

Lipide und Membranen

Lipide: amphiphile Strukturen mit 1-3 Fettsäureresten (typisch 2 Fettsäuren)

(A) Schematic diagram of a phospholipid molecule showing a polar head group (Choline and Phosphate linked to Glycerol) and two nonpolar hydrophobic tails (Fatty Acids). Labels indicate the polar head group, nonpolar tails, and glycerol carbons 1 and 2.

(B) Detailed chemical structure of a phospholipid molecule with a phosphate group containing a choline group ($\text{CH}_3-\text{N}^+(\text{CH}_3)_2$) and a glycerol backbone with two fatty acid chains. The fatty acids are shown with their chemical structures, including a cis-double bond.

(C) 3D space-filling model of a phospholipid molecule, showing the hydrophilic head group at the top and the hydrophobic tails extending downwards.

(D) A small schematic diagram showing a red hydrophilic head and two grey hydrophobic tails.

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Lipidtypen

(A) Sterol structure (e.g., cholesterol).

(B) Schematic of a rigid steroid ring structure with a polar head group and a nonpolar hydrocarbon tail.

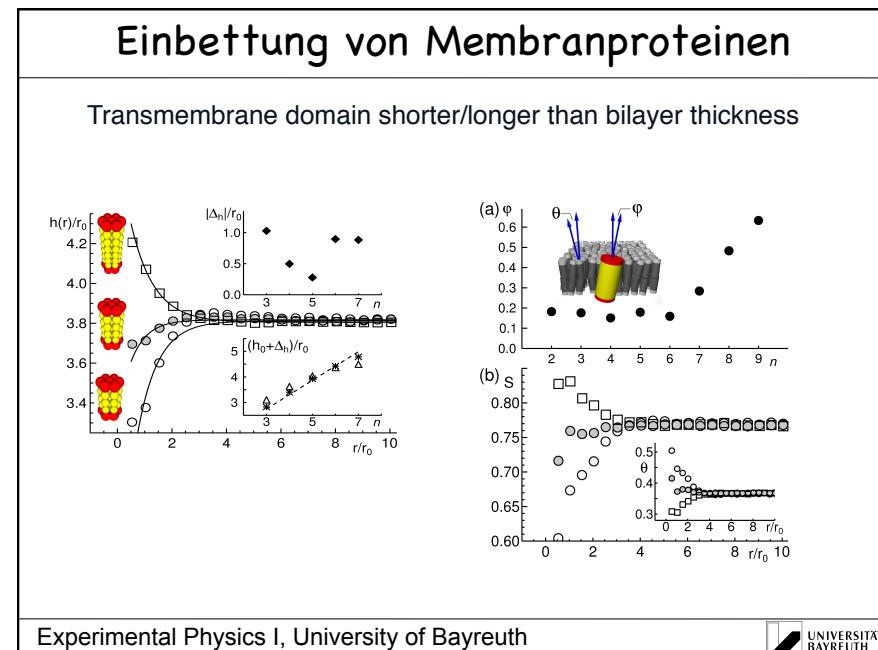
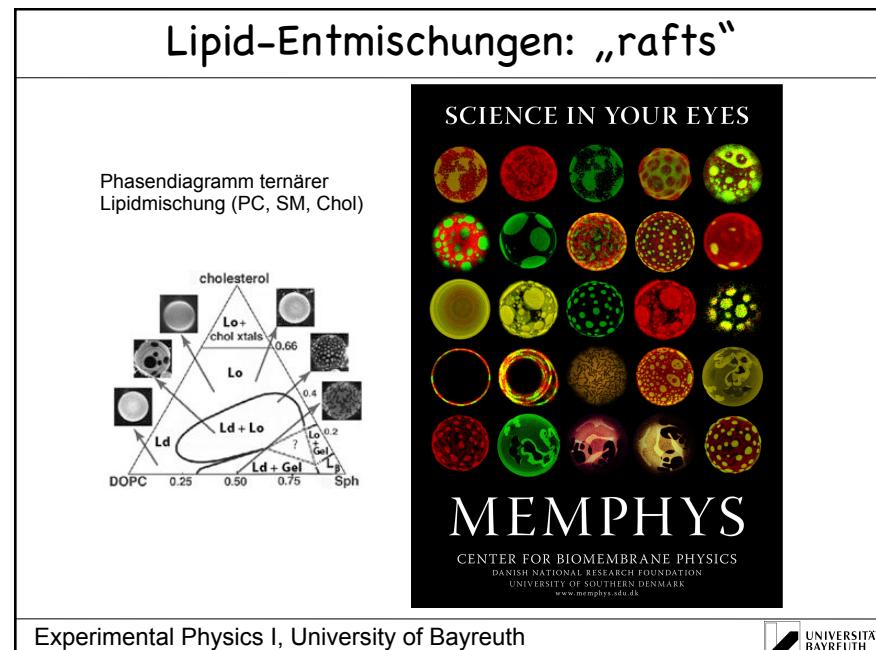
(C) 3D space-filling model of a sterol molecule.

