

## Anatomy of the respiratory airways

### Learning objectives:

- ✓ Describe the different parts of the respiratory airways.
- ✓ Identify the clinical associated cases.

#### ➤ External Nose

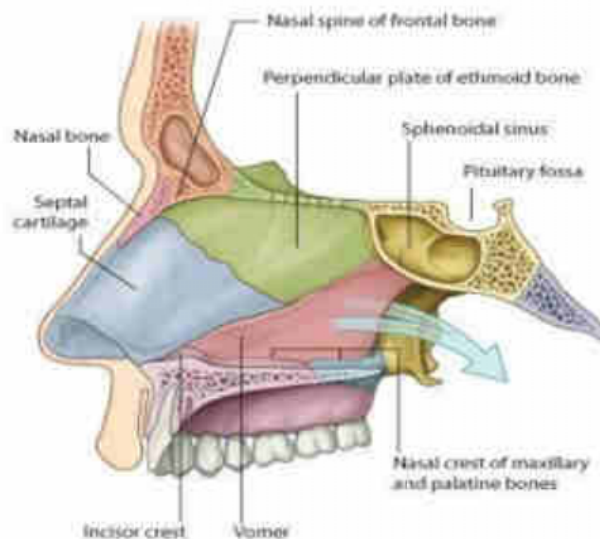
The external nose has two orifices called the nostrils.

#### ➤ Nasal Cavity

The nasal cavity is divided into right and left halves by the nasal septum.

### Nasal septum:

The septum is made up of the septal cartilage, the vertical plate of the ethmoid and the vomer.



*Nasal septum*

### Boundaries of nasal cavity:

- Anterior: nostrils.
- Posterior: the posterior nasal apertures (choanae).
- Floor: The palate.

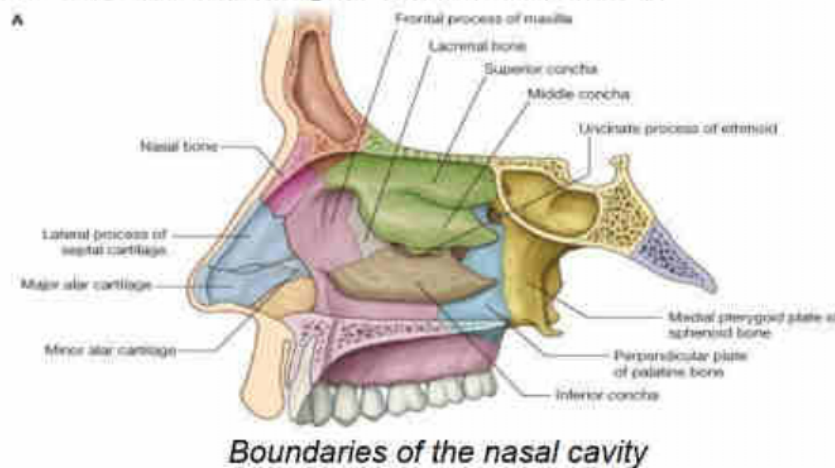
**-Roof:**

- ✓ Anteriorly: the nasal and frontal bones.
- ✓ In the middle: the cribriform plate of the ethmoid.
- ✓ Posteriorly: body of the sphenoid.

**-Medial wall: the nasal septum.**

**-Lateral wall:**

The lateral wall has three projections, the superior, middle and inferior nasal conchae. The space below each concha is called a meatus. The space above the superior concha is called sphenoethmoidal recess.



**Mucous Membrane of the Nasal Cavity**

- ✓ The vestibule is lined with modified skin and has coarse hairs.
- ✓ The roof is lined with olfactory mucous membrane.
- ✓ The lower part is lined with respiratory mucous membrane.

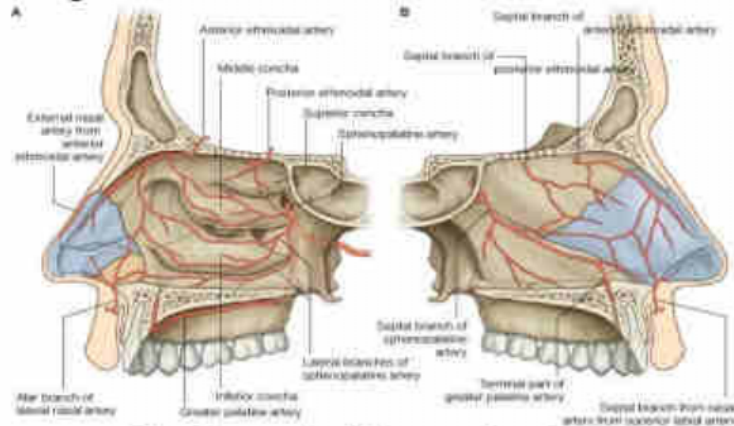
**Nerve Supply of the Nasal Cavity**

- ✓ The olfactory nerve carries smell sensation.
- ✓ The trigeminal nerve carries ordinary sensation.

