



Sculpting Membranes: A Mechanism of Membrane-Curvature Generation by Proteins

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Abstract:

A wide spectrum of intracellular processes is dependent on the ability of cells to dynamically regulate membrane shape. Membrane bending by proteins is necessary for the generation of intracellular transport carriers and for the maintenance of otherwise intrinsically unstable regions of high membrane curvature in cell organelles. Understanding the mechanisms by which proteins curve membranes is therefore of primary importance. Crescent shaped N-BAR domains containing amphipathic helices can induce membrane curvature by two mechanisms: the scaffolding mechanism due to the very shape of the BAR dimer, and the hydrophobic insertion mechanism by which small shallow inclusions penetrate the membrane matrix and act as a wedge changing the local membrane curvature. We will focus on this latter mechanism, and study it from a quantitative point of view. We use an elastic model of the lipid bilayer, taking into account the internal strains and stresses generated by the presence of an inclusion. We show that large membrane curvatures found in vitro experiments can be ascribed to this mechanism, and that shallow insertions are more powerful curvature generators than lipids.

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