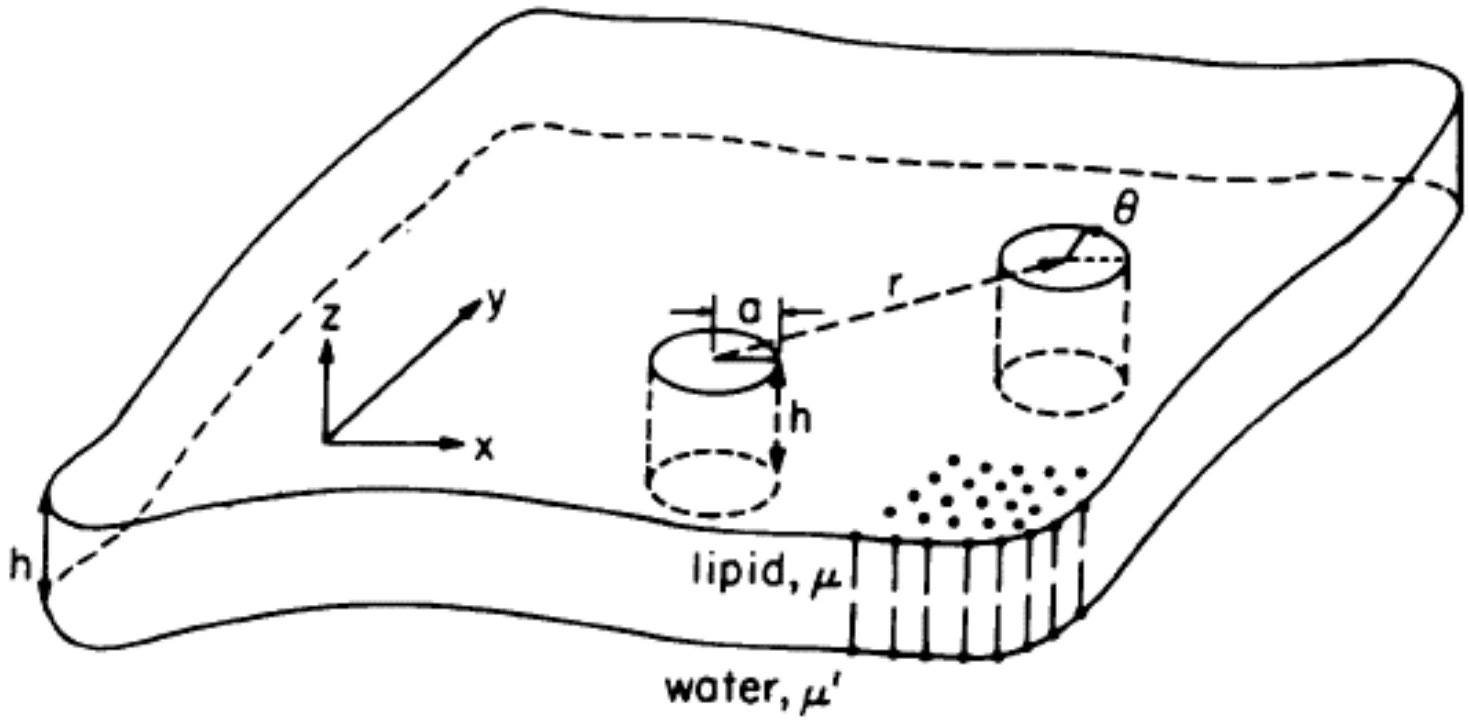
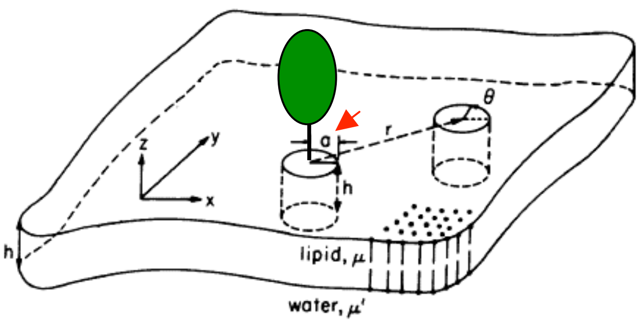

