swapping" experiments were then carried out to pinpoint sequences in DmVas that could direct ApVas1 and DmVas itself to the posterior germplasm. The thorough survey led to a remarkable finding: the HELICc domain of DmVas, either when linked to ApVas1 or alone, was essential for posterior localization; moreover, glutamine (Gln) 527 in the HELICc domain of DmVas was found to be critical for the interaction between Vas and Osk. A residue corresponding to Gln527, which is present in the HELICc domains of grasshopper Vas protein but not in those of aphids, crickets, and mice, may explain why only grasshopper Vas could be restricted to the posterior germ plasm. Published results show that segregation of germ cells in the grasshopper *Schistocerca gregaria* is initiated during mid-embryogenesis via signal induction rather than being driven by a maternal germ plasm, indicating that the conserved Gln527 residue has existed in some insect Vas proteins long before the existence of Osk in *Drosophila*. The results mentioned above have been published in *Scientific Reports*, an open-access online journal from the publishers of Nature, in September 2015.

From the evolutionary and developmental study of insect Vas proteins to the discovery of sequences indispensable to the interaction with Osk, members of both the Chang and Lin laboratories felt excited by the unpredicted yet fruitful outcome. Their findings shed light on the evolution of germline specification in insects and on Osk/Vas-dependent germ-plasm assembly in *Drosophila*. They expect that the AID project will evolve to facilitate the functional exploration of additional germline and developmental genes in rising insect models with the "aid" of the powerful approaches used in *Drosophila* genetics.

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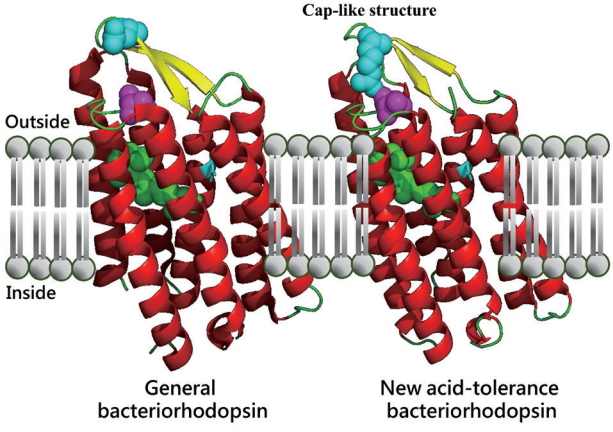
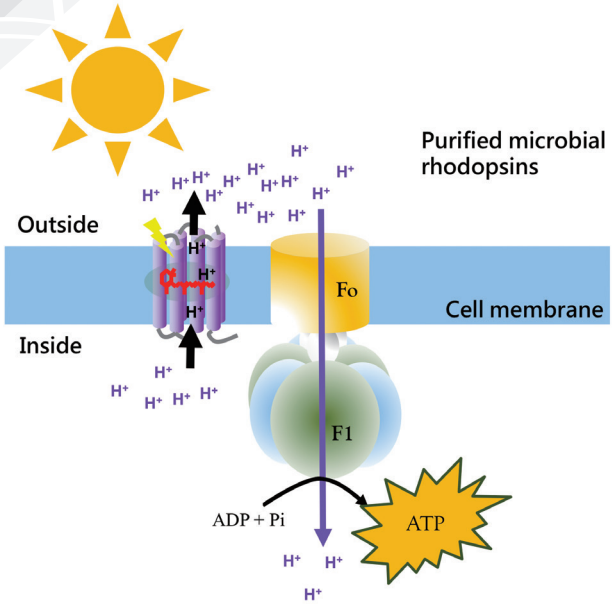
New type of powerful photoreceptor provides new possibilities for applications

For approximately 3.5 billion years, solar light has been the main energy source for all life forms on Earth. Therefore, the ability of proteins to capture solar rays and convert them into usable forms of energy is a "natural" development of all living systems.

The Dead Sea is one of the most saline lakes on Earth, and few microorganisms are found in its waters. Among these microorganisms, the haloarchaeon (a salt-loving archaea) *Haloarcula marismortui* survives such harsh conditions by adopting a unique six-rhodopsin system (1). Thee six rho-





dopsins, often called microbial rhodopsins, are activated by different wavelengths of sun rays and function in light energy harvest and phototaxis.

More than 1000 microbial rhodopsins have been identified in bacteria, eukaryotes and archaea. The rhodopsin involved in capturing light for biological usage is called bacteriorhodopsin.

Bacteriorhodopsin is a light-driven outward proton pump. Upon light activation, it pumps a proton pre-bound in the interior of the protein and re-uptakes another from inside the cell. This process can be carried out repeatedly every ~10 msec. The protons accumulated outside will then re-enter the cell through another protein called F1Fo ATP synthase. Every three protons that reenter will trigger the generation of one ATP, a universal, biologically consumable form of energy. Ultimately, haloarchaea can harvest energy via exposure to sun rays.

A study conducted in the lab of professor Chii-Shen Yang at the College of Life Science unveiled a new kind of bacteriorhodopsin (2) that is at least ten times more powerful than any currently known bacteriorhodopsin in pumping protons outside of the cell. Yang's lab further worked with a research group in Academia Sinica and resolved the atomic structure of this new bacteriorhodopsin. These researchers found a cap-like structure that faced the outside of the cell and was stabilized by some extra chemical bonding networks, leading to functional enhancement.

This research will be noted as an important milestone for the application of such microbial rhodopsins because it provides a lucid principle for future protein engineering to improve the functionality of such proteins.

In this study, Yang's lab used this powerful bacteriorhodopsin to develop an ITO-based device (3) and showed that measurable electric current could be produced upon light activation. This device provides new design possibilities for the development of medical and electronic applications of bacteriorhodopsins.

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