

The Respiratory System

B.Sc Second year Honours / Subsidiary (Zoology) Paper - 4

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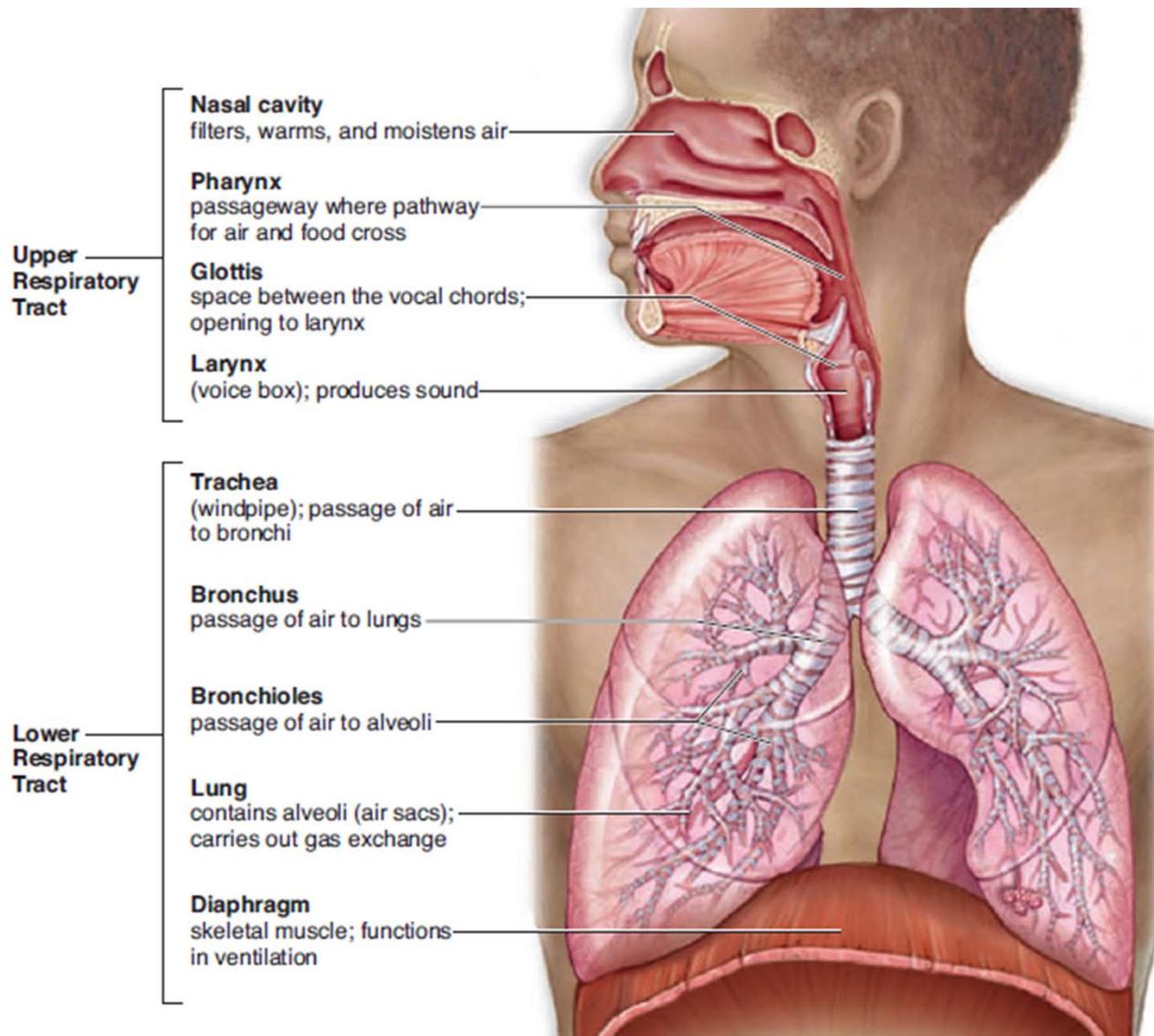
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The Respiratory System

- The organs of the respiratory system ensure that oxygen enters the body and carbon dioxide leaves the body.
- During inspiration, or inhalation (breathing in), air is conducted from the atmosphere to the lungs by a series of cavities, tubes, and openings.
- During expiration, or exhalation (breathing out), air is conducted from the lungs to the atmosphere by way of the same structures.
- Ventilation is another term for breathing (respiration) that includes both inspiration and expiration.
- Gas exchange is necessary because the cells of the body carry out cellular respiration to make energy in the form of ATP.
- During cellular respiration, cells use up O₂ and produce CO₂.
- The respiratory system provides these cells with O₂ and removes CO₂.