Cholesterol
PE
PS
PC
SM

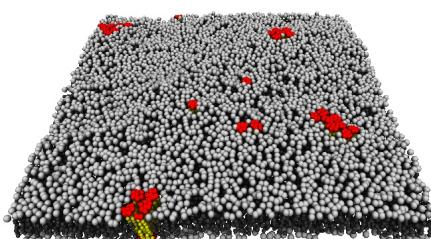
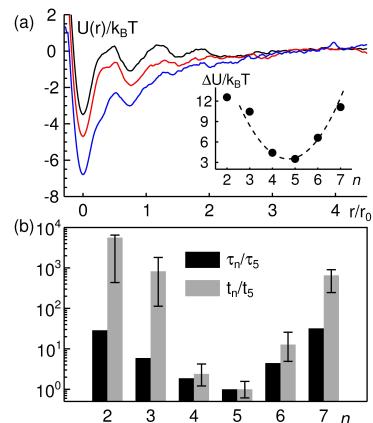
phosphatidylethanolamine
phosphatidylserine
phosphatidylcholine
sphingomyelin

FATTY ACID TAIL

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Cluster-Bildung via hydr. mismatch

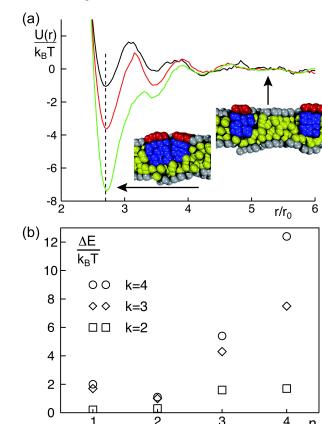


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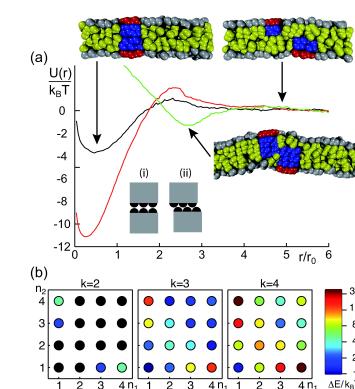


Einbettung peripherer Proteine

in-plane dimerization



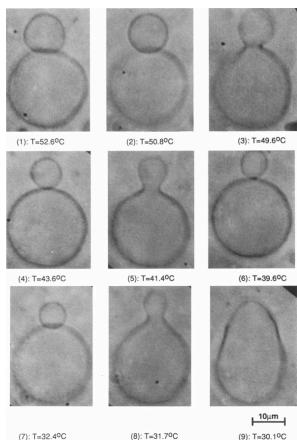
cross-leaflet dimerization



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Vesikelformen: exp. Beobachtung

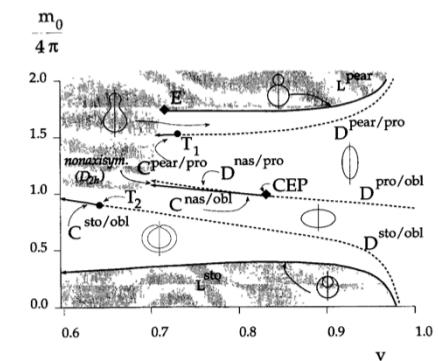
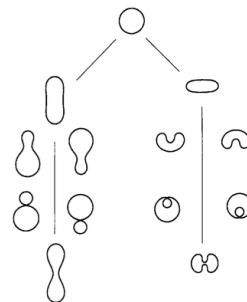


