

## Unit 3: Circulatory and Respiratory Systems - Notes

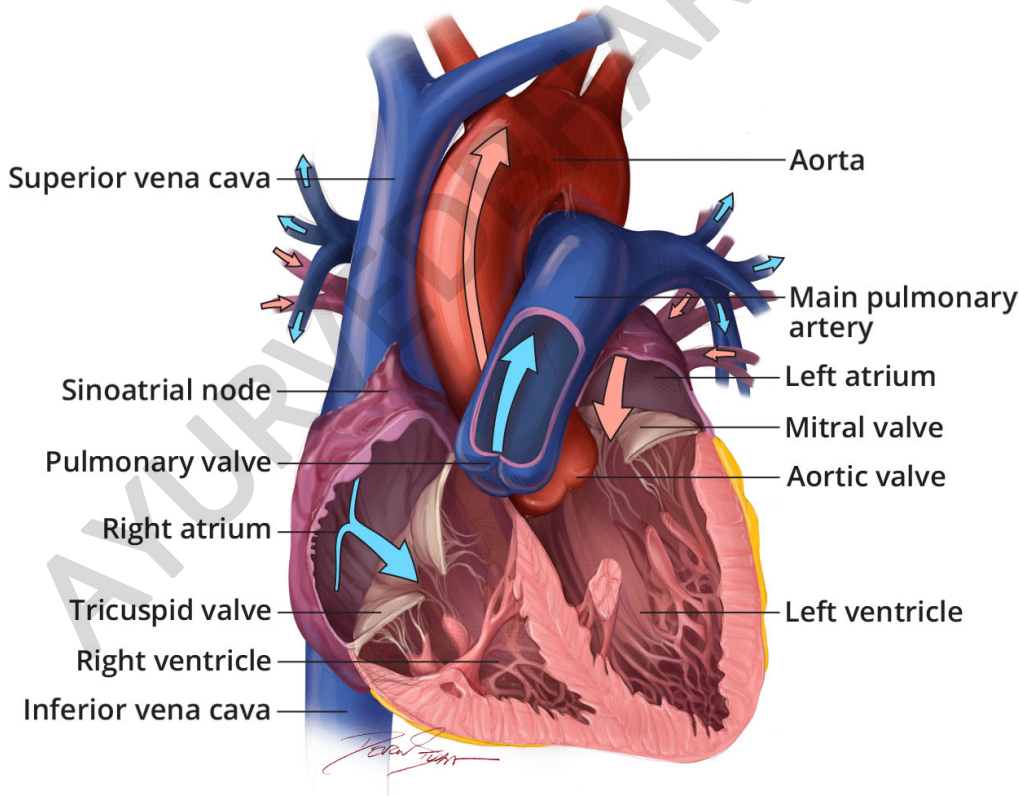
# PART A · CIRCULATORY SYSTEM (CARDIOVASCULAR SYSTEM)

