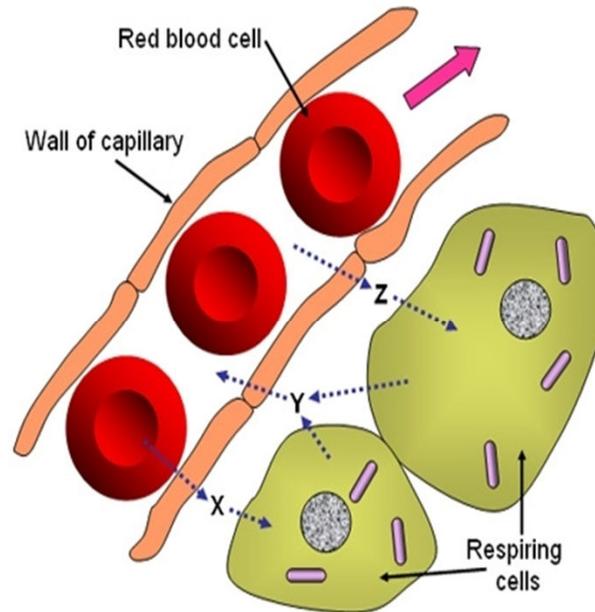
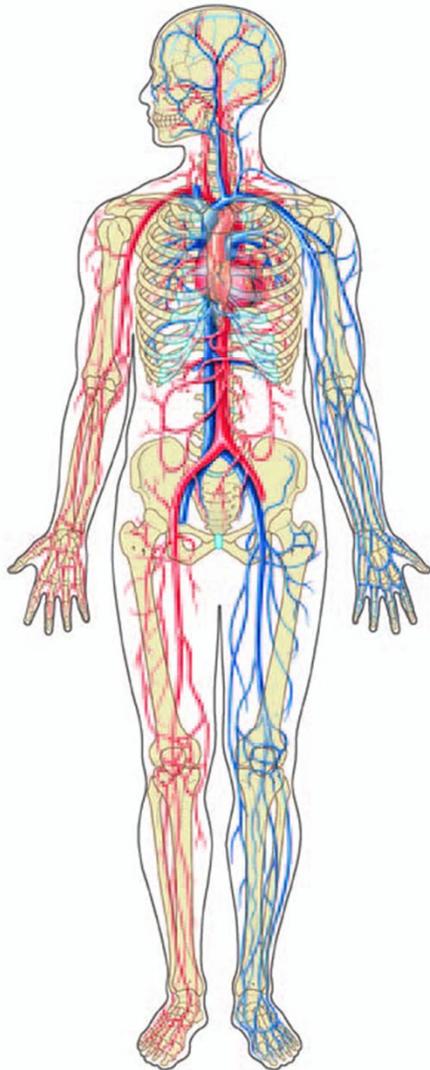


Myoglobin (Mb) and Hemoglobin (Hb) have related, but different, roles in the body

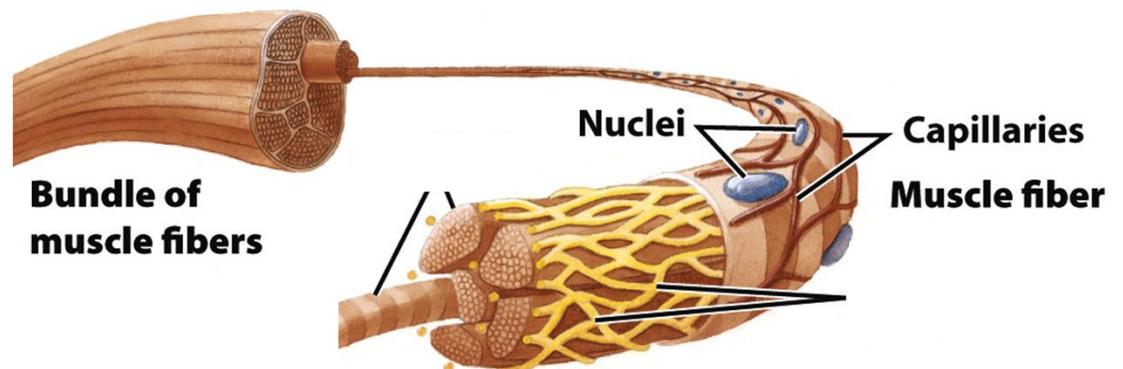


Hemoglobin:

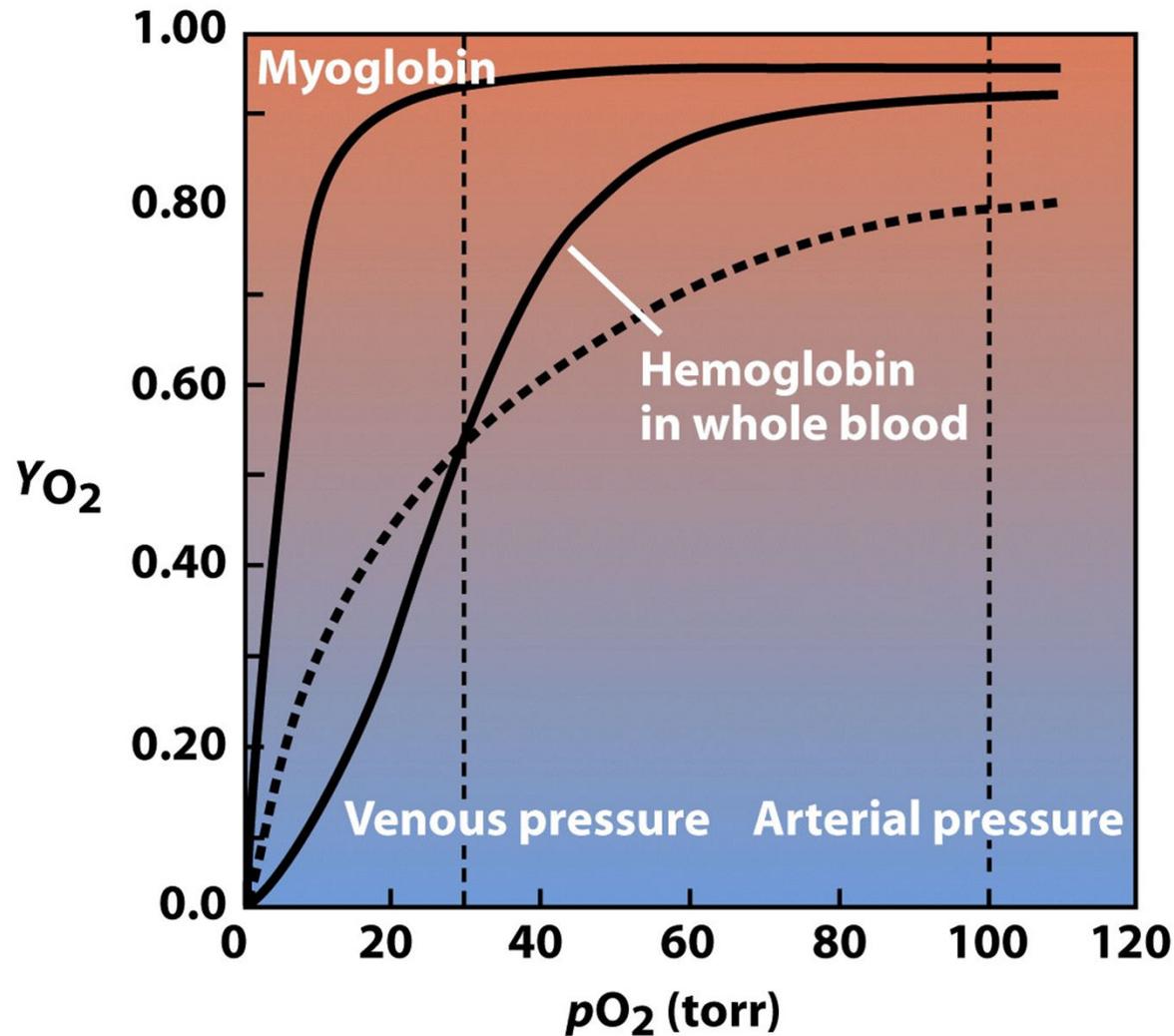
- Found in red blood cells
- Promotes diffusion of O_2 throughout the body (binds O_2 at lungs, releases at tissues)

Myoglobin:

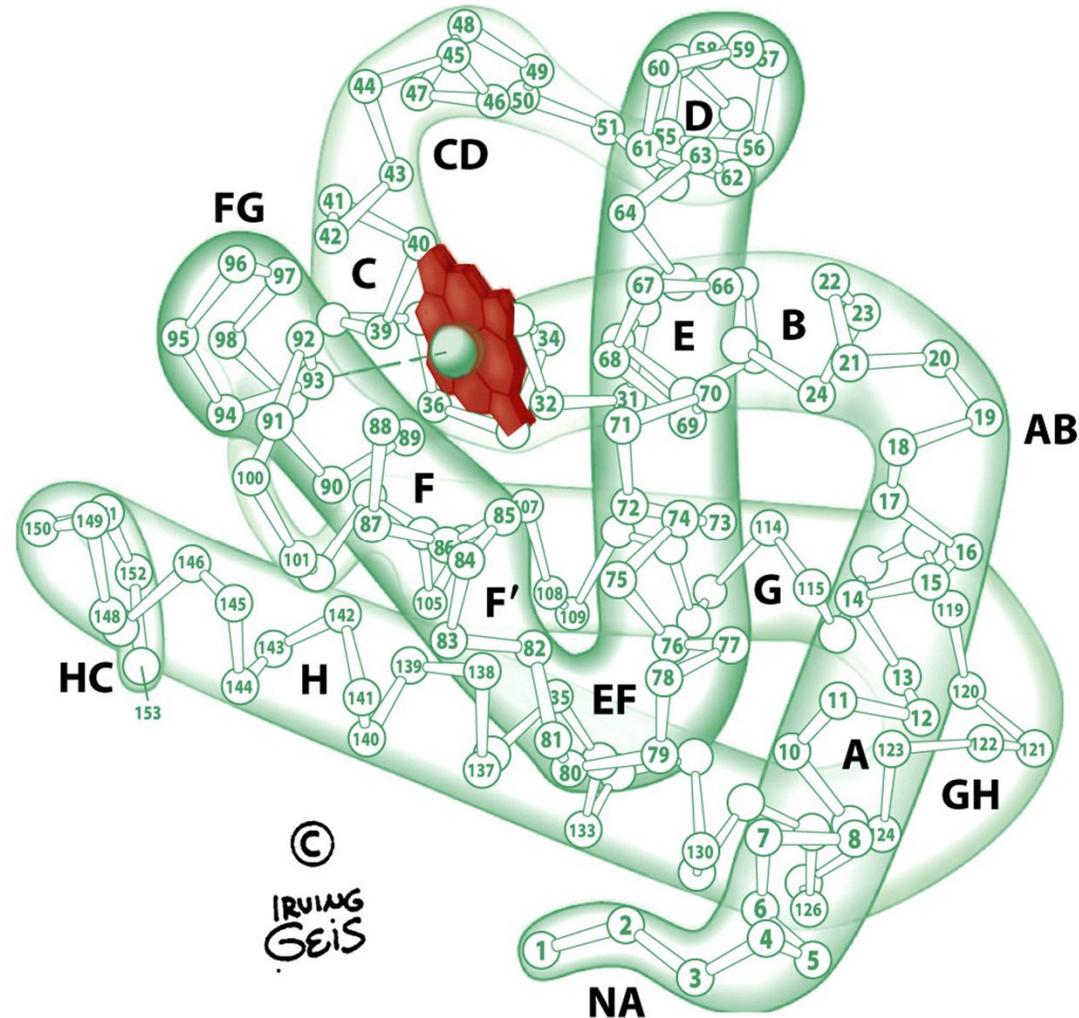
- Found in muscle cells
- Promotes diffusion of O_2 into and throughout muscle cell



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



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A porphyrin ring forms the base structure of heme (with different hemes differing at X)

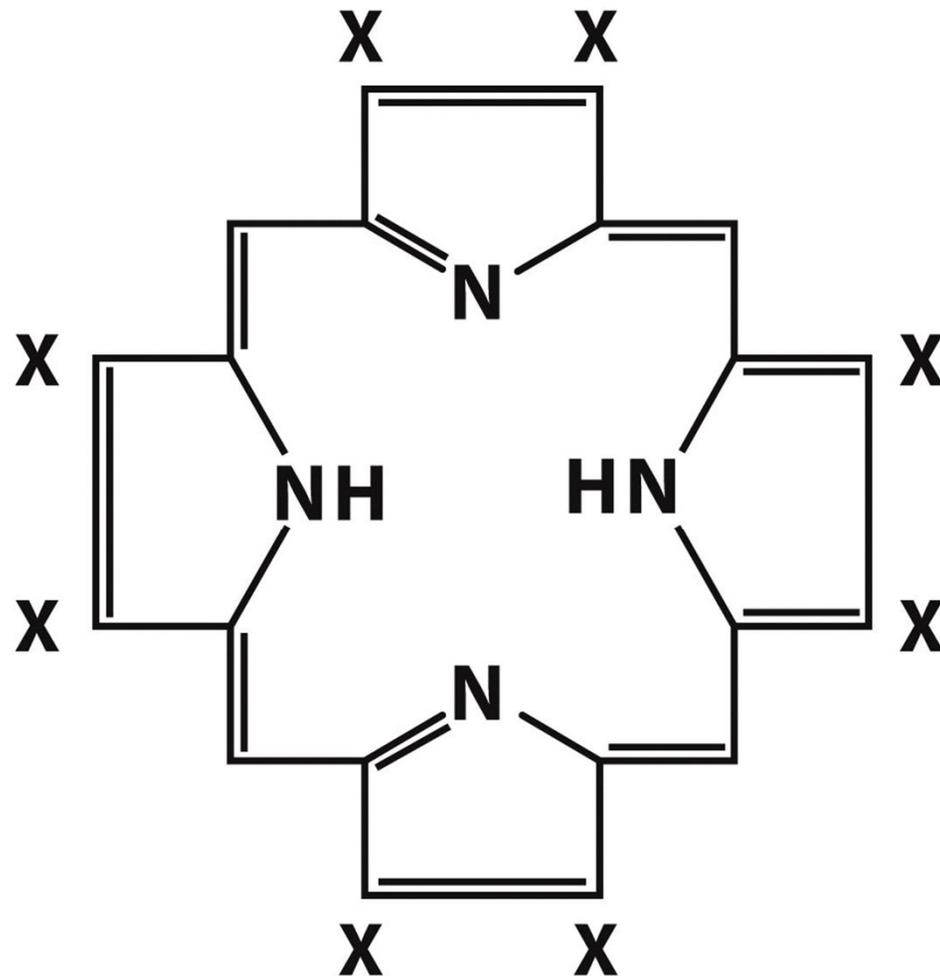
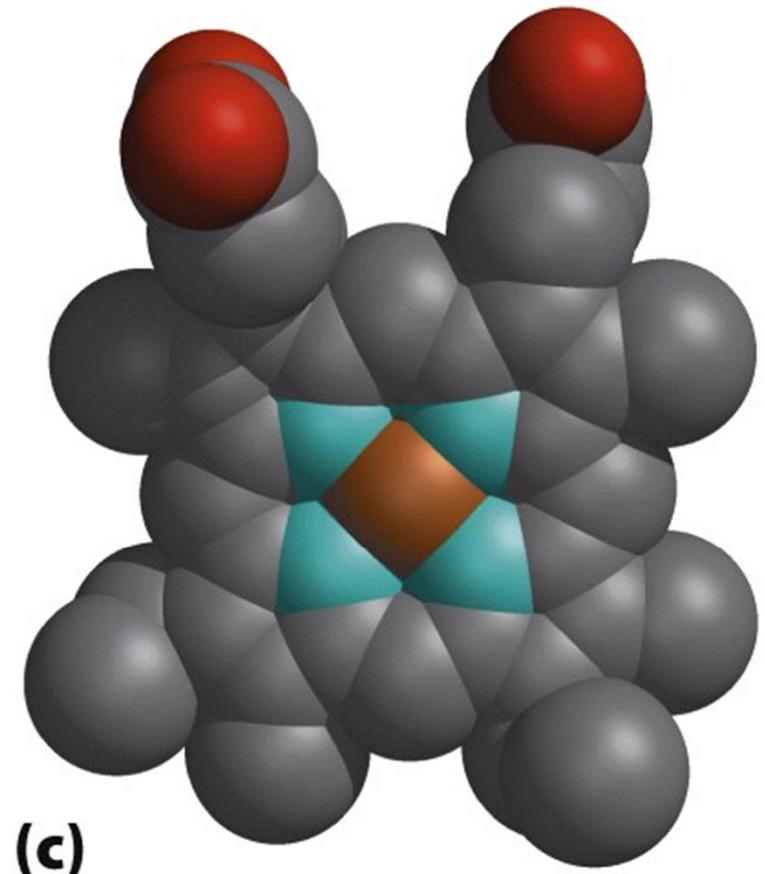
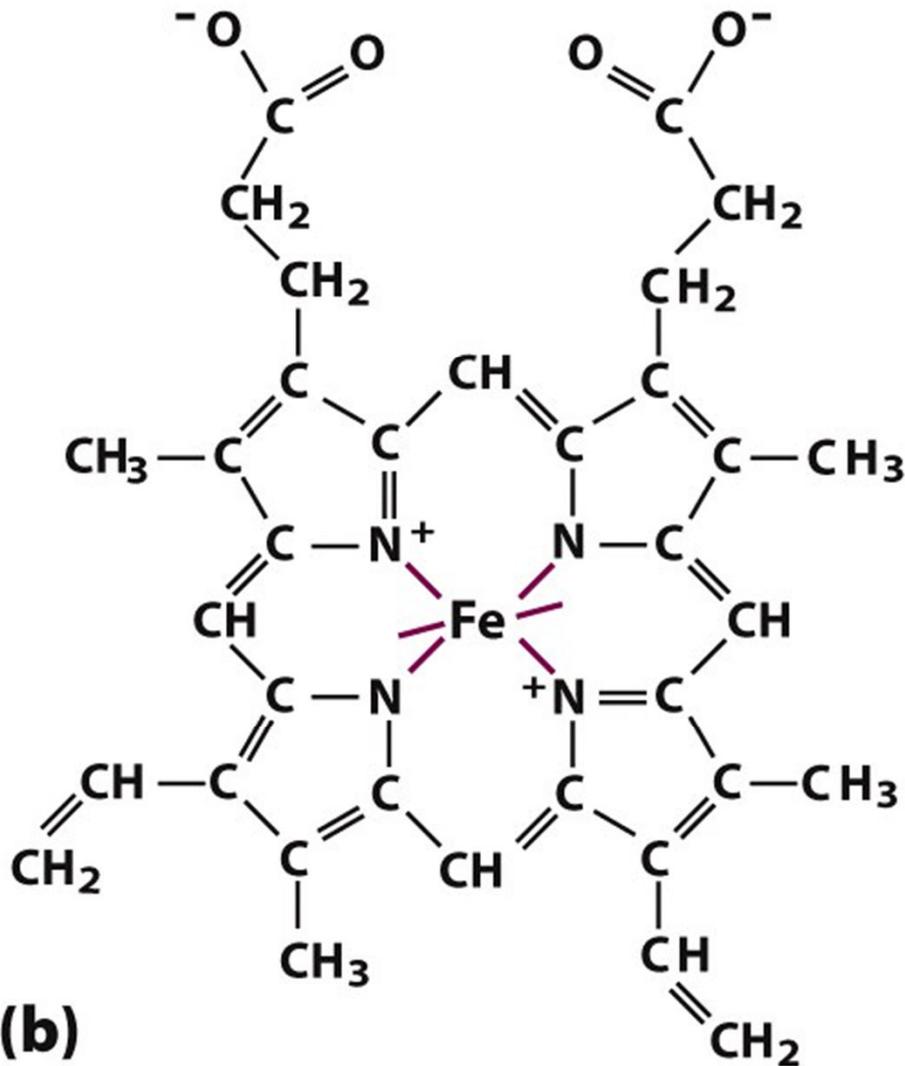


