Systematics and Limits to Metabolic Rates

Chris Kempes

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