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Organizing biochemical reactions: Lessons from cyanobacteria[1]
NIALL MANGAN, Harvard University Systems Biology PhD Program, MICHAEL BRENNER, Harvard School of Engineering and Applied Sciences — Cyanobacteria are model organisms for photosynthesis and are of interest for bio-fuel production and carbon dioxide sequestration. I present a mathematical model of the carbon concentrating mechanism (CCM) in cyanobacteria. The CCM is a combination of transporters and enzymes distinctively organized in the cell, which increase the internal concentration of carbon dioxide, and improve the efficiency of converting carbon dioxide to sugar. I find that the internal carbon concentration can be completely described by solutions in two parameter regimes of the model. These solutions correspond to varying transporter and enzymatic activity, which can be directly connected to experimental measurements. I also find a dependence of the carbon concentration on the spatial organization of the reactions within the cell. Understanding the CCM in cyanobacteria gives us insight into design principles for the cellular organization of biological reactions.

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