Myoglobin (Mb) and Hemoglobin (Hb) have related, but different, roles in the body.

**Hemoglobin:**
- Found in red blood cells
- Promotes diffusion of $O_2$ throughout the body (binds $O_2$ at lungs, releases at tissues)

**Myoglobin:**
- Found in muscle cells
- Promotes diffusion of $O_2$ into and throughout muscle cell
The oxygen-binding curves of Mb and Hb reflect their different functions.
Myoglobin is a single-subunit, α-helical protein, with a heme cofactor that binds O$_2$.
A porphyrin ring forms the base structure of heme (with different hemes differing at X)
The heme of myoglobin and hemoglobin is a protoporphyrin IX with a bound Fe$^{2+}$.
In the globins, the heme iron binds $O_2$ and the ‘proximal’ histidine of the protein.

**Figure 5-2**

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Heme is held in place by the proximal His and by hydrophobic residues.
Myoglobin is structurally similar to the subunits of hemoglobin
Hemoglobin is a heterotetramer with two $\alpha$- & two $\beta$-subunits (a dimer of $\alpha\beta$ protomers)
Hemoglobin can adopt two conformations, called ‘deoxyhemoglobin’ & ‘oxyhemoglobin’.
Hb’s conformations are also called ‘T-state’ (for tense) and ‘R-state’ (for relaxed)
Oxygen binding promotes flattening of the porphyrin ring and shifting of helix F.
The proximal His links flattening of the heme to shifting of helix F in the T→R transition.
Movement of helix F shifts the entire quaternary structure of hemoglobin
The T and R states have shifted contacts between α & β subunits.
The T and R states have shifted contacts between \( \alpha \) & \( \beta \) subunits.
The T and R states have shifted contacts between α & β subunits.
(a) T State (deoxygenated)

(b) R State (oxygenated)
T-state salt bridges are broken in the R-state
Heme also binds CO, NO, and H$_2$S (with much higher affinity than O$_2$)

$P_{50}$ of CO binding to free heme is ~20,000x lower than $P_{50}$ of O$_2$ binding to free heme
Globin structure reduces heme affinity for CO

\[ P_{50} \text{ of CO binding to globin-bound heme is } \sim 200x \text{ lower than } P_{50} \text{ of } O_2 \text{ binding to globin-bound heme} \]
CO is a competitive inhibitor and positive effector of $O_2$ binding to hemoglobin.