

**Ministry of Higher Education and Scientific Research**

**Al-Mustaqbal University College**

**Bio-Medical Engineering Department**



**Subject: Systemic Physiology**

**Class: 3 rd**

**FiSemester**

**Lecture Number: 2**

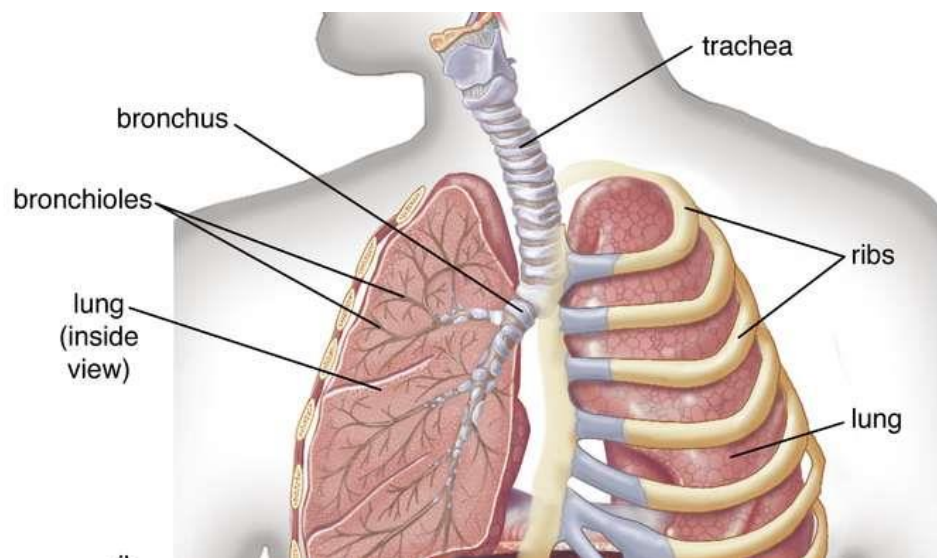
**Lecture Title: Respiratory System**

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## The Respiratory System

The respiratory system is the network of organs and tissues that help breathe. It includes airways, lungs, and blood vessels. The muscles that power lungs are also part of the respiratory system. These parts work together to move oxygen throughout the body and clean out waste gases like carbon dioxide.



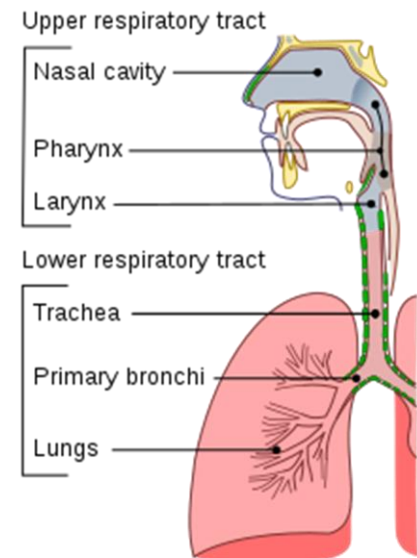
The respiratory system has many functions. Besides helping you inhale (breathe in) and exhale (breathe out), it:

- Allows you to talk and to smell.
- Brings air to body temperature and moisturizes it to the humidity level your body needs.
- Delivers oxygen to the cells in your body.
- Removes waste gases, including carbon dioxide, from the body when you exhale.
- Protects your airways from harmful substances and irritants.

## The parts of the respiratory system

The respiratory system has many different parts that work together to help breathe. Each group of parts has many separate components. The airways deliver air to the lungs. The airways are a complicated system that includes:

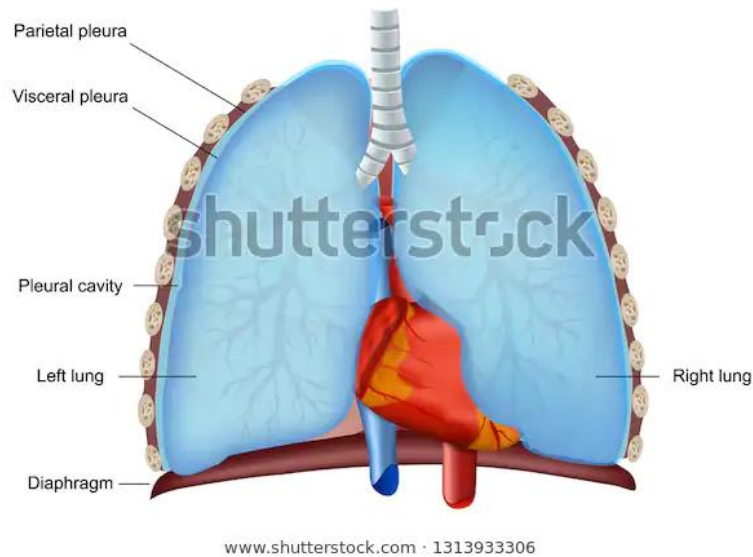
- **Mouth and nose:** Openings that pull air from outside the body into the respiratory system.
- **Sinuses:** Hollow areas between the bones in the head that help regulate the temperature and humidity of the air they inhale.
- **Pharynx (throat):** Tube that delivers air from the mouth and nose to the trachea (windpipe).
- **Trachea:** The **trachea** is the largest tube in the respiratory tract and consists of tracheal rings of hyaline cartilage. It branches off into two bronchial tubes, a left and a right main bronchus.



