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Dynamics of membrane growth and form

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The growth, form, and division of membrane-bound vesicles and organelles is a unifying motif across biology. Membranes form the boundaries of the nucleus and cell, organelles such as mitochondria and endoplasmic reticulum, and vesicles used to transport proteins and other biomolecules. Importantly, these membranes are out-of-equilibrium systems as their lipid constituents are in a state of continual turnover and exchange. Here, we build on a model [1] in which vesicle growth is driven purely by physicochemical processes of membrane growth, permeability, and elasticity. We use the immersed boundary method to explore the fluid-structure interaction of growing vesicles. By comparing our simulation results to experiments on fatty acid vesicles [2], we show how the model captures essential behaviors required of prebiotic vesicles, membraneous bags of fluid of varying components and shapes is hypothesized to have served as the substrate for the origin of life.

REFERENCES

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