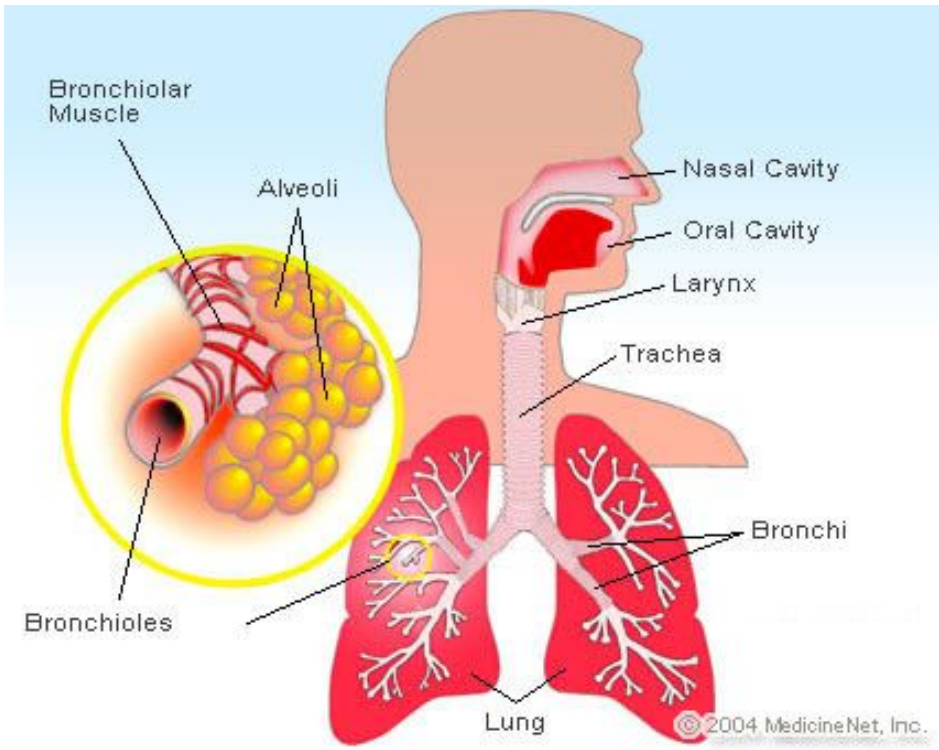
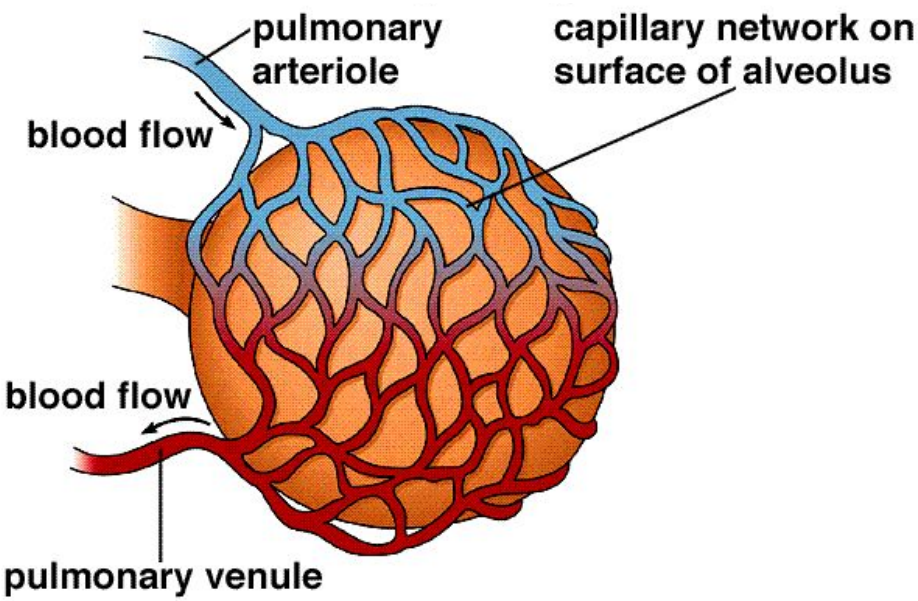
Human Gas exchange system
Lungs (pg 142-143)



Upper Respiratory Tract (trachea, bronchii, bronchioles)

- Goblet cells that produce mucous
- Ciliated epithelial cells
- Walls made of muscle tissue, to allow the airway to expand and contract

Alveoli (pg143 & 146)