θ
r
a
z
y
x
h
h
lipid, μ
water, μ′

Lateral Diffusion (Saffman-Delbruck)

$$D_L = \frac{kT}{4\pi\eta_m h}\left(\ln\frac{\eta_m h}{\eta_w \boxed{a}} - 0.58\right)$$

- weak dependence on radius
- no dependence on things outside of the membrane



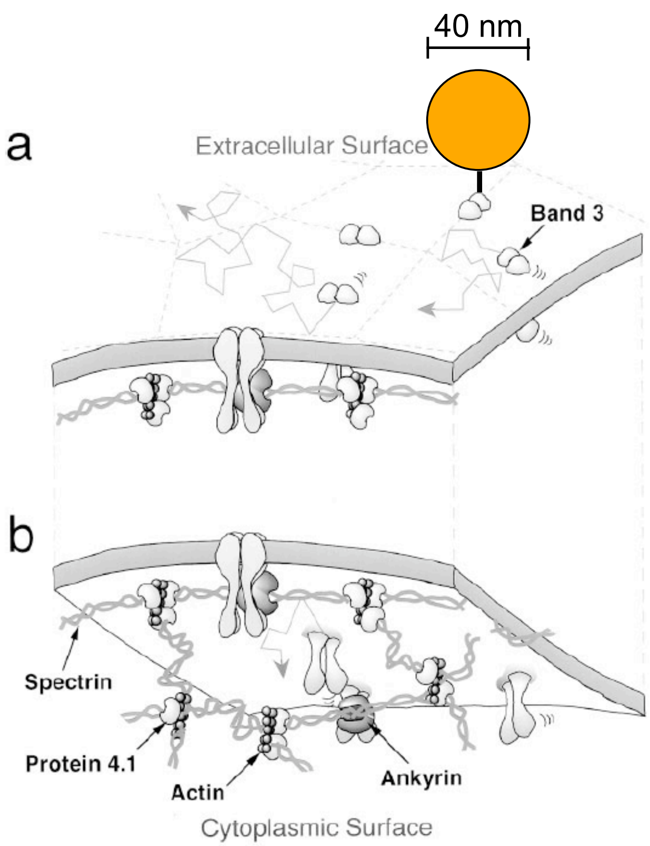
Protein	Cell type	Mutation	Length of cytoplasmic domain	D (cm^2/sec)
H-2	Mouse cells	wild-type	31	1.2×10^{-9}
		mutant	4	1.5×10^{-9}
EGF receptor	COS-1	wild-type	542	1.2×10^{-10}
		mutant	9	1.2×10^{-10}
VSV "G" protein	COS-1	wild-type	29	0.8×10^{-10}
		mutant[a]	3	2×10^{-10}

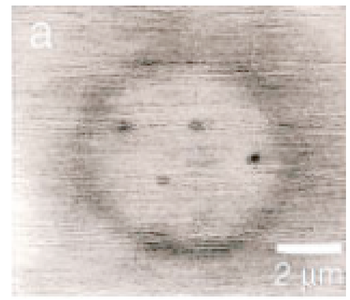
(mutant is a replacement of the entire cytoplasmic domain with a short peptide)

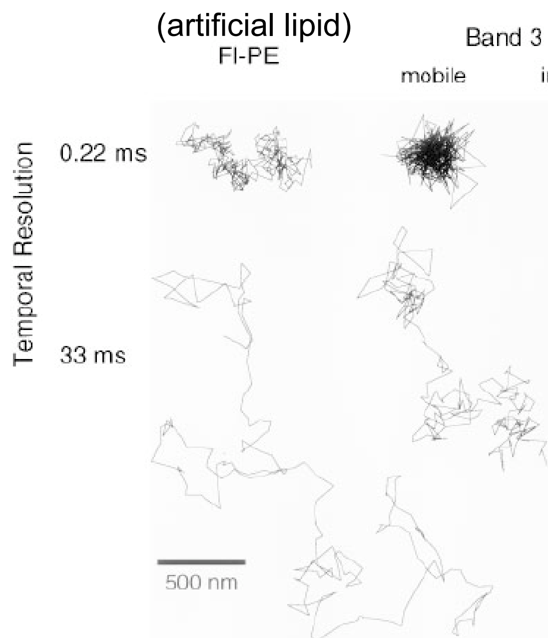
(Saffman and Delbruck, 1975; Jacobson et al., 1987)

