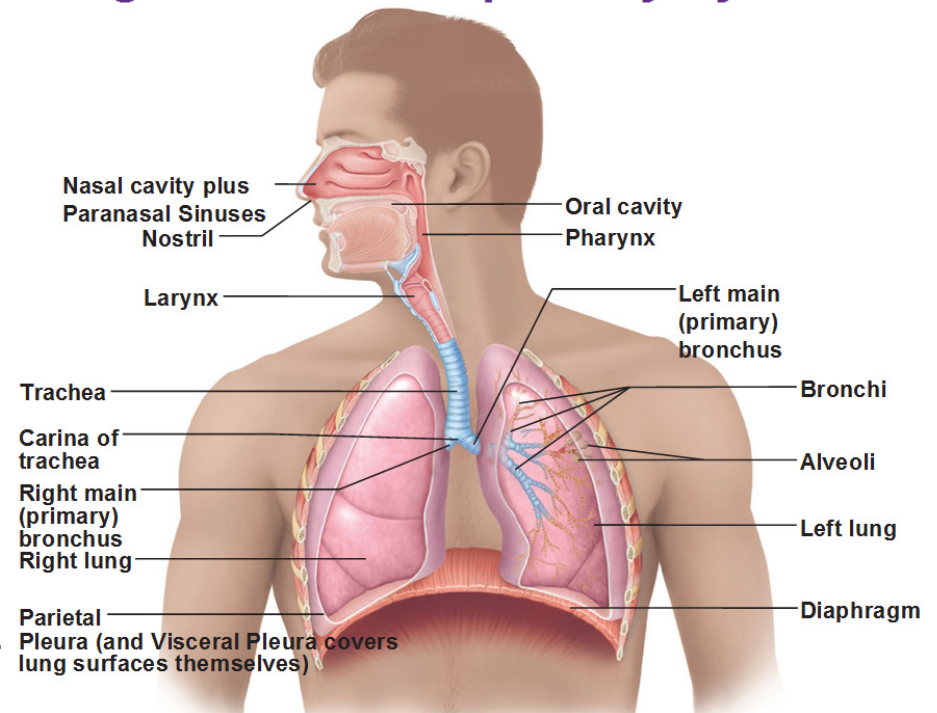


The Respiratory System

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Organs of the Respiratory System



Divisions of the Respiratory System

- **Structurally:** (according to embryological origin)
 - Upper respiratory system
 - Nose, pharynx and associated structures
 - Lower respiratory system
 - Larynx, trachea, bronchi and lungs
- **Functionally:**
 - Conducting zone – conducts air
 - Nose, pharynx, larynx, trachea, bronchi, bronchioles and terminal bronchioles
 - Respiratory zone – site of gas exchange
 - Respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli

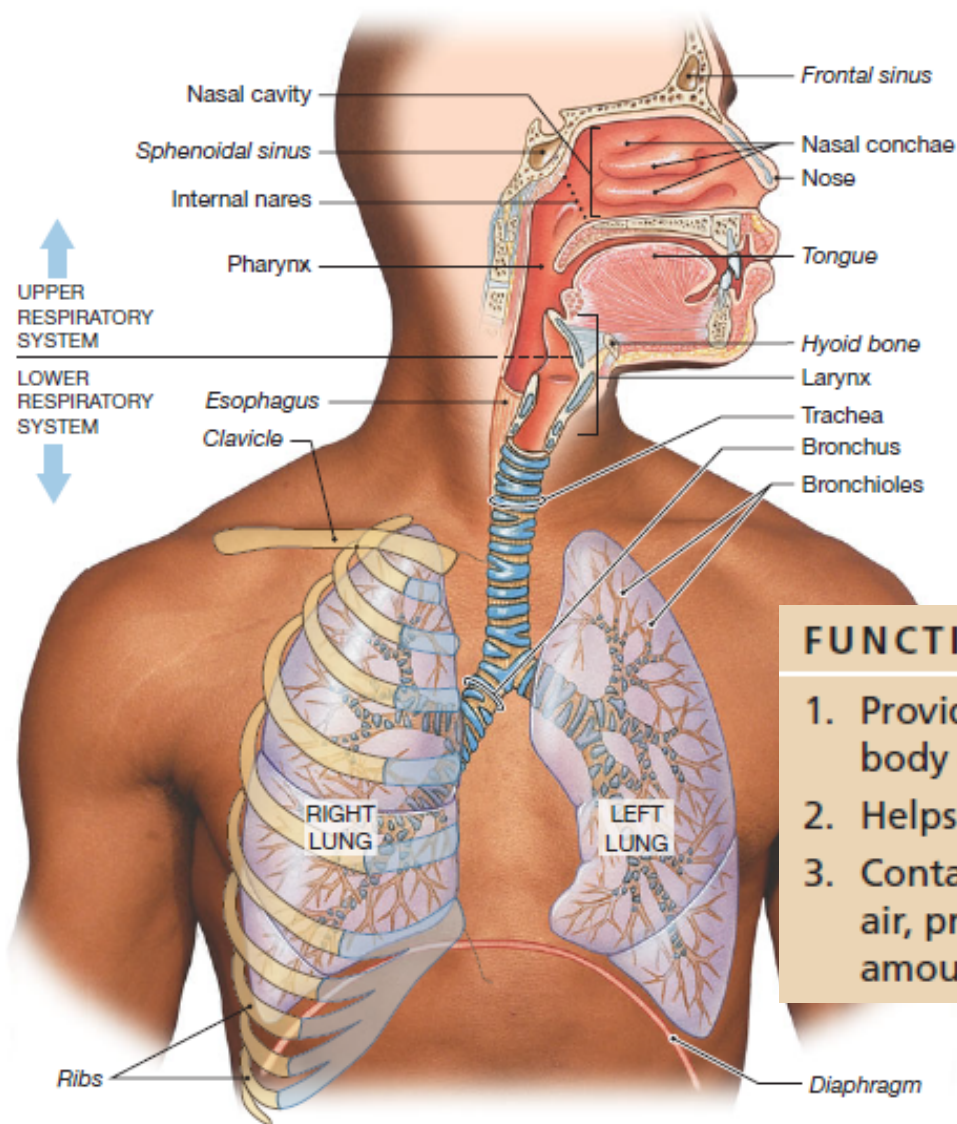


Fig.1: The respiratory system.

FUNCTIONS

1. Provides for gas exchange—intake of O_2 for delivery to body cells and removal of CO_2 produced by body cells.
2. Helps regulate blood pH.
3. Contains receptors for the sense of smell, filters inspired air, produces sounds (phonation), and excretes small amounts of water and heat.

The Nose

- Consists of the External nose and Internal nose.
- **External nose** – portion visible on face
 - Formed of a small bony part – the nasal bones (bridge of the nose) and a larger cartilaginous part. All covered by muscles and skin.
 - Its openings are called the **external nares** or **nostrils**.
 - The area just inside the nostrils is called the **vestibule**. Its lower half is lined by skin.

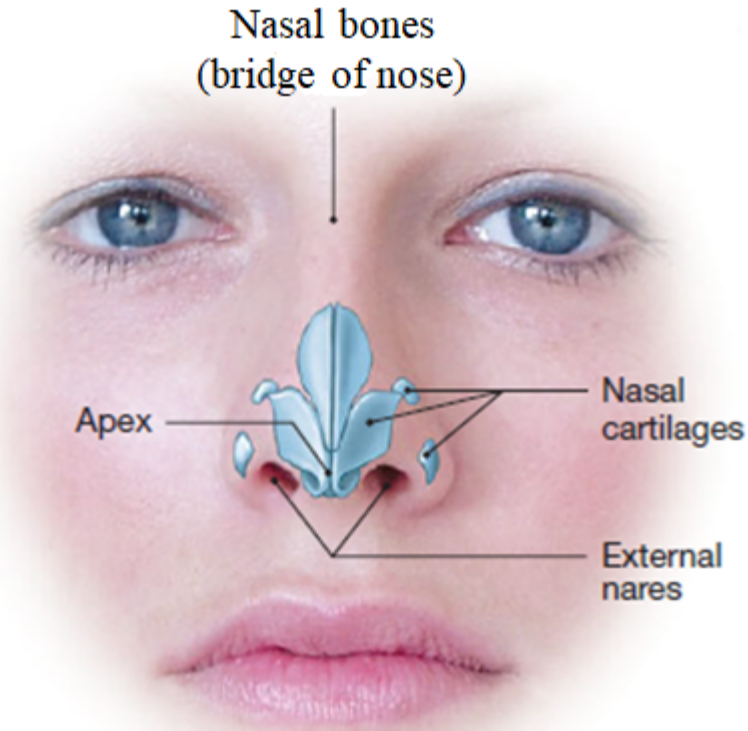


Fig.2: The external nose.

- **Internal nose** – large cavity beyond the vestibule mostly lined by respiratory epithelium.
 - ❑ Extends from vestibule to the internal nares or choanae.
 - ❑ Nasal cavity divided by nasal septum.
 - ❑ The lateral wall has projections that increase the surface area called conchae. Between these conchae and the lateral wall are small passages called meatuses.
 - ❑ Ducts from paranasal sinuses and nasolacrimal ducts open into the meatuses of the internal nose.
 - ❑ Olfactory epithelium responsible for the sense of smell lines the roof of the nasal cavity.

