Switches back and forth between Fe^{2+} and Fe^{3+}

The **cytochromes** contain iron in the form of an iron-porphyrin, usually the heme group. In contrast to hemoglobin and myoglobin where the iron is always in the ferrous state, the heme iron of the cytochromes **switches back and forth between Fe^{2+} and Fe^{3+}.** Also most cytochromes *(but not cytochrome a/a3)*, the heme iron is bound to two amino acid side chains rather than one. This prevents the binding of molecular oxygen, carbon monoxide, and other potential ligands.

Cytochromes are, in general, membrane-bound **hemoproteins** that contain heme groups and carry out **electron transport.** They are found either as monomeric proteins *(e.g., cytochrome c)* or as subunits of bigger enzymatic complexes that catalyze redox reactions. Cytochromes are found in the mitochondrial inner membrane and endoplasmic reticulum of eukaryotes, in the chloroplasts of plants, in photosynthetic microorganisms, and in bacteria.

The **electron transport chain** is the final common pathway by which electrons derived from different fuels of the body flow to oxygen. **Note:** Electron transport and ATP synthesis by oxidative phosphorylation proceed continuously in all cells of the body that contain mitochondria.

Cytochromes receive electrons from the reduced form of coenzyme Q *(ubiquinone)*. Each contains a heme group made of a porphyrin ring containing an atom of iron. This cytochrome iron atom is the electron carrier and is reduced when the cytochrome accepts an electron *(Fe^{3+}, Fe^{2+})*.

Cytochromes are distinguished by differences in their light-absorption spectra and are designated **b, c_1, c, a_3, and a**. These differences are a result of the heme prosthetic group. **Note: Cytochromes a_3** and **a** are the terminal members of the electron transport chain. They exist as a complex, which is called **Complex IV** or **cytochrome oxidase** complex.

Note: The **prosthetic groups** of cytochromes have four five-membered, nitrogen-containing rings in a cyclic structure called a **porphyrin.** The four nitrogen atoms are coordinated with a central Fe ion that can be either Fe^{2+} or Fe^{3+}. **Remember:** These porphyrins are also found in the heme proteins **hemoglobin** and **cytochrome P450.** Glycine and succinyl-CoA are the precursors to the biosynthesis of these rings.