



Respiratory System

Overview:

The respiratory system consists of organs and tissues involved in gas exchange. It allows the uptake of oxygen from the atmosphere and the release of carbon dioxide generated during aerobic respiration. This process, also known as breathing or external respiration, ensures that cells receive oxygen and eliminate carbon dioxide.

Features of the Human Respiratory System:

- **Oxygen Transport:** Inhaled oxygen is transported to various body parts and used to metabolize glucose at the cellular level through a series of chemical reactions.

- **ATP Generation:** The breakdown of glucose releases energy, which is stored in the form of ATP (adenosine triphosphate).

Parts of the Respiratory System and Their Functions:

1) External Nostrils:

Function: Allow the intake of air into the respiratory system.

2) Nasal Chamber:

Structure: Lined with hair and mucus.

Function: Filters air to remove dust and dirt, and adds moisture to the inhaled air.

3) Pharynx:

Function: Acts as a common passageway for air and food, located behind the nasal chamber.

4) Larynx (Voice Box):

Nickname: Soundbox.

Function: Houses the vocal cords, essential for sound production.

5) Trachea (Windpipe):

Structure: Extends from the larynx and is supported by C-shaped cartilaginous rings.

Function: Maintains an open airway; bifurcates into two bronchi, each leading to a lung.

6) Epiglottis:

Structure: Flap-like structure.

Function: Covers the glottis to prevent food from entering the windpipe during swallowing.

7) Bronchi:

Function: The trachea divides into the left and right bronchi, which carry air to each lung.

8) Bronchioles:

Function: Smaller branches of the bronchi that further divide into finer channels.

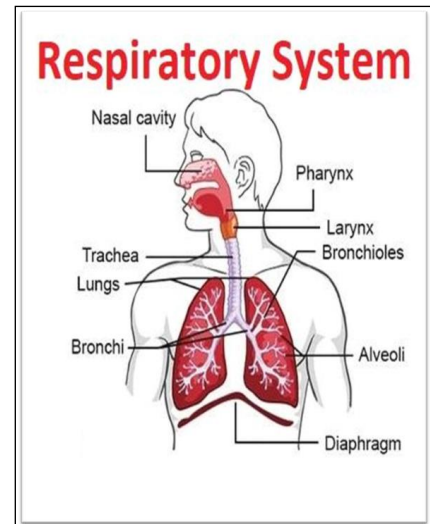
9) Alveoli:

Structure: Balloon-like structures.

Function: The bronchioles terminate in alveoli, where gas exchange occurs between air and blood.

10) Lungs:

Structure: A pair of sac-like structures covered by a double-layered membrane known as the pleura.





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Function: Facilitate gas exchange and are protected by the pleural membrane, which reduces friction during breathing.

Types of Respiration:

1) Aerobic Respiration:

- **Definition:** Cellular respiration that occurs in the presence of oxygen to produce energy.
- **Chemical Equation**– $\text{Glucose}(\text{C}_6\text{H}_{12}\text{O}_6) + \text{Oxygen}(\text{6O}_2) \rightarrow \text{Carbon dioxide}(\text{6CO}_2) + \text{Water}(\text{6H}_2\text{O}) + \text{Energy (ATP)}$

2) Anaerobic Respiration:

- **Definition:** Cellular respiration that occurs in the absence of oxygen to produce energy.
- **Process:** Typically occurs in some microorganisms and muscle cells during intense exercise.
- **Chemical Equation**– $\text{Glucose}(\text{C}_6\text{H}_{12}\text{O}_6) \rightarrow \text{Alcohol } 2(\text{C}_2\text{H}_5\text{OH}) + \text{Carbon dioxide } 2(\text{CO}_2) + \text{Energy (ATP)}$
- In human muscle cells, anaerobic respiration produces lactic acid instead of alcohol
- $\text{Glucose } (\text{C}_6\text{H}_{12}\text{O}_6) \rightarrow \text{Lactic Acid } (2\text{C}_3\text{H}_6\text{O}_3) + \text{Energy (ATP)}$

Process of Respiration:

1) External Respiration:

- **Ventilation (Breathing):**
 - **Inhalation:** Oxygen is brought into the respiratory system.
 - **Exhalation:** Carbon dioxide is expelled from the respiratory system.
- **Gas Exchange:**
 - **In the Lungs:** Oxygen diffuses into the blood; carbon dioxide diffuses out of the blood.
 - **In the Gills:** Oxygen diffuses into the blood; carbon dioxide diffuses out into the water.

