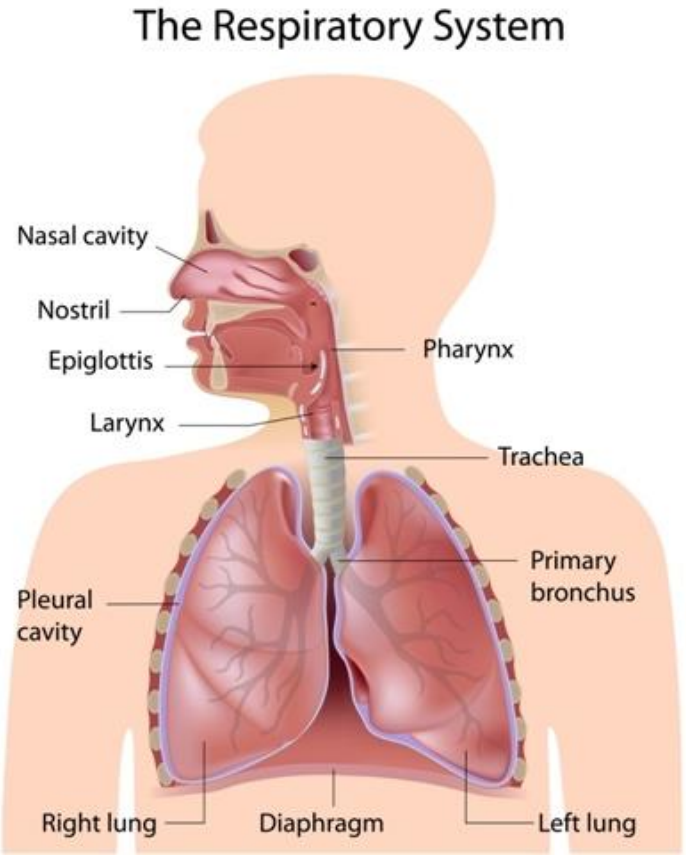
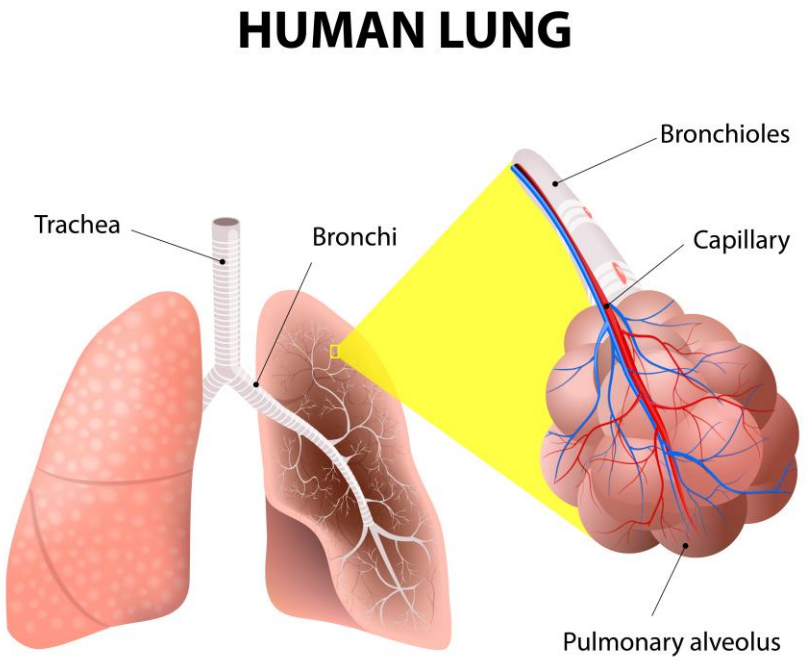
Anatomy and physiology

Respiratory system


The Respiratory System
Nasal cavity
Nostril
Epiglottis
Larynx
Pharynx
Trachea
Primary bronchus
Pleural cavity
Right lung
Diaphragm
Left lung


