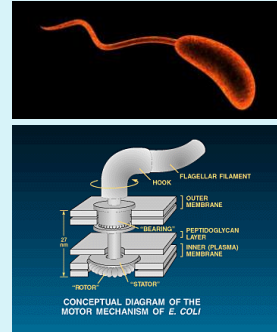


It's All About Concentration Gradients

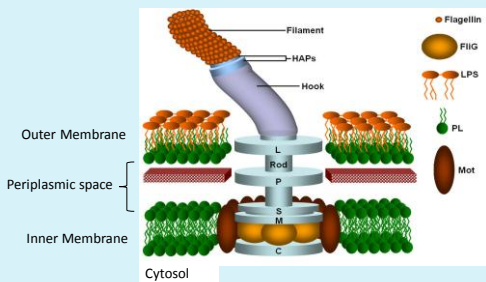
Gopal R Periyannan
Chemistry

Fascinating Flagellum



[Image sources: www.veritas-ucsb.org, biologos.org](http://www.veritas-ucsb.org/biologos.org)

Fascinating Flagellum

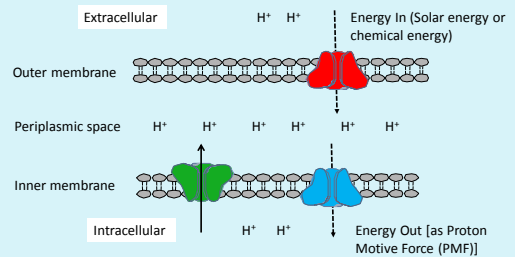


Where does the power come from?

[Image Source: www.cronodon.com](http://www.cronodon.com)

Proton Concentration Gradient

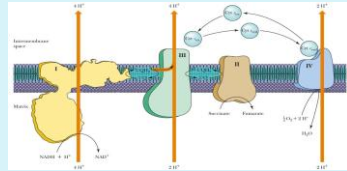
- Cellular lipid membrane-bound proteins act as proton pumps



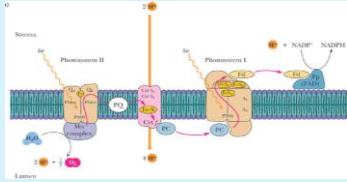
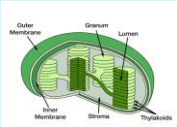
- A method of energy storage

Natural Proton Gradient Generators

Respiration in Mitochondria
– Biochemical Energy

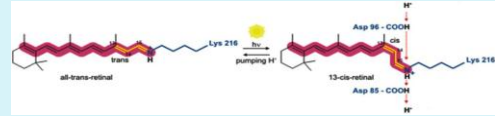


Photosynthesis in Chloroplast
– Solar Energy

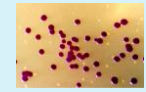
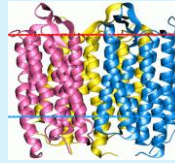


Another Natural Proton Gradient Generator

Rhodopsins: Proteins with a pigment to absorb light energy



Bacteriorhodopsin/Proteorhodopsin:
Light activated bacterial proton pumps

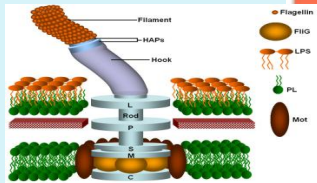
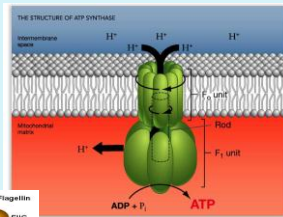


Halobacterium salinarum



Proton Gradient Users

ATP Synthesis by ATPase

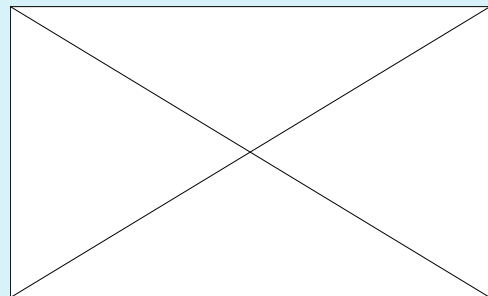


Biological Motors

<http://en.wikipedia.org/wiki/>

Fascinating Flagellum

- Proposed functional mechanism



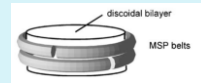
“There are two possible outcomes: if the result confirms the hypothesis, then you’ve made a discovery. If the result is contrary to the hypothesis, then you’ve made a discovery.”

