

Protocells

Sarah Maurer

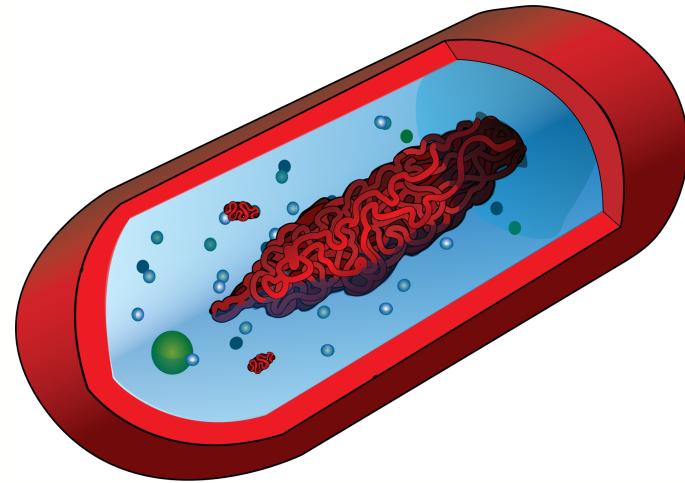
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Importance of aggregates to origins of life

Necessary:

- Co-localize metabolic/genetic components
- Define the individual to allow for selection
- Direct involvement in metabolism
 - Chemical gradients
 - Electron transfer reactions
 - Catalytic
- Protect metabolic/genetic components



Reviews?

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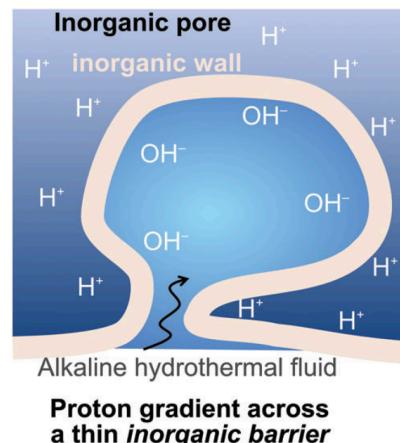
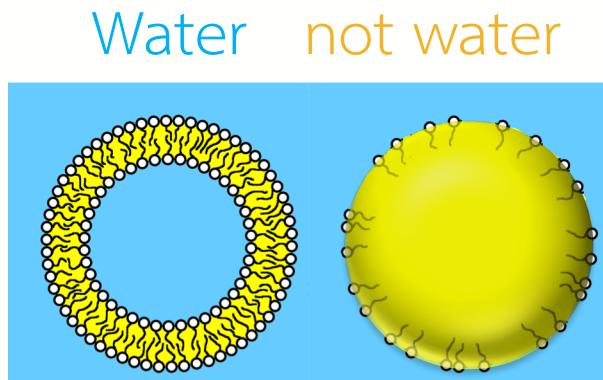
Maurer, S. E. & Monnard. *Entropy* **13**, 466–484 (2011).

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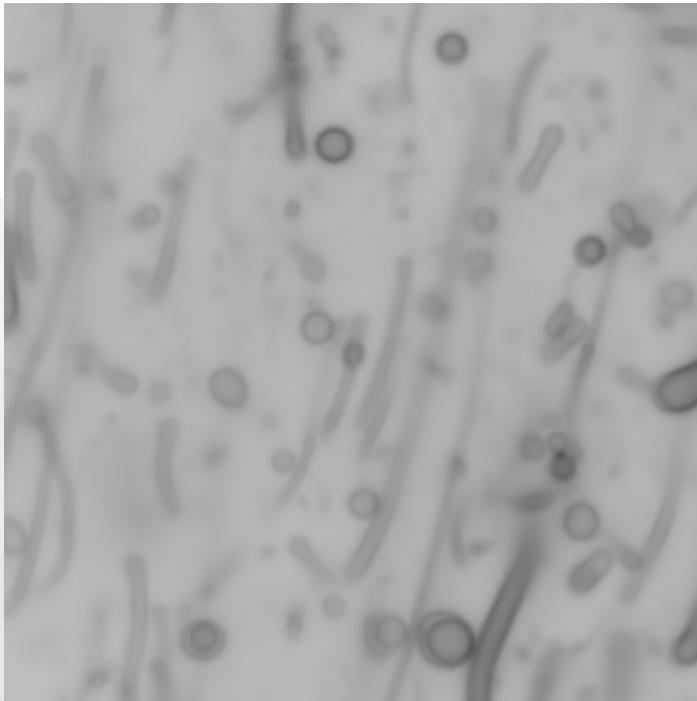
Self-assembled structures