**Blood Supply to the Nasal Cavity**

- ✓ The anterior and posterior ethmoidal arteries.
- ✓ Branches of facial arteries.

- ✓ The sphenopalatine artery. It anastomoses with branches of anterior ethmoidal arteries and with the septal branch of the superior labial artery (facial artery). This septal region (**Little's area**) is a common site of bleeding from the nose.



*Arterial supply of the nasal cavities.*

### **Lymph Drainage of the Nasal Cavity**

Anterior part: The submandibular nodes.

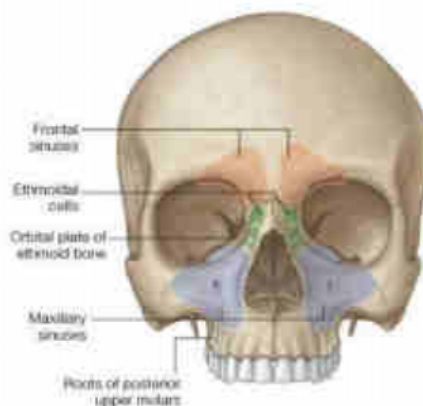
Posterior part: The deep cervical nodes.

### **➤ The Paranasal Sinuses**

- The paranasal sinuses are cavities found in the interior of the maxilla, frontal, sphenoid, and ethmoid bones.
- They communicate with the nasal cavity through relatively small apertures.

### **The function:**

The sinuses act as resonators to the voice and reduce the weight of the skull.



*Paranasal air sinuses*



## **Drainage of Paranasal Sinuses**

### **1-Maxillary Sinus**

It is pyramidal in shape and located within the body of the maxilla.

It opens into the middle meatus of the nose through the hiatus semilunaris.

### **2-Frontal Sinuses**

It opens into the middle meatus of the nose through the infundibulum.

### **3-Sphenoidal Sinuses**

The two sphenoidal sinuses lie within the body of the sphenoid bone.

Each sinus opens into the sphenoethmoidal recess.

### **4-Ethmoid Sinuses (anterior, middle, and posterior)**

- ✓ The anterior sinuses open into the infundibulum.
- ✓ The middle sinuses open into the middle meatus, on or above the bulla ethmoidalis.
- ✓ The posterior sinuses open into the superior meatus.

**NB:** The inferior meatus receives the opening of the lower end of the nasolacrimal duct.

## **➤ The Pharynx**

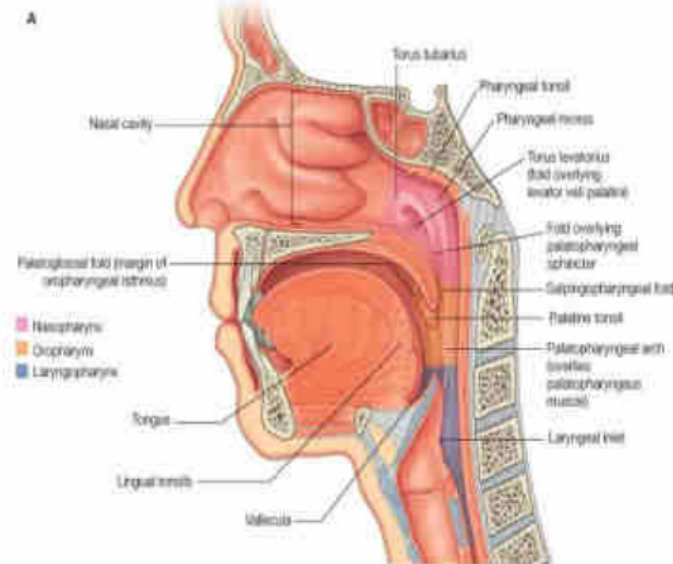
- The pharynx is a fibromuscular chamber, 12 cm long.
- It is attached above to the base of the skull and continuous below with the esophagus.
- Communicating from front with the nasal, oral, and laryngeal cavities.
- It is divided into three parts; **nasopharynx, oropharynx and laryngopharynx.**

### **1-Nasopharynx:**

- It lies behind the nasal cavities.
- The pharyngeal end of the auditory tube opens in its lateral wall.
- At the junction of the roof and its posterior wall, there is a collection of lymphoid follicles forming the **pharyngeal tonsils**. In children it may be enlarged to form **adenoids**.