Enrico Fermi

“Research is what I'm doing when I don't know what I'm doing!”

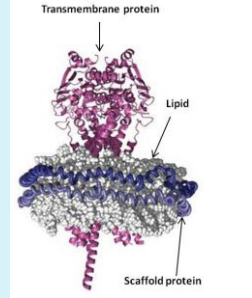
Wernher von Braun

Lipid Nanodisc



A simpler method to handle membrane proteins.

Lipid Nanodisc with Membrane Protein

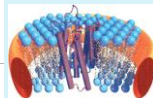


T. K. Ritchie et al. *Methods Enzymol.* **464**, 211–231 (2009)

Self-assembly of single integral membrane proteins into soluble nanoscale phospholipid bilayers

TIMOTHY H. BAYBURT^{1,2} AND STEPHEN G. SLIGAR^{1,2,3}
¹Department of Biochemistry, ²Department of Chemistry, and ³The Beckman Institute, University of Illinois, Urbana, Illinois 61801, USA

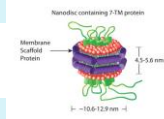
[Protein Sci.](#) 2003 Nov;12(11):2476-81



Assembly of single bacteriorhodopsin trimers in bilayer nanodiscs

Timothy H. Bayburt^{a,b}, Yelena V. Grinkova^{a,b}, Stephen G. Sligar^{a,b,c,*}

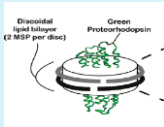
[Arch Biochem Biophys.](#) 2006 Jun 15;450(2):215-22.



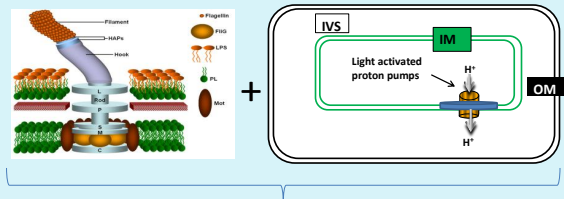
Green Proteorhodopsin Reconstituted into Nanoscale Phospholipid Bilayers (Nanodiscs) as Photoactive Monomers

Matthew J. Ranaghan,¹ Christine T. Schwall,¹ Nathan N. Alder,¹ and Robert R. Birge^{1,2}

[J Am Chem Soc.](#) 2011 Nov 16;133(45):18318-27.



Step Towards Synthetic Life?