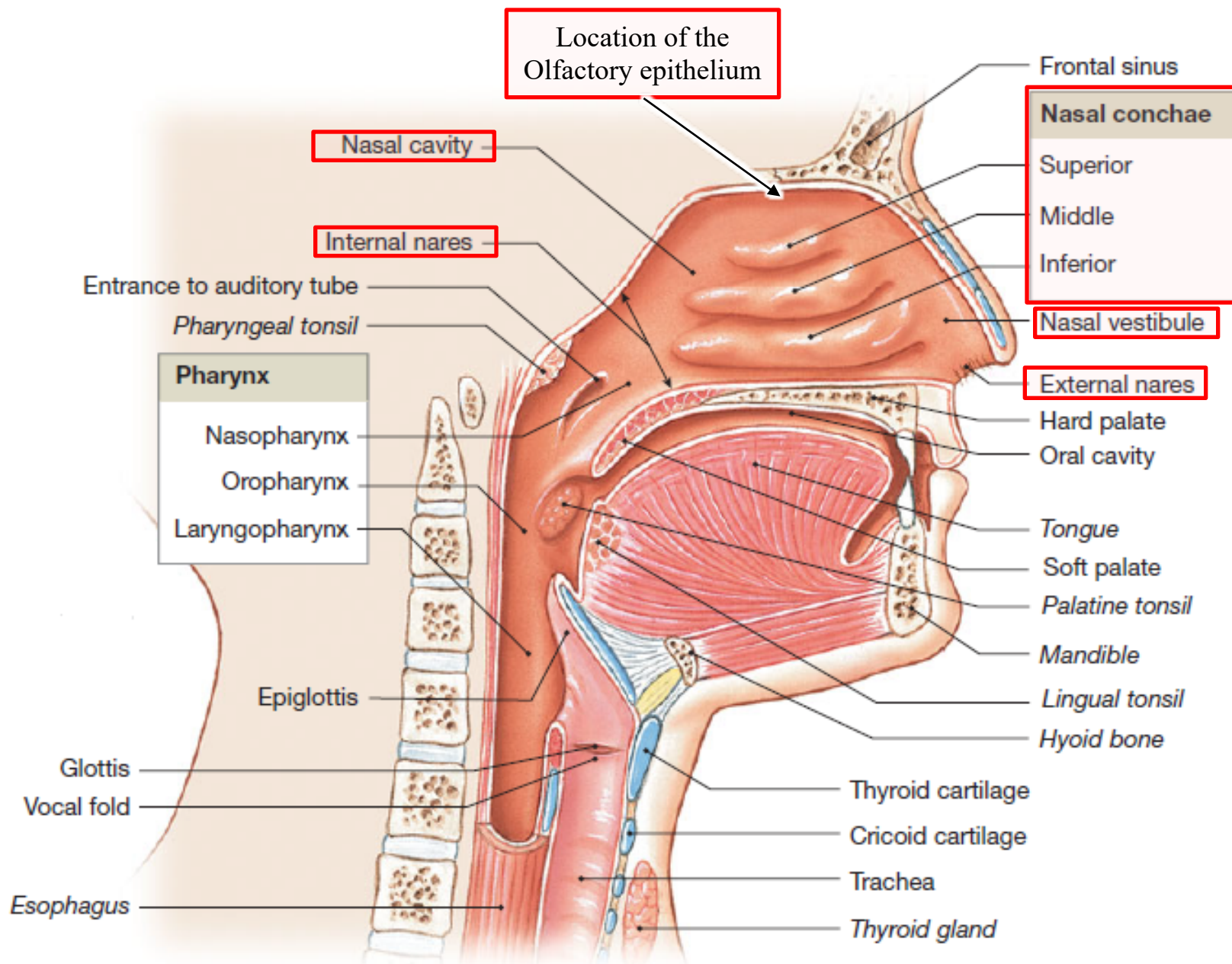


Fig.3: The internal nose (pink boxes).

Functions of the nose:

1. Warms air coming through the nose due to the rich capillaries of the mucosa of the nose.
2. Moistens incoming air by the mucus secreted by goblet cells of the mucosa.
3. Traps and removes dust particles by cilia and hair.
4. Affects quality of voice.
5. Olfactory epithelium responsible for the sense of smell.

The Pharynx

- Funnel shaped tube that starts at internal nares and extends to the level of the cricoid cartilage of larynx (C6 vertebra).
- Contraction of skeletal muscles assists in swallowing.
- Functions
 - Passageway for air and food
 - Resonating chamber
 - Houses tonsils
- 3 anatomical regions
 - Nasopharynx
 - Oropharynx
 - Laryngopharynx