**2-Oropharynx:** It lies behind the mouth and tongue. Its side wall presents the palatine tonsil on each side.

**3-Laryngo-pharynx:** It lies behind the larynx. It is continuous with oesophagus opposite the lower border of the cricoid cartilage (level of the sixth cervical vertebra).



### ➤ The Larynx

#### **Function:**

The larynx provides a protective sphincter at the inlet of the air passages and is responsible for voice production.

#### **Structure:**

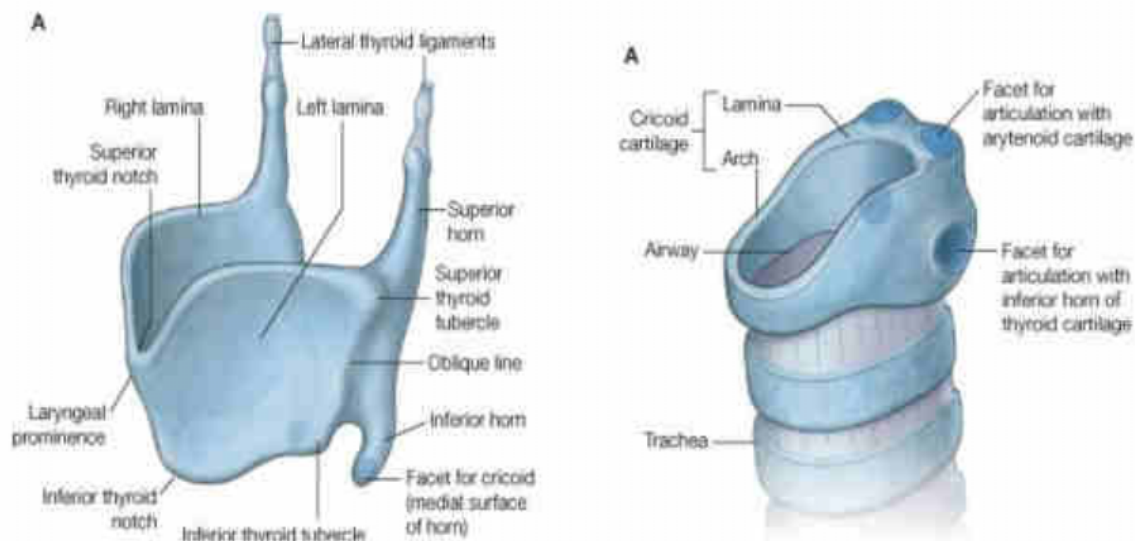
The framework of the larynx is formed of cartilages that are held together by ligaments and membranes, moved by muscles, and lined by mucous membrane.

#### ✓ **Cartilages:**

Single	Paired
Thyroid cartilage	Arytenoid cartilages
Cricoid cartilage	Corniculate cartilages
Epiglottis	Cuneiform cartilages

- **Thyroid cartilage:** This is the largest cartilage of the larynx and consists of two laminae of hyaline cartilage. The posterior border extends upward into a superior cornu and downward into an inferior cornu. On the outer surface of each lamina is an oblique line for the attachment of muscles.

- **Cricoid cartilage:** This cartilage is signet ring, having a broad plate behind and a shallow arch in front. Posteriorly, the lamina has on its upper border on each side a facet for articulation with the arytenoid cartilage.
- **Epiglottis:** This leaf-shaped lamina of elastic cartilage. The upper edge of the epiglottis is free.
- **Arytenoid cartilages:** There are pyramid shaped. They articulate with the upper border of the lamina of the cricoid cartilage. Each cartilage has an apex above that articulates with corniculate cartilage, a base below that articulates with the lamina of the cricoid cartilage. They have a vocal and muscular processes.
- **Corniculate cartilages:** Two conical-shaped cartilages articulate with the arytenoid cartilages.
- **Cuneiform cartilages:** These two small rod-shaped cartilages are found in the aryepiglottic folds.