Käs & Sackman, BPJ 1991

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Vesikelformen: Theorie



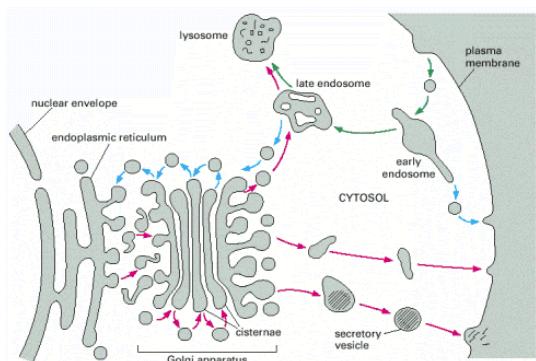
Area difference model (versch. Lipidzahl in Membranblättern)
=> spont. Krümmung

Seifert, Adv. Phys 1997

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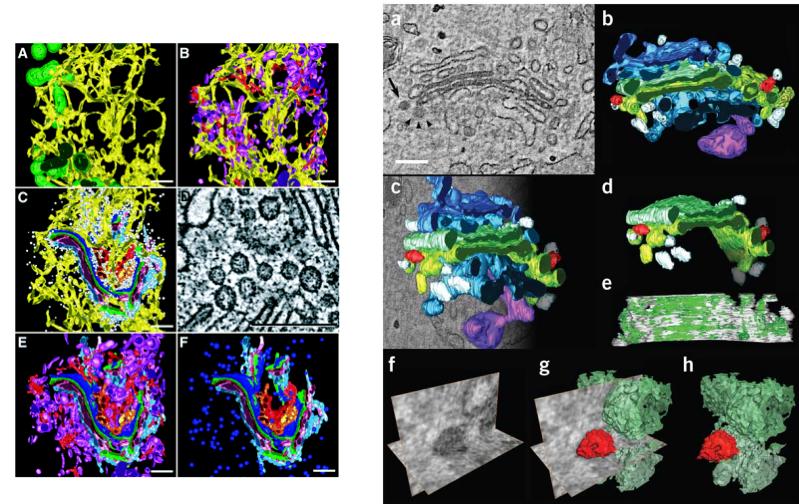
Membrane traffic



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Membranstrukturen, sekr. Pfad



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Three ways to make a vesicle...

A: COPI/II pathway. A vesicle pinches off from a membrane. It is coated by a green mesh-like structure (coatomer) and contains a yellow adaptor protein (ARF-1). **B**: COP II pathway. A vesicle pinches off from a membrane. It is coated by a green mesh-like structure (coatomer) and contains a yellow adaptor protein (ARF-1). **C**: Clathrin-mediated pathway. A vesicle pinches off from a membrane. It is coated by a green mesh-like structure (coatomer) and contains a yellow adaptor protein (ARF-1). **D**: Clathrin-mediated pathway. A vesicle pinches off from a membrane. It is coated by a green mesh-like structure (coatomer) and contains a yellow adaptor protein (ARF-1).

COPI/II: Adaptor GTPase (ARF-1, Sar1), coat (coatomer, Sec23/24+13/31), GAP (ARFGAP1/3, Sec23/24+13/31)

(A) Electron micrograph of a vesicle. (B) Schematic of a vesicle with heavy chain and light chain. (C) Electron micrograph of a vesicle. (D) Schematic of a vesicle.

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Fusion & Fission von Membranen

SNAREs ziehen Membranen zusammen

The diagram shows a synaptic vesicle (containing v-SNARE synaptobrevin) fusing with a nerve cell plasma membrane (containing t-SNARE SNAP25). The fusion is driven by the interaction of v-SNARE and t-SNARE.

b Zipping

The vesicle membrane (red) and target membrane (blue) approach each other. The SNARE proteins (green) on both membranes interact, pulling the membranes together. This is labeled **b Zipping**.

c Hemifusion

The vesicle membrane (red) and target membrane (blue) partially merge at a fusion pore. The SNARE proteins (green) remain on opposite sides of the membrane. This is labeled **c Hemifusion**.

d

Dynamin (represented by an orange sphere) pinches off a vesicle from the parent membrane. This is labeled **f**.

