General Physiology

Physiology of Respiratory System

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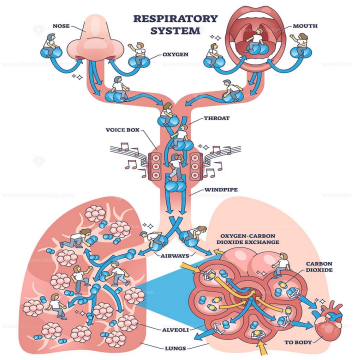

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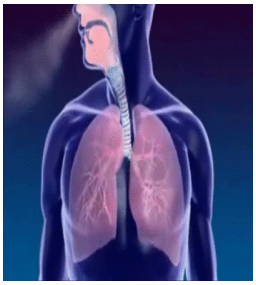
Contents:

- Introduction to the respiratory system (RS).
- Components of the respiratory system.
- Classification of the respiratory organs.
- The steps that occur during respiration.
- General functions of respiratory system.



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Objectives:

By the end of this lecture, you will be able to:

- Define the respiratory system.
- Describe the components of the respiratory system.
- Classify the respiratory organs based on:
  - ✓ **Structure**
  - ✓ **Function**
- Know the steps that occur during respiration.
- Describe the functions of respiratory system.

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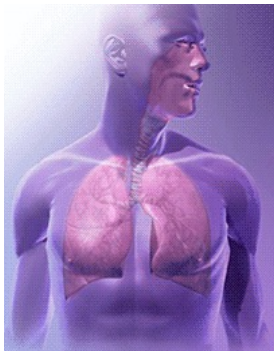
Introduction:

- **Like other body systems, the respiratory system, contributes to homeostasis:**
  - By providing for the **exchange of gases** between the:

atmospheric air ➔ blood ➔ cells

  - It also helps **adjust the pH** of body fluids.



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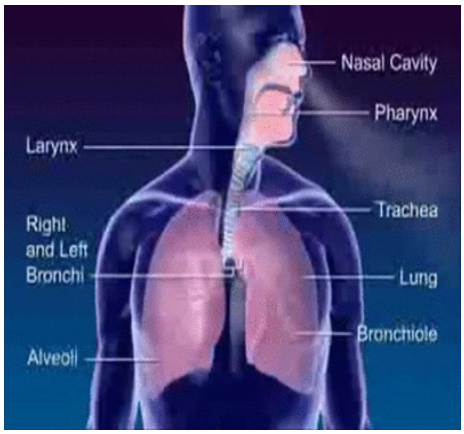
Components of Respiratory System:

- **The RS consists of the:**

- Nose,
- Pharynx (throat),
- Larynx (voice box),
- Trachea (windpipe),
- Bronchi,
- Lungs.



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Structural Classification of Respiratory System:

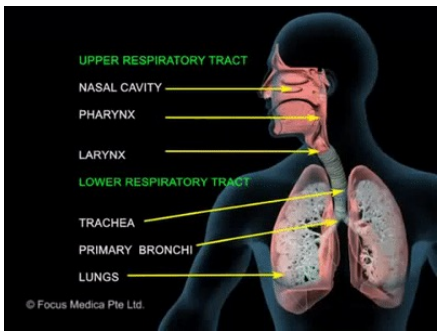
- **Structurally, the RS consists of two parts:**

1. The upper RS:

- Nose (external nose)
- Nasal cavity (internal nose)
- Pharynx
- Larynx

2. The lower RS:

- Trachea
- Bronchi
- Lungs



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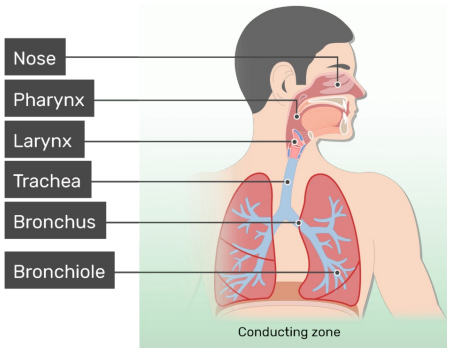
Functional Classification of Respiratory System:

- **Functionally, the RS consists of two parts: 1 of 2**

1. The Conducting Zone:

- Nose,
- Nasal cavity,
- Pharynx,
- Larynx,
- Trachea,
- Bronchi,
- Bronchioles, and
- Terminal bronchioles.