- Located inside the ribcage for protection
- Minute air-sacs, found at the end of the bronchioles
- Gas exchange surface
- Made of one layer of epithelial cells (0.05um to 0.3 um thickness)
- Collagen and elastic fibres surround the alveoli
- Allows the alveoli to expand and contract during ventilation (stretch and recoil action)
- large surface area, enough to cover half a tennis court

Gas exchange is efficient (pg 147) because

- RBCs can only flow past slowly, giving more time for diffusion

-RBCs flattened against capillary wall, increased SA for diffusion

- both aveoli and capillary are only one cell thick, therefore short diffusion distance

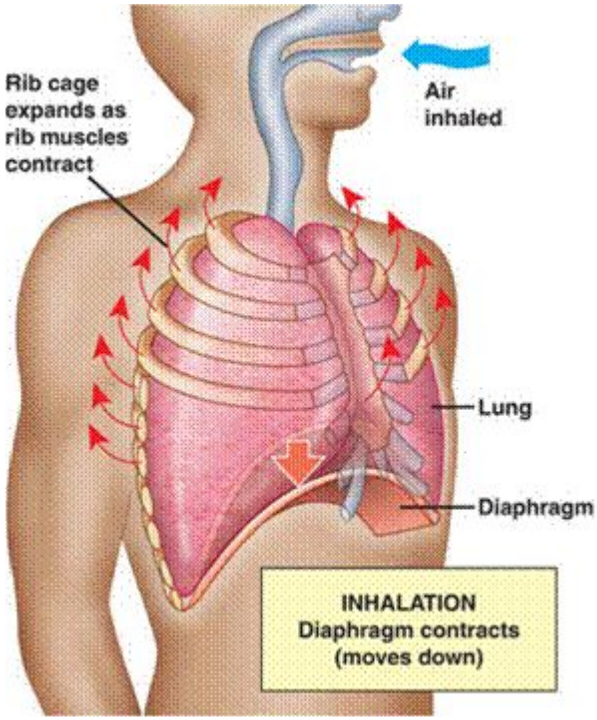
- both alveoli and capillaries have a large SA

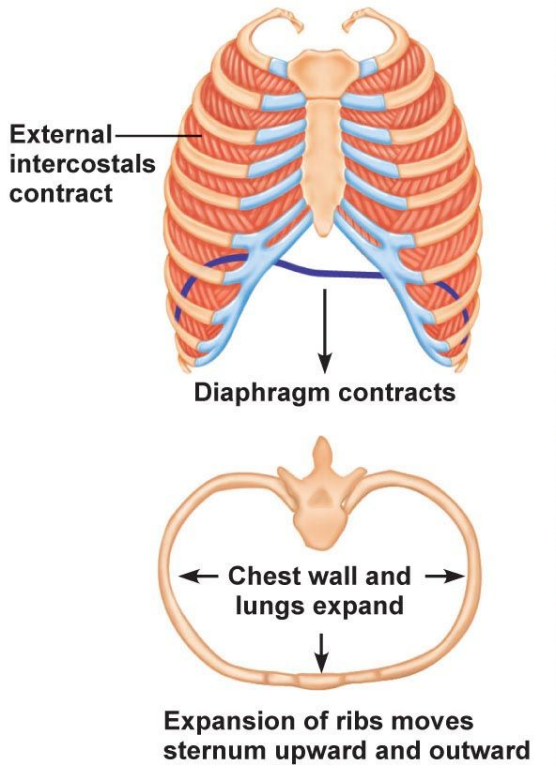
- movement of the diaphragm helps with mass flow of air

- movement of blood in the capillaries maintains a constant concentration gradient

Mechanism of Ventilation

Inspiration (pg 144)