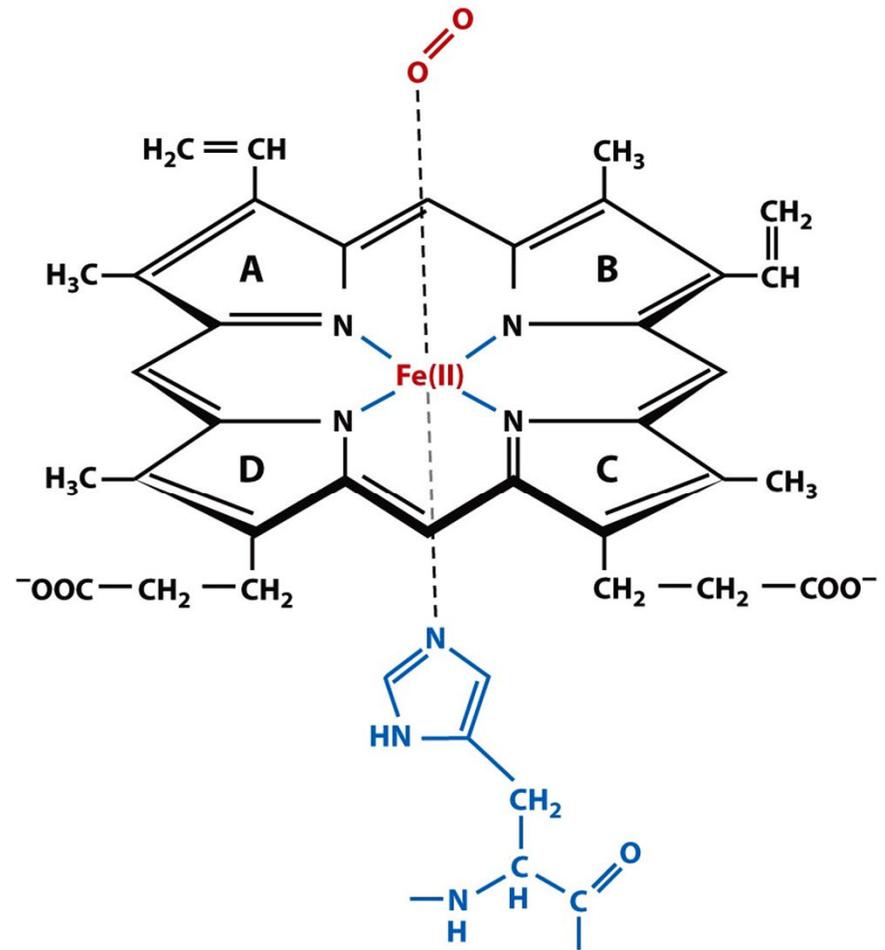
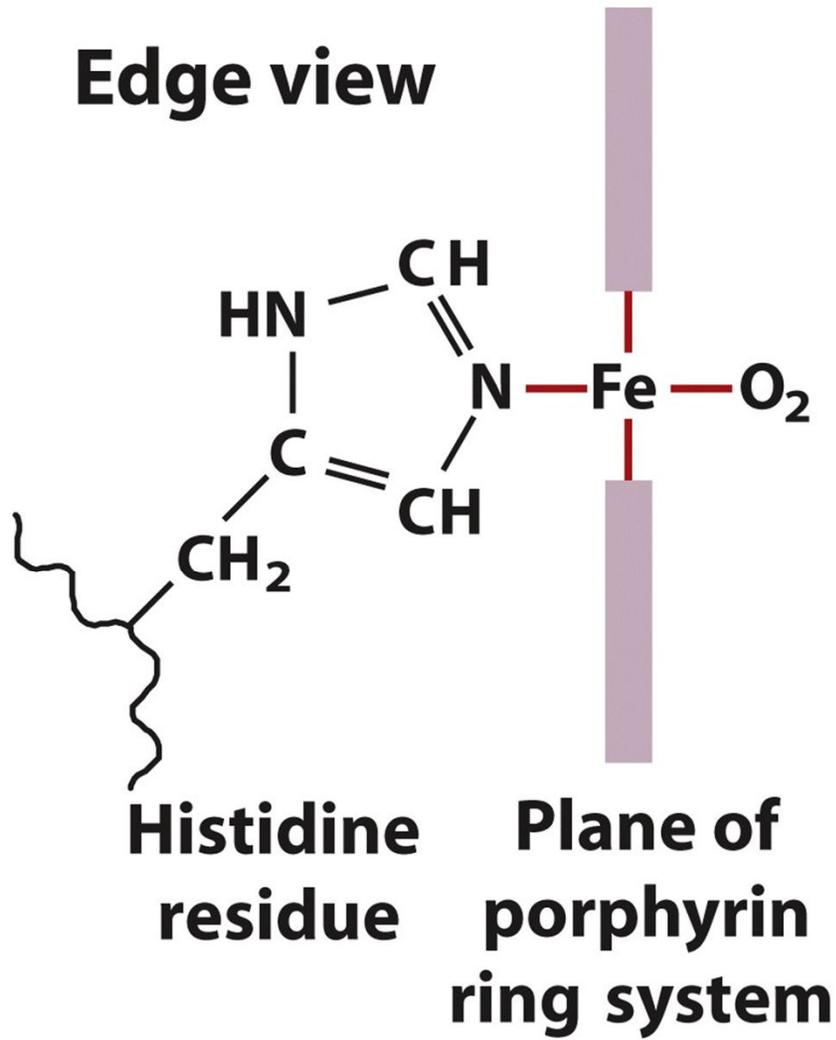
Figure 5-1a
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The heme of myoglobin and hemoglobin is a protoporphyrin IX with a bound Fe^{2+}



In the globins, the heme iron binds O_2 and the 'proximal' histidine of the protein

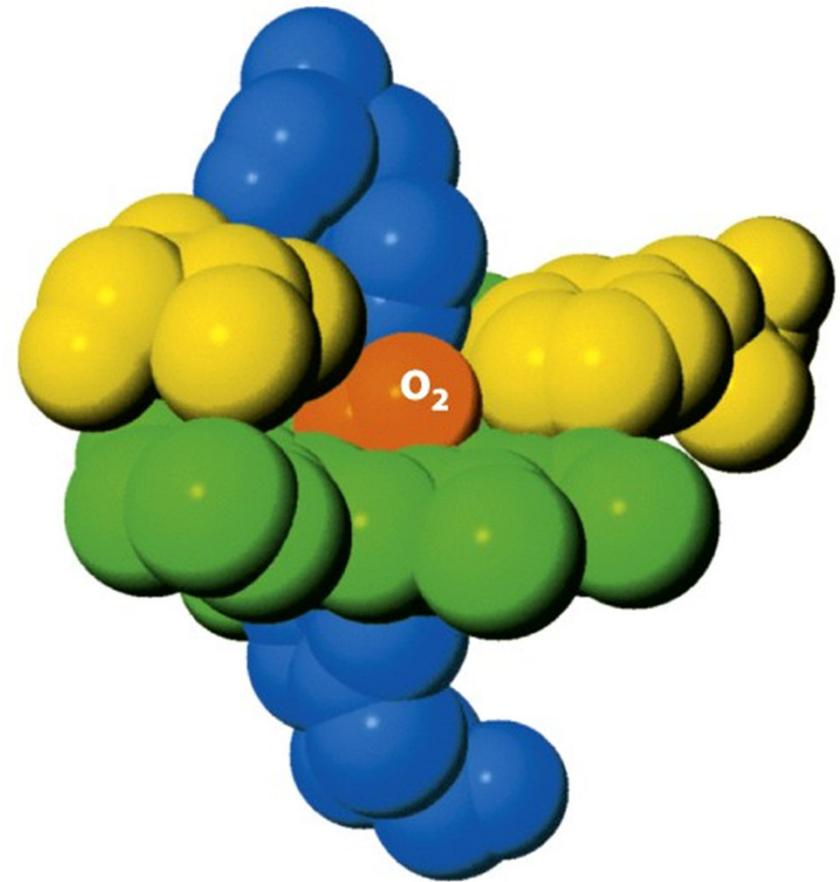
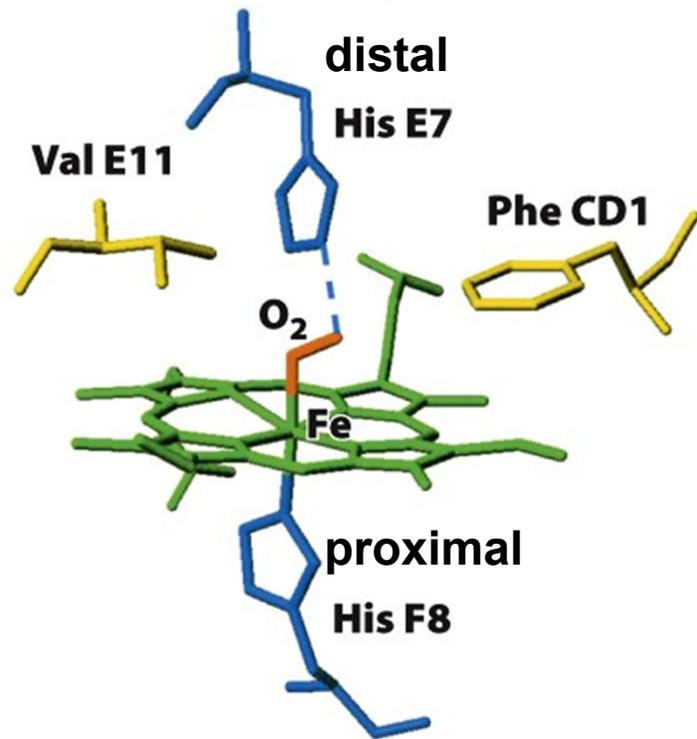
Edge view