The Upper Respiratory Tract

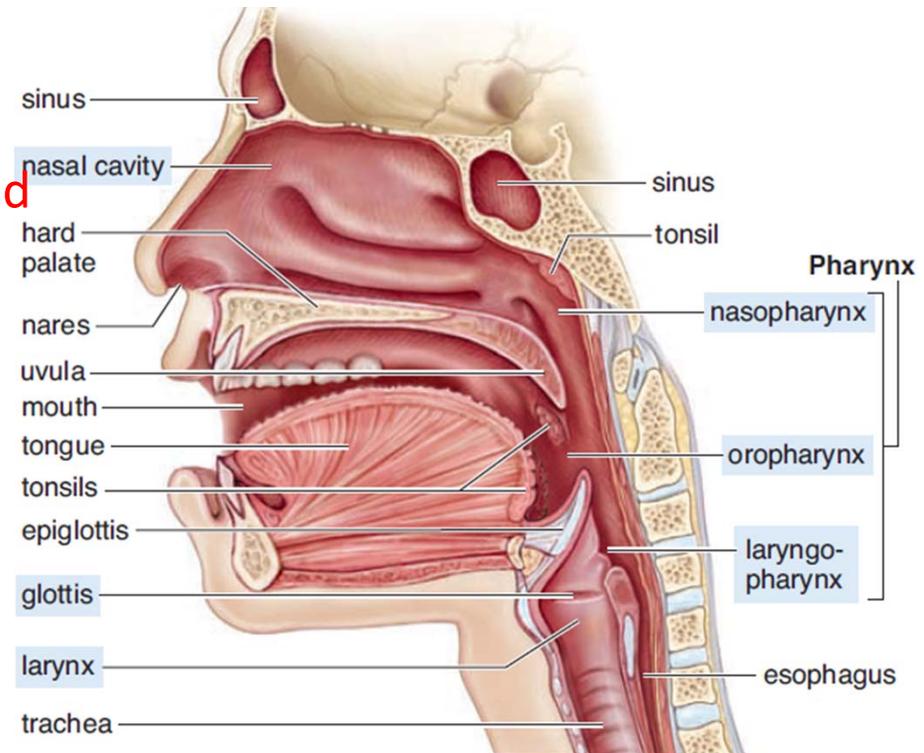
- The nasal cavities, pharynx, and larynx are the organs of the upper respiratory tract

The Nose

- The nose opens at the nares (nostrils) that lead to the **nasal cavities**.
- The nasal cavities are narrow canals separated from each other by a septum composed of bone and cartilage.
- Air entering the nasal cavities is met by large stiff hairs that act as a screening device.
- The hairs filter the air and trap small particles (dust, mold spores, pollen, etc.) so they don't enter air passages.
- The rest of the nasal cavities are lined by mucous membrane.
- The mucus secreted by this membrane helps trap dust and move it to the pharynx, where it can be **swallowed or expectorated by coughing or spitting**.

- In the narrow upper recesses of the nasal cavities are special ciliated cells that act as **odor receptors**.

- Some times, fluid may accumulate in these sinuses, causing an excess of pressure, resulting in a **sinus headache**.



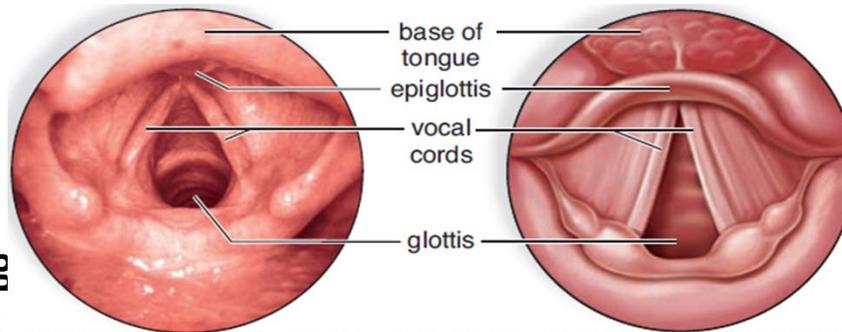
- Air in the nasal cavities passes into the **naso-pharynx**, the upper portion of the pharynx.
- The naso-pharynx connected by tubes called **auditory (eustachian) tubes** to the middle ear.

The Pharynx

- The pharynx is a funnel-shaped passageway that connects the nasal and oral cavities to the larynx. Therefore, the pharynx, commonly referred to as the “throat,” and has three parts:
 1. Nasopharynx, where the nasal cavities open above the soft palate.
 2. Oropharynx, where the oral cavity opens.
 3. Laryngopharynx, which opens into the larynx.
- The tonsils form a protective ring at the junction of the oral cavity and the pharynx.
- In the pharynx, the air passage and the food passage lie parallel to each other and share a common opening in the laryngopharynx.
- The larynx is normally open, allowing air to pass, but the esophagus is normally closed and opens only when a person swallows.
- If someone swallows and some of the food enters the larynx, coughing occurs in an effort to dislodge (remove) the food.

