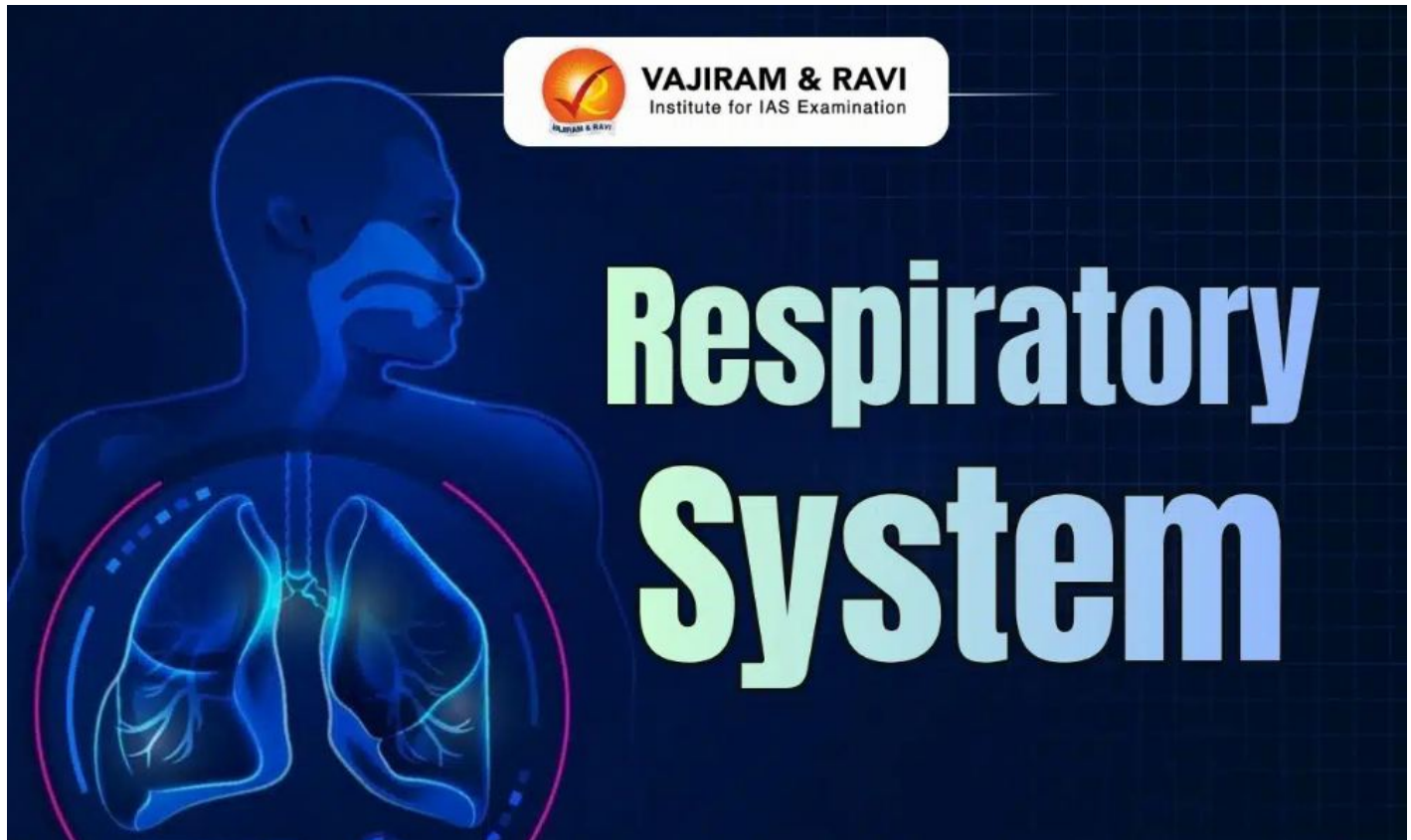


Respiratory System, Parts, Structure, Functions & Breathing Process

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The **Respiratory System** is one of the most important organ systems in the human body. It is responsible for supplying oxygen (O_2) to the body and removing carbon dioxide (CO_2), a waste product of metabolism. Every cell in the body depends on oxygen to produce energy, making the respiratory system essential for survival. Along with breathing, it also plays a role in speech, smell, and maintaining the body's acid-base balance.

Respiratory System Parts

The **Respiratory System** is divided into the **upper respiratory tract** and the **lower respiratory tract**, which work together to carry air into and out of the lungs. Each part performs a specific role in **filtering, warming, humidifying, and transporting air** to ensure efficient breathing and gas exchange.

- **Nose:** The **nose** is the primary entry point for air. It filters dust and microorganisms with tiny hairs (**cilia**) and mucus while warming and moistening the inhaled air.
- **Nasal Cavity:** The **nasal cavity** is lined with a mucus membrane that traps harmful particles, allergens, and pathogens. It also helps regulate the temperature and humidity of incoming air.

- **Sinuses:** The **paranasal sinuses** are air-filled spaces within the skull that lighten its weight, produce mucus, and enhance the resonance of the voice.
- **Pharynx (Throat):** The **pharynx** is a muscular passage that connects the nasal cavity to the larynx. It serves as a common pathway for both **air and food**.
- **Larynx (Voice Box):** The **larynx** contains the vocal cords responsible for speech. It also protects the lower airways by preventing food and liquids from entering the trachea during swallowing.
- **Trachea (Windpipe):** The **trachea** is a flexible tube supported by C-shaped cartilage rings. It carries air to the lungs and uses cilia to remove trapped dust and foreign particles.
- **Bronchi:** The **right and left bronchi** branch from the trachea and transport air into each lung. These airways further divide into smaller branches inside the lungs.
- **Bronchioles:** The **bronchioles** are the smallest branches of the bronchial tree. They regulate airflow and deliver air directly to the alveoli.
- **Alveoli:** The **alveoli** are tiny air sacs where **oxygen enters the bloodstream** and **carbon dioxide leaves the blood** through diffusion. They provide a large surface area for efficient gas exchange.
- **Lungs:** The **lungs** are the primary respiratory organs containing millions of alveoli. They facilitate the exchange of gases and help maintain adequate oxygen levels in the body.
- **Diaphragm:** The **diaphragm** is the main muscle of respiration. It contracts during inhalation to expand the chest cavity and relaxes during exhalation to push air out of the lungs.