## 1 · Introduction

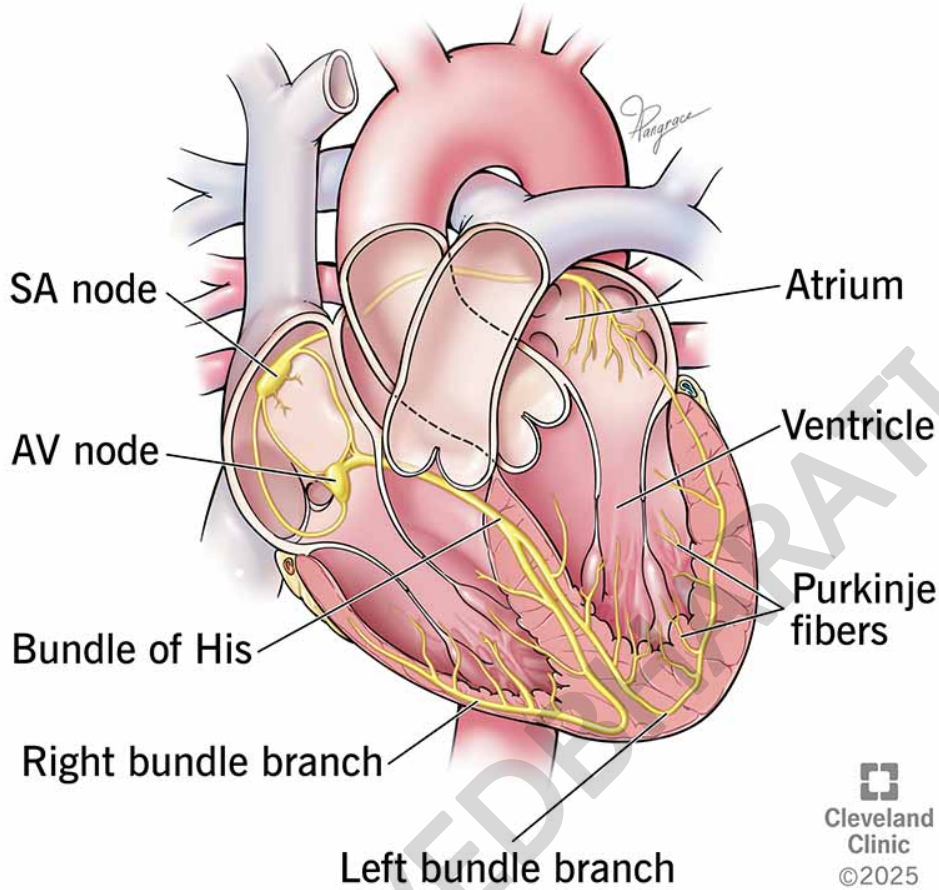
The circulatory system is responsible for **transport and distribution** of oxygen, nutrients, hormones, and waste products throughout the body. It maintains **homeostasis, temperature regulation, and pH balance**.

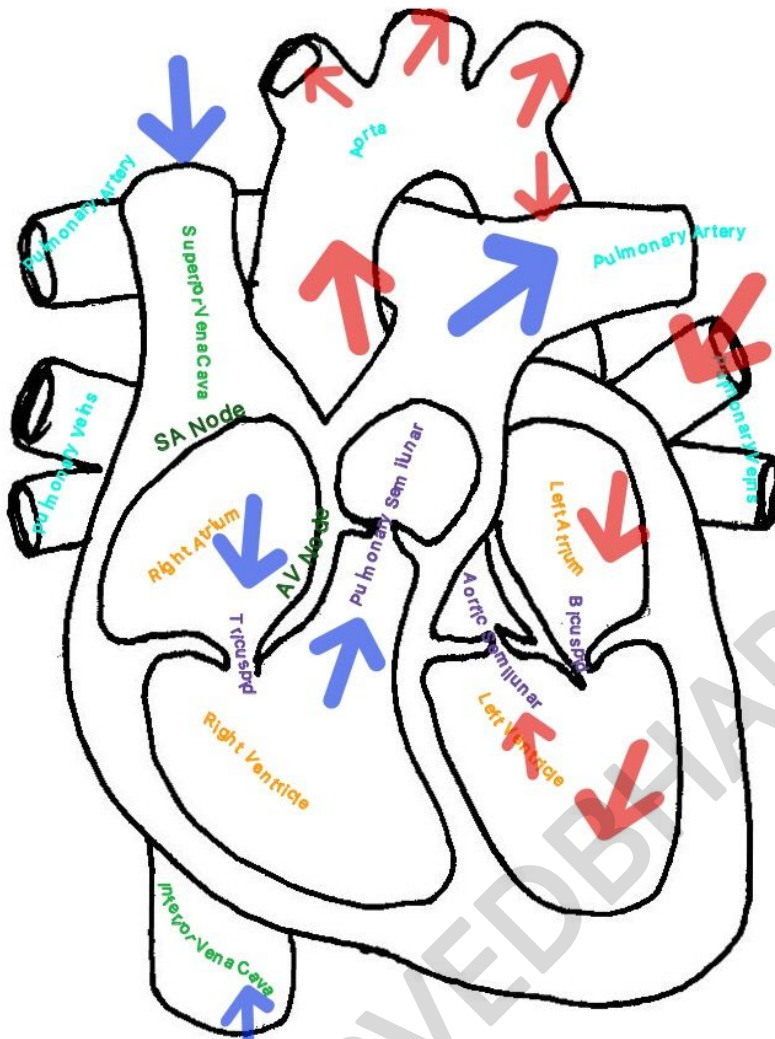
## 2 · Components of Circulatory System

### 2.1 Heart



## Cardiac conduction system





**Structure:**

- 4 chambers → Right atrium, Right ventricle, Left atrium, Left ventricle
- Valves → Tricuspid, Mitral, Aortic, Pulmonary

