

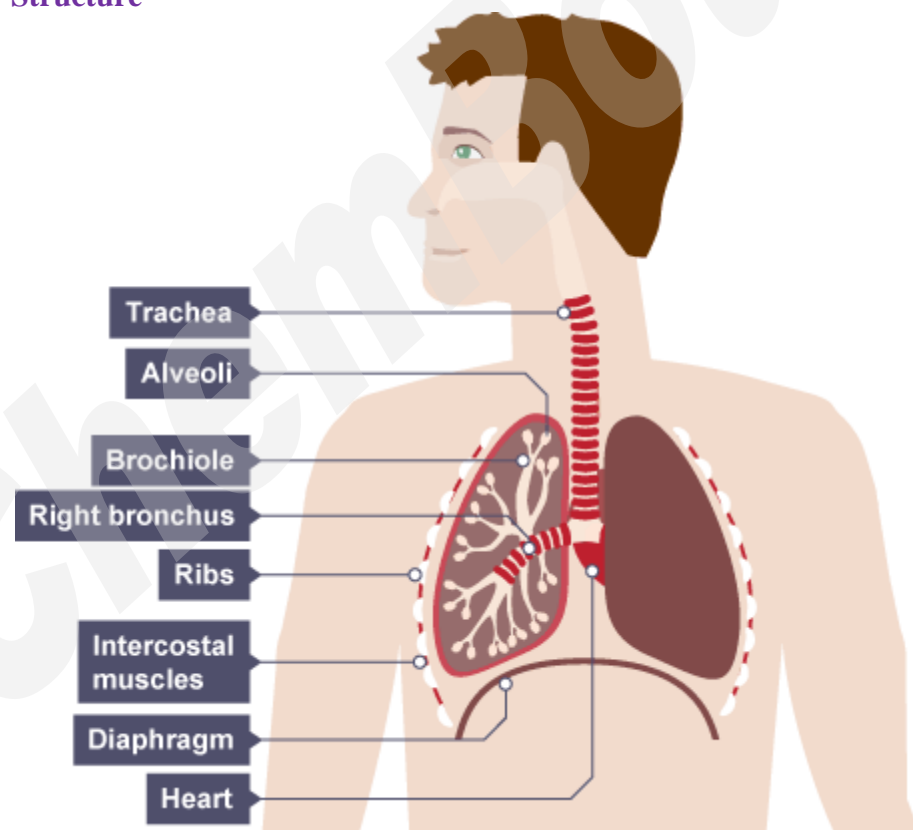
Gas Exchange in Humans

(IGCSE Biology Syllabus 2016-2018)

Gas Exchange

Feature	Reason
Thin (one cell thick)	Short distance to diffuse
Large surface area	Many molecules can diffuse at once
Moist	Cells die if not kept moist
Well ventilated	Concentration gradients for oxygen and carbon dioxide are kept up by regular fresh supplies of air
Close to blood supply	Gases can be carried to/from the cells that need/produce them

Structure



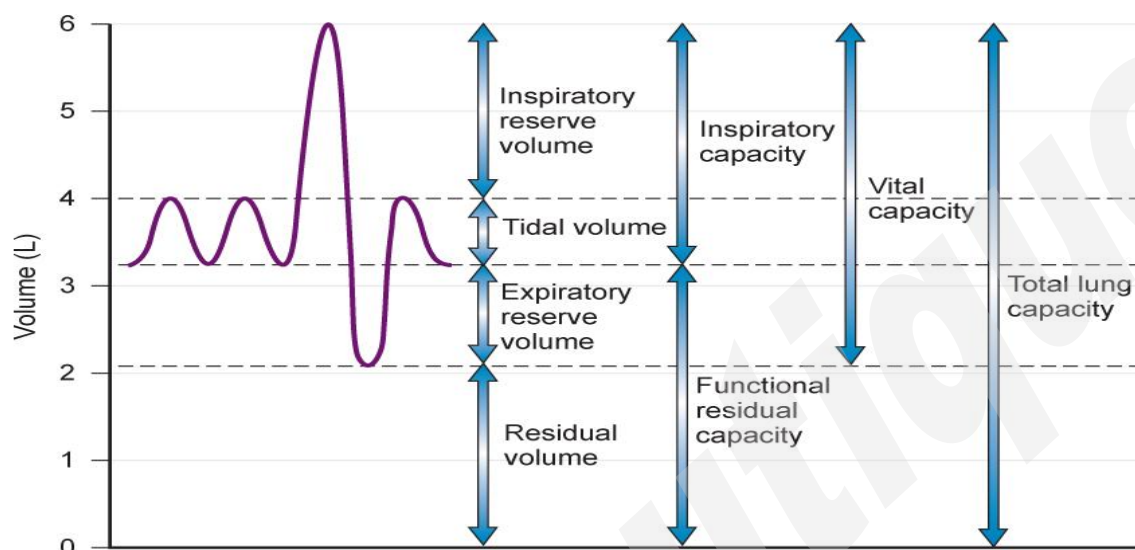
Structure	Function
Ribs	To protect vital organs and blood vessels; expands and contracts → efficient breathing
Cartilage (trachea)	Prevents the trachea from collapsing during absence of air and also to protect it
Intercostals (internal and external) muscles	Situated between the ribs that create and move the chest wall
Diaphragm	Produces volume and pressure changes in the thorax leading to the ventilation of the lungs