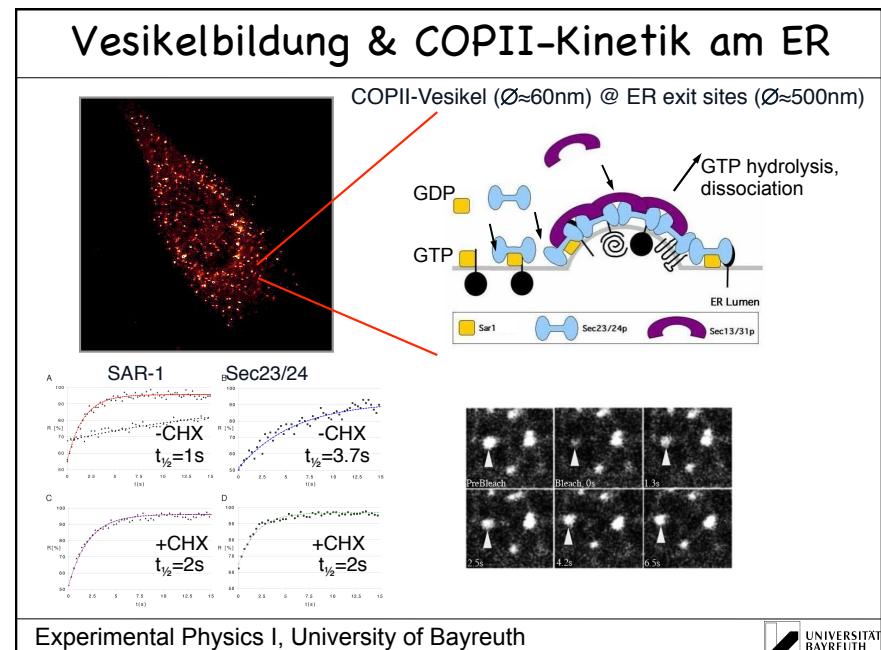
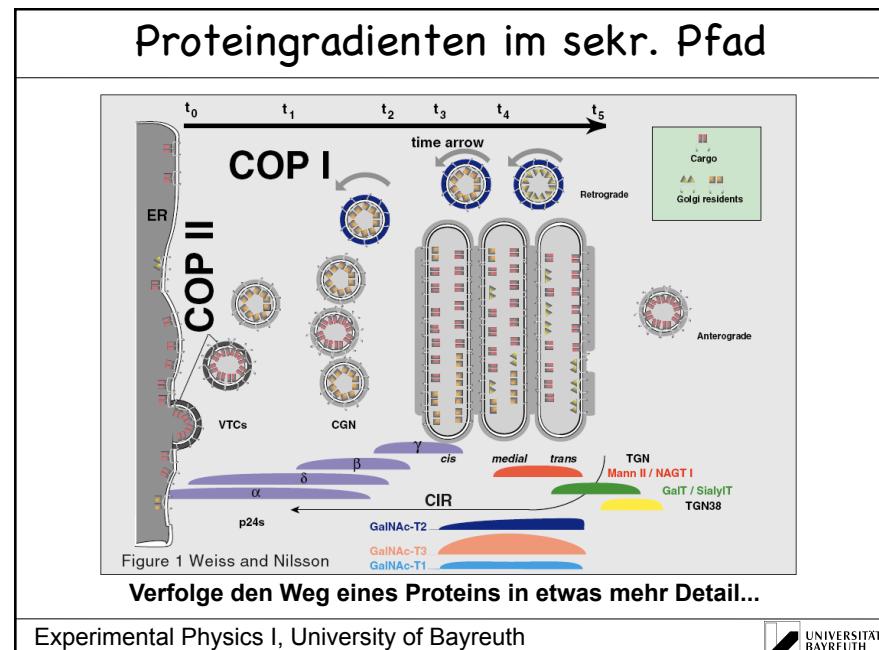
e Fusion pore

The vesicle membrane (red) and target membrane (blue) are partially fused. The SNARE proteins (green) remain on opposite sides of the membrane. This is labeled **e Fusion pore**.