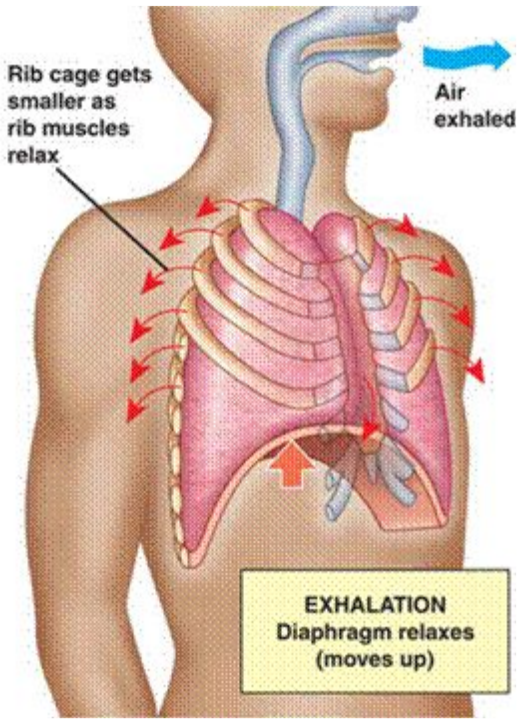


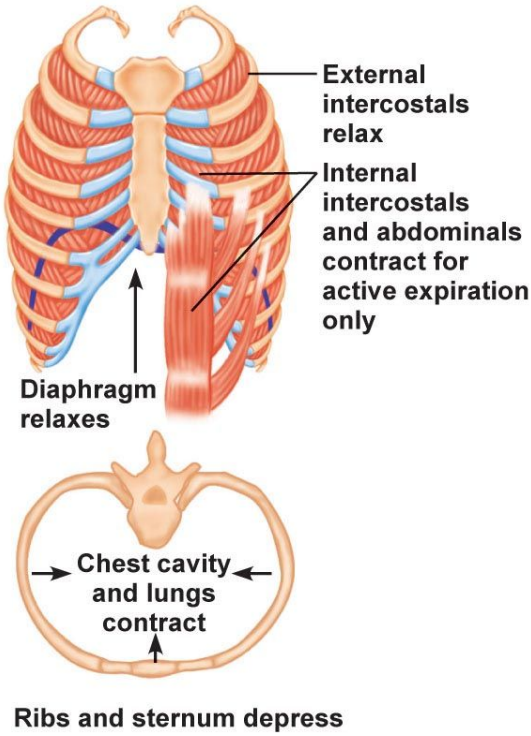
Ventilation is a passive process (does not require ATP) and is controlled by the medulla oblongata in the brain

Inspiration

- Diaphragm contracts and flattens, moving downwards
- External intercostal muscles contract
- Internal intercostal muscles relax
- Ribcage pulled upwards and outwards
- Volume of thorax increase
- Reduces air pressure inside the lungs
- Atmospheric pressure is now greater than pulmonary pressure
- Air pulled into the lungs

Expiration (pg 145)





Expiration

- stretch receptors in the elastic tissue around the alveoli prevent the alveoli from stretching too far

- the brain sends a signal to the diaphragm, causing it to relax and move back to its original position (upwards)

- this is helped by contraction of the abdominal muscles

- the internal intercostal muscles contract

- the external intercostal muscles relax

- the ribcage moves downwards and inwards

- volume of the thorax decreases

- air pressure in the thorax increases

- Pulmonary pressure is now greater than air pressure, and air is forced out of the lungs

Pulmonary ventilation (pg 145)

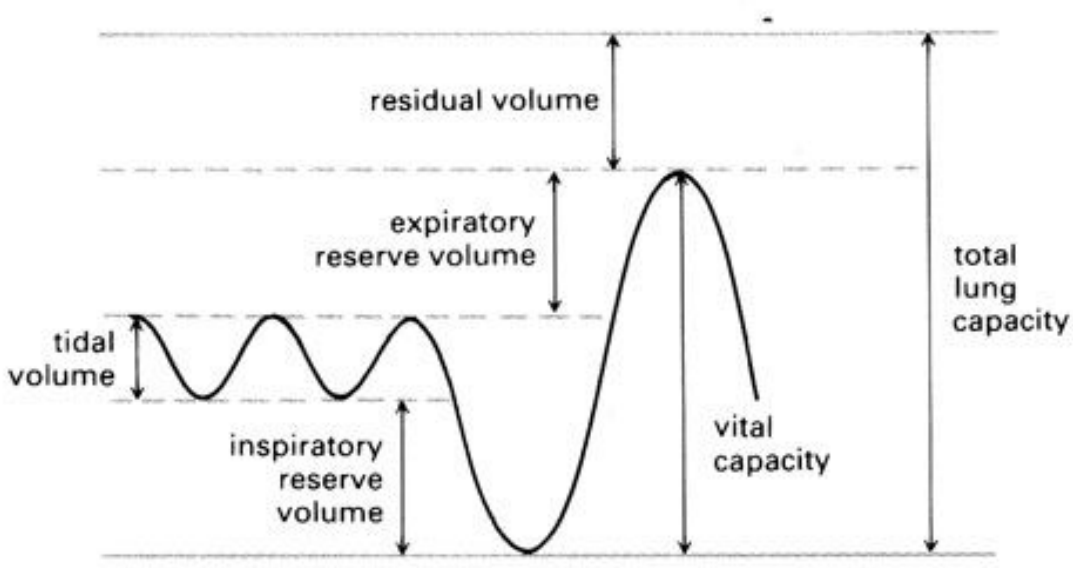
Pulmonary ventilation = tidal volume x breathing rate

Tidal volume: volume of air normally taken in at each breath, when the body is at rest. Measured in dm^3.