**Function:**

Acts as a **double pump**:

- Right heart → Pulmonary circulation
- Left heart → Systemic circulation

**2.2 Blood Vessels**

| Type               | Function                             |
|--------------------|--------------------------------------|
| <b>Arteries</b>    | Carry blood away from heart          |
| <b>Veins</b>       | Return blood to heart                |
| <b>Capillaries</b> | Exchange of gases, nutrients, wastes |

## 2.3 Blood

| Component                 | Function                      |
|---------------------------|-------------------------------|
| <b>RBC (Erythrocytes)</b> | Oxygen transport (hemoglobin) |
| <b>WBC (Leukocytes)</b>   | Immunity                      |
| <b>Platelets</b>          | Blood clotting                |
| <b>Plasma</b>             | Transport medium              |

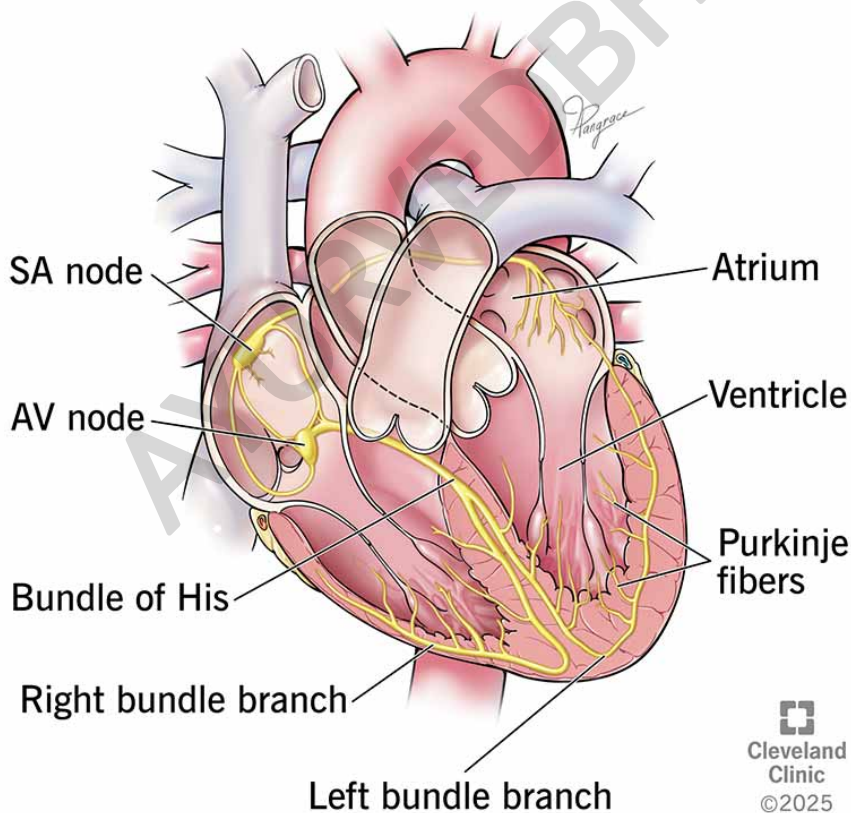
## 3 · Cardiac Physiology

### 3.1 Cardiac Cycle

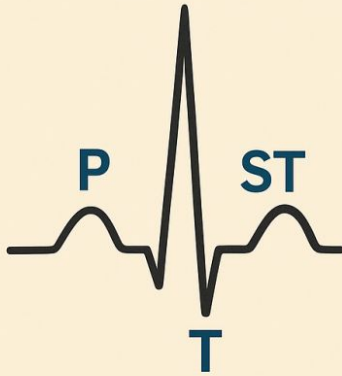
| Phase           | Event                   |
|-----------------|-------------------------|
| <b>Diastole</b> | Ventricular filling     |
| <b>Systole</b>  | Ventricular contraction |