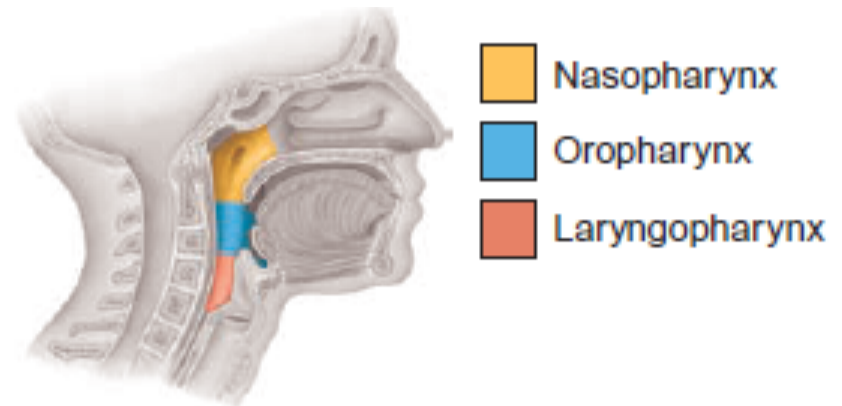


Fig.4: Regions of the pharynx.

The Nasopharynx

- Located posterior to the nasal cavities and above the soft palate and inferiorly opens into the oropharynx. It's a passageway for air.
- Its lateral walls exhibit the opening of the ***auditory (Eustachian) tubes***.
- The posterior wall of the nasopharynx has a collection of lymphoid tissue called the ***pharyngeal Tonsil (adenoid)***.

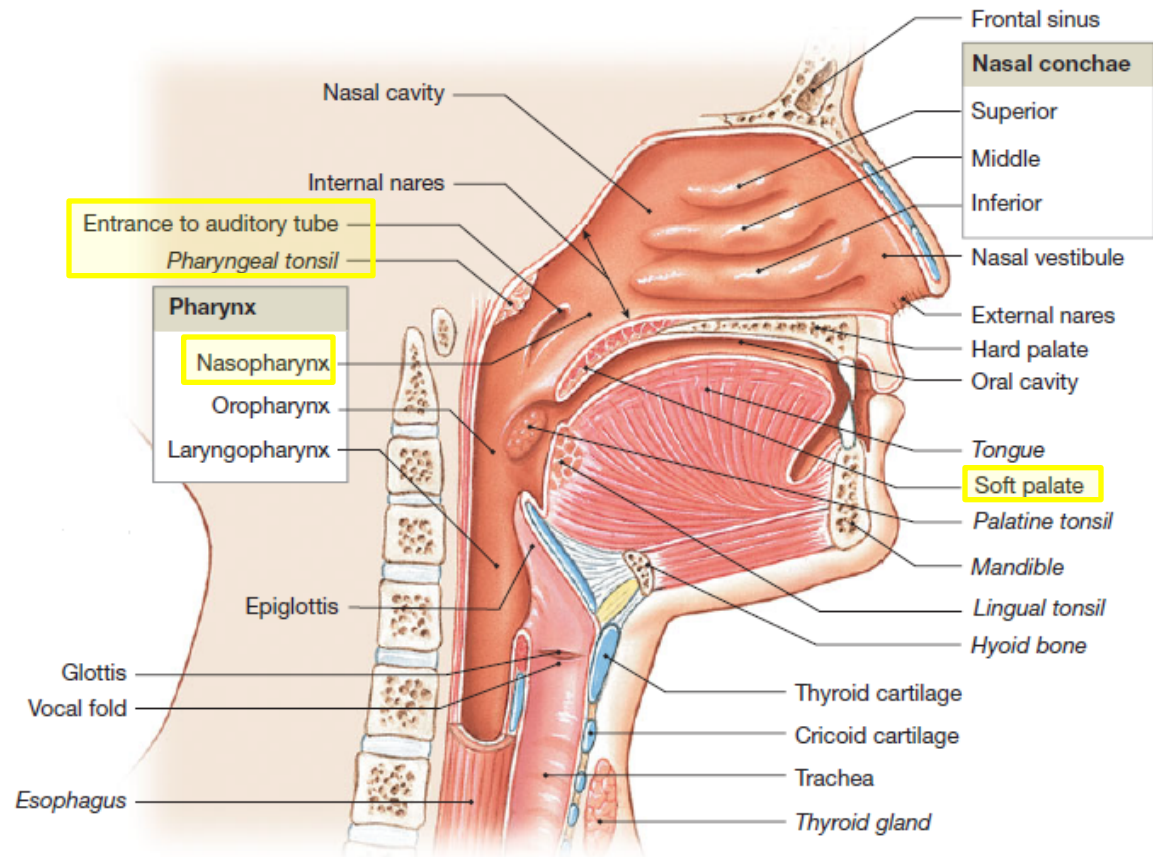


Fig.5: The nasopharynx (yellow boxes).

The Oropharynx

- Located posterior to the oral cavity with which it communicates. It allows passage of both air and food. Inferiorly, it extends to the level of the hyoid bone.
- Anteriorly, in the posterior aspect of the tongue, there's the **lingual tonsil**. Anterolaterally, we have the two **palatine tonsils**.