Nature Reviews | Molecular Cell Biology

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Bildung von ERES - ein Modell

Concept: Condensation of protein clusters on membrane

Rule of the game

Monomers

- attach from cytoplasm (k_{on})
- detach from membrane (k_{off})

Clusters

- diffuse (size-dependent mobility)
- fuse when in proximity ('touching')

Vesicle buds from cluster (k_{bud})

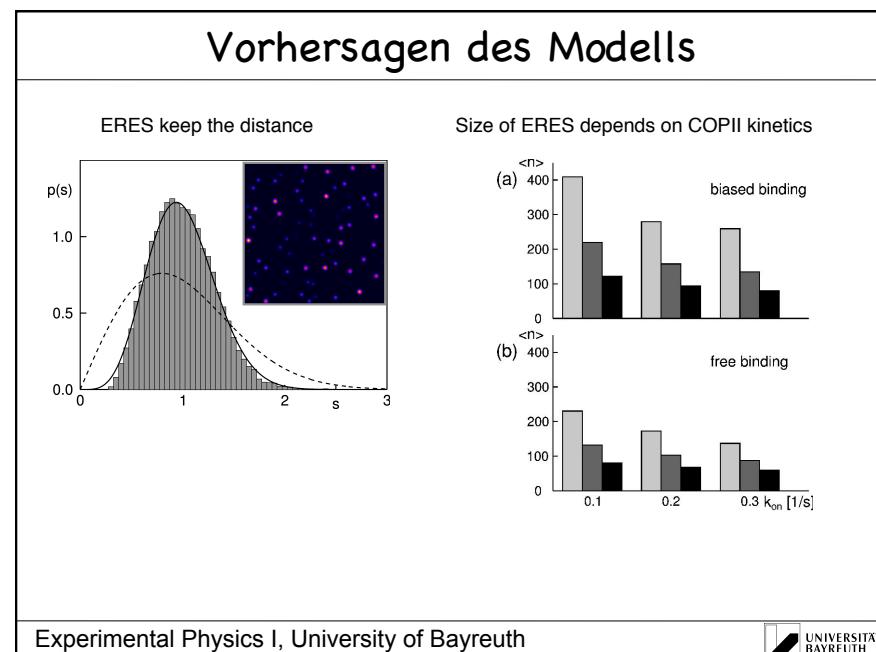
Observations in yeast (Glick lab)