Functions of the Respiratory System

The **respiratory system** performs several vital functions that ensure the body receives **oxygen** for energy production while removing **carbon dioxide** and maintaining overall health.

- **Supplies Oxygen:** Delivers **oxygen (O₂)** from the air to the bloodstream, where it is transported to all body cells.
- **Removes Carbon Dioxide:** Eliminates **carbon dioxide (CO₂)**, a waste product of cellular respiration, through exhalation.
- **Facilitates Gas Exchange:** Enables the exchange of oxygen and carbon dioxide in the **alveoli** of the lungs.
- **Maintains Blood pH:** Helps regulate the body's **acid-base balance** by controlling carbon dioxide levels in the blood.
- **Filters and Cleans Air:** Traps dust, pollen, bacteria, and other harmful particles using **mucus and cilia**.
- **Warms and Humidifies Air:** Adjusts the temperature and moisture of inhaled air to protect the lungs.
- **Supports Speech:** The **larynx (voice box)** produces sound by vibrating the vocal cords during airflow.
- **Enables Sense of Smell:** The **olfactory receptors** in the nasal cavity detect different odors.
- **Protects Against Infections:** Acts as a defense system by preventing harmful microorganisms from reaching the lungs.
- **Supports Cellular Respiration:** Provides the oxygen required by body cells to produce **energy (ATP)** for normal functioning.

How the Respiratory System Works?

The **respiratory system** works by drawing **oxygen-rich air** into the lungs, exchanging gases in the **alveoli**, and expelling **carbon dioxide-rich air** from the body. This continuous process ensures that body tissues receive oxygen for energy production while removing waste gases. Step-by-Step Working of the Respiratory System:

1. **Air Enters the Body:** Breathing begins when air enters through the **nose or mouth**, where it is filtered, warmed, and humidified.
2. **Air Travels Through the Airways:** The air passes through the **pharynx, larynx, and trachea**, then enters the **right and left bronchi**.
3. **Distribution of Air:** The bronchi divide into smaller **bronchioles**, which carry air deep into the lungs.
4. **Gas Exchange in the Alveoli:** Air reaches the **alveoli**, where **oxygen diffuses into the blood** through surrounding capillaries, while **carbon dioxide diffuses from the blood into the alveoli**.
5. **Transport of Oxygen:** Oxygen binds to **hemoglobin** in **red blood cells** and is transported to all tissues and organs for **cellular respiration**.
6. **Removal of Carbon Dioxide:** Carbon dioxide produced by body cells is carried back to the lungs through the bloodstream.
7. **Exhalation:** During exhalation, the **diaphragm relaxes**, reducing lung volume and forcing carbon dioxide-rich air out through the nose or mouth.

Common Diseases of the Respiratory System

Respiratory diseases affect the lungs and airways, making it difficult to breathe and reducing the body's ability to receive sufficient oxygen. These conditions may be caused by infections, allergies, smoking, air pollution, or genetic factors.

- **Asthma:** A chronic inflammatory disease that narrows the airways, causing **wheezing, coughing, chest tightness, and shortness of breath**.
- **Chronic Obstructive Pulmonary Disease (COPD):** A progressive lung disease, mainly caused by **smoking**, that damages the airways and lungs, making breathing increasingly difficult.
- **Pneumonia:** A **lung infection** that inflames the alveoli, which may fill with fluid or pus, causing **fever, cough, chest pain, and difficulty breathing**.
- **Tuberculosis (TB):** A contagious bacterial infection caused by **Mycobacterium tuberculosis** that primarily affects the lungs and spreads through airborne droplets.
- **Bronchitis:** Inflammation of the **bronchial tubes**, leading to persistent cough, mucus production, and breathing discomfort. It may be **acute or chronic**.
- **Emphysema:** A type of **COPD** in which the alveoli are permanently damaged, reducing the lungs' capacity for efficient gas exchange.
- **Lung Cancer:** A serious disease characterized by the uncontrolled growth of abnormal cells in the lungs, commonly associated with **smoking, air pollution, and occupational exposure to harmful substances**.
- **Influenza (Flu):** A contagious viral infection that affects the respiratory tract, causing **fever, sore throat, cough, body aches, and fatigue**.
- **COVID-19:** A viral respiratory disease caused by **SARS-CoV-2** that can range from mild cold-like symptoms to severe pneumonia and respiratory failure.

- **Allergic Rhinitis:** An allergic condition affecting the nasal passages, resulting in **sneezing, nasal congestion, runny nose, and itchy eyes**.
- **Sinusitis:** Inflammation of the **paranasal sinuses**, causing facial pain, nasal blockage, headache, and thick nasal discharge.
- **Pleurisy:** Inflammation of the **pleura** (the membrane surrounding the lungs), leading to **sharp chest pain**, especially during breathing or coughing.
- **Pulmonary Fibrosis:** A chronic disease in which **lung tissue becomes scarred and stiff**, making it difficult for the lungs to function properly.

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