2) Internal Respiration:

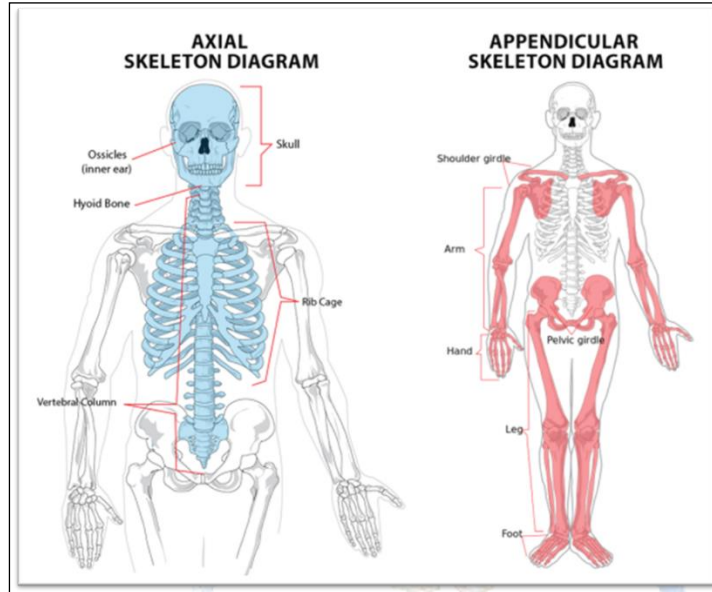
- Internal respiration refers to the metabolic processes that occur within cells to produce energy. It involves the following stages:
 - **Glycolysis:**
 - ✓ Takes place in the cytoplasm.
 - ✓ Does not require oxygen.
 - ✓ Occurs in anaerobic respiration.
 - ✓ $\text{Glucose} \rightarrow \text{Pyruvic acid} + 2 \text{ATP}$
 - **Krebs Cycle (Citric Acid Cycle):**
 - ✓ Takes place in the mitochondria.
 - ✓ Requires oxygen.
 - ✓ Oxidation of Pyruvic Acid into water, CO_2 and energy (36 ATP)
 - ✓ It produces maximum energy (36 ATP).

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Skeletal System

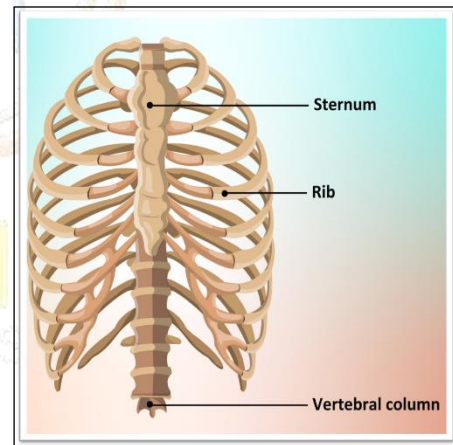
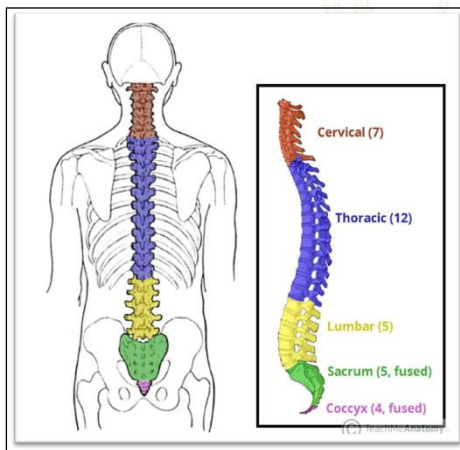
Overview:



The skeletal system is a complex structure that provides support, protection, and movement. It consists of bones, cartilage, ligaments, and other connective tissues.