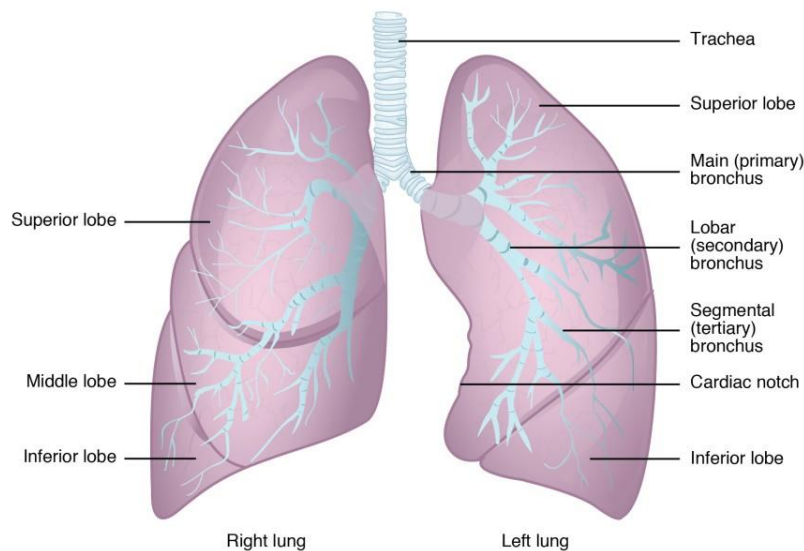
The bronchi branch off into smaller sections inside the lungs, called bronchioles. These bronchioles give rise to the air sacs in the lungs called the alveoli. The trachea passage connecting the throat and lungs.

- **Bronchial tubes:** Tubes at the bottom of the windpipe that connect into each lung.
- **Lungs:** are the largest organs in the lower respiratory tract. The lungs are suspended within the pleural cavity of the thorax. These organs remove oxygen from the air and pass it into the blood. The pleurae are two thin membranes, one cell layer thick, which surround the lungs. The inner (visceral pleura) covers the lungs and the outer (parietal pleura) lines the inner surface of the chest wall.

## Pleura and pleural cavity



This membrane secretes a small amount of fluid, allowing the lungs to move freely within the pleural cavity while expanding and contracting during breathing.



The lungs are divided into different lobes. The right lung is larger in size than the left, because of the heart's being situated to the left of the midline. The right lung has three lobes – upper, and the left lung has two – upper and lower.

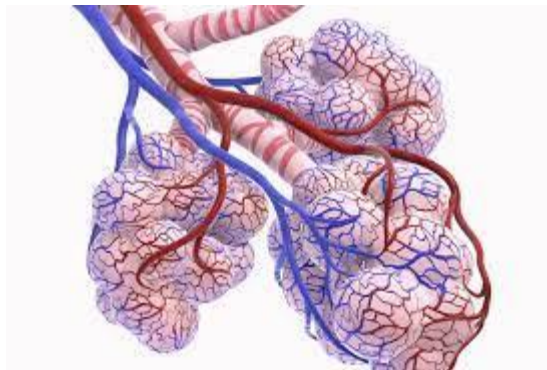
From the lungs, the bloodstream delivers oxygen to all organs and other tissues.

