Haemoglobins are **protein molecules with a quaternary structure that has evolved to make it efficient at loading oxygen** under one set of conditions but **unloading it** in another.

Their structure:

Primary Structure: **sequence of amino acids in the four polypeptide chains**

Secondary Structure: **each of these polypeptide chains is coiled into a helix**

Tertiary Structure: where each **polypeptide chain is folded into a precise shape** (important for its ability to carry oxygen).

Quaternary Structure: **all four polypeptides are linked together to form an almost spherical shape. Each polypeptide is associated with a haem group which contains a ferrous (Fe2+) ion. Its this ion that can combine with a single oxygen molecule, making a total of four O2 molecules that can be carried by a single haemoglobin molecule in humans.**

Role of haemoglobin is to transport oxygen.

To be efficient, haemoglobin must:

- **Readily associate with oxygen at the surface where gas exchange takes place.**
- **Readily dissociate from oxygen at those tissues requiring it.**

Haemoglobin changes its affinity (chemical attraction) for oxygen under different conditions. It does this because its **shape changes in the presence of certain substances such as CO2.** In the presence of CO2, the shape of the haemoglobin molecule binds more loosely to oxygen, making it release it.

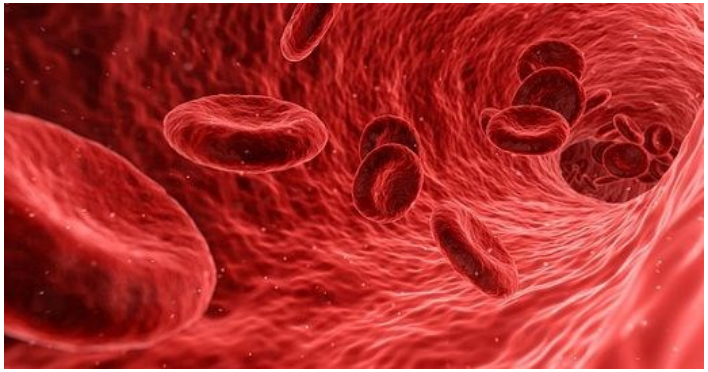
Region of body	O2 concentration	CO2 concentration	Affinity of haemoglobin for oxygen	Result
Gas Exchange Surface	High	Low	High	Oxygen is associated
Respiring Tissues	Low	High	Low	Oxygen is dissociated

Haemoglobin

Loading and unloading oxygen:

Haemoglobin binds with oxygen through a process called loading (taking place in the lungs) and when haemoglobin releases its oxygen this is unloading (taking place in tissues).

Haemoglobins with a high affinity for oxygen take up oxygen more easily but release it with more difficulty. If they have a **low affinity for oxygen** they find it more difficult to take up oxygen than release it.



Each species produces a haemoglobin with a slightly different amino acid sequence. The haemoglobin of each species therefore has a slightly different tertiary and quaternary structure and hence different oxygen binding properties.