Breathing rate = number of breaths per minute.

Units of pulmonary ventilation = $dm^3\ min^{-1}$

Tidal volume and reserve volume

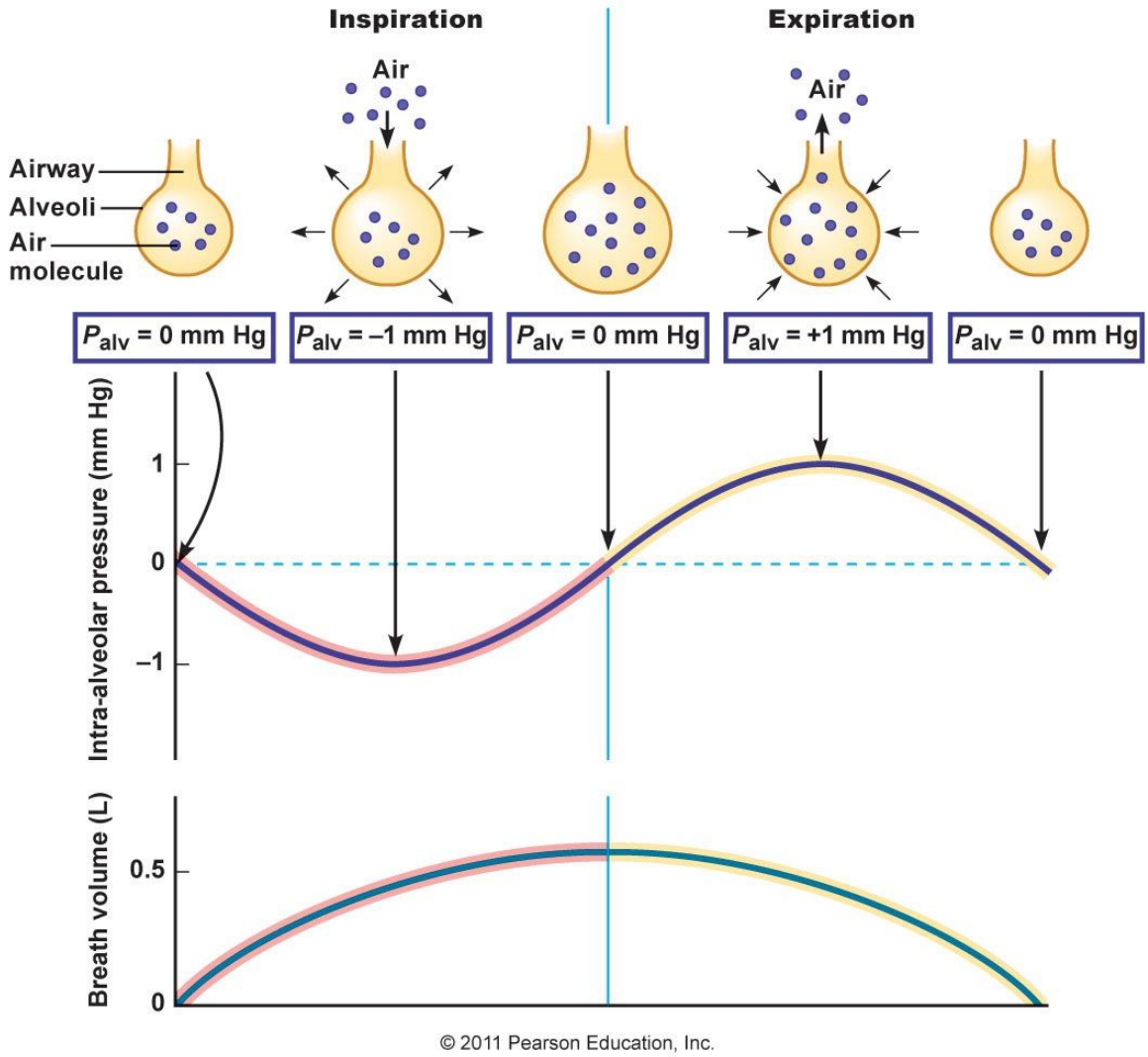


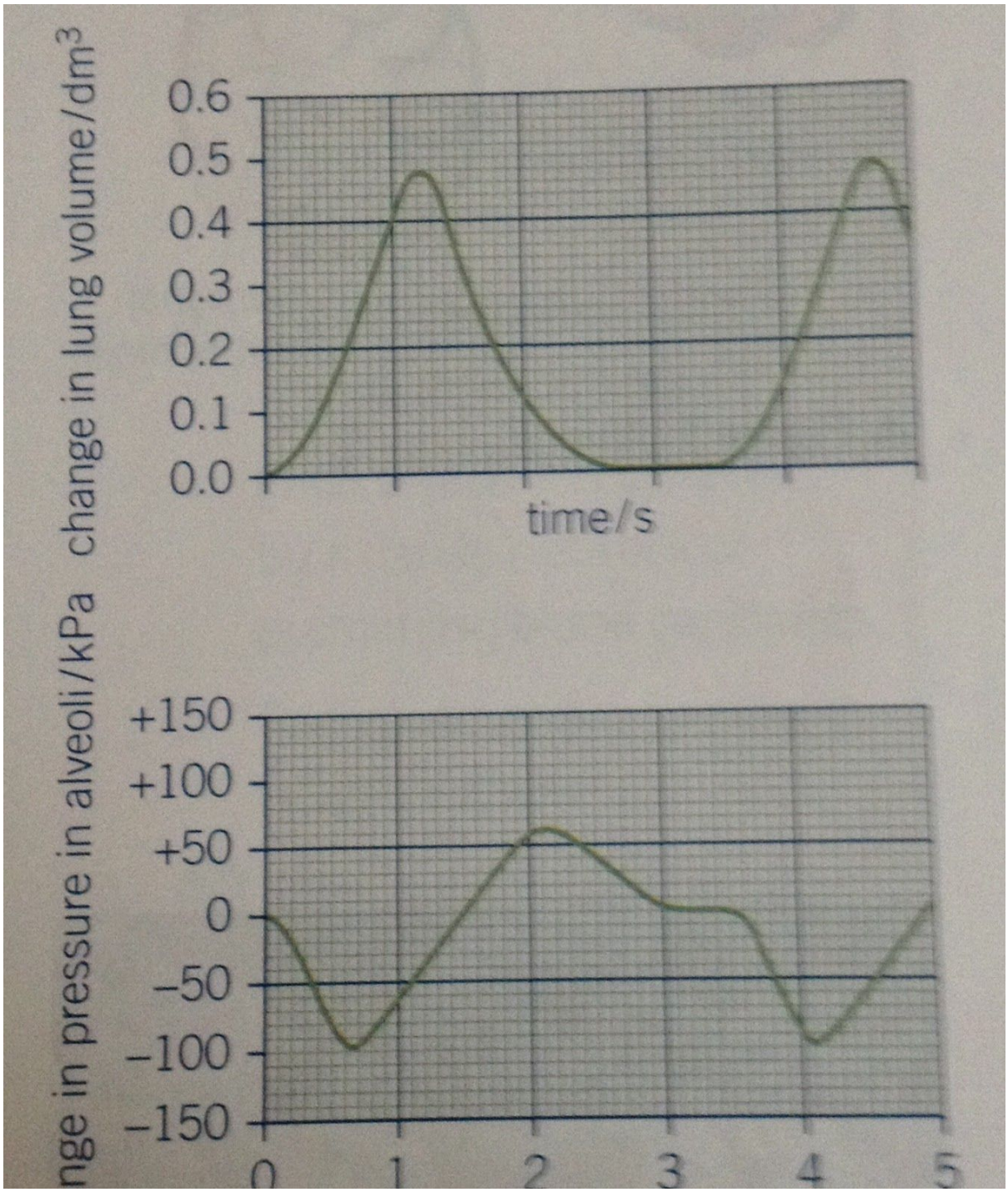
We don’t use the full capacity of the lungs during normal breath.

Vital capacity is the maximum amount of air that can be inhaled and exhaled into/from the lungs.

There is always a small amount of residual air left over in the lungs.

Volume and Pressure changes in the Lungs (pg 145, Fig 3)




change in lung volume/dm³
0.6
0.5
0.4
0.3
0.2
0.1
0.0
time/s
nge in pressure in alveoli/kPa
+150
+100
+50
0
−50
−100
−150
0
1
2
3
4
5