Divisions of the Skeletal System:

1) Axial Skeleton:



- Forms the main axis of the body.
- Consists of 80 bones, including the skull, vertebral column, and bones of the chest.

• **Skull:**

- Consists of 29 bones.
- 8 bones protect the brain (cranium).
- 14 bones make up the face.
- 6 bones in the ear.
- 1 hyoid bone in the throat.



- **Vertebral Column (Backbone):**

- Made up of 33 vertebrae.
- Found at the back of humans, resembling a thick rod.
- All vertebrae are joined by intervertebral discs.
- The 1st vertebra (Atlas) holds the skull and provides flexibility to the neck and body.

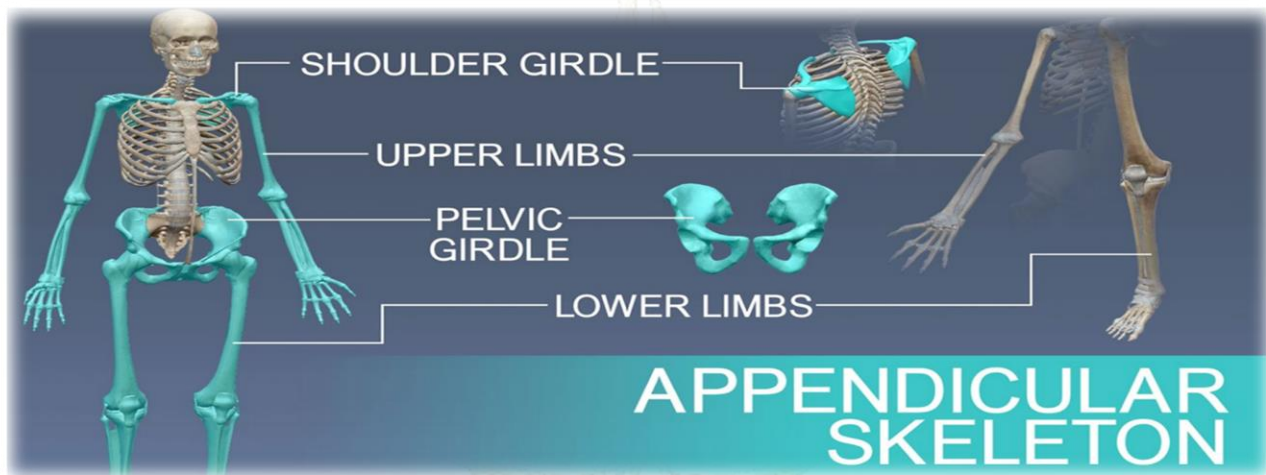
- **Ribs:**

- 12 pairs (24 ribs) in the body.

- **Sternum:**

- A single bone that connects all the ribs together.
- Located in the middle of the chest.

2) Appendicular Skeleton:



- Consists of 126 bones.
- Provides the body with a definite shape and a basis for muscle attachment.
- Supports the limbs and connects them to the axial skeleton.

- **Pectoral Girdle (Shoulder Girdle):**

- Clavicles (Collarbones): Connects the arms to the body, stabilizes shoulder movement.
- Scapulae (Shoulder Blades): Provides attachment for muscles, enabling arm movement.

- **Upper Limbs:**

- Humerus: The upper arm bone, connecting the shoulder to the elbow.
- Radius and Ulna: The two forearm bones, enabling wrist and arm rotation.
- Carpals (Wrist Bones): Eight small bones forming the wrist.
- Metacarpals (Hand Bones): Five bones forming the palm.
- Phalanges (Finger Bones): Bones of the fingers.