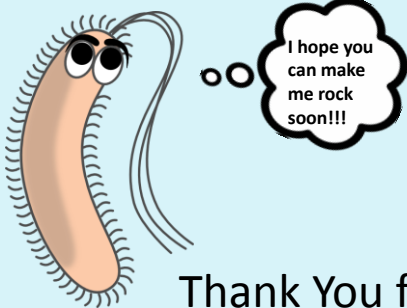
Solar power

Current Status

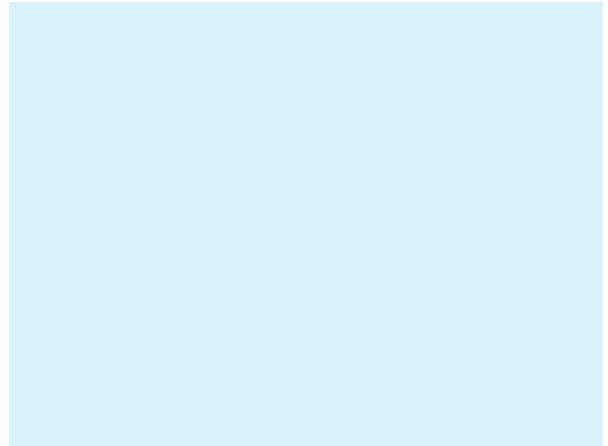
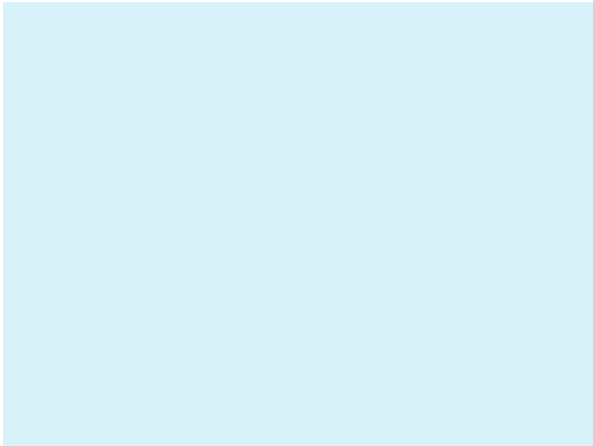
- Collaborative research with UIUC
- Internal grant funded (PIF)
- Internal grant application pending (PRF)

“You have to dream before your dreams can come true”

Dr. Abdul Kalam



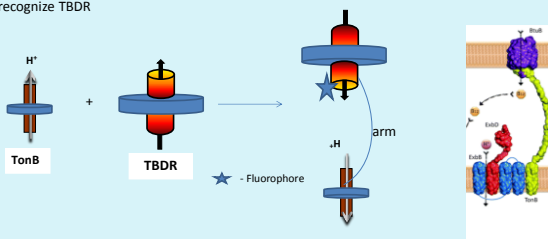
Thank You for Your
Attention!



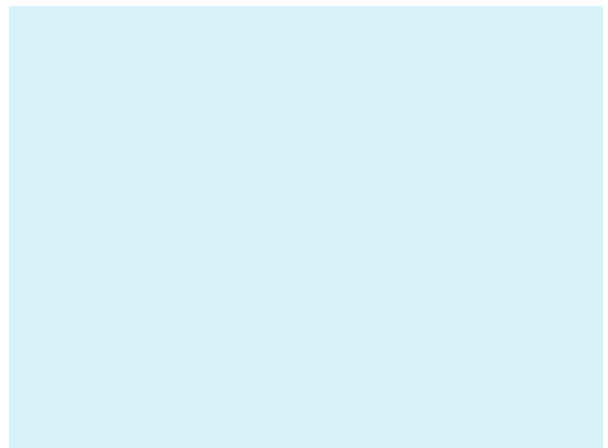
Stage 2: Assembly of protein containing nanodiscs