Controlled by the hydrophobic effect (entropy) and non-bonding interactions (e.g., hydrogen bonds)

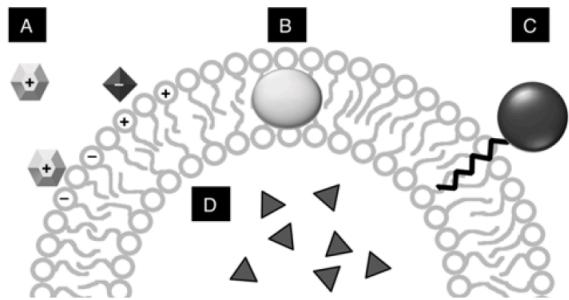
Type	Definition	Biological example
Vesicle (Liposome)	Bilayer-enclosed aqueous compartment	Cells, membrane bound organelles,
Oil droplet	Nonpolar bulk phase often stabilized by amphiphiles	Lipoproteins (LDL)
Coacervate	Polar bulk phase separated from the water phase	P-bodies, membrane-less organelles



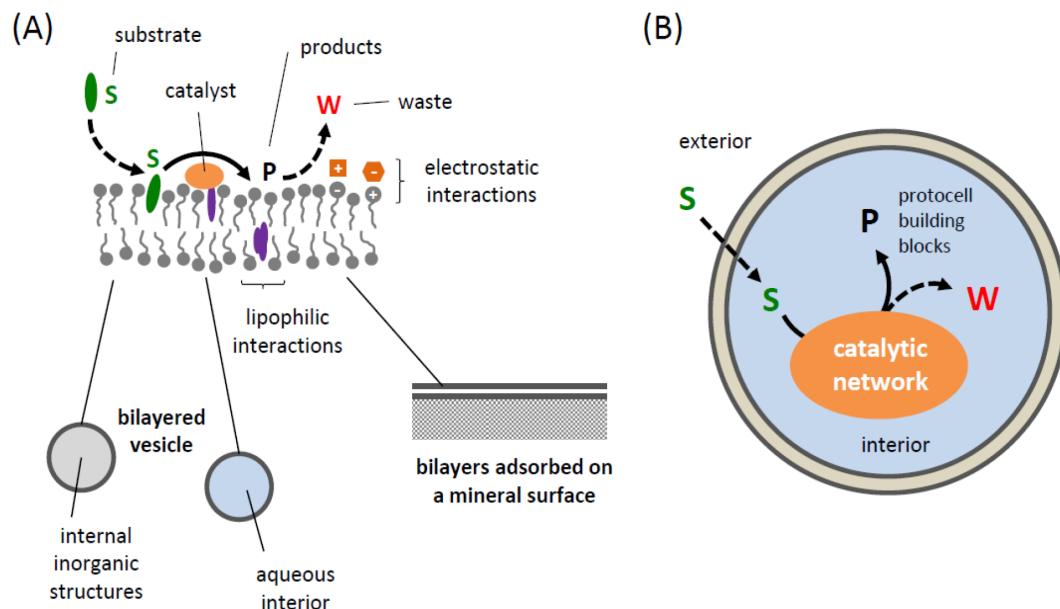
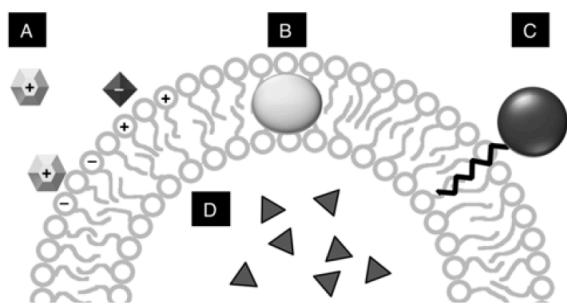
Factors that affect aggregation