The Laryngopharynx

- Located posterior to the larynx with which it communicates. It begins at the level of the hyoid bone and ends at the level of the cricoid cartilage (C6) where it becomes continuous with esophagus.
- *Muscles of the pharynx play a part in the process of deglutition. These muscles are supplied by the pharyngeal plexus derived from the glossopharyngeal (IX) and vagus (X) nerves*

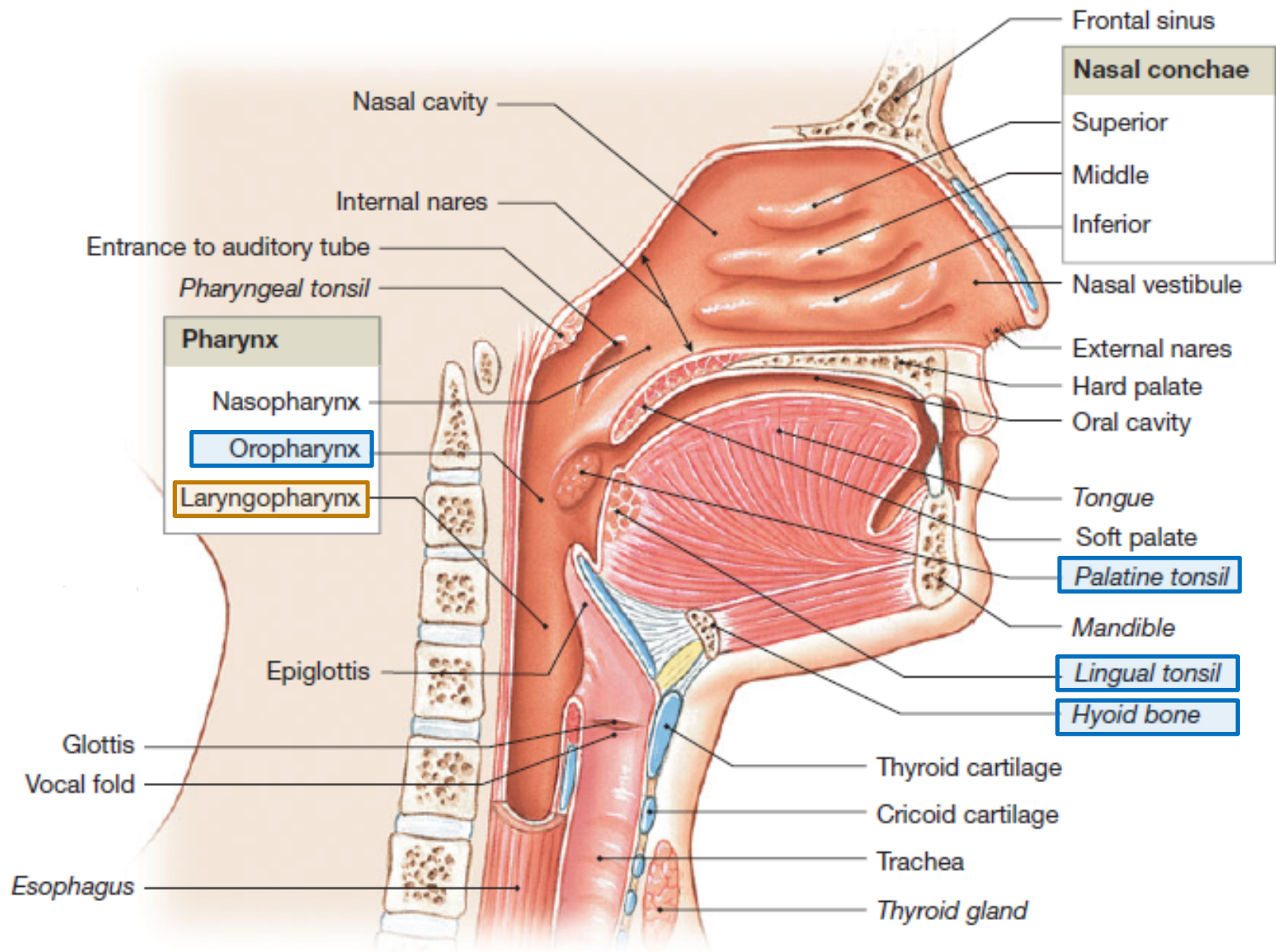


Fig.6: The oropharynx (blue boxes) and the laryngopharynx (brown box).

The Larynx

- Short passageway connecting laryngopharynx with trachea that's responsible for the production of sound. Its inlet also provides a protective cover for the airway passages.
- It lies in the midline of the neck opposite C4-C6 vertebrae. At the level of C6, it becomes continuous with the trachea.
- The larynx is formed of cartilages held together by ligaments and membranes and moved by muscles.