*Cartilages of the larynx*

### ✓ Membranes and Ligaments of the Larynx

**Thyrohyoid membrane:** This connects the upper margin of the thyroid cartilage to the hyoid bone. In the midline it is thickened to form the median

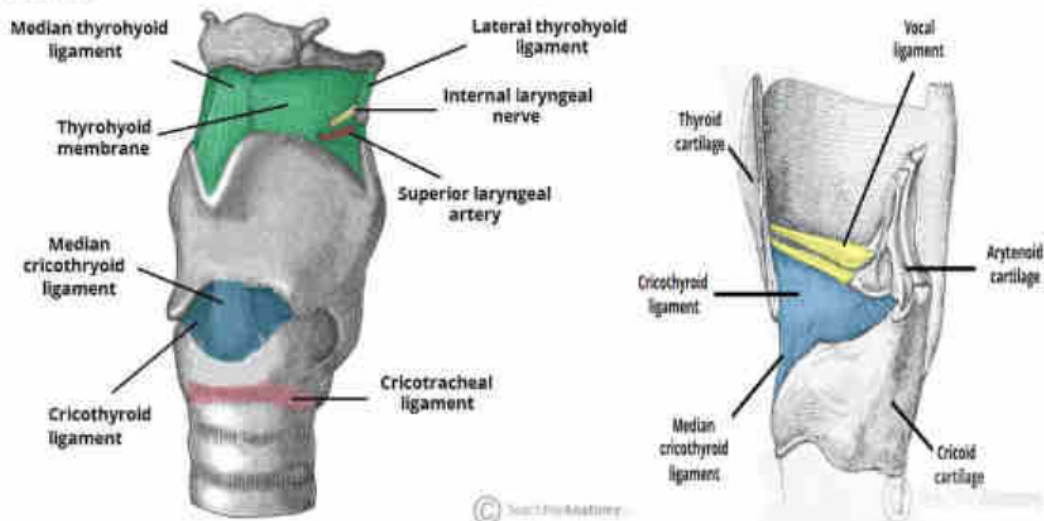


thyrohyoid ligament. The membrane is pierced on each side by the superior laryngeal vessels and the internal laryngeal nerve.

**Cricotracheal ligament:** This connects the cricoid cartilage to the first ring of the trachea.

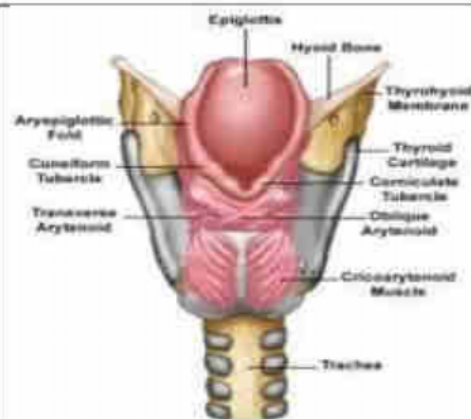
**Quadrangular membrane:** This extends between the epiglottis and the arytenoid cartilages. Its thickened inferior margin forms the vestibular ligament.

**Cricothyroid ligament:** The lower margin is attached to the upper border of the cricoid cartilage. Its upper free margin forms the vocal ligament on each side.



### **Inlet of the Larynx**

It is bounded by the epiglottis anteriorly, the aryepiglottic folds laterally, and the arytenoid cartilages posteriorly.



## Laryngeal Folds

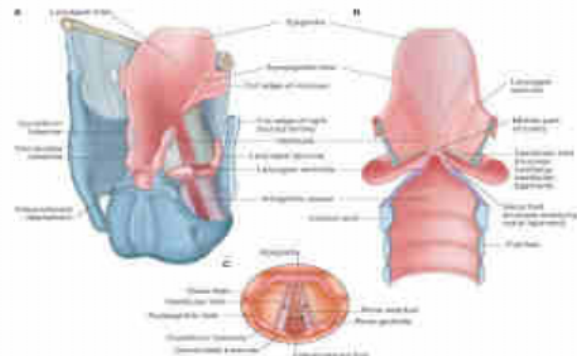
### a-Vestibular Fold

It is formed by mucous membrane covering the vestibular ligament.

### b-Vocal Fold (Vocal Cord)

It is formed by mucous membrane covering the vocal ligament.

The gap between the vocal folds is called the rima glottidis or glottis.

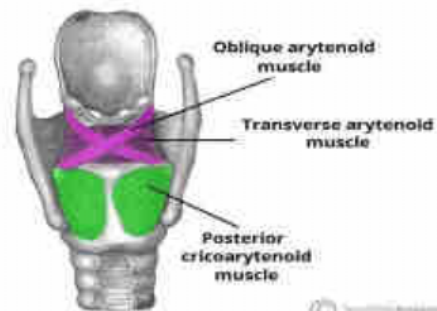


## Muscles of the Larynx

### a) Intrinsic Muscles

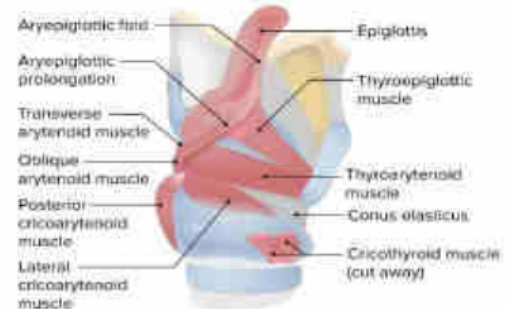
Narrowing the inlet:

**Oblique arytenoid muscle**

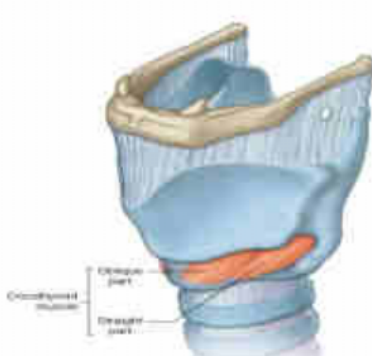
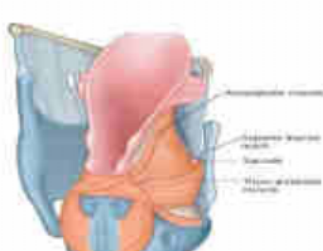
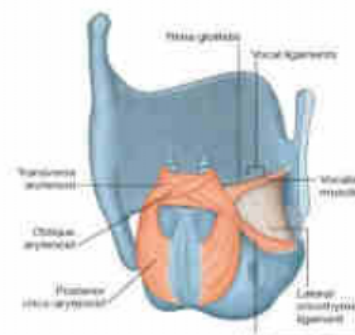


Widening the inlet:

**Thyroepiglottic muscle**





<p>Tensing the vocal cords:</p> <p><b>Cricothyroid muscle</b></p>	
<p>Relaxing the vocal cords:</p> <p><b>Thyroarytenoid (vocalis) muscle</b></p>	
<p>Adducting the vocal cords:</p> <p><b>Lateral cricoarytenoid muscle</b></p>	
<p>Abducting the vocal cords:</p> <p><b>Posterior cricoarytenoid muscle</b></p>	
<p>Approximates the arytenoid cartilages:</p> <p><b>Transverse arytenoid muscle</b></p>	

## b) Extrinsic Muscles

These muscles move the larynx up and down during swallowing.

### Cavity of the Larynx

The region, which is situated between the vestibular folds above and the vocal folds below (**Sinus or ventricle of the Larynx**).



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### Nerve Supply:

#### ✓ Sensory Nerves

-Above the vocal cords: The internal laryngeal branch of the superior laryngeal branch of the vagus.

-Below the level of the vocal cords: The recurrent laryngeal nerve.

#### ✓ Motor Nerves

All the intrinsic muscles of the larynx **except** the **cricothyroid muscle** are supplied by the recurrent laryngeal nerve. The cricothyroid muscle is supplied by the external laryngeal branch of the superior laryngeal branch of the vagus.

### Blood Supply:

Upper half of the larynx: The superior laryngeal artery.

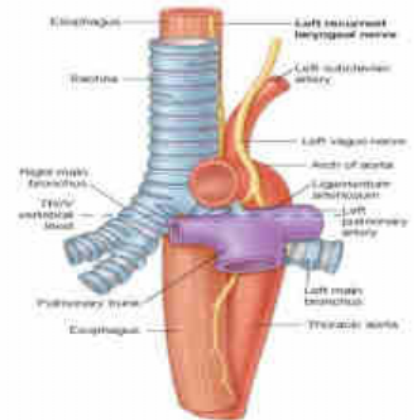
Lower half of the larynx: The inferior laryngeal artery.

### Lymph Drainage:

The lymph vessels drain into the deep cervical group of nodes.

### ➤ The Trachea

- ✓ The trachea is cartilaginous and membranous tube. It begins in the neck as a continuation of the larynx.
- ✓ It ends by dividing into right and left principal (main) bronchi at the level of the sternal angle (opposite the disc between the fourth and fifth thoracic vertebrae).
- ✓ In adults, the trachea is about 12 cm.



### ➤ The Bronchi

The trachea bifurcates into the right and left main bronchi. They divide and give rise to several terminal bronchioles that terminate in one or more respiratory bronchioles.

Right bronchus	Left bronchus
Wider	Narrower
Shorter	Longer
More vertical, with the same line with trachea	More oblique
Before entering the hilum of the right lung, it gives off the superior lobar bronchus	

#### References:

- Kaplan Medical USMLE Step 1 Lecture Notes anatomy 2021.
- Gray's Anatomy, 40th edition.