HUMAN LUNG
Bronchioles
Trachea
Bronchi
Capillary
Pulmonary alveolus

The respiratory system

Upper respiratory tract:

Nose (nasal cavity, olfactory mucosa, paransal sinuses) → filters, warms and moistens air

Pharynx (nasopharynx, oropharynx and laryngopharynx) → passageway for both air and food C3-6

Nasoapharynx – pharangeal Tonsils (adenoids)

Oropharynx – palatine tonsil

(lymph organs providing protection against pathogens entering the mouth)

The respiratory system

Lower respiratory tract (LRT)

- Larynx – continues passage of air, prevents food from entering LRT.
- Trachea – continues to filter, warm and moisten air.
- Carina – point of division of trachea into two primary bronchi.
- Bronchi tree – connects trachea and alveoli, continues to filter, warm and moisten air.
- Alveoli – site of gaseous exchange.

Lungs

- **Apex** – base of neck 25mm above the middle third of clavicle, close to first rib.
- **Base** – upper surface of diaphragm.
- **Costal surface** – directly against costal cartilage, ribs and intercostal muscles.
- **Medial surface** – triangular-shaped area; hilum at level T 5–7, area of primary bronchus, pulmonary arteries and veins.
- **Mediastinum** – the space between the lungs contains the heart, great blood vessels, trachea, right and left bronchi, oesophagus, lymph nodes, vessels and nerves.
- The right lung has three lobes and the left two, as it has a small notch where it sits around the heart.
- **Pleura** – enclose the lung tissue, produce lubricating fluid to prevent friction between the lungs and the chest wall.

Pleura and pleural cavity

Pleura

- Sac of serous membrane enclose each lung.
- Contains a tiny amount of serous fluid.
- Sac forms two layers – visceral pleura adheres to the lung, the parietal, the thoracic cavity (chest wall, surface of diaphragm) and is continuous with the visceral pleura at hilum.

Pleural cavity

- Potential space with film of serous fluid (think of two panes of glass separated by a film of water).
- Prevents friction during breathing.

Protection

Warming of the air

- By the trachea the air is at body temperature.
- This is achieved by warming from the vascularity of the mucosa.

Moisten of the air

- Moistened with water vapour, if inhaled through the nose, and will be fully saturated by the time the air reaches the trachea.
- Both protect the delicate epithelium from irritation and drying out.

Filtering

- To clean inhaled air.
- Hairs – cilia trap particles, dust, pathogens.
- Mucus – sticky surface that catches particles.

Cilia of the trachea

- Tiny cilia line the bronchial tree.
- These work together with goblet cells (epithelial cells that secret mucous).
- They beat in time in one direction (up) to ‘waft’ debris up and away from the lungs.
- A cough can be initiated to help remove the debris once it reaches the trachea.