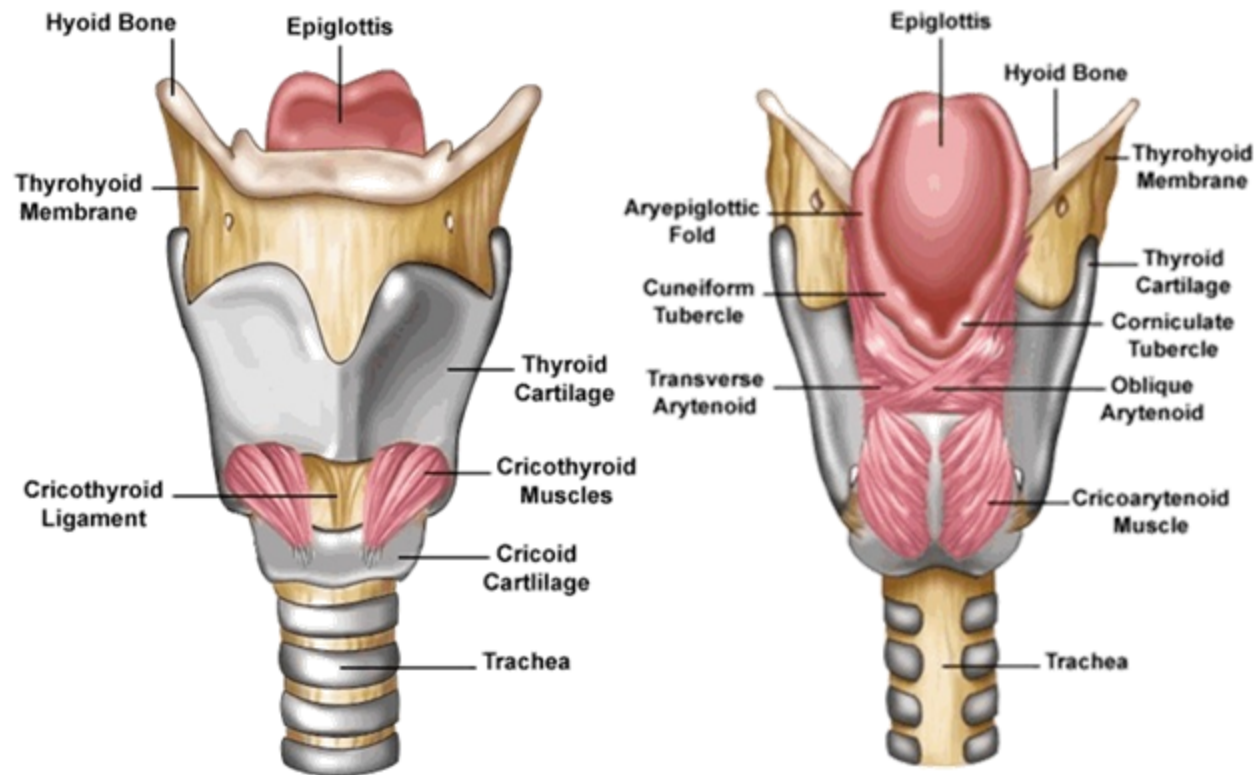


Fig.7: Structure of the larynx. Left, anterior view. Right, posterior views.

Cartilages of the Larynx

1. **Thyroid**: single V-shaped cartilage. The largest and forms prominence of the neck called Adam's Apple.
2. **Cricoid**: a single ring shaped cartilage. The lower boundary of the larynx.
3. **Epiglottis**: a leaf-shaped single cartilage that's present at the inlet of the larynx. Closes the larynx when the person swallows.
4. **Arytenoid**: a pair of pyramidal cartilages to which the vocal cords are attached. Movement of these cartilages leads to movement of the cords.
5. **Corniculate** cartilages (pair).
6. **Cuneiform** cartilages (pair).