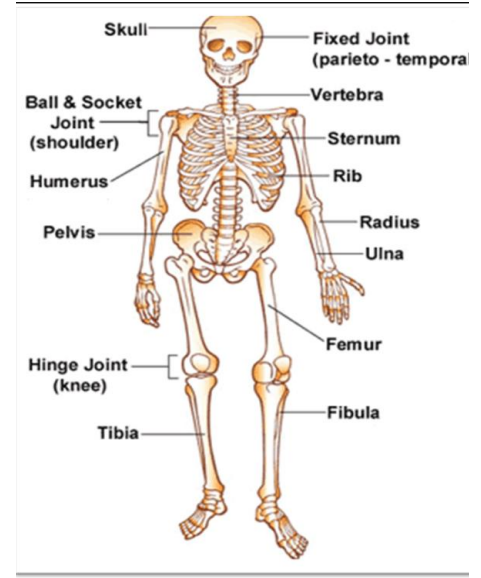
- **Pelvic Girdle (Hip Girdle):**

- Hip Bones: Connects the spine to the lower limbs, supports body weight, and protects pelvic organs.



• Lower Limbs:

- **Femur (Thigh Bone):** The longest and strongest bone, connecting the hip to the knee.
- **Patella (Kneecap):** Protects the knee joint.
- **Tibia and Fibula:** The two bones of the lower leg, supporting weight and enabling ankle movement.
- **Tarsals (Ankle Bones):** Seven bones forming the ankle.
- **Metatarsals (Foot Bones):** Five bones forming the arch and sole of the foot.
- **Phalanges (Toe Bones):** Bones of the toes.



Main Functions of the Skeletal System:

- 1) **Support:** Provides a structural framework for the body, supporting soft tissues and giving the body its shape.
- 2) **Protection:** Protects vital organs, such as the brain (encased in the skull), heart, and lungs (protected by the rib cage), and the spinal cord (protected by the vertebral column).
- 3) **Movement:** Works in conjunction with the muscular system to facilitate movement by serving as points of attachment for muscles.
- 4) **Mineral Storage:** Stores essential minerals such as calcium and phosphorus, which can be released into the bloodstream as needed.
- 5) **Blood Cell Production:** The red bone marrow within certain bones produces blood cells in a process called hematopoiesis.
- 6) **Energy Storage:** Yellow bone marrow stores fat, which serves as an energy reserve.

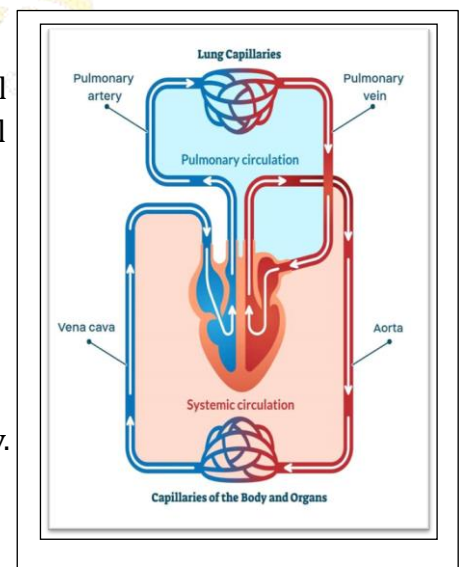
Human Circulatory System:

The circulatory system, also known as the cardiovascular system, is vital for transporting blood, nutrients, oxygen, and other essential substances throughout the body. This system ensures that every cell receives the necessary materials for proper function.

Main Components of the Circulatory System

1) Heart

- **Function:** Central pump that drives blood circulation.
- **Structure:**
 - **Four Chambers:**
 - ✓ **Right Atrium:** Receives deoxygenated blood from the body.
 - ✓ **Right Ventricle:** Pumps deoxygenated blood to the lungs.
 - ✓ **Left Atrium:** Receives oxygenated blood from the lungs.
 - ✓ **Left Ventricle:** Pumps oxygenated blood to the body.





