Respiration During Exercise

O_2 Transport in the Blood

- O_2 is transported by haemoglobin – protein, contains iron, in all red blood cells
  - 4 O_2 molecules per haemoglobin
  - direction of reaction depends on: PO_2 of blood + affinity between Hb+O_2
  - the amount of O_2 that can be transported per blood unit depends on the concentration of haemoglobin
    - O_2 + haemoglobin = 'loading' → oxyhaemoglobin
    - release of O_2 from haemoglobin = 'unloading' → deoxyhaemoglobin

Oxyhaemoglobin Dissociation Curve (sigmoidal curve)

At lungs: high PO_2 = formation of oxyhaemoglobin
At tissues: low PO_2 = release of O_2 to tissues

- Effect of pH
  - decreased pH lowers Hb-O_2 affinity
  - "right" shift ← Bohr effect (H^+ binds to haemoglobin)
  - favours offloading of O_2 to tissues

- Effect of Temperature
  - increased blood temperature lowers Hb-O_2 affinity
  - "right shift" – O_2 offloading

- Effect of 2-3 DPG
  - by-product of red blood cell glycolysis
  - "right" shift during altitude exposure

Ventilation & Acid-Base Balance

changes in pH due to pCO_2 changes

Pulmonary ventilation removes H^+ from blood by HCO_3^- reaction:

lung ←

$$CO_2 + H_2O \longleftrightarrow H_2CO_3 \longleftrightarrow H^+ + HCO_3^-$$

muscle →

- INCREASED ventilation = CO_2 exhalation; reduced PCO_2 & H^+ concentration
- DECREAED ventilation = CO_2 build-up; increased PCO_2 & H^+ concentration

O_2 Transport in the Muscle

Myoglobin shuttles O_2 from cell membrane to mitochondria.

- Large quantities in slow-twitch fibres
- Small quantities in intermediate fibres
- Limited quantities in fast-twitch fibres

Higher O_2 affinity than haemoglobin (event at low PO_2)
- *Allows Mb to store O_2 = reserve*

Which is important as at the start of exercise there's a <u>time log</u> between onset of muscle contraction & increased O_2 delivery so reserves buffer the muscle O_2 needs (at start) – this contributes to O_2 debt.

CO_2 Transport in the Blood

At tissue: H^+ binds to Hb HCO_3^- diffuses out of RBC into plasma Cl^- diffuses into RBC = chloride shift	At lung: O_2 binds to Hb reaction reverses to release CO_2