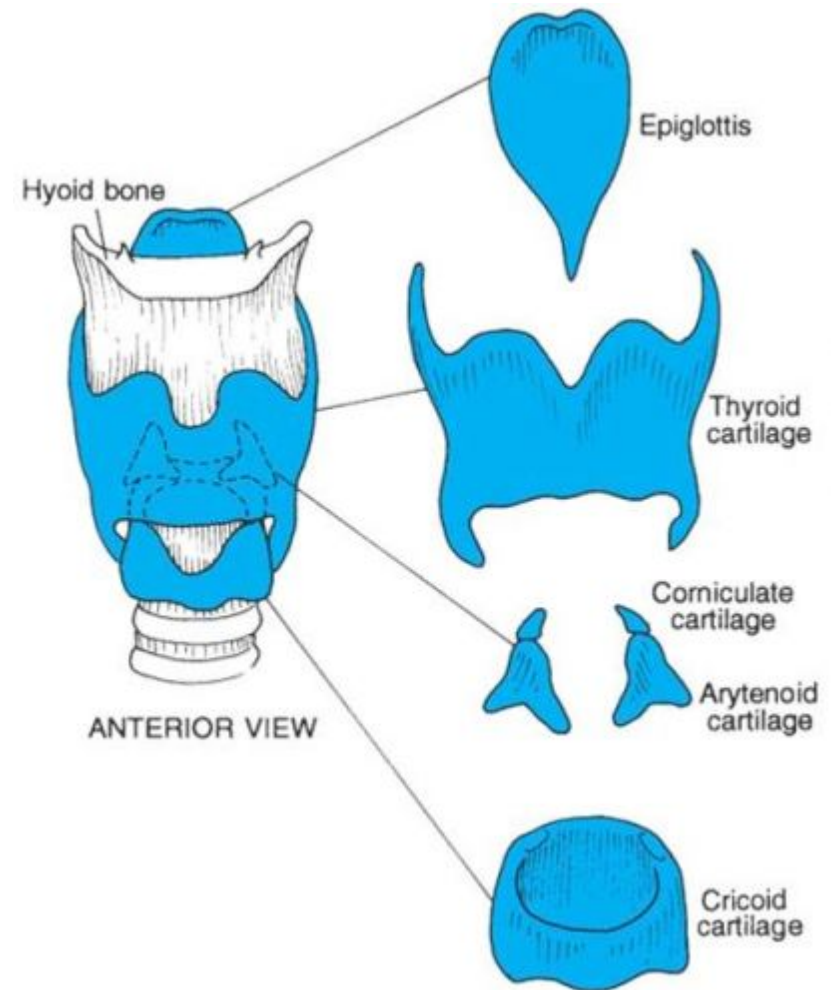


Fig.8: Cartilages of the larynx.

Structures of Sound Production

- Mucous membrane of larynx forms 2 folds:
 - **Vestibular folds** (false vocal cords) – superior pair
 - Function in holding breath.
 - **Vocal folds** (true vocal cords) – inferior pair
 - Contain elastic tissue.
 - Muscle contraction pulls elastic ligaments which stretch vocal folds.
 - Passing air vibrates the cords and produces sound.
 - Folds can move apart or together, elongate or shorten.
 - Muscles of the larynx are Intrinsic or Extrinsic. The intrinsic muscles are supplied by branches of the vagus (X) nerve.

The Trachea

- A Tubular passage of air that extends from the larynx to superior border of **T5** where it divides into right and left primary bronchi. Between the two primary bronchi there's an angle called *carina*.
- 16-20 C-shaped hyaline cartilages are found in the wall to keep the trachea patent.
 - The open part of the C faces posteriorly towards the esophagus.
 - The opening of the C is bridged by a fibromuscular membrane formed of elastic fibers and the smooth *trachealis* muscle.

The Bronchial Tree

- Right and left primary bronchi pass to the corresponding lung.
- Divide to form bronchial tree:
 - Secondary lobar bronchi (one for each lobe), tertiary (segmental) bronchi, bronchioles, terminal bronchioles
- Structural changes with branching:
 - Changes in the epithelium.
 - Cartilage decreases. As it decreases, smooth muscle increases.
- *Terminal bronchioles will form Respiratory bronchioles. At this point gas exchange begins to occur.*

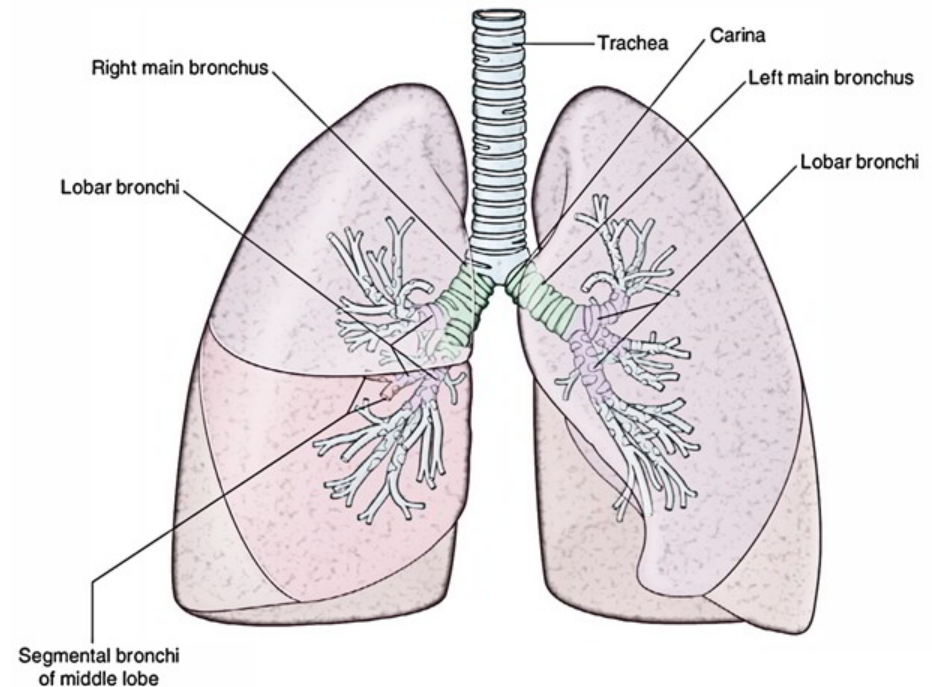


Fig.11: The bronchial tree.