Inspired air	Expired air
21% oxygen	18% oxygen
0.04% carbon dioxide	3% carbon dioxide
78% nitrogen	78% nitrogen
Water vapour varies to climate	Saturated water vapour

Test for carbon dioxide: blow carbon dioxide through limewater; positive result = milky solution

Effect of Physical Activity on Breathing

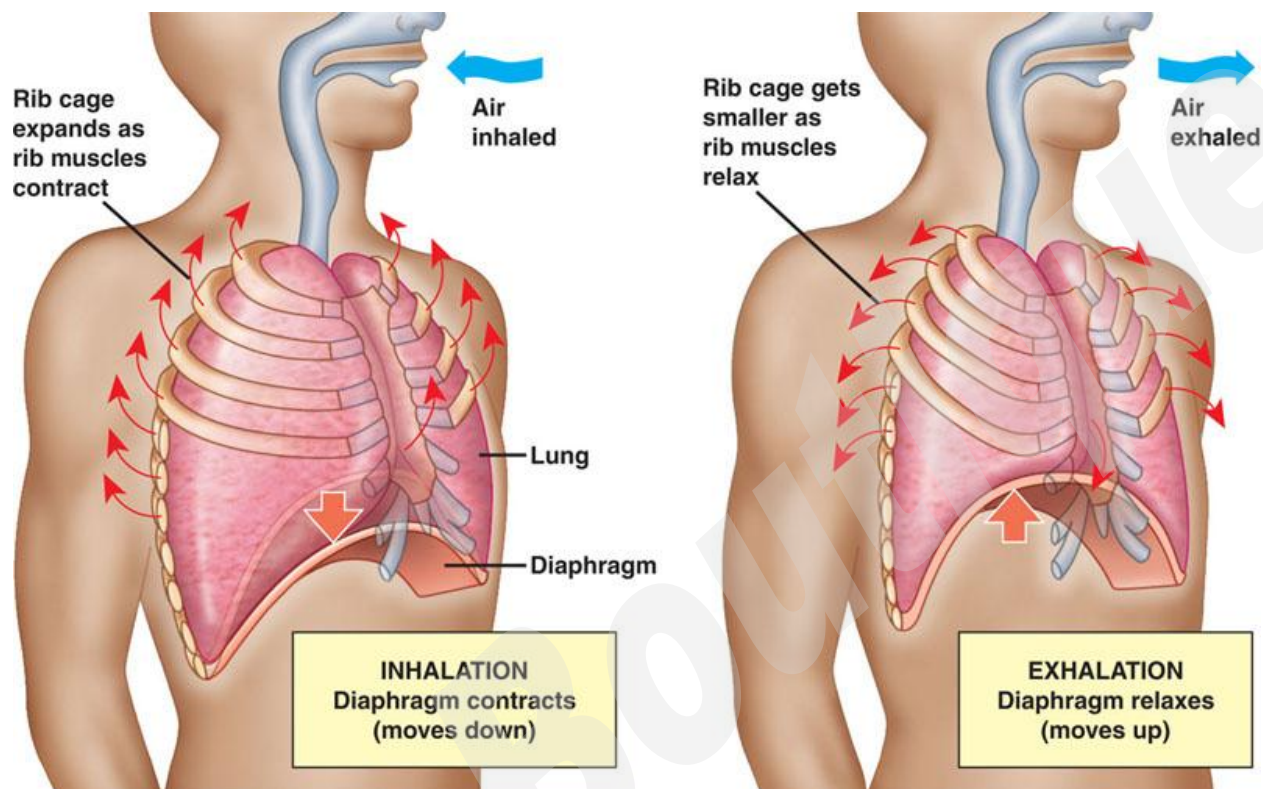
- Physical activity increases the breathing rate (more breaths per minutes) and the tidal volume (more air per breath)
- Breathing rate can be measured with a spirometer to produce a spirogram



- During exercise, tissues respire at a higher rate, the change in breathing volume and rate helps to keep carbon dioxide concentration and pH at safe levels

Breathing

Breathing in (inhalation)	Breathing out (exhalation)
External intercostals muscles contract	External intercostals muscles relax
Rib cage pulls upwards and outwards	Rib cage falls downwards and inwards
Diaphragm muscles contract & move upwards	Diaphragm muscles relax & returns to dome shape
Lung volume increases and pressure decreases	Lung volume decreases and pressure increases
Air rushes in	Air is forced out



- **Internal intercostals muscles:** used in coughing and sneezing
- **Mucus** (nasal cavity and trachea): goblet cells produce sticky mucus to trap and eliminate particulate matter and microorganisms
- **Ciliated cells** (nasal cavity and trachea): little hairs which sweep back and forward in a coordinated way to brush mucus up the lungs into the mouth