### 3.2 Electrical Conduction System

#### Cardiac conduction system



# PQRST on an ECG



● **P Wave**  
Atrial depolarization

● **PR Interval**  
Atrial to ventricular delay

● **QRS Complex**  
Ventricular depolarization

● **ST Segment**  
Early ventricular repolarization

● **T Wave**  
Ventricular repolarization

**Migdad Dafaalla**



Sequence:

SA Node → AV Node → Bundle of His → Purkinje fibers

### 3.3 Cardiac Output

**Formula:**

Cardiac Output = Heart Rate × Stroke Volume

Normal ≈ **5 L/min**

## 4 · Blood Pressure Regulation

| Factor                | Effect                |
|-----------------------|-----------------------|
| Cardiac output        | Directly proportional |
| Peripheral resistance | Increases BP          |
| Blood volume          | Increases BP          |

**Regulation Mechanisms:**

- Neural → Baroreceptors
- Hormonal → RAAS, ADH
- Renal → Fluid balance



---

## 5 · Circulation Types

| Type             | Description                  |
|------------------|------------------------------|
| <b>Systemic</b>  | Heart → Body → Heart         |
| <b>Pulmonary</b> | Heart → Lungs → Heart        |
| <b>Coronary</b>  | Blood supply to heart muscle |

---

## PART B · RESPIRATORY SYSTEM

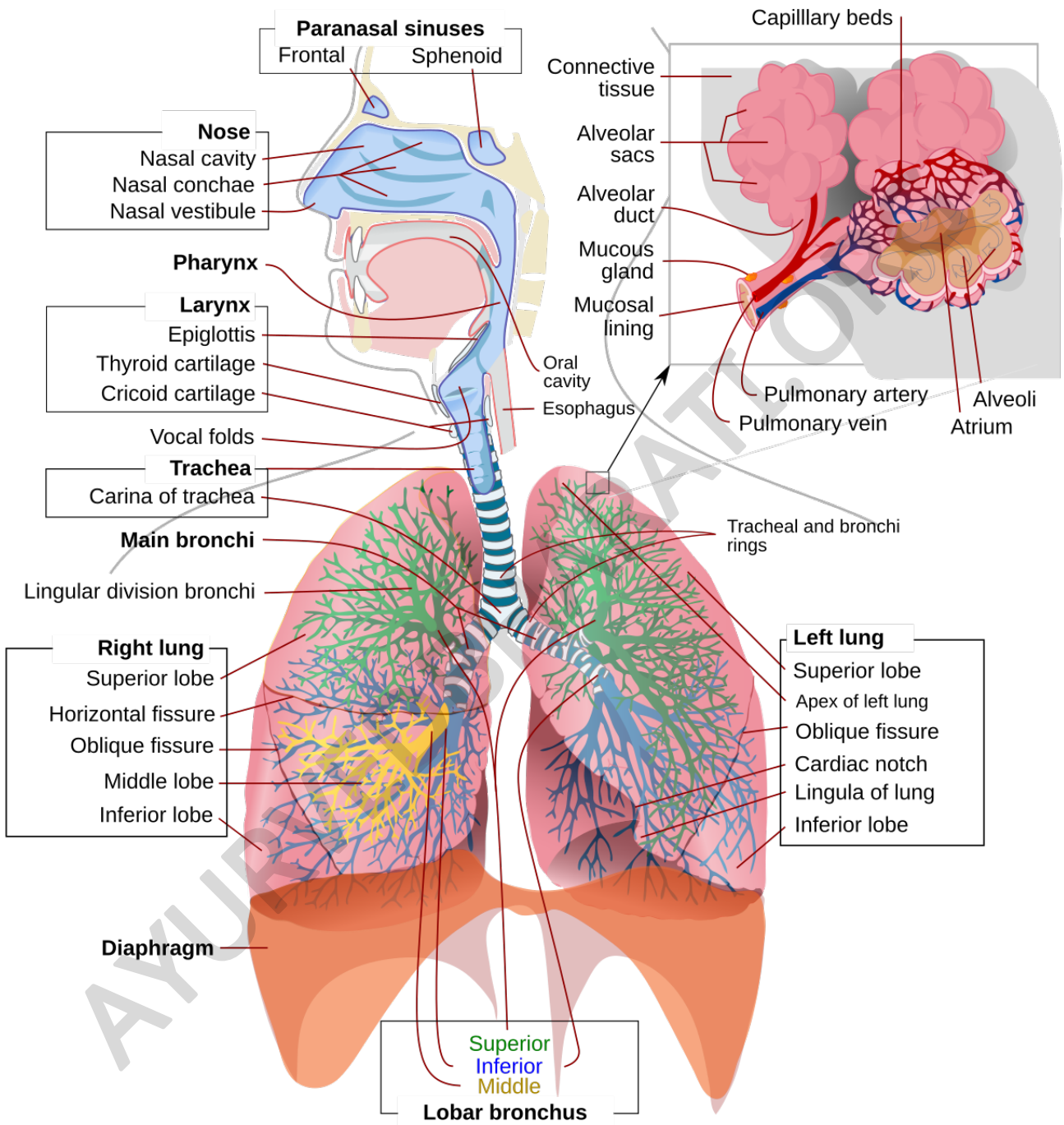
---

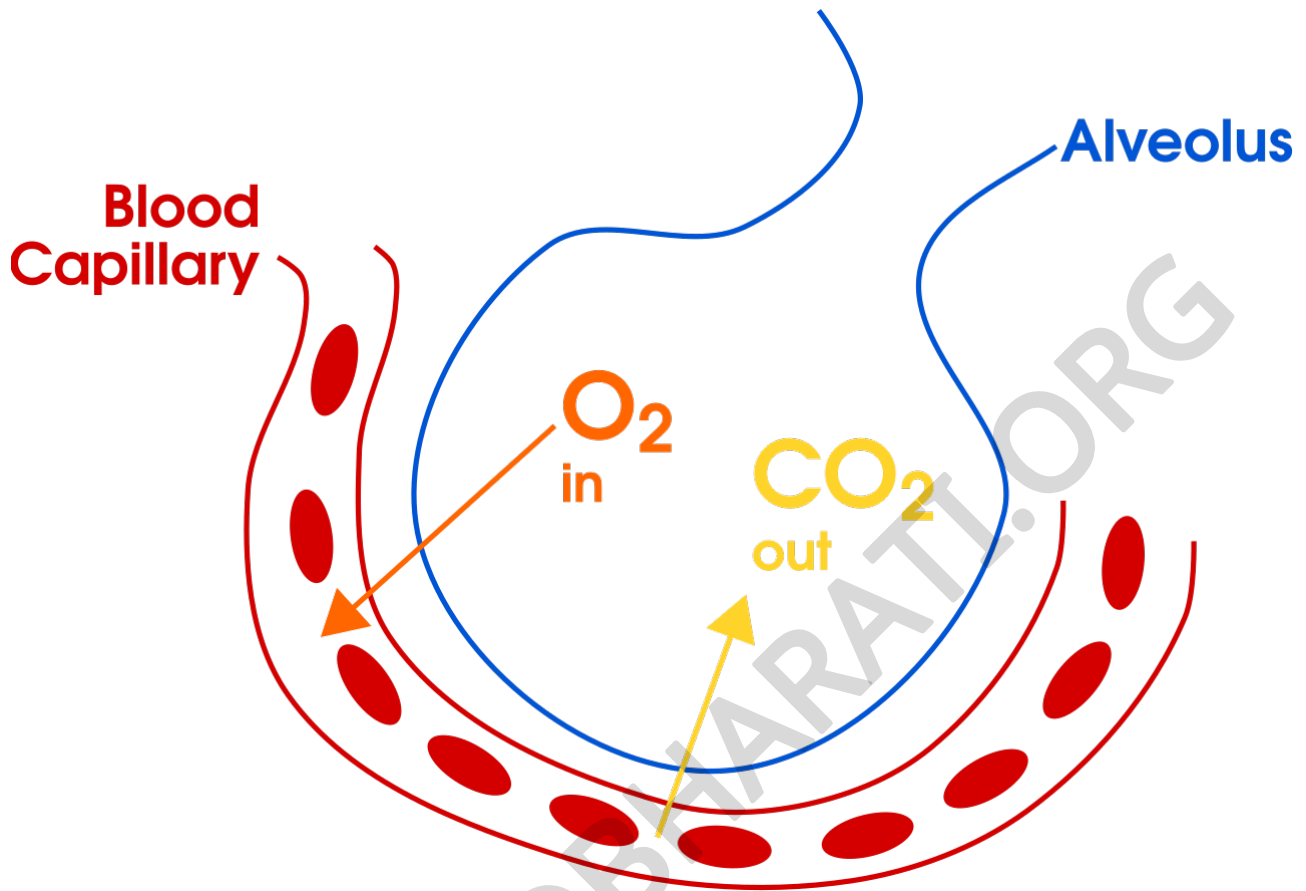
### 6 · Introduction

The respiratory system ensures **gas exchange (O<sub>2</sub> and CO<sub>2</sub>)** and plays a key role in **acid-base balance and voice production**.