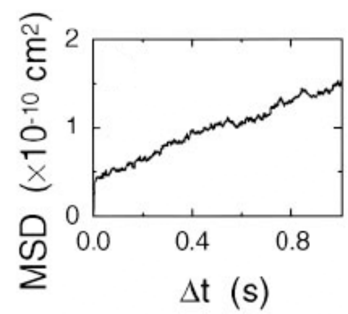
Single-Molecule Measurements of Lateral Diffusion

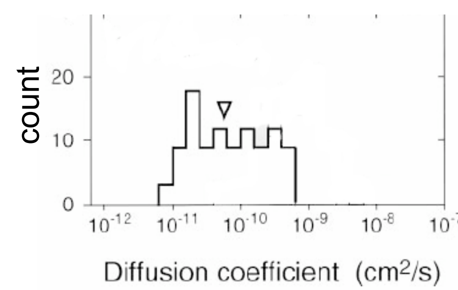
- Proteins can be labeled with gold probes without affecting lateral diffusion
- Motion is tracked via a camera











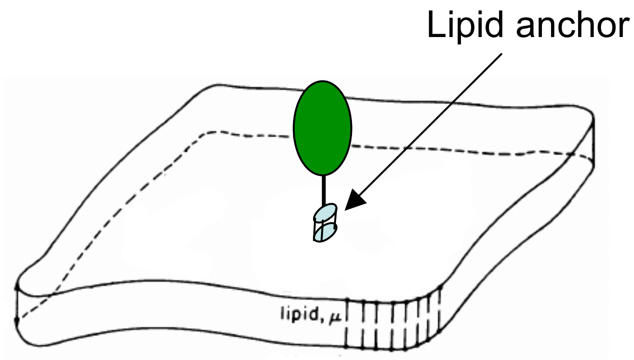
(Kusumi, J. Cell Biol., 1998)

Speeding Up Diffusion

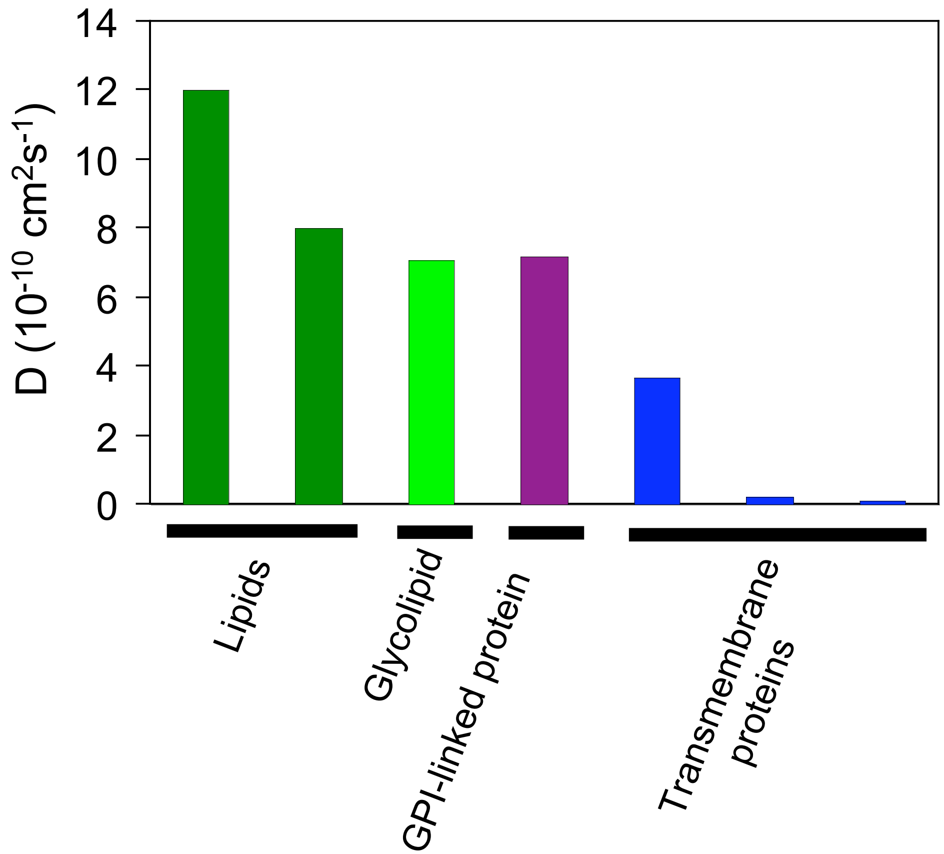
- The only way to speed up lateral diffusion is to reduce *a*

