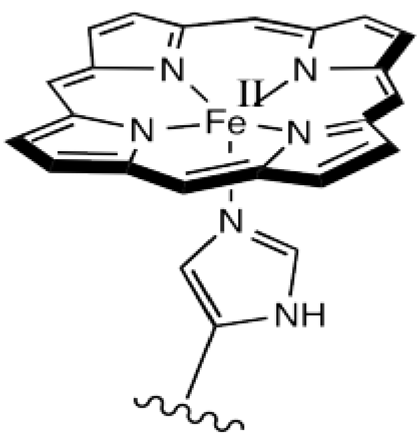
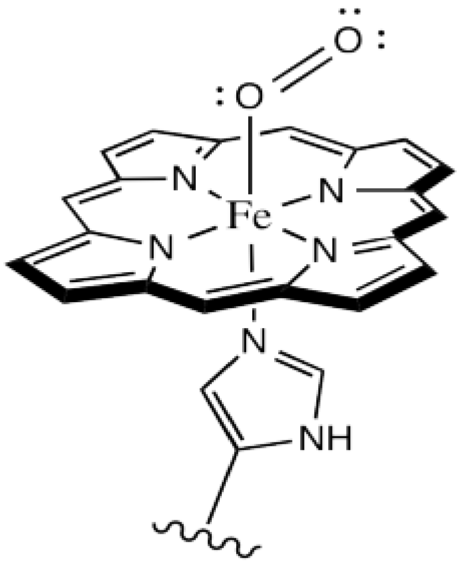
OXYGEN BINDING

Oxygen is vital to life. Very small organisms can get enough oxygen passively from their surroundings, but larger, more complicated organisms need to have better mechanisms for getting oxygen to the cells. Medium-sized organisms such as insects can manage to pump air to their tissues via a system of tubes leading in from pores along their bodies. Organisms bigger than that need a more complicated circulation system involving arteries and veins. Oxygen dissolves pretty well in water, but we can get even more oxygen into our system by binding it to carrier molecules.

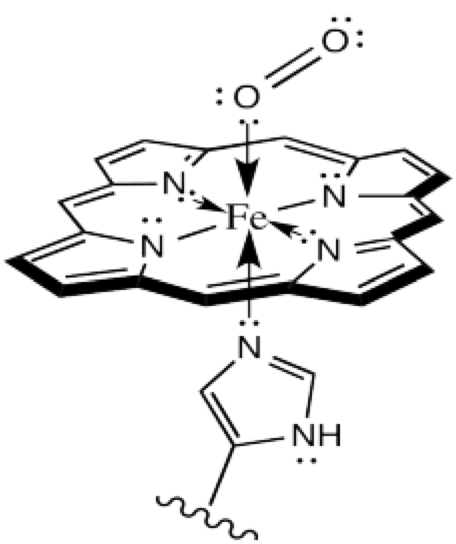
The most common carrier molecule for oxygen, used by vertebrates like us, is hemoglobin. Hemoglobin contains a five-coordinate Fe(II) centre in a heme or porphyrin ligand. In the picture, only the coordination complex is shown, stripped of the surrounding protein. Also, there are other groups attached to the porphyrin (the nitrogen-containing ring) but they are left out of the picture for simplicity.



Oxygen binds to the iron in the heme, forming an octahedral iron complex. This form is called oxyhemoglobin; the form without the bound oxygen is called deoxyhemoglobin. Lots of interesting things happen as a result of oxygen binding, structurally speaking. First of all, the heme changes shape. In order to accommodate the change from a pseudo-square planar geometry to an octahedral one, the shape of the heme changes from a distorted bowl to a plane.



Sometimes, keeping track of oxidation states in coordination complexes is easier if using dative bond formalisms. In particular, if a donor arom is neutral, the bond to the metal is shown using a dative bond symbol. That's a short, straight arrow from the donor electron pair to the metal. Bonds between anionic donor atoms and the metal are shown as regular short lines, as we typically draw other bonds.



Looking at the complex that way, it is easier to see that the iron atom is depicted as Fe(II); it has two anionic nitrogen donors from the heme ring. We'll look into the situation more closely later.

Source: http://employees.csbsju.edu/cschaller/Reactivity/oxygen/ORbinding.htm