The Lungs

- Two cone shaped organs separated from each other by the heart and other structures in the mediastinum.
- Each lung is enclosed by the double-layered pleura (serous membrane): ***Parietal pleura*** (lines wall of thoracic cavity) and ***visceral pleura*** (covers the lungs). A space between them called the ***pleural cavity*** contains pleural fluid to reduces friction.
- Lungs receive (1) deoxygenated blood from the pulmonary artery and (2) oxygenated blood from bronchial branches of the aorta.
- The right lung is formed of three lobes; whereas, the left lung is formed of two. The left lung also has a ***cardiac notch*** in which the heart is situated.

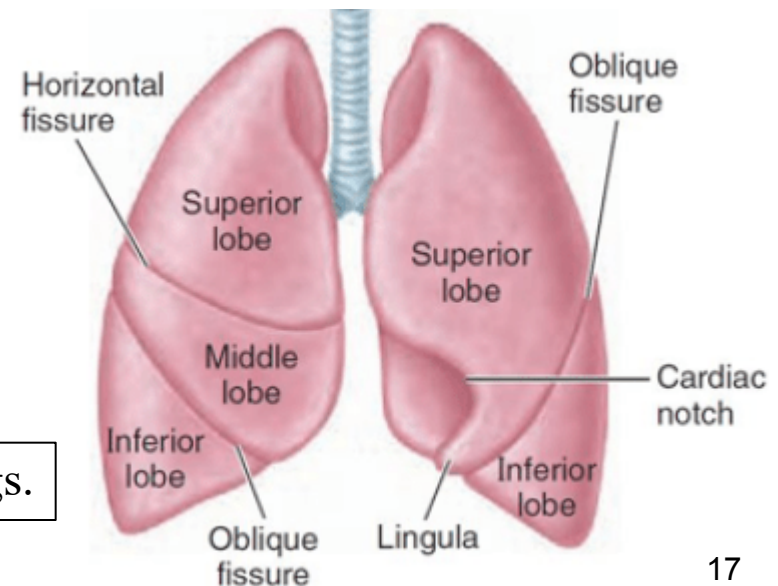


Fig.12: The lungs.

Alveoli

- Cup-shaped outpouching
- Alveolar cells:
 - Type I alveolar cells (simple squamous) – main site of gas exchange.
 - Type II alveolar cells – secrete surfactant factor which reduces tendency to collapse.
 - Macrophages
- **Respiratory membrane**: a very thin cellular membrane separating air from blood and across which gas exchange occurs:
 - Alveolar wall – type I alveolar cells
 - Epithelium basement membrane
 - Capillary basement membrane
 - Capillary endothelium

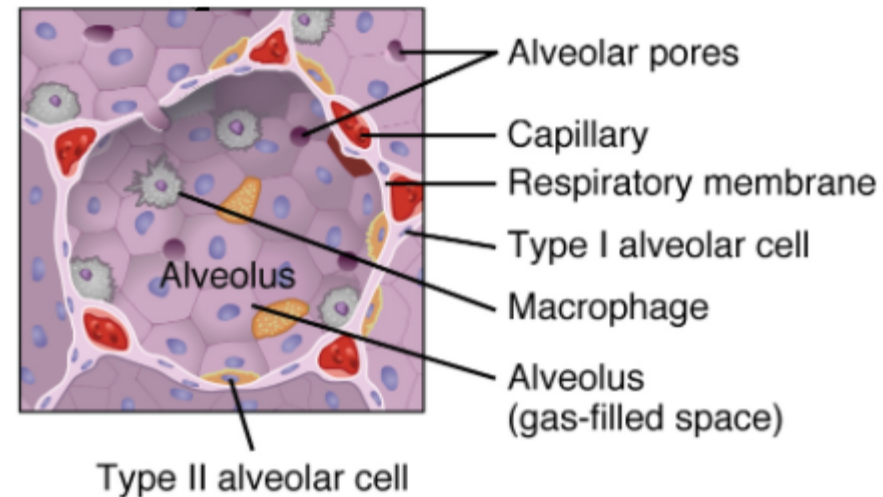


Fig.13: Above, alveolar cells.
Below, the respiratory membrane.