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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

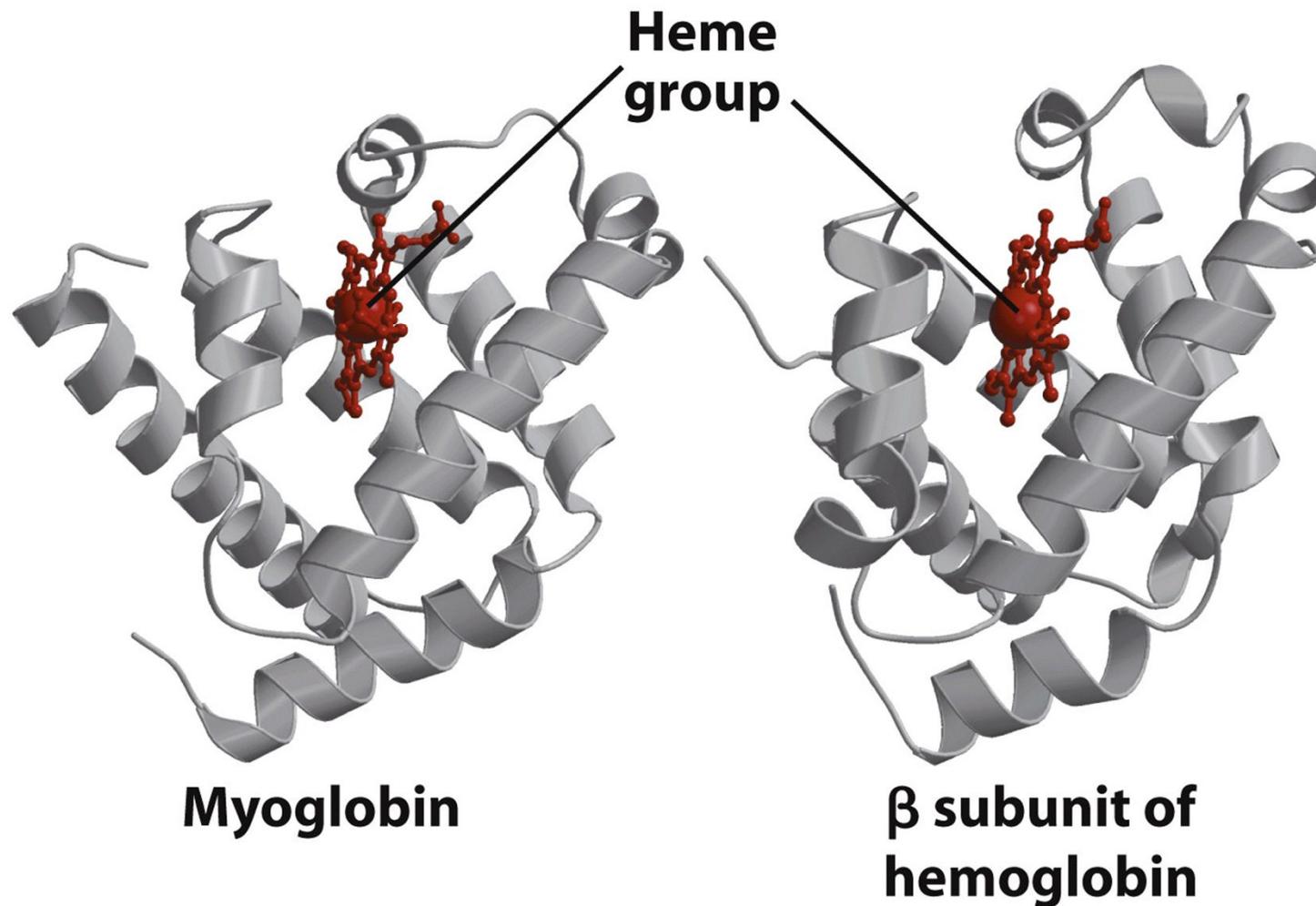
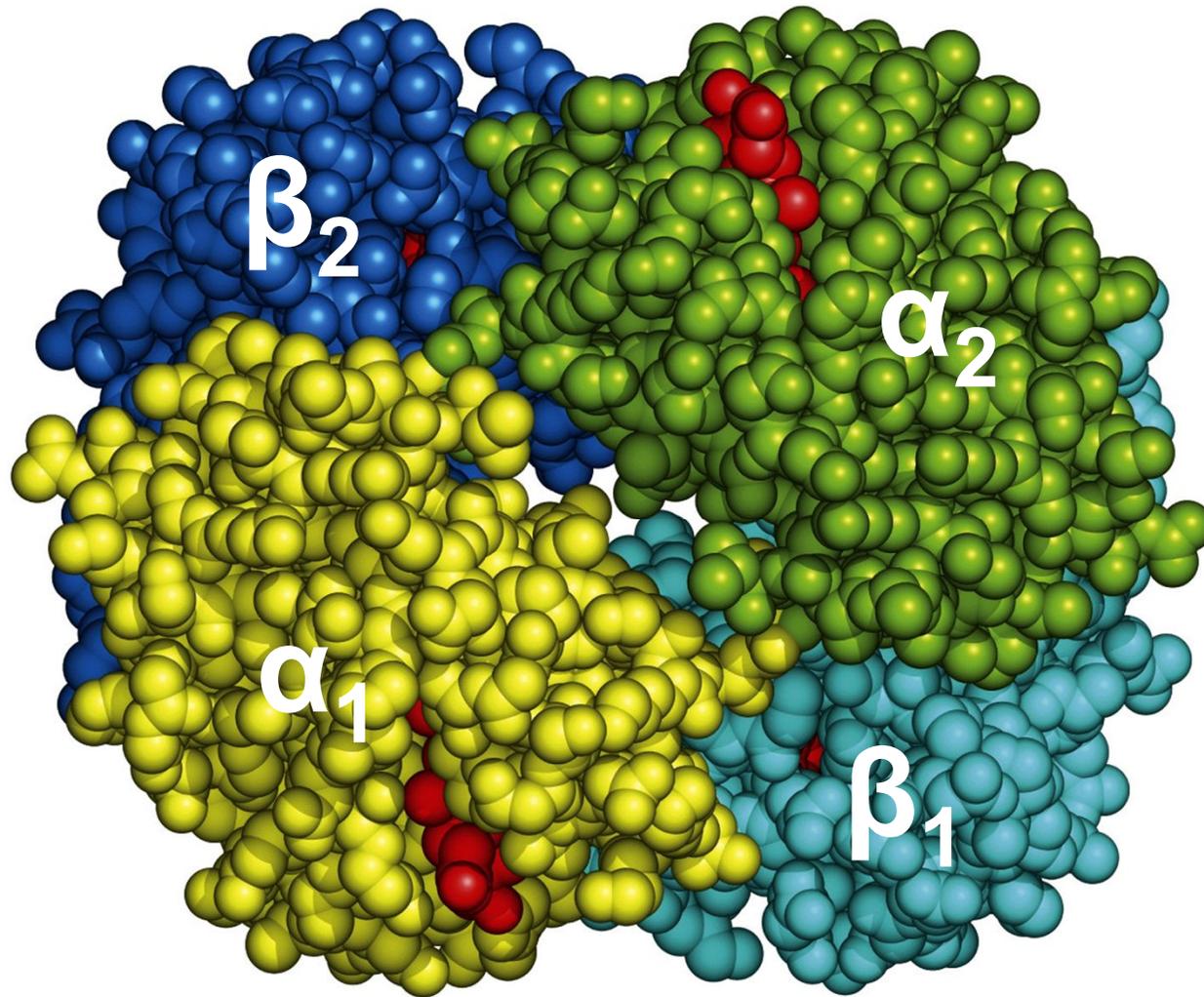
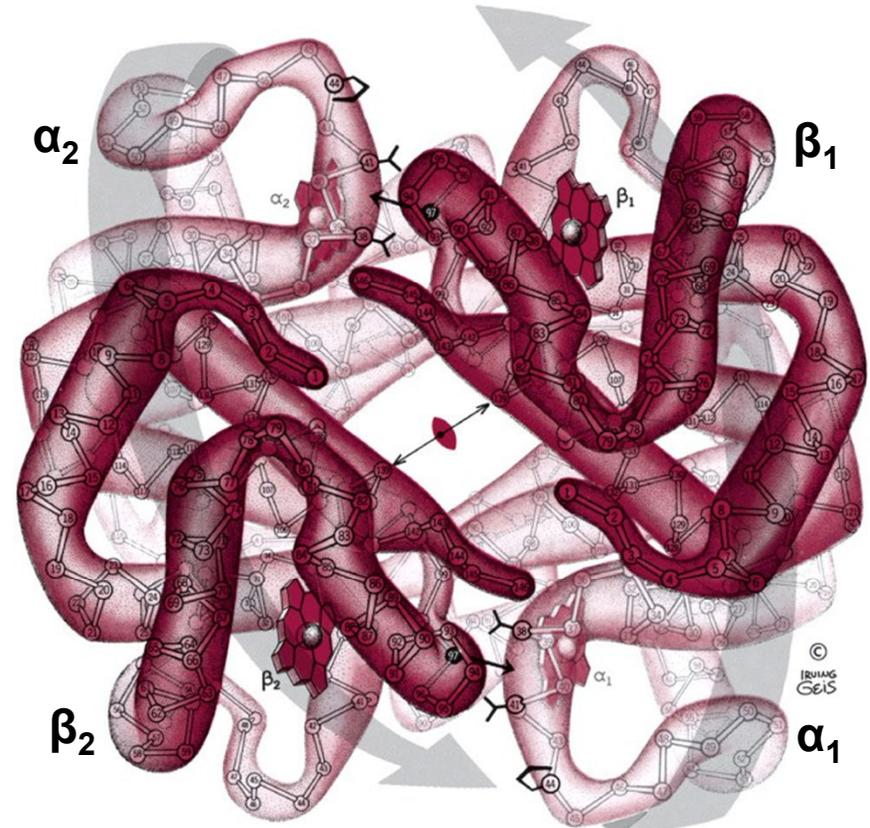
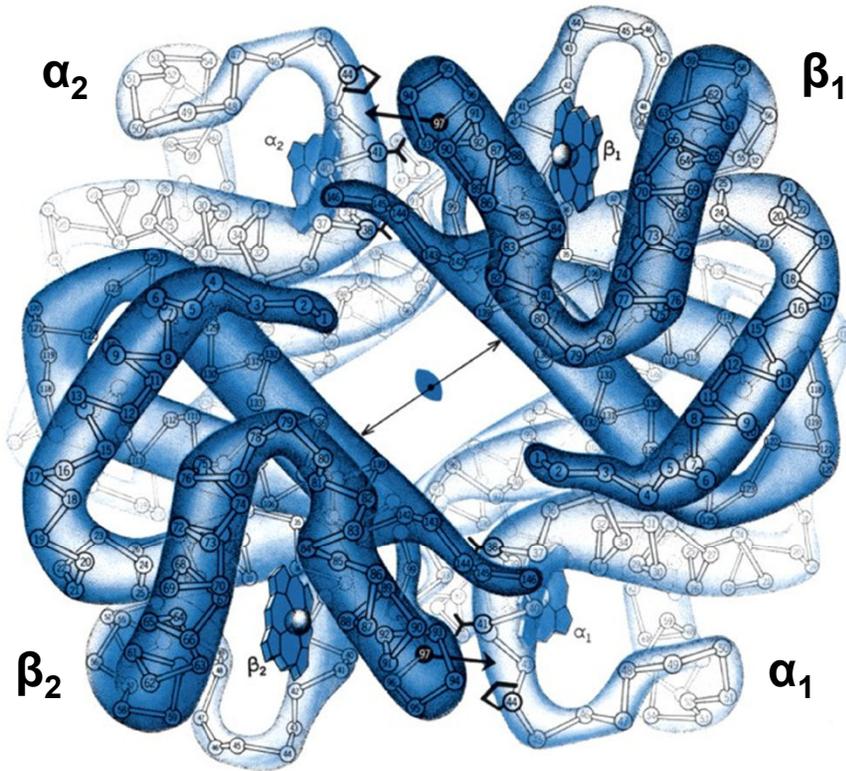