$$D_L = \frac{kT}{4\pi\eta_m h}\left(\ln\frac{\eta_m h}{\eta_w \boxed{a}} - 0.58\right)$$

- In fibroblast membranes

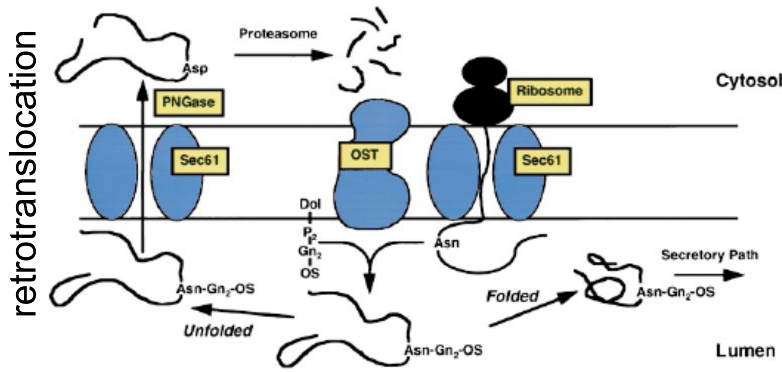


(*e.g.*, glycosylphosphatidylinositol, a posttranslational C-terminal lipid anchor)



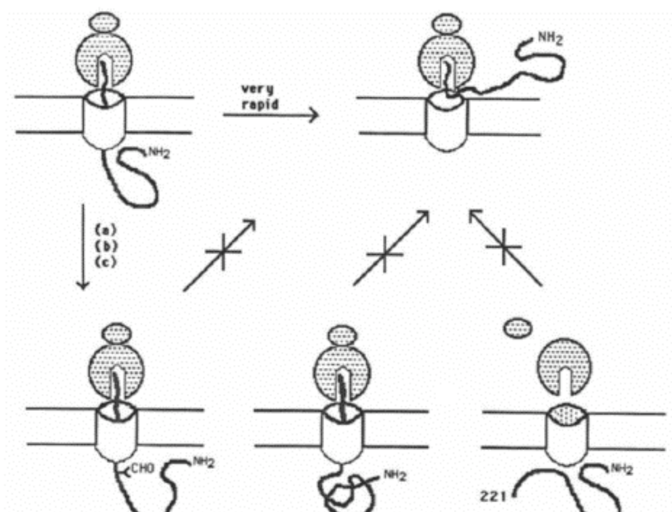
(Saxton and Jacobson, 1997)

Bidirectional Motion in a Passive Pore



Endoplasmic Reticulum

- in vitro transcription/translation system
- discovered that proteins were translocated but not maintained in microsomes (a small vesicle deprived from the ER when cells are homogenized)



(a) glycosylation (b) folding (c) stop codon

(Ooi and Weiss, Cell, 1992)