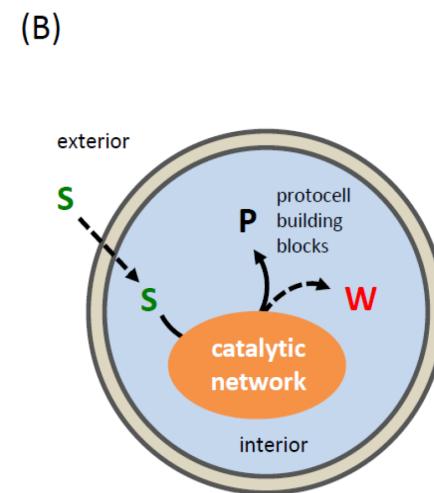
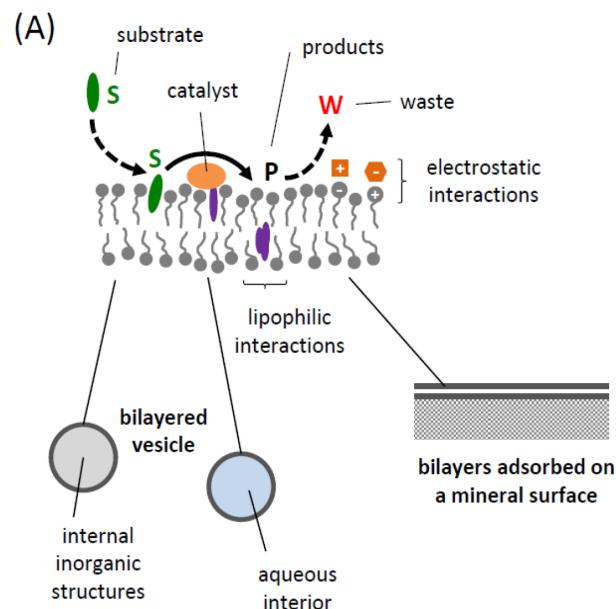
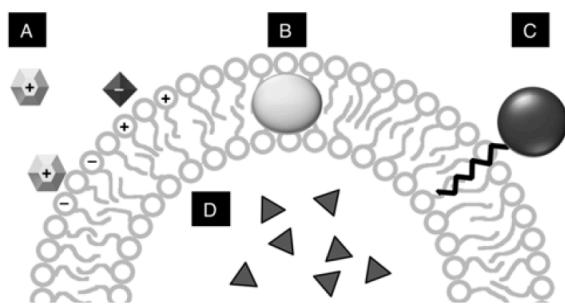
Protocells and reactions