Figure 5-6
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Hemoglobin is a heterotetramer with two α - & two β -subunits (a dimer of $\alpha\beta$ protomers)



Hemoglobin can adopt two conformations, called 'deoxyhemoglobin' & 'oxyhemoglobin'

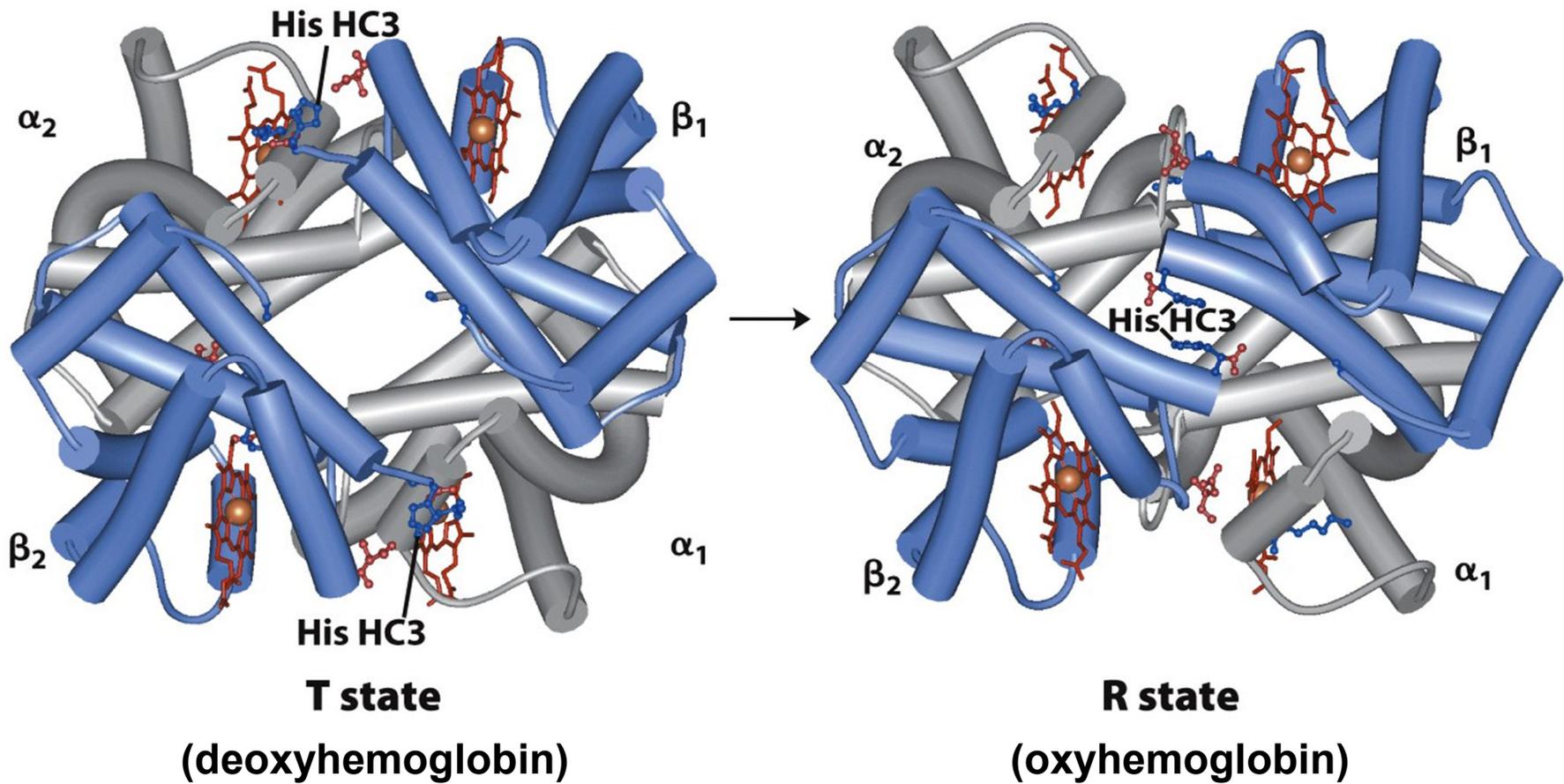


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deoxyhemoglobin

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

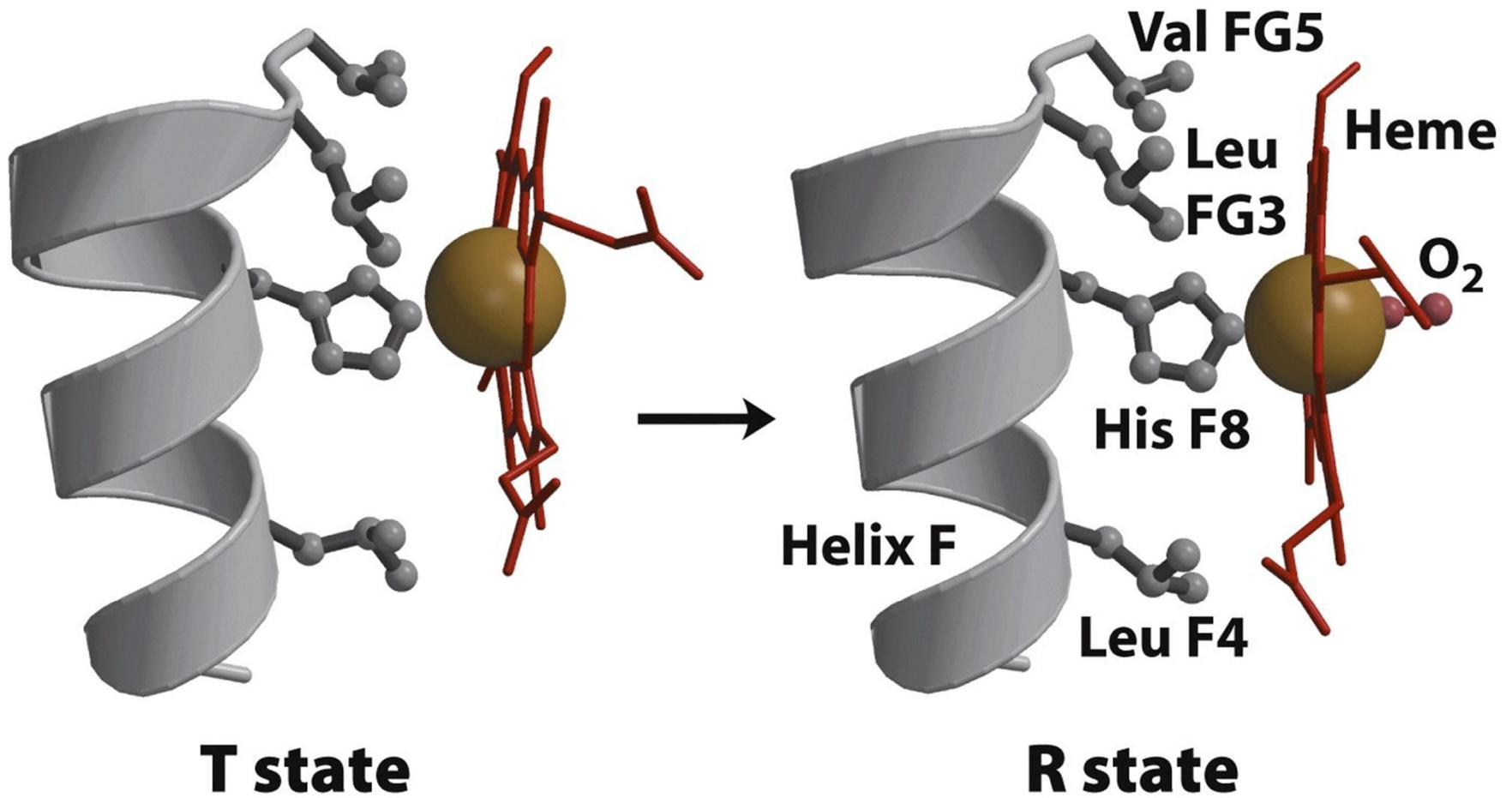