The Larynx

- The larynx is a cartilaginous structure that serves as a passageway for air between the pharynx (Laryngopharynx) and the trachea.
- The larynx can be pictured as a triangular box whose apex, the Adam's apple (or laryngeal prominence), is located at the front of the neck.
- The larynx is called the voice box because it houses the vocal cords. The vocal cords are mucosal folds supported by elastic ligaments, and the slit between the vocal cords is called the glottis.
- Ordinarily, when food is swallowed, the larynx moves upward against the epiglottis, a flap of tissue that prevents food from passing into the larynx.



The Lower Respiratory Tract

- Once the incoming air makes its way past the larynx, it enters the lower respiratory tract.
- The lower respiratory tract consists of the trachea, the bronchial tree, and the lungs.

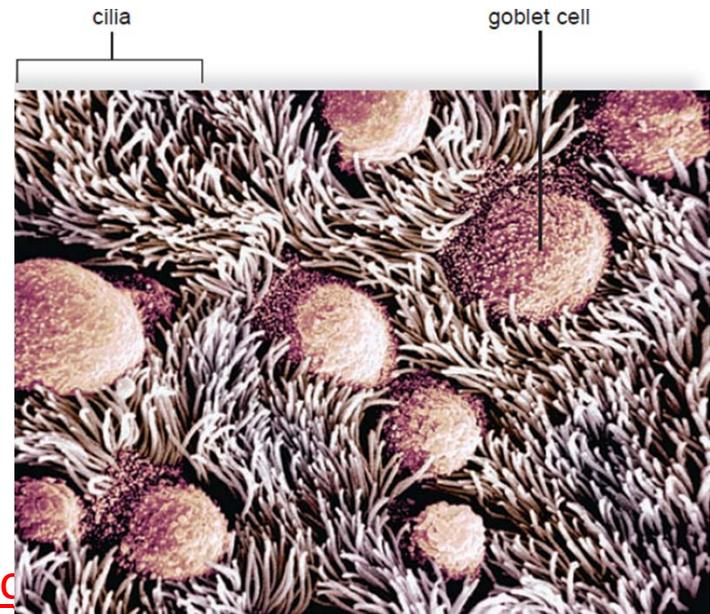
The Trachea

- The trachea, commonly called the windpipe, is a tube connecting the larynx to the primary bronchi.
- Its walls consist of connective tissue and smooth muscle reinforced by C-shaped cartilaginous rings. The rings prevent the trachea from collapsing.
- The trachea lies anterior to the esophagus. It is separated from the esophagus by a flexible muscular wall. This orientation allows the esophagus to expand when swallowing.
- The mucous membrane lines the trachea has an outer layer of pseudostratified ciliated columnar epithelium and goblet cells.

- The goblet cells produce mucus, which traps debris in the air as it passes through the trachea.
- The mucus is then swept toward the pharynx and away from the lungs by the cilia that project from the epithelium.

The Bronchial Tree

- The trachea divides into right and left primary bronchi which lead into
- The bronchi branch into a few secondary bronchi that also branch, until the branches become about 1 mm in diameter and are called bronchioles.
- The bronchi resemble the trachea in structure. As the bronchial tubes divide and subdivide, their walls become thinner, and the small rings of cartilage are no longer present.
- Each bronchiole leads to an elongated space enclosed by a multitude of air pockets or sacs called alveoli.



The Lungs

- The lungs are paired, cone-shaped organs in the thoracic cavity.
- In the center of the thoracic cavity are the trachea, heart, thymus, and esophagus.
- The lungs are on either side of the trachea.
- The right lung has three lobes, and the left lung has two lobes, allowing room for the heart, which points left.
- Each lobe is further divided into lobules, and each lobule has a bronchiole serving many alveoli.
- The lungs follow the contours of the thoracic cavity, including the diaphragm, the muscle that separates the thoracic cavity from the abdominal cavity.
- Each lung is enclosed by pleurae, two layers of serous membrane that produces serous fluid.
- The parietal pleura adheres to the thoracic cavity wall, and the visceral pleura adheres to the surface of the lung.

The Alveoli

- The lungs have about 300 million alveoli, with a total cross sectional area of 50–70 m². That's about the size of a tennis court.
- Each alveolar sac is surrounded by blood capillaries.
- The walls of the sac and the capillaries are largely simple squamous epithelium.
- Gas exchange occurs between air in the alveoli and blood in the capillaries.
- Oxygen diffuses across the alveolar wall and enters the blood stream, and carbon dioxide diffuses from the blood across the alveolar wall to enter the alveoli.
- The alveoli of human lungs are lined with a surfactant, a film of lipoprotein that lowers the surface tension of water and prevents the alveoli from closing.
- The lungs collapse in some newborn babies—especially premature infants—who lack this film.

➤ The condition, called infant respiratory distress syndrome, is now treatable by surfactant replacement therapy.

