Frequently Asked Question: *How does oxygen and light modify protein structure and activity?*

Answered by Dr. Arjun Raman

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Let’s consider the examples in halobacterium of bat for oxygen and bop for light. The bat protein contains a PAS domain, which incorporates a heme (iron) prosthetic group that can bind oxygen. However, only reduced (Fe2+) ferrous iron in the heme group reacts with oxygen, which will temporarily oxidize the ion to ferric iron (Fe3+), which cannot react with oxygen. Therefore, the amount of oxygen in the environment (oxygen tension), will affect the rate of iron oxidation in the heme group of the bat protein, thus changing its structure and activity. In this case, its’ activity is binding to DNA and transcription of the genes necessary for production of bacteriorhodopsin.

Halobacterium can obtain energy from light by expressing the transmembrane protein bacteriorhodopsin, which is actually a combination of the bacterio-opsin (bop) protein and a bound retinal cofactor. Retinal, a vitamin A derivative, is a chromophore, which means that it produces color by absorbing photons of a certain wavelength, while reflecting or transmitting photons of other wavelengths. The retinal molecule absorbs photons of light, causing a conformational shift in itself and the folded state of the bacteriorhodopsin protein. Using specific amino acids of the shifting bacteriorhodopsin protein, a proton (H+) from the inside of the membrane is pumped and released to the outside of the membrane. When the proton is released extracellularly, bacteriorhodopsin (including the retinal moiety) return to the original state, ready to absorb another photon. Thus the energy of light is converted to mechanical energy of protein movement and proton transport.