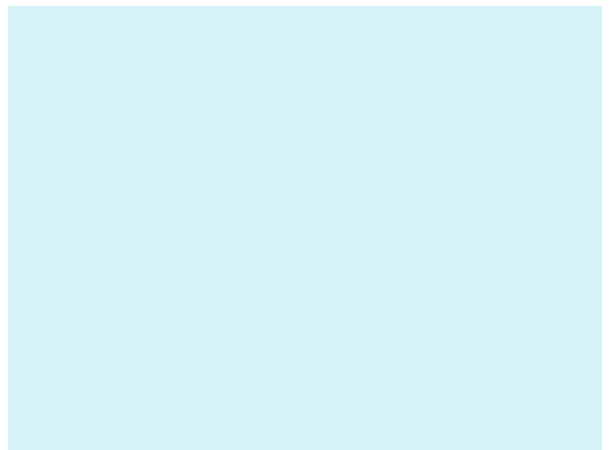
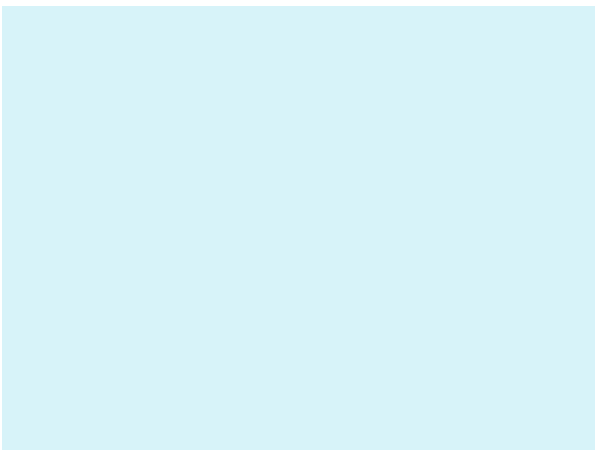
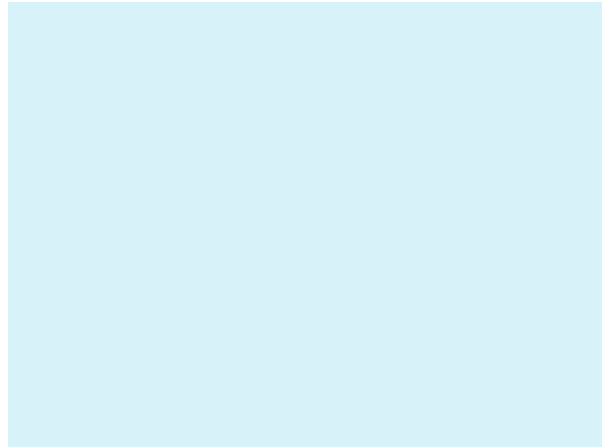
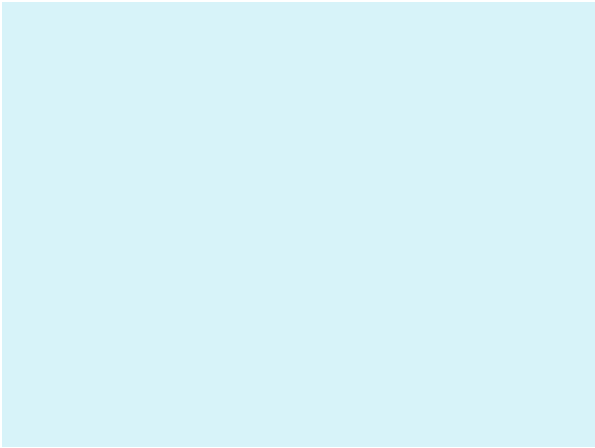
(A) TonB – TBDR interaction

Hypothesis: Upon mixing nanodiscs with TonB/TBDR proteins, TonB arm would recognize TBDR



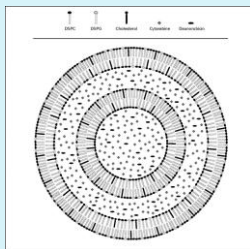
- Labeled proteins can be monitored by microscopy / spectroscopy to detect association
- Alternative recognition method – CRY2 System





Who is Pitching In?

- Bilamellar Vesicle (BLV)



[Complex dynamics of a bilamellar vesicle as a simple model for leukocytes](#)

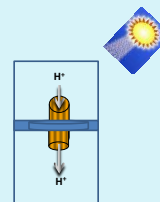
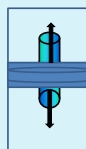
By Kaoui, Badr; Krueger, Timm; Harting, Jens
From *Soft Matter* (2013), 9(33), 8057-8061.

Feldman E J et al. *JCO* 2011;29:979-985

Stage 2: Assembly of protein containing nanodiscs

(b) Functionalization of Porin and Rhodopsin

OprB porin



- Compartmentalization – Literature precedent
- Nanodisc-protein on the divider / Liposome?
- Establish diffusion / proton transfer
- Characterize diffusion / proton transfer