The mechanism of respiration

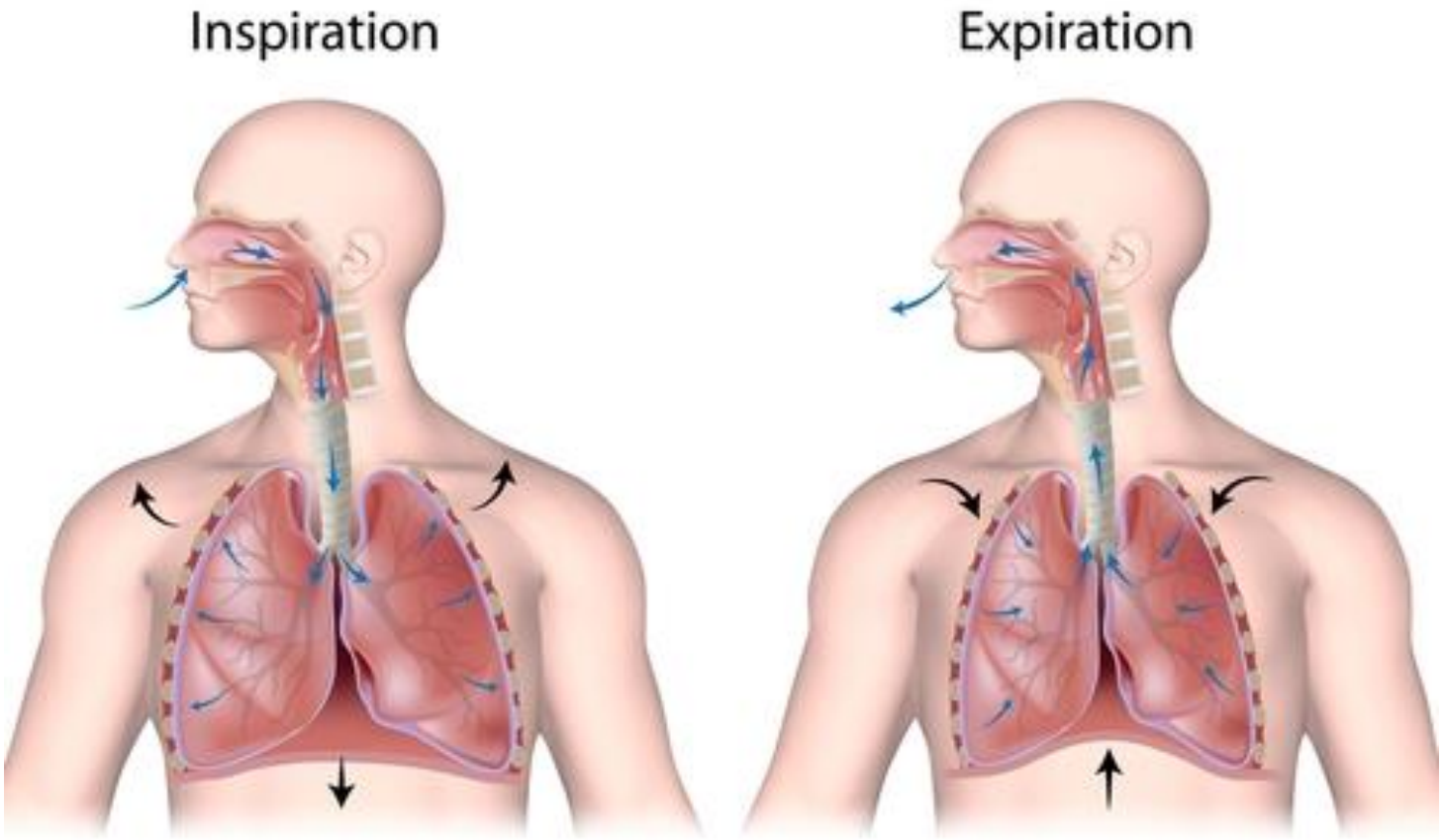
Air moves in and out of the lungs by the combined action of the diaphragm and the intercostal muscles.

Inspiration – diaphragm contracts and becomes flatter, pushing down against the contents of the abdominal cavity. The ribs pull upwards and outwards.

Volume of the thoracic cavity increases, pressure decreases and the lungs fill with air. External intercostal muscles contract to increase the depth of the thoracic cavity by pulling the ribs upwards and outwards (bucket handle).

Air flows from outside where pressure is high, to low pressure inside.

Inspiration and expiration



The mechanism of respiration

Expiration – diaphragm relaxes and rises, the elastic recoil of the lungs reduces the volume of the thoracic cavity.

Breathing is a passive process; pressure increases in the lungs and air flows out.

When more air is needed to be exhaled, for example, playing a wind instrument, the internal intercostal muscles contract with assistance from the muscles of the abdomen.