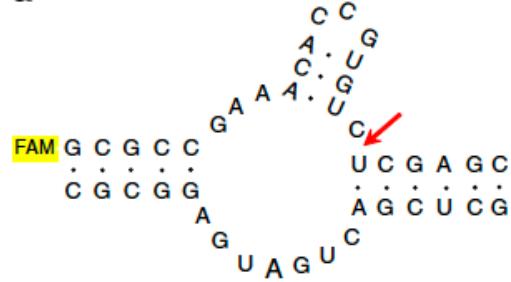
Protocells and reactions



Protocells and reactions

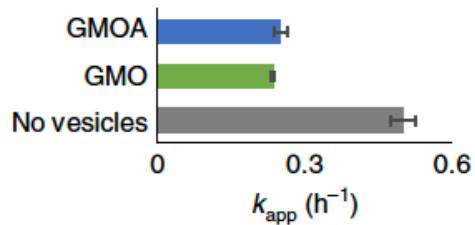


a

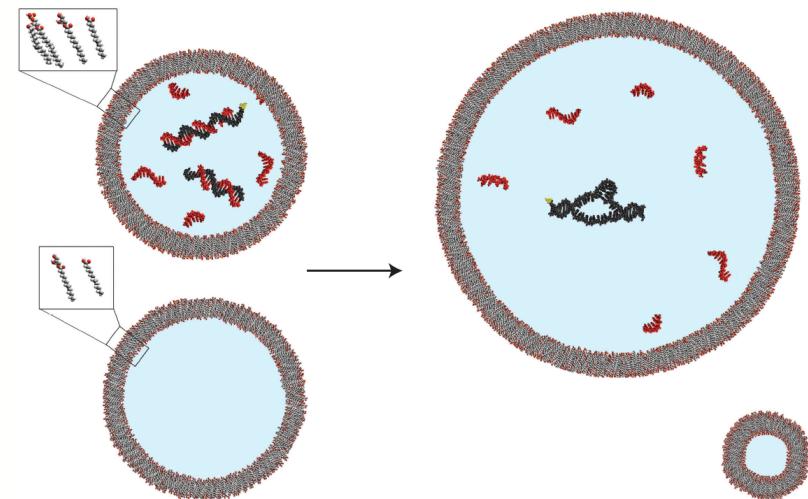
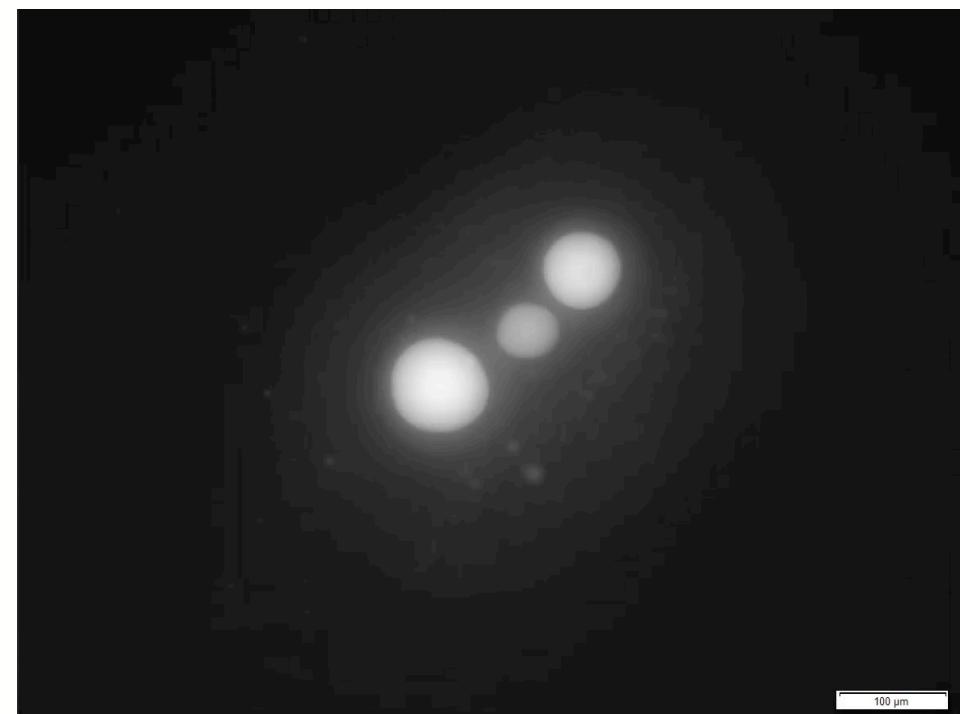


Hammerhead ribozyme

b



Protopcell Growth and division

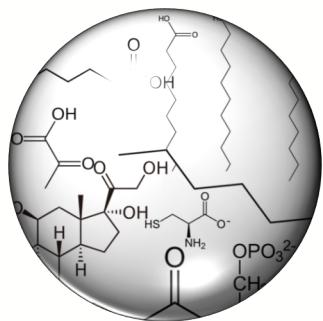


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Zhu, T. F.; Adamala, K.; Zhang, N.; Szostak, J. W. *Proc. Natl. Acad. Sci.* **2012**, 109 (25), 9828–9832.

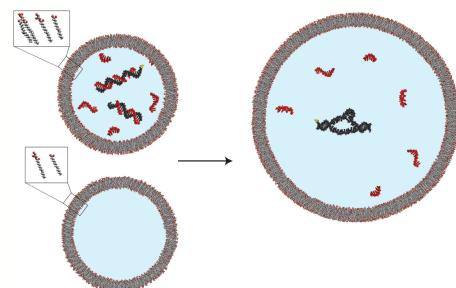
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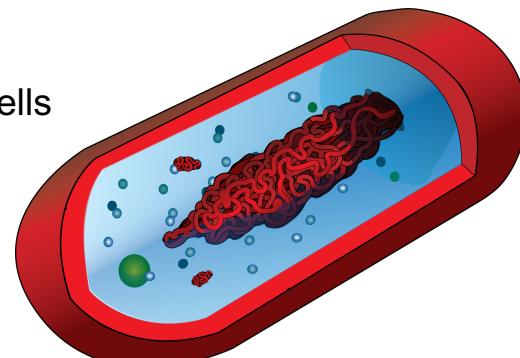
Prebiotic soup

Aggregation



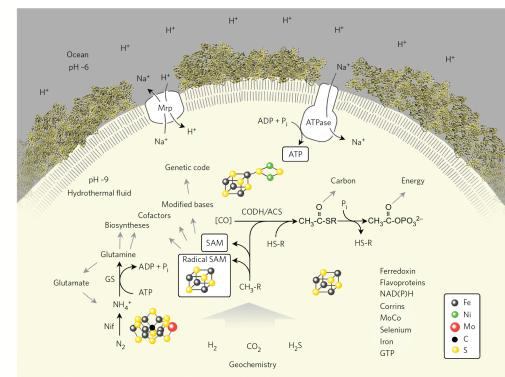
Self-assembled protocells

Decrease of molecular diversity,
increase in functional complexity



First life

Evolution to modern biology



LUCA