavity](https://en.wikipedia.org/wiki/Thoracic_cavity) of the [chest](https://en.wikipedia.org/wiki/Chest). The right lung is bigger than the left. The lungs are part of the [lower respiratory tract](https://en.wikipedia.org/wiki/Lower_respiratory_tract) that begins at the [trachea](https://en.wikipedia.org/wiki/Trachea) and branches into the [bronchi](https://en.wikipedia.org/wiki/Bronchi) and bronchioles (**the Conducting Zone**), then alveolar sacs that contain the alveoli (**the Respiratory Zone**) where gas exchange takes place.

Together, the lungs contain approximately 2,400 kilometres of airways and 300 to 500 million alveoli.

The lungs have a unique blood supply, receiving deoxygenated blood from the heart in the pulmonary circulation for the purposes of (gas exchange) and a separate supply of oxygenated blood to the tissue of the lungs, in the bronchial circulation.

The bronchial airways terminate in alveoli which make up the functional tissue (parenchyma) of the lung, and veins, arteries, nerves, and lymphatic vessels. The trachea and bronchi have plexuses of lymph capillaries in their mucosa and submucosa.

The connective tissue of the lungs is made up of elastic and collagen fibres that are interspersed between the capillaries and the alveolar walls. Elastin is the key protein of the extracellular matrix and is the main component of the elastic fibres.

All of the lower respiratory tract including the trachea, bronchi, and bronchioles is lined with respiratory epithelium. This ciliated epithelium interspersed with goblet cells which produce mucin protien the main component of mucus.

Alveoli make up the functional tissue of the lungs known as the lung parenchyma, which takes up 90 percent of the total lung volume, An alveolus consists of an epithelial layer of three major types of alveolar cell. Type I , Type II, and macrophages,

**Type I** alveolar cells, are the larger of the two cell types; they are thin, flat epithelial lining cells, that form the structure of the alveoli. They are squamous and have long cytoplasmic extensions that cover more than 95% of the alveolar surface. Type I cells are involved in the process of gas exchange between the alveoli and blood. These cells are extremely thin – sometimes only 25 nm – the electron microscope was needed to prove that all alveoli are lined with epithelium. This thin lining enables a fast diffusion of gas exchange between the air in the alveoli and the blood in the surrounding capillaries.

**Type II** alveolar cells, release pulmonary surfactant to lower surface tension, and can also differentiate to replace damaged type I cells.

**The Alveolar Macrophages** reside on the internal luminal surfaces of the alveoli, the alveolar ducts, and the bronchioles. They are mobile scavengers that serve to engulf foreign particles in the lungs, such as dust, bacteria, carbon particles, and blood cells from injuries. They are also called pulmonary macrophages, and dust cells.

 In the alveolar walls there are interconnecting air passages between the alveoli known as the pores of **Kohn**. The alveolar septa that separate the alveoli in the alveolar sac contain some collagen fibers and elastic fibers. The elastic fibres allow the alveoli to stretch when they fill with air during inhalation. They then spring back during exhalation in order to expel the carbon dioxide-rich air.

Breathing

The lungs are not capable of inflating themselves, and will expand only when there is an increase in the volume of the thoracic cavity. this is achieved primarily through the contraction of the diaphragm, but also by the contraction of the intercostal muscles

**Hyperventilation** occurs when the rate or tidal volume of breathing eliminates more carbon dioxide than the body can produce. This leads to

**hypocapnia**, a reduced concentration of carbon dioxide dissolved in the blood. The body normally attempts to compensate for this homeostatically, but if this fails or is overridden, the blood pH will rise,(normal PH=7.34-7.45) leading to **Respiratory Alkalosis**. Like in anxiety , The symptoms of respiratory alkalosis include: dizziness, tingling in the lips, hands or feet, headache, weakness, fainting, and seizures. In extreme cases it may cause carpopedal spasms, a flapping and contraction of the hands and feet.

**HYPERVENTILATION – DECREASE BLOOD CO2- INCREASE PH- R. Alkalosis**

**Hypoventilation** occurs when the rate or tidal volume of breathing eliminates less carbon dioxide than the body can produce. it causes an increased concentration of carbon dioxide (hypercapnia) leads to respiratory acidosis. Like in narcotic toxicity , diazepam.

**Hypoventilation-increase Blood CO2-decrease PH- R. Acidosis**