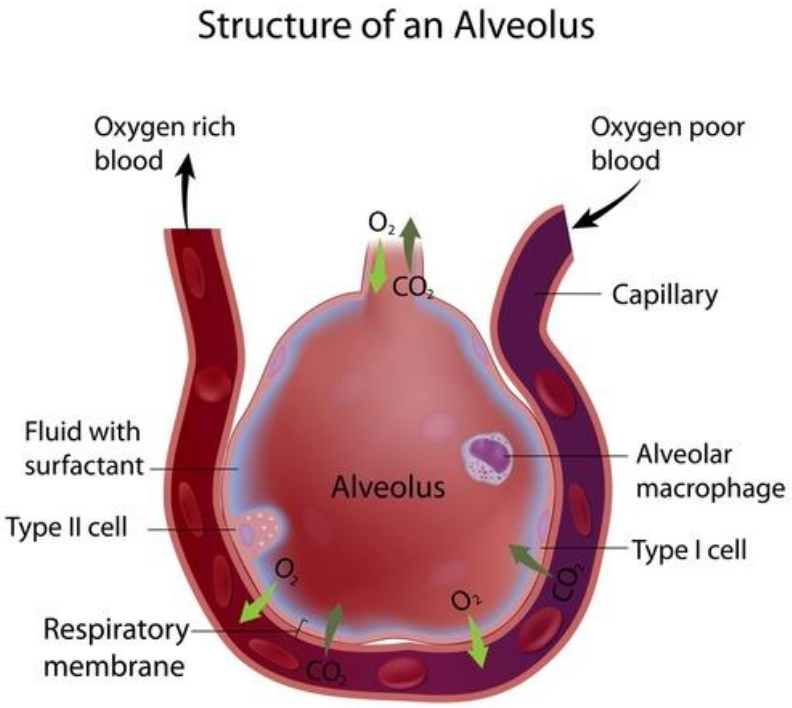
Correct breathing is essential to ensure that all the body's cells receive an adequate amount of oxygen and can dispose of enough carbon dioxide to enable cells to function efficiently (cell respiration).

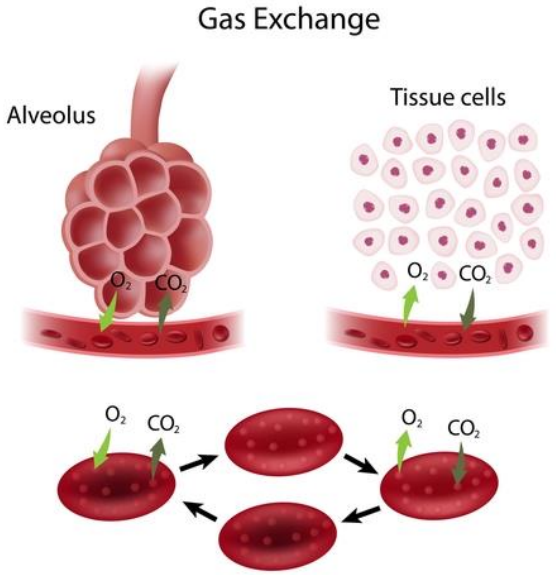
Gaseous exchange

Absorption of O_2 from the air in exchange for CO_2

- O_2 is inhaled through the nose/mouth and flows along the trachea and bronchial tubes to the alveoli of the lungs.
- Diffuses through the thin film of moisture lining the alveoli. The air, now rich with O_2 comes into contact with the blood in the capillary network surrounding the alveoli.
- O_2 diffuses across a permeable membrane wall surrounding the alveoli, to be taken up by red blood cells.
- **Oxygenated** blood transported via the **pulmonary vein** to the heart.
- **Deoxygenated blood** transported from the **pulmonary artery** from heart.
- CO_2 collected by the respiring cells around the body passes in the opposite direction by diffusing from the capillary walls into the alveoli. It passes through the bronchi and trachea and exhaled through the nose and mouth.

Exchange of gases





What controls breathing?

- Controlled by respiratory centre of the brain (medulla and pons).
- Chemical control:
  - regulated according to the concentration of CO2, O_2 and acid in the body
  - chemoreceptors in the brain and heart that sense levels of O_2 and other regulators
  - lung stretch receptors – over-inflation of the lungs, irritation of the mucus membranes in the lung.
- Average breaths per minute = 12–18.