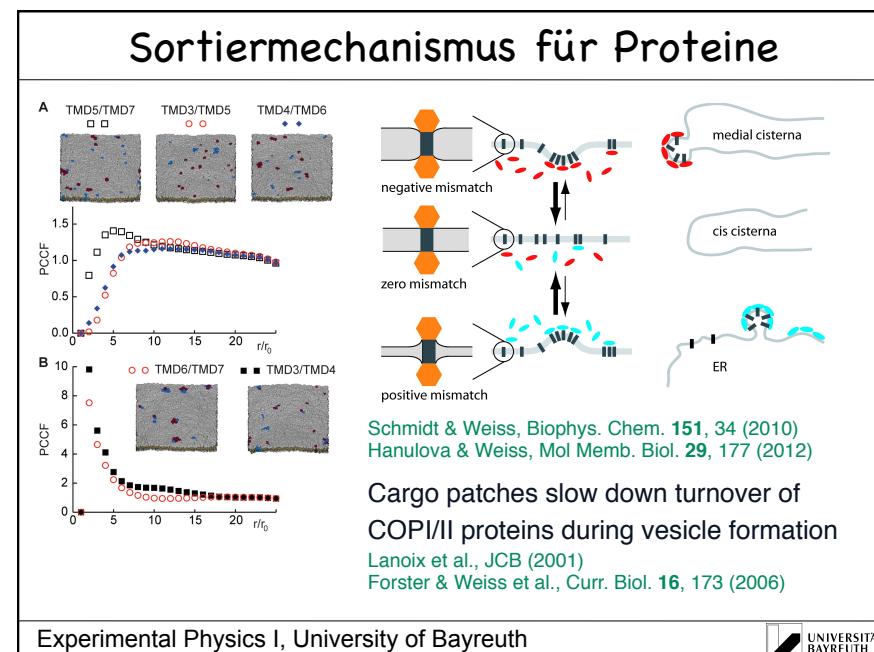
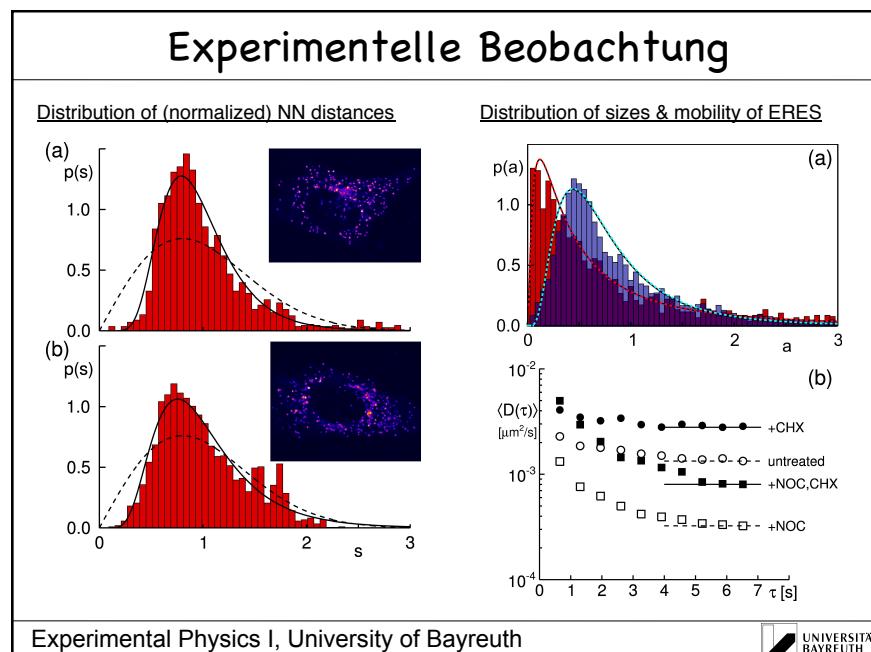
- + ERES form *de novo*
- + ERES fuse with each other
- + ERES grow & shrink (preferred size)

Entmischung wie in Flory-Huggins-Theorie

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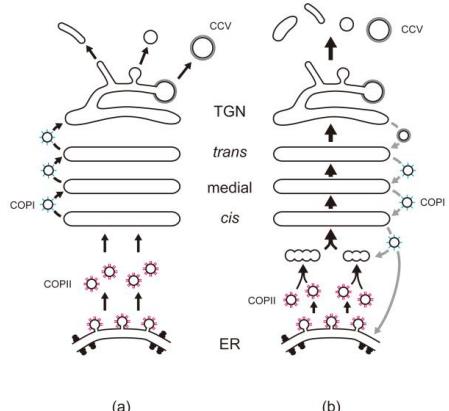
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Modelle für Intra-Golgi-Transport

Maturation vs. stabile Zisternen



Aktuell: Maturation durch mehr experimentelle Daten unterstützt
Lanoix et al; Glick & Nakano labs

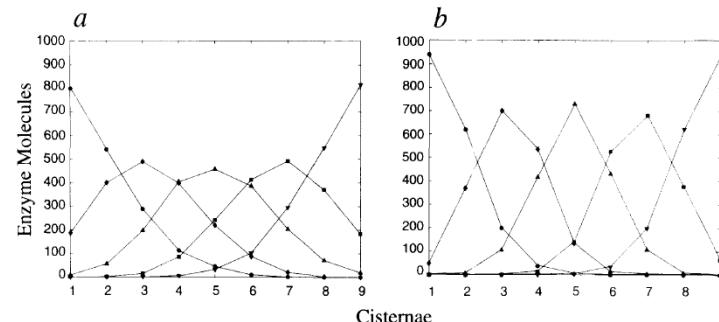
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Maturation & Proteingradienten

Sorting by competition

verschicke N Proteine pro Zeitschritt, suche Teilnehmer in jeder Zisterne aus nach Kompetitivität e_j : $p_j = e_j n_j / \sum e_i n_i$ [Glick, Elson, Oster 2000]



Problem: nicht robust gegen
Überexpression, neue Teilchensorte, Variation der Zisternenzahl etc.
Abhilfe ist ein lokaler Trigger (pH, Membrandicke etc.) [Weiss & Nilsson]

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