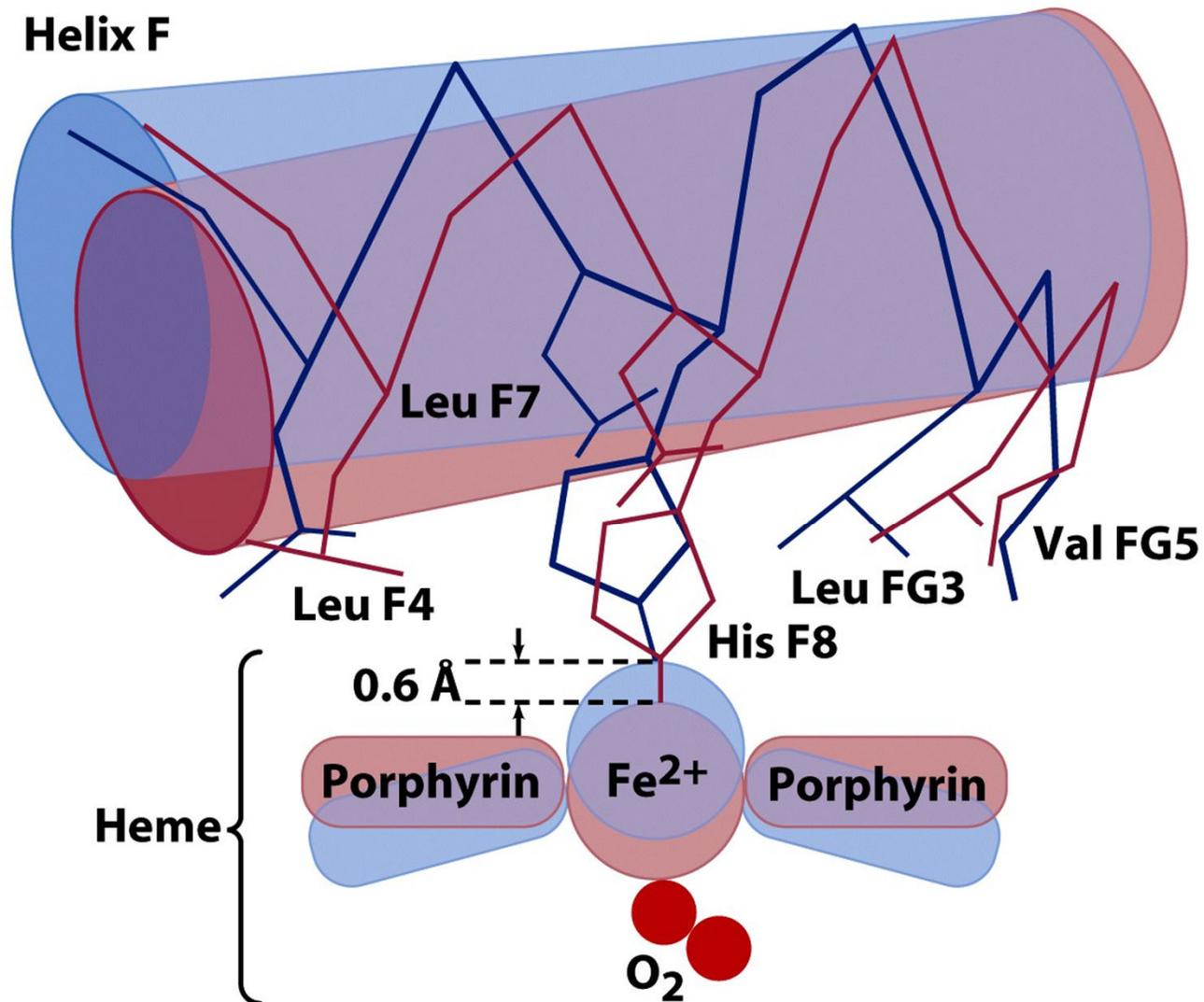
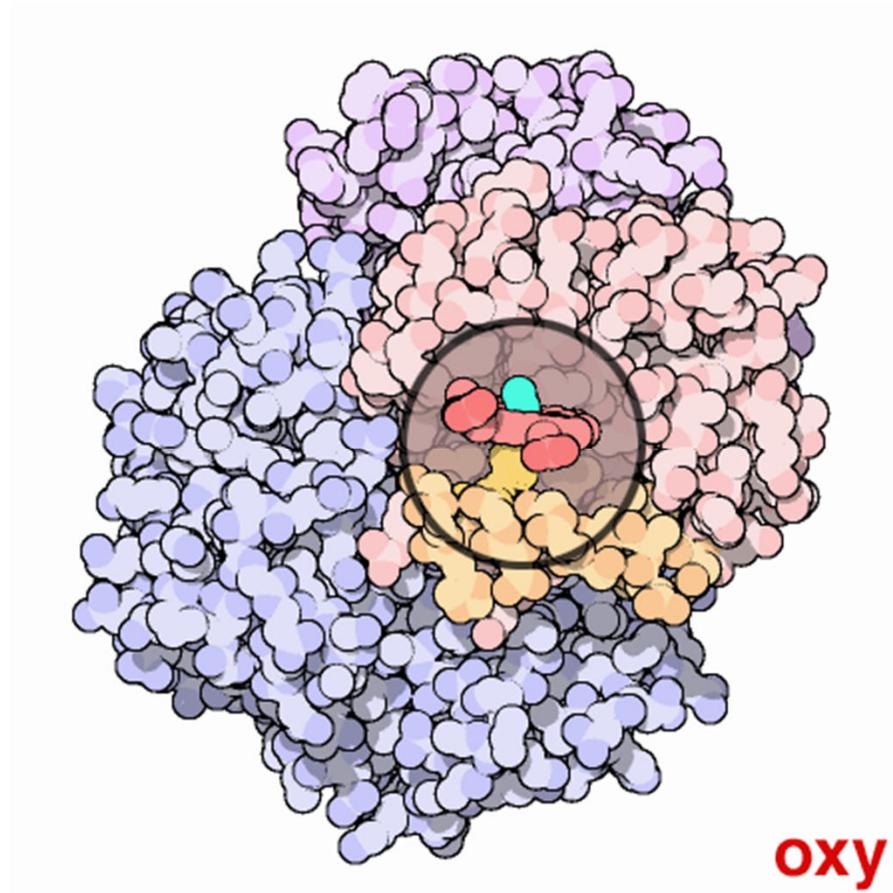


Figure 5-11
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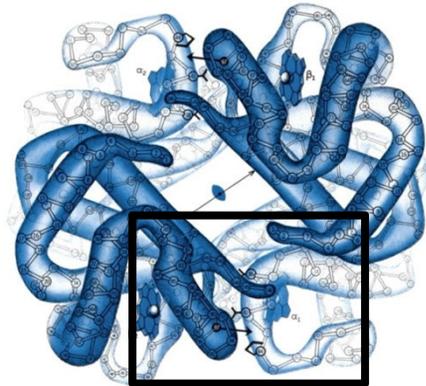
The proximal His links flattening of the heme to shifting of helix F in the T→R transition



Movement of helix F shifts the entire quaternary structure of hemoglobin

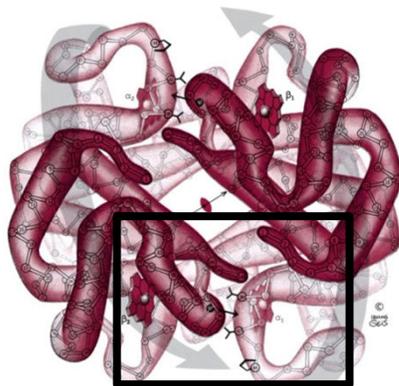
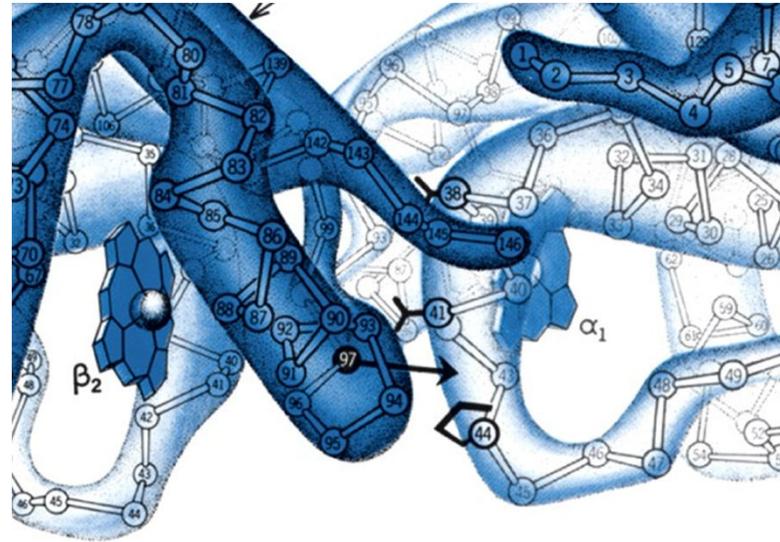