- **Function:**
  - **Filter**, **Warm**, and **Moisten** air.
  - **Conducting** air into the lungs.

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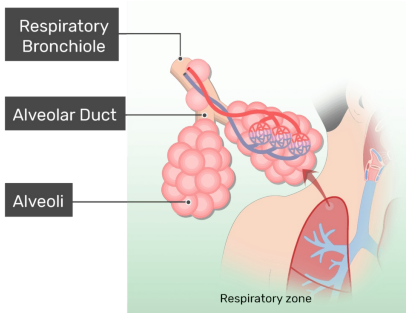
Functional Classification of Respiratory System:

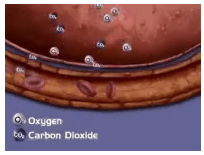
- **Functionally, the RS consists of two parts: 2 of 2**

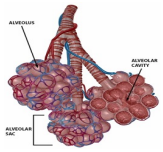
2. The Respiratory Zone:

- The respiratory bronchioles,
- Alveolar ducts,
- Alveolar saccules (sacs),
- Pulmonary **alveoli**.
  - ✓ **the main sites of gas exchange.**



- **Function:**
  - **Gas Exchange**.





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Upper Respiratory system:

- **Nose:**

- **External nose:**

✓ provides structure and protection

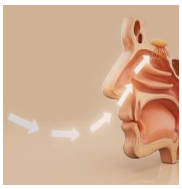
✓ directs airflow into the nostrils

- **Internal nose (nasal cavity):**

✓ Warming, moistening, and filtering incoming air

✓ Containing receptors, detecting olfactory stimuli

✓ Modifying speech vibrations



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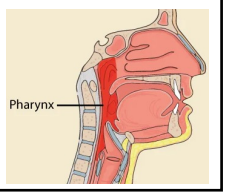
Upper Respiratory system:

- **Pharynx:**

- It functions as a **passageway** for **air** and **food**
- provides a **resonating chamber** for speech sounds
- houses the **tonsils** (immunological reactions).
- Its wall is composed of **skeletal muscles**:

✓ **Relaxation:** help keep the pharynx patent.

✓ **Contraction:** assist in deglutition (swallowing).



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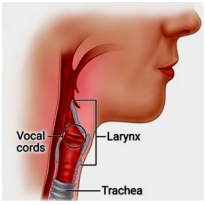
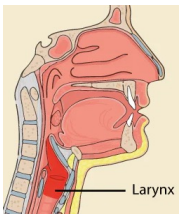
Lower Respiratory system:

- **Larynx:**
- The larynx (or **voice box**), is a **short passageway** that connects the **laryngopharynx** with the **trachea**.
- **Functions:**
  - Contains vocal folds (produce sound as they vibrate):
  - ✓ **Taut (tense) folds** produce **high pitches (Females)**
  - ✓ **Relaxed (thick) folds** produce **low pitches (Males)**





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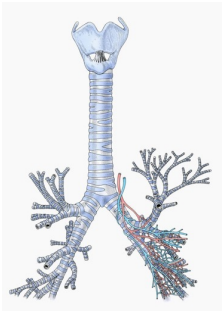
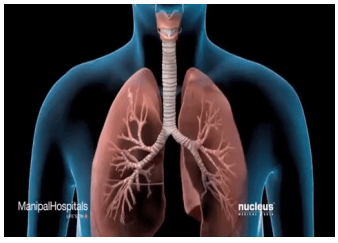
Lower Respiratory system:

- **Trachea (windpipe):**
- Composed of 16–20 **C-shaped rings** of cartilage and smooth muscle.
- Extends from the larynx to the main bronchi.



