

# Respiratory System

Function:

- breathing (pulmonary ventilation)
- gas exchange
- acid balance (reduced pH when there is excess CO<sub>2</sub>)
- filters and protects respiratory surfaces from pathogens and dehydration
- vocalisation
- olfaction (receptors on posterior nasal cavity)

## Upper Respiratory Tract

Made up of pseudo stratified columnar epithelium contains goblet cells that secrete mucin. This prevents the pharynx and nasal cavity from being dry. Mucous glands secrete lysozyme for protection from bacteria.

### Nasal Cavity

The openings into the external nose are the external nares or nostrils, which lead into cavities about the size of a finger tip called the nasal vestibules. They have hairs that prevent invasion of objects into the nose. Nasal cartilages increase surface area.

Small particles that do enter will end up in the mucous.

Nasal septum is the central wall of bone and cartilage that divide the nasal cavity.

Conchae are bony plates found on the lateral walls that increase the SA of the mucous membrane.

Meatus cause turbulence so the air stays in longer and can warm up.

Olfactory region is at superior nasal conchae. Respiratory region is inferior.

### Pharynx

Originates posterior to the nasal and oral cavities and extends inferior near the level of the bifurcation of the larynx and oesophagus.

Walls lined with mucosa and contains skeletal muscle that permits swallowing.

Partitioned into 3 regions:

Nasopharynx: pseudo-stratified ciliated columnar epithelium

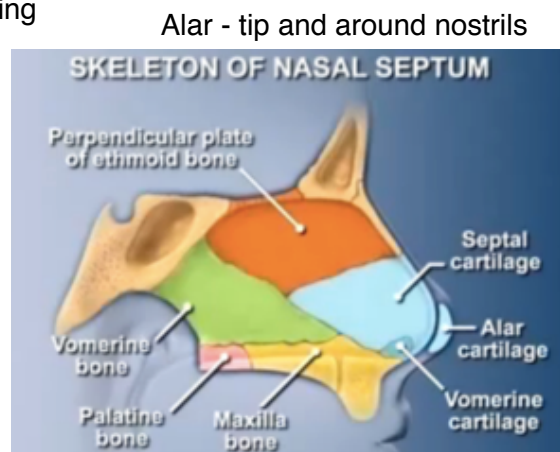
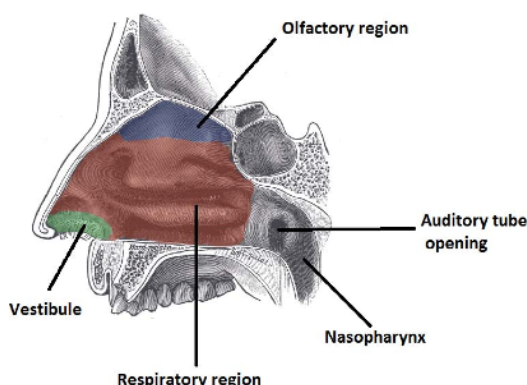
- posterior to nasal cavity and extends to soft palate
- respiration only
- prevents drying of surface

Oropharynx: non-keratinised stratified epithelium

- posterior to oral cavity, extends from soft palate to hyoid bone
- respiration and digestion
- epithelium protects abrasion of food from swallowing

Laryngopharynx: non-keratinised stratified epithelium

- from hyoid bone to bifurcation into oesophagus and larynx
- respiration and digestion
- epithelium protects abrasion of food from swallowing



## Trachea

Flexible, slightly rigid tube in mediastinum. Runs from C6 to T4/5 where it bifurcates into the primary bronchi. Function is to filter, warm and humidify air. It contains 15-20 U-shaped hyaline tracheal cartilages and trachealis muscle. Anular ligaments connect the cartilage rings. It is made up of pseudo-stratified ciliated columnar epithelium.

Oesophagus is behind trachea and expands when eating. If there is cartilage here then it cannot expand. The trachealis muscle allows it to create more space for the oesophagus.

The ridge where it bifurcates is the carina.

1. Primary bronchus
  - right is vertical, shorter and wider than left
  - aspirated object more likely to enter right bronchus
2. Secondary bronchus
  - one for each lobe [right has 3, left has 2]
3. Tertiary bronchus
4. Bronchioles
5. Terminal bronchioles
6. Respiratory bronchioles [respiratory zone in red]
7. Alveolar ducts
8. Alveolar sacs
9. Alveoli

Plates of cartilage gradually replace the incomplete rings of cartilage in main bronchi and disappear in the distal bronchioles. In the bronchioles, the hyaline cartilage is replaced by smooth muscle to keep them open. It is lined by columnar cuboidal epithelium (facilitates gas diffusion).

## **Alveolar Pressure Changes**

	Beginning	End
Inspiration	Contraction of muscles and increase of thoracic volume. Expansion of lungs and increase in alveolar volume. $P(\text{alveolar pressure}) < P(\text{barometric air pressure})$ Air flows in the lungs	Alveoli and thorax stop expanding. Air flow into lungs causes $P_b = P_{alv}$ . No more movement of air occurs.
Expiration	Decrease of thoracic volume and alveolar volume. $P_{alv} > P_b$ . Air flows out.	$P_b = P_{alv}$ No more movement of air occurs

Boyle's Law: pressure of a gas decreases if the volume of the container increases, and vice versa.

- Increasing volume of thoracic cavity during inhalation decreases intrapulmonary pressure relative to atmospheric pressure = air flows in
- Volume of thoracic cavity decreases during exhalation relative to outside atmospheric pressure = air forced out

When diving, you should not stop breathing. This is because as you go up, the pressure around you decreases and the volume in alveoli increase and may burst.

## **Lungs**

Paired conical organs with a concave base resting on the diaphragm and blunt apex near clavicle. Costal surface is the surface underlying the ribs. The medial/mediastinal surface contains the hilum, through which bronchi, pulmonary blood vessels, lymphatic vessels and nerves enter and exit.

Right lung is thicker and broader, and shorter because the diaphragm is higher on the right side to accommodate the liver. Has 3 lobes.

Left lung is longer and thinner. Has 2 lobes. Medial side of left lung has a concavity called the cardiac notch, into which the apex of the heart projects.