The T and R states have shifted contacts between α & β subunits



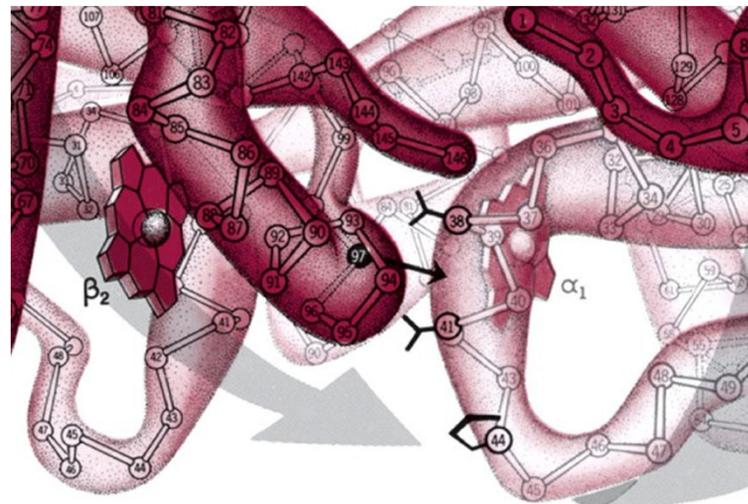
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T-state

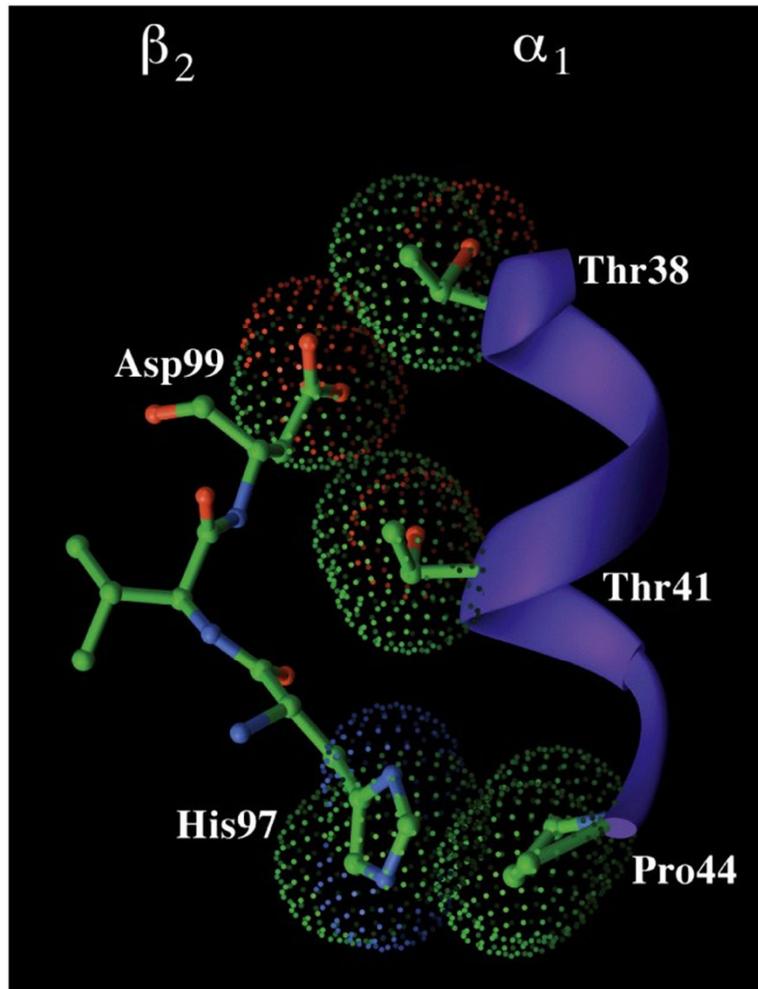


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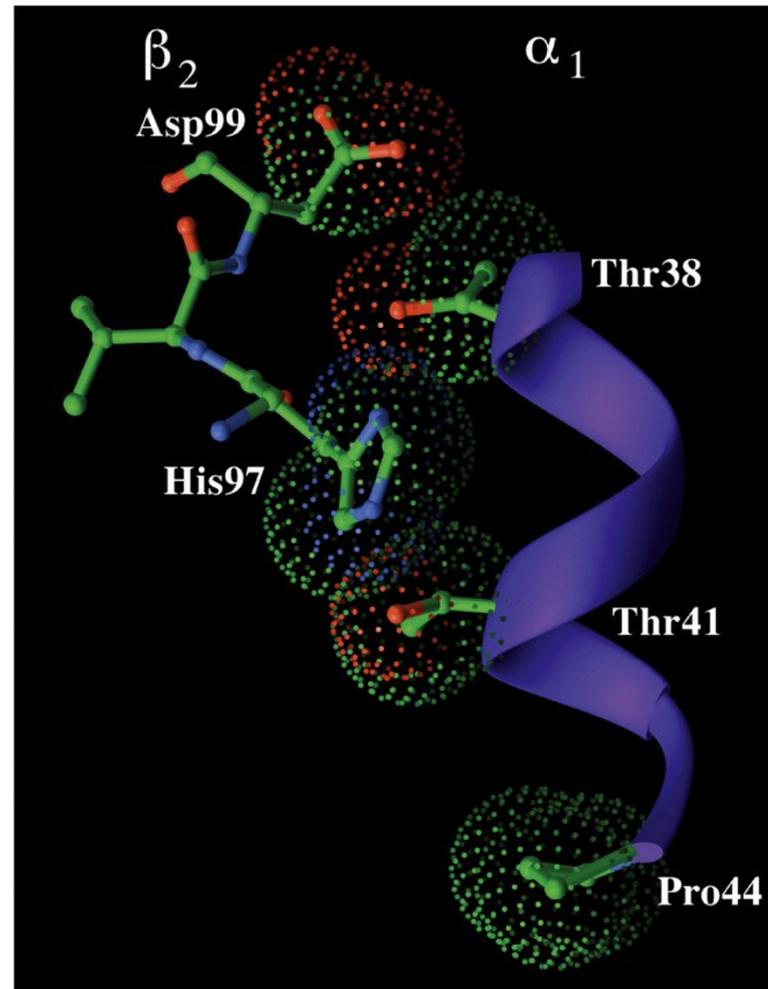
R-state



The T and R states have shifted contacts between α & β subunits

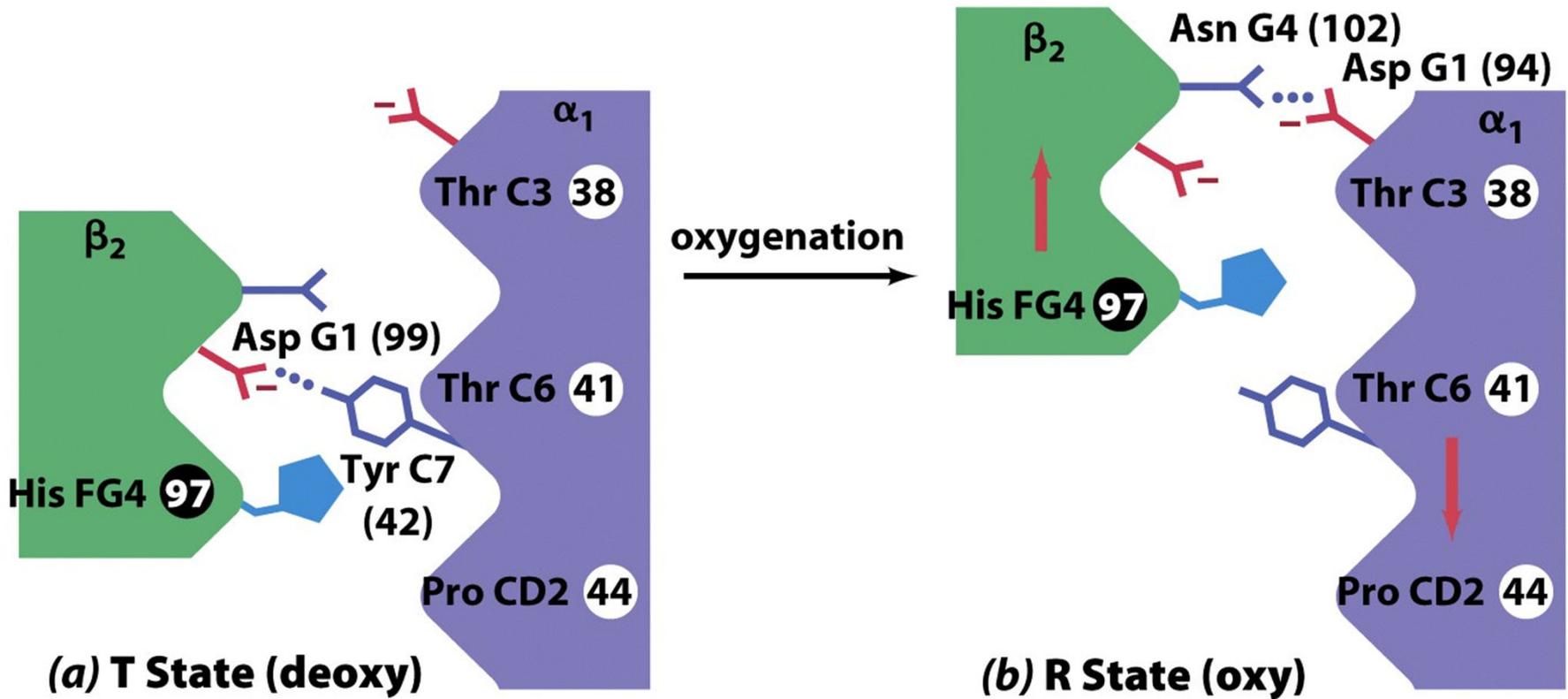


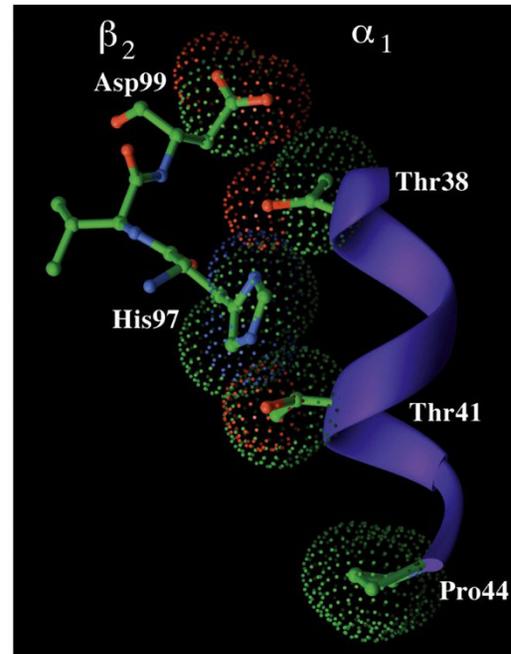
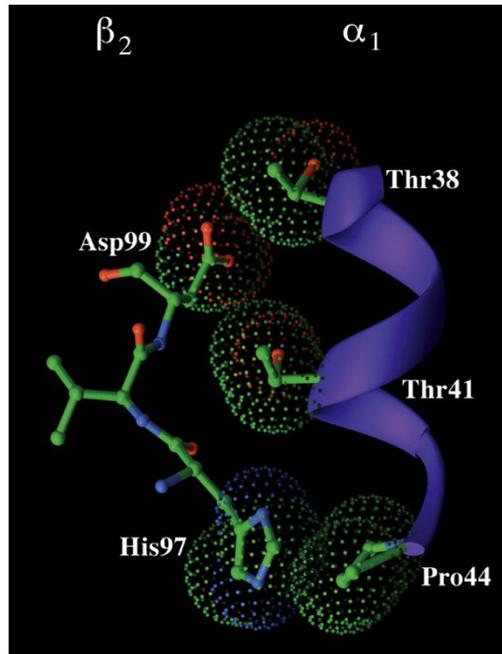
T-state



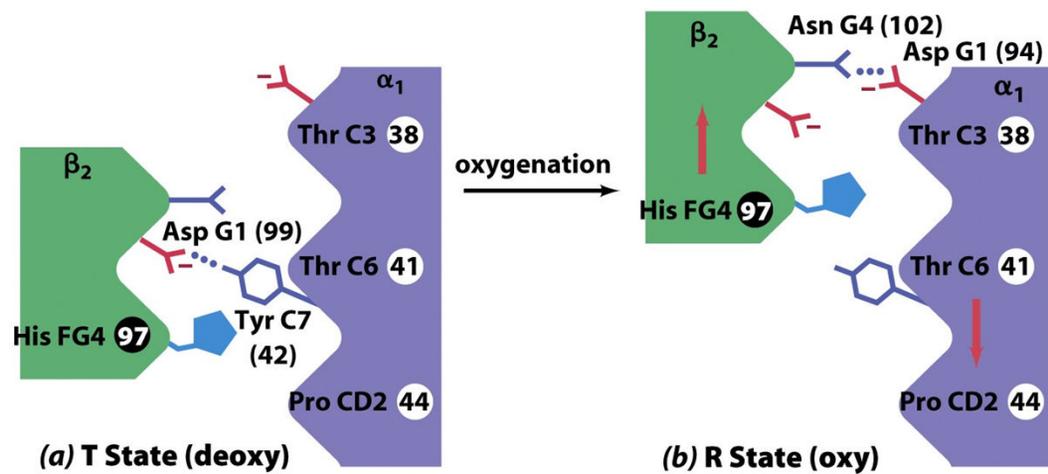
R-state

The T and R states have shifted contacts between α & β subunits



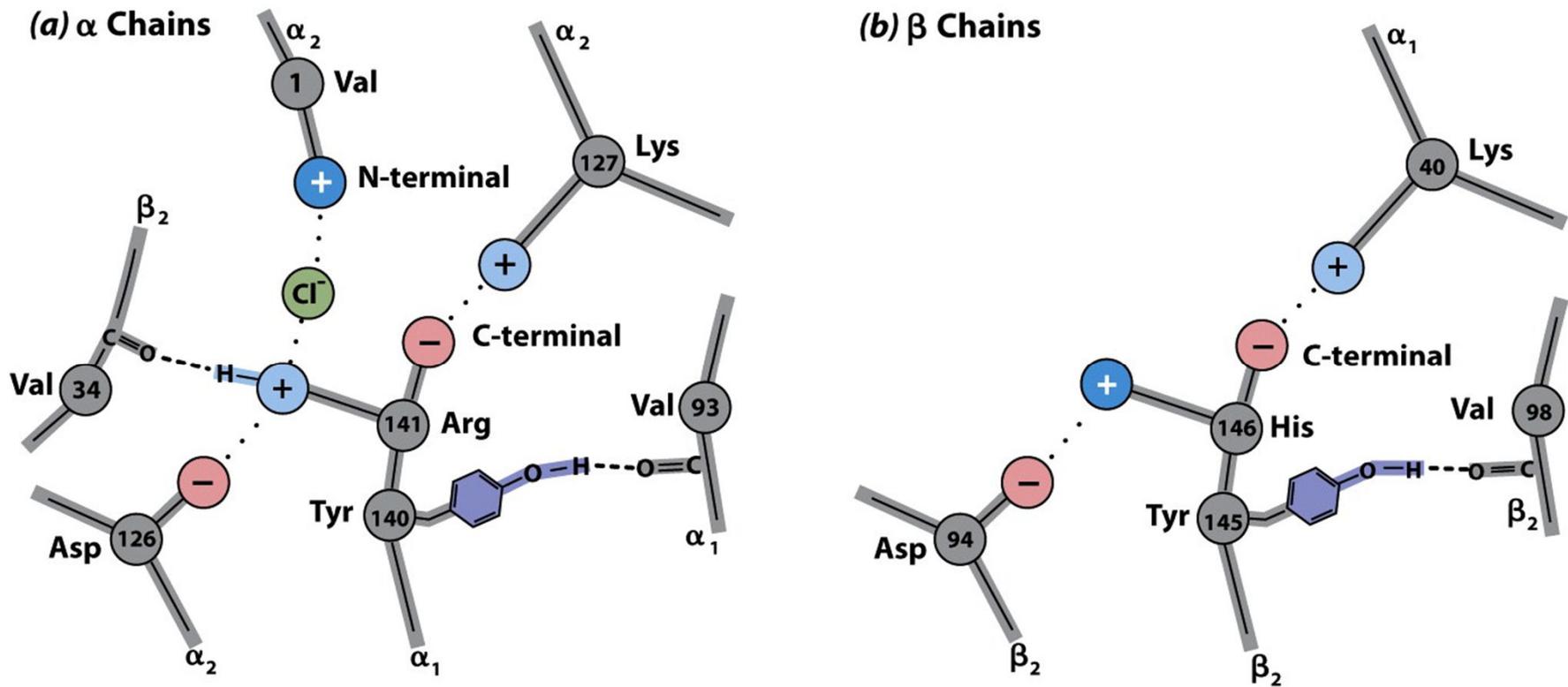


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T-state salt bridges are broken in the R-state



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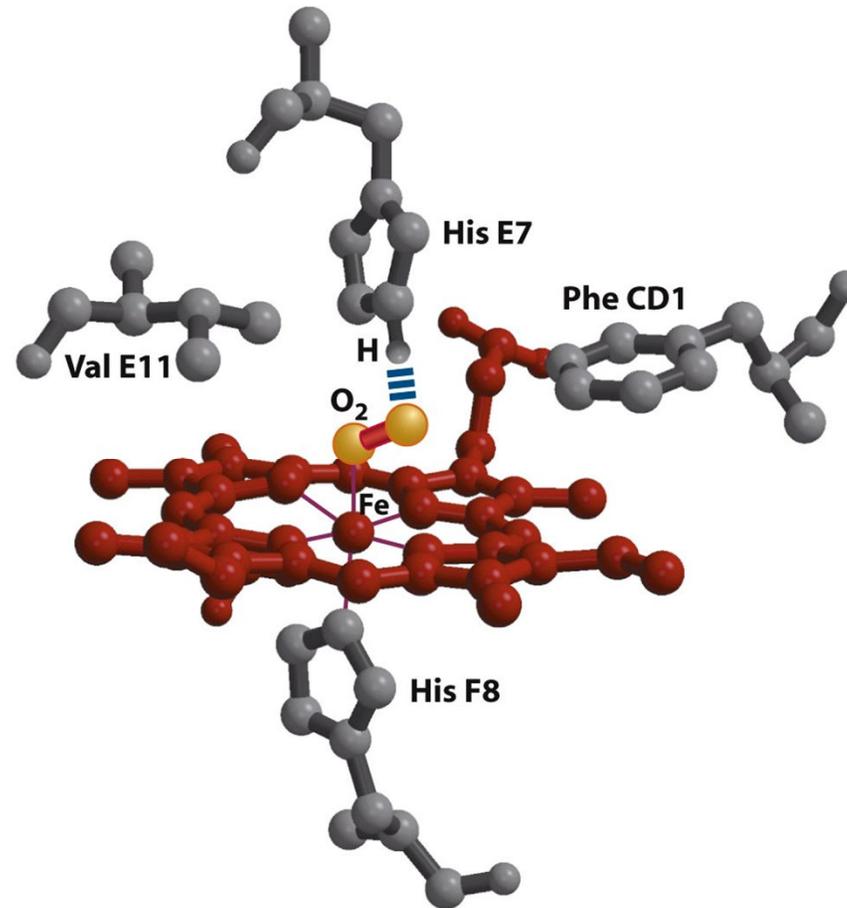
Heme also binds CO, NO, and H₂S
(with much higher affinity than O₂)



Figure 5-5ab
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P_{50} of CO binding to free heme is $\sim 20,000\times$ lower
than P_{50} of O₂ binding to free heme

Globin structure reduces heme affinity for CO



P_{50} of CO binding to globin-bound heme is ~200x lower than P_{50} of O₂ binding to globin-bound heme

CO is a competitive inhibitor and positive effector of O₂ binding to hemoglobin