- **Bronchi (bronchial tree):**
  - **Right primary bronchus: goes into the right lung**
  - **Left primary bronchus: goes into the left lung**



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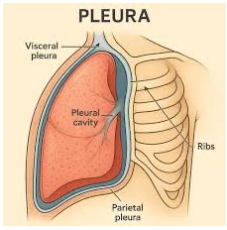
Lower Respiratory system:

- **Lungs:**
- paired **cone-shaped** organs in the thoracic cavity.
- Enclosed and protected by a **double-layered** (**pleural**) membrane:
  - ✓ **parietal pleura:** superficial layer, lines the wall of the thoracic cavity.
  - ✓ **visceral pleura:** deep layer, covers the lungs.
- **pleural cavity:** contains of **lubricating fluid**.



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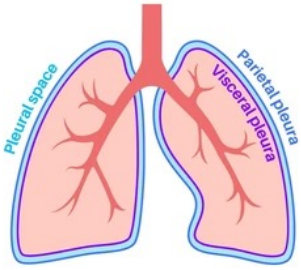
Lower Respiratory system:

- **Functions of the pleural fluid:**
  - ✓ **Reduces friction** between the membranes (**slide easily during breathing**).
  - ✓ It causes the two membranes to **adhere** to one another.



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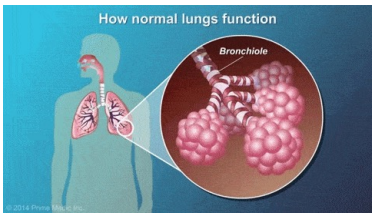
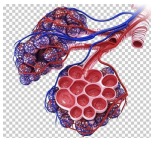
Lower Respiratory system:

- **Alveoli:**
- Tiny air sacs at the end of the bronchioles in the lungs.
- $150x10^6$ per each lung
- acting as the **primary site for gas exchange**.
- they **maximize surface area** for efficient gas diffusion into the blood.





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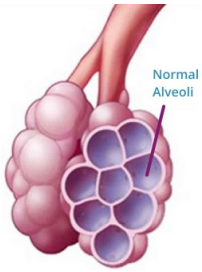
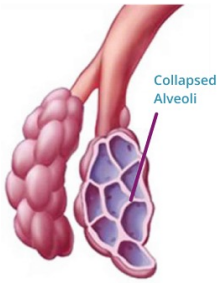
Lower Respiratory system:

- **Surfactant:**
- a complex mixture of **phospholipids** and **lipoproteins** in the alveolar fluid.
- **Functions of the Surfactant:**
- a surface-active agent that **lowers the surface tension of alveolar fluid**, **enhancing its wetting and spreading properties** which reduces the tendency of alveoli to collapse.





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General Functions of Respiratory system:

- Provides for **gas exchange**
- **Blood pH regulation:** (**Acid-Base Balance**)
- **Olfaction:** detecting olfactory stimuli (**sense of smell**)
- **Protection:** The airway, lined with mucus and cilia, filters, warms, and humidifies air, trapping particles and pathogens to prevent their entry into the lungs.
- **Vocalization:** produces **vocal sounds** (**phonation**)
- **Thermoregulation:** Breathing contributes to losing heat from the body, helping to manage internal temperature.

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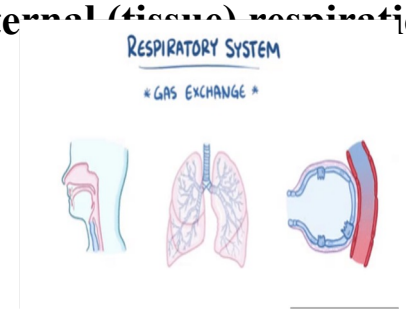
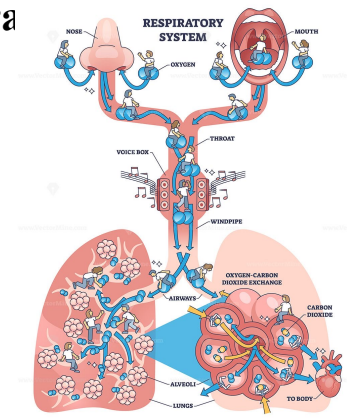
Mechanics of Respiration:

The Steps Involved in Respiration:

1. **Pulmonary ventilation (breathing).**
2. **External (pulmonary) respira**
3. **Inte[illegible]ion.**





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Differences Between Ventilation and Respiration:

Pulmonary Ventilation:

- The **mechanical (physical) process** of breathing, which involves the **movement of air** in and out of the lungs.