- ✓ **Right Side:** Pumps deoxygenated blood to the lungs.
- ✓ **Left Side:** Pumps oxygenated blood to the rest of the body.

2) Blood Vessels

- **Types:**
 - **Arteries:** Carry oxygen-rich blood away from the heart.
 - **Veins:** Return oxygen-depleted blood to the heart.
 - **Capillaries:** Facilitate exchange of gases, nutrients, and wastes between blood and tissues.

3) Blood

- **Components:**
 - **Red Blood Cells:** Transport oxygen and carbon dioxide.
 - **White Blood Cells:** Defend against infections.
 - **Platelets:** Aid in blood clotting.
 - **Plasma:** Liquid part carrying nutrients, hormones, and wastes.

Importance of the Circulatory System :

- **Oxygen Supply:** Delivers oxygen to cells for energy production.
- **Nutrient Distribution:** Transports essential nutrients.
- **Waste Removal:** Removes carbon dioxide and metabolic wastes.
- **Immune Defense:** Distributes white blood cells to combat infections.
- **Temperature Regulation:** Maintains body temperature by distributing heat.

Structure of the Heart :

- **Four Chambers:**
 - **Right Atrium:** Receives deoxygenated blood.
 - **Right Ventricle:** Pumps it to the lungs.
 - **Left Atrium:** Receives oxygenated blood.
 - **Left Ventricle:** Pumps it to the body.
- **Valves:** Ensure correct blood flow and prevent backflow.
 - **Tricuspid Valve:** Between right atrium and ventricle.
 - **Pulmonary Valve:** Between right ventricle and pulmonary artery.
 - **Mitral Valve:** Between left atrium and ventricle.
 - **Aortic Valve:** Between left ventricle and aorta.

Blood Circulation Path :

1) Pulmonary Circulation:

- **Right Atrium:** Receives deoxygenated blood.
- **Right Ventricle:** Pumps blood to the lungs via the pulmonary artery.
- **In Lungs:** Blood picks up oxygen and releases carbon dioxide.



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2) Systemic Circulation:

- **Left Atrium:** Receives oxygen-rich blood from the lungs.
- **Left Ventricle:** Pumps oxygenated blood to the body via the aorta.

3) Cycle Repeats:

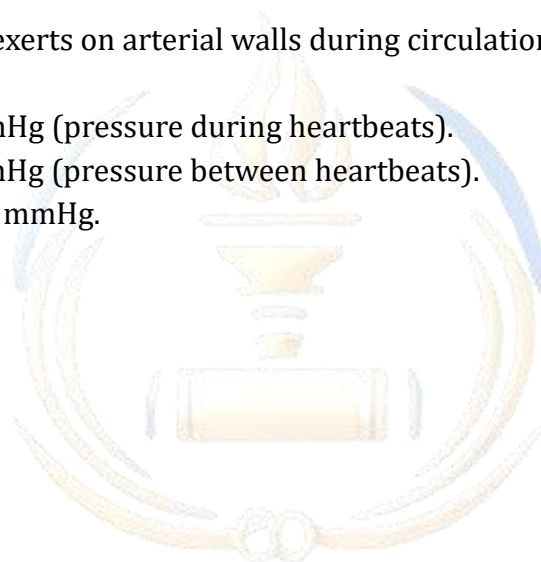
- **Diastole:** Heart relaxes, filling with blood for the next cycle.
- **Rate:** Normally beats 60-100 times per minute.

Heartbeat and Electrical System

- **SA Node:** Natural pacemaker that initiates heartbeats.
- **AV Node:** Delays the impulse, ensuring proper chamber filling before ventricular contraction.

Blood Pressure

- **Definition:** The force blood exerts on arterial walls during circulation.
- **Normal Range:**
 - ✓ **Systolic:** Less than 120 mmHg (pressure during heartbeats).
 - ✓ **Diastolic:** Less than 80 mmHg (pressure between heartbeats).
 - ✓ **Normal:** Less than 120/80 mmHg.



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