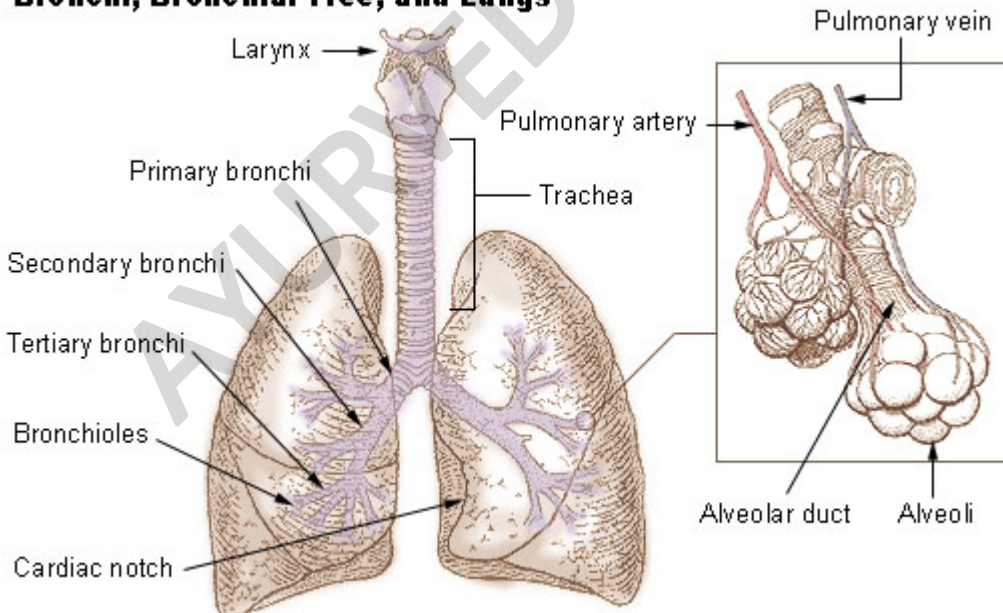
---

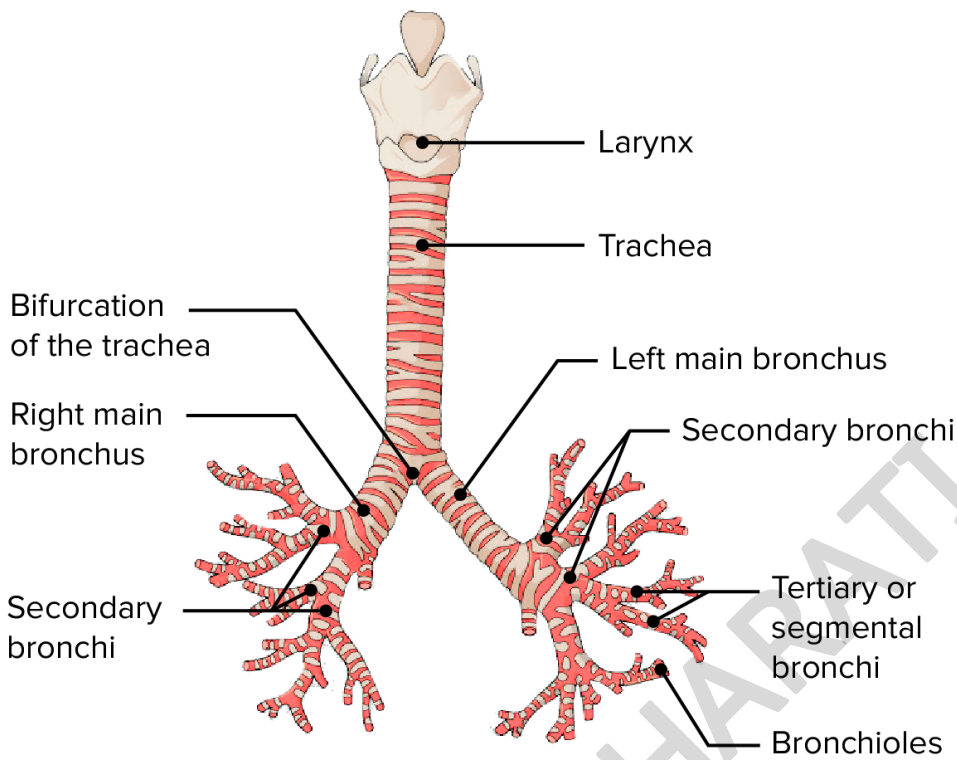
### 7 · Structure of Respiratory System





### Bronchi, Bronchial Tree, and Lungs





| Component             | Function                |
|-----------------------|-------------------------|
| Nose & nasal cavity   | Air filtration, warming |
| Pharynx               | Air passage             |
| Larynx                | Voice production        |
| Trachea               | Air conduction          |
| Bronchi & bronchioles | Distribution            |
| Alveoli               | Gas exchange            |

## 8 · Mechanism of Breathing

### 8.1 Inspiration

- Diaphragm contracts ↓
- Thoracic cavity expands
- Air enters lungs

### 8.2 Expiration

- Diaphragm relaxes
- Thoracic cavity decreases
- Air expelled



## 9 · Gas Exchange

### 9.1 External Respiration

Alveoli ↔ Blood

### 9.2 Internal Respiration

Blood ↔ Tissues

## 10 · Transport of Gases

| Gas             | Transport Form                              |
|-----------------|---|
| Oxygen          | 98% Hb-bound, 2% dissolved                  |
| CO <sub>2</sub> | 70% bicarbonate, 23% Hb-bound, 7% dissolved |

## 11 · Regulation of Respiration

| Control Center     | Location                | Function                     |
|--------------------|-------------------------|------------------------------|
| Medullary centers  | Medulla                 | Basic rhythm                 |
| Pneumotaxic center | Pons                    | Rate control                 |
| Chemoreceptors     | Carotid & aortic bodies | CO <sub>2</sub> , pH sensing |

## 12 · Respiratory Volumes

| Parameter       | Value (Approx) |
|-----------------|----------------|