Respiration:

- It refers to the **chemical (physiological) process** that occurs within the cells of the body.

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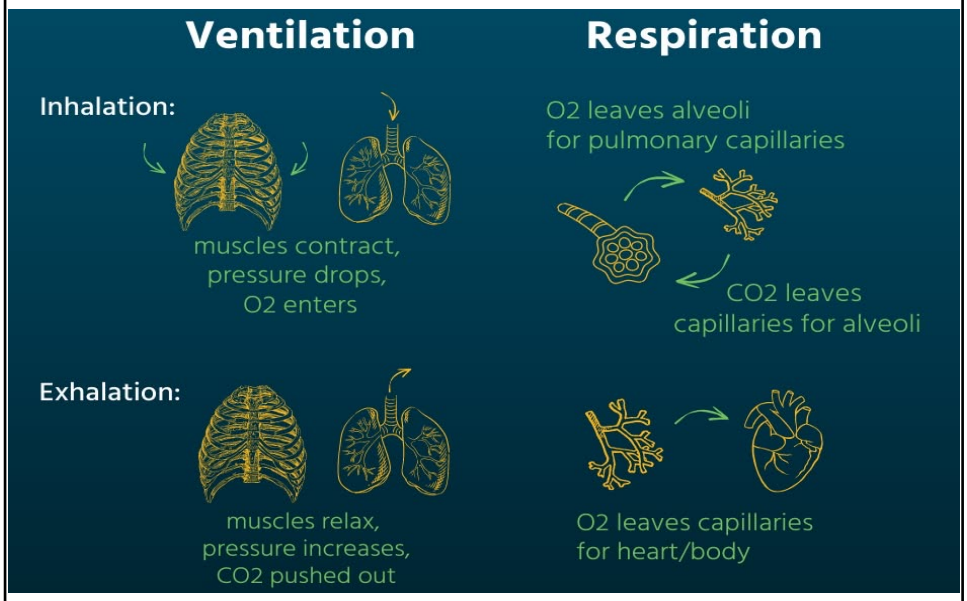
Differences Between Ventilation and Respiration:



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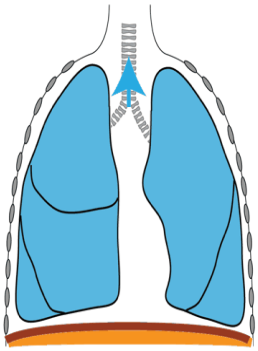
The Steps Involved in Respiration: 1 of 3

❶ Pulmonary Ventilation (Breathing):

- The **exchange of air** between the **atmosphere** and the **pulmonary alveoli** of the lungs.



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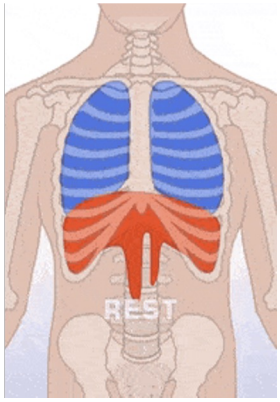
The Steps Involved in Respiration: 1 of 3

❶ Pulmonary Ventilation (Breathing): *cont….*

- **Ventilation is the movement of air through the respiratory tract.**
- Ventilation is primarily controlled by the **respiratory muscles**, which include:
  - ✓ **The diaphragm**
  - ✓ **The intercostal muscles**
- **Breathing consists of two phases:**
  - ✓ **Inspiration** (= **air goes in**)
  - ✓ **Expiration** (= **air goes out**)



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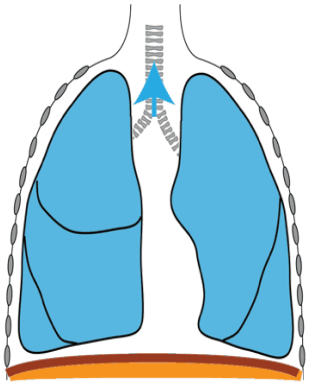
The Steps Involved in Respiration: 1 of 3

