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Molecular Photovoltaics and Artificial Sight[1]

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The goal of this project is insertion of purified Photosystem I (PSI) reaction centers or other photoactive agents into retinal cells where they will restore photoreceptor function to people who suffer from age-related macular degeneration (AMD) or retinitis pigmentosa (RP), diseases that are the leading causes of blindness world-wide. Although the neural "wiring" from eye to brain is intact, these patients lack photoreceptor activity. It is the ultimate goal of this project to restore photoreceptor activity to these patients using PSI as the optical trigger. In principle, the approach should work. PSI is a robust integral membrane molecular photovoltaic device. Depending on orientation, it can depolarize or hyperpolarize the cell membrane with sufficient voltage to trigger an action potential. The first objective of this work, reported here, is to impart photoreceptor activity to mammalian cells using the previously determined molecular photovoltaic properties of isolated Photosystem I reaction centers. Incubation of WERI-Rb-1 retinoblastoma cells with functional PSI reaction centers that were isolated from spinach leaves and reconstituted into proteoliposomes resulted in a light-induced PSI-dependent increase in intracellular Ca^{2+}. The increase, due to Ca^{2+} uptake, was dependent on the presence of extracellular Ca^{2+} ions.

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