| Tidal Volume    | 500 mL         |
| Vital Capacity  | 3-5 L          |
| Residual Volume | 1-1.5 L        |

## 13 · Integration of Circulatory & Respiratory Systems

| Process                 | System Involved |
|-------------------------|-----------------|
| Oxygen intake           | Respiratory     |
| Oxygen transport        | Circulatory     |
| Cellular respiration    | Metabolic       |
| CO <sub>2</sub> removal | Both systems    |

### Key Concept:

□ Efficient oxygen delivery = lung function + cardiac output + hemoglobin

## 14 · Clinical Correlation



---

| Condition     | System      | Mechanism                        |
|---------------|-------------|----------------------------------|
| Hypertension  | Circulatory | Increased resistance             |
| Heart failure | Circulatory | Reduced cardiac output           |
| Anemia        | Circulatory | Reduced oxygen carrying capacity |
| Asthma        | Respiratory | Bronchoconstriction              |
| COPD          | Respiratory | Airflow limitation               |
| Hypoxia       | Both        | Inadequate oxygen supply         |

---

## 15 · Key Takeaways

1. Circulatory system = **transport system of body**
  2. Respiratory system = **gas exchange system**
  3. Heart and lungs work in **close coordination**
  4. Blood is the **connecting medium**
  5. Oxygen delivery depends on **three factors**: lungs, heart, hemoglobin
- 

## Self-Assessment

1. Explain cardiac output and its regulation.
  2. Describe oxygen transport in blood.
  3. Differentiate internal and external respiration.
  4. Explain the role of hemoglobin in oxygen transport.
  5. Describe how respiratory and circulatory systems are interdependent.
-