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A free energy model for observed morphology of mitochondrial cristae ARLETTE BALJON, MARIAM GHOCHANI, JIM NULTON, PETER SALAMON, TERRENCE FREY, San Diego State University, AVINOAM RABINOVITCH, Ben-Gurion University of the Negev — Electron tomograms have revealed that in normal mitochondria the inner membrane self-assembles into a complex structure that contains both tubular and flat lamellar cristae components. This structure, which contains one matrix compartment, is believed to be essential to the proper functioning of mitochondria as the powerhouse of the cell. It was indeed observed that the morphology is lost during programmed cell death - the mitochondrial inner membrane transforms into multiple vesicular matrix compartments. We have been able to construct a model in which the observed morphology can be obtained by minimizing the system's free energy. The model assumes that mechanical forces act on the membrane, which we believe to be exerted by proteins. In order to test the model, we measured the structural features of mitochondria in HeLa cells and mouse embryonic fibroblasts using 3D electron tomography. Data obtained from different mitochondria show excellent agreement. The model predicts that the crista membrane structure of healthy mitochondria is stabilized by tensile forces of the order of 10 pN, comparable to those typical of motor proteins. The model also predicts reasonable values for the pressure difference across and the surface tension of crista membranes.

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