❶ **Pulmonary Ventilation (Breathing):** *cont….*

- **Inspiration:**
  - ✓ Inhalation of air (Breathing air in)
  - ✓ It permits O_2 to enter the lungs
  - ✓ Moving air into the lungs
- **Expiration:**
  - ✓ Exhalation of air (Breathing air out)
  - ✓ It permits **CO_2 to leave** the lungs
  - ✓ Moving air out of the lungs



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The Steps Involved in Respiration: 2 of 3

❷ **External (pulmonary) respiration:**

- The **exchange of gases** between the **pulmonary alveoli** of the lungs and the **blood** in pulmonary capillaries.
- **In this process, pulmonary capillary blood:**
  - ✓ **gains O_2**
  - ✓ **loses CO_2**

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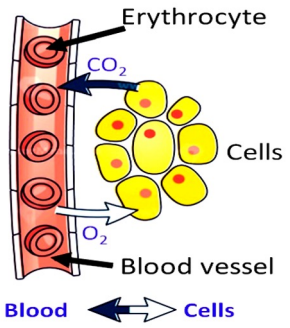
The Steps Involved in Respiration: 3 of 3

❸ Internal (tissue) respiration:

- The **exchange of gases** between **blood** (**systemic capillaries**) and **tissue cells**.
- **In this step the systemic capillary blood:**
  - ✓ **loses O_2**
  - ✓ **gains CO_2**



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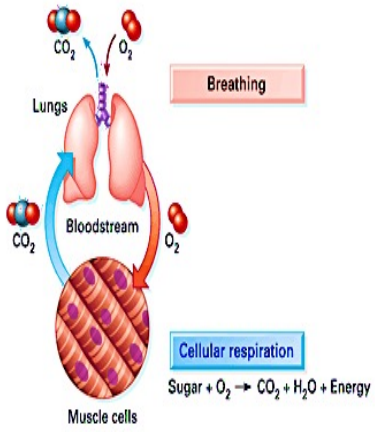
The Steps Involved in Respiration: 3 of 3

❸ Internal (tissue) respiration: *cont….*

- Within cells, the metabolic reactions that **consume O_2** and **give off CO_2** during the **production of ATP** (adenosine triphosphate) are termed **Cellular Respiration.**



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The Steps Involved in Respiration: 3 of 3

Cellular Respiration:

- Is the process by which cells **break down glucose** and **other nutrients** to **produce energy** and release CO_2 as a waste product.
- This process occurs in the **mitochondria** of the cells and is essential for the functioning of all living organisms.

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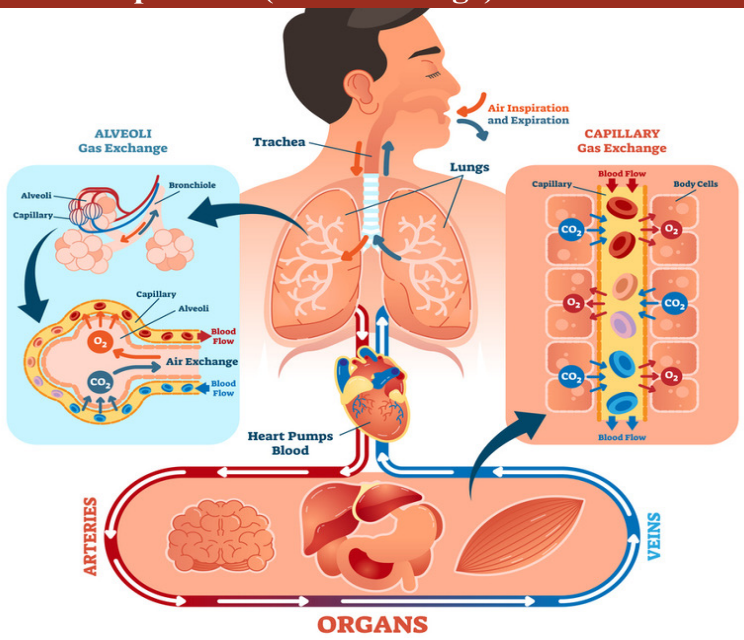
Respiration (Gas Exchange) in Human:



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What is the medical term for:

- Normal Quiet Breathing?
- Difficulty in Breathing?
- Increased Breathing?
- Deceased Breathing?
- No Breathing?

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Questions and Comments:

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