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Understanding blue-light photoreceptors[1]

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Blue-light sensing proteins coordinate many biological processes that include phototropism, photomorphism, stress responses, virulence and the entrainment of circadian clocks. Three major types of blue-light sensors all bind flavin nucleotides as chromophores, but the photochemistry employed and conformational responses invoked differ considerably among the classes. Nevertheless, photoinduced electron transfer reactions play a key role in many mechanisms. How such reactivity leads to conformational signaling will be discussed for both cryptochromes (CRYs) and light- oxygen- voltage (LOV) domains. In CRYs, blue-light mediated flavin reduction promotes proton transfer within the active center that then leads to displacement of a key signaling element. For LOV proteins, blue light causes formation of a covalent cysteinyl-flavin adduct, which rearranges hydrogen bonding and restructures the N-terminal region of the protein. Interestingly, a new class of LOV-like sensor does not undergo adduct formation and instead can operate by flavin photoreduction, like CRY. Conserved aspects of reactivity in these proteins provide lessons for the design of new photosensors, which may find use as tools in optogenetics

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