Muscles and bones help move the air the inhale into and out of the lungs. Some of the bones and muscles in the respiratory system include:

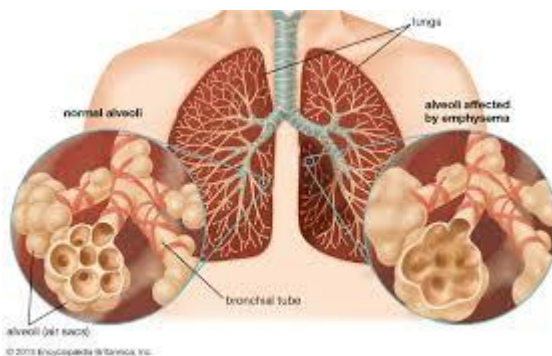
- **Diaphragm:** Muscle that helps the lungs pull in air and push it out
- **Ribs:** Bones that surround and protect the lungs and heart

When breathe out, the blood carries carbon dioxide and other waste out of the body. Other components that work with the lungs and blood vessels include:

- **Alveoli:** Tiny air sacs in the lungs where the exchange of oxygen and carbon dioxide takes place.



- **Bronchioles:** Small branches of the bronchial tubes that lead to the alveoli.



- **Capillaries:** Blood vessels in the alveoli walls that move oxygen and carbon dioxide.
- **Lung lobes:** Sections of the lungs – three lobes in the right lung and two in the left lung.

- **Pleura:** Thin sacs that surround each lung lobe and separate your lungs from the chest wall.

Some of the other components of the respiratory system include:

- **Cilia:** Tiny hairs that move in a wave-like motion to filter dust and other irritants out of your airways.
- **Epiglottis:** Tissue flap at the entrance to the trachea that closes when you swallow to keep food and liquids out of your airway.
- **Larynx (voice box):** Hollow organ that allows you to talk and make sounds when air moves in and out.

### Conditions affect the respiratory system

Many conditions can affect the organs and tissues that make up the respiratory system. Some develop due to irritants breathe in from the air, including viruses or bacteria that cause infection. Others occur as a result of disease or getting older.

Conditions that can cause inflammation (swelling, irritation, and pain) or otherwise affect the respiratory system include:

- **Allergies:** Inhaling proteins, such as dust, mold, and pollen, can cause respiratory allergies in some people. These proteins can cause inflammation in airways.
- **Asthma:** A chronic (long-term) disorder, asthma causes inflammation in the airways that can make breathing difficult.
- **Infection:** Infections can lead to pneumonia (inflammation of the lungs) or bronchitis (inflammation of the bronchial tubes). Common respiratory infections include the flu (influenza) or a cold.



- **Disease:** Respiratory disorders include lung cancer and chronic obstructive pulmonary disease (COPD). These illnesses can harm the respiratory system's ability to deliver oxygen throughout the body and filter out waste gases.
- **Aging:** Lung capacity decreases as get older.
- **Damage:** Damage to the respiratory system can cause breathing problems.

### The difference between inhalation and exhalation

Basis for Comparison	Inhalation	Exhalation
<b>Definition</b>	Inhalation is a part of breathing where the air is taken into the lungs by creating negative pressure by the contraction of respiratory muscles and diaphragm.	Exhalation is a part of breathing where the air is drawn out of the lungs by the relaxation of respiratory muscles.
<b>Also called</b>	Inhalation is also called inspiration.	Exhalation is also called expiration.
<b>Process</b>	Inhalation is an active process as it involves the contraction of muscles.	Exhalation is a passive process as it involves the relaxation of muscles.
<b>Diaphragm</b>	The diaphragm contracts and flattens during inhalation causing it to move down.	The diaphragm relaxes and becomes dome-shaped causing it to move up.
<b>External intercostal muscles</b>	The external intercostal muscles contract during inhalation.	The external intercostal muscles relax during exhalation.
<b>Ribs and sternum</b>	The ribs and sternum move forwards and outward as a result of the contraction of intercostal muscles.	The ribs and sternum move downwards and inward as a result of the relaxation of intercostal muscles.
<b>Thoracic cavity</b>	During inhalation, the volume of the thoracic cavity increases.	During exhalation, the volume of the thoracic cavity decreases.

<b>Lungs</b>	The size of the lungs increases during inhalation.	The size of the lungs decreases during exhalation.
<b>Air composition</b>	The air going into the lungs is composed largely of nitrogen and oxygen.	The air coming out of the lungs is composed largely of carbon dioxide and nitrogen.
<b>Air pressure</b>	The pressure of the air inside the lungs is less than that of the external environment.	The pressure of the air inside the lungs is greater than that of the external environment.
<b>Air movement</b>	The air moves from the environment into the lungs.	The air is drawn out from the lungs into the environment.
<b>Diffusion</b>	Oxygen diffuses from the alveoli into the blood.	Carbon dioxide diffuses out of the blood into the alveoli.
<b>Time</b>	The process of inhalation is shorter than exhalation.	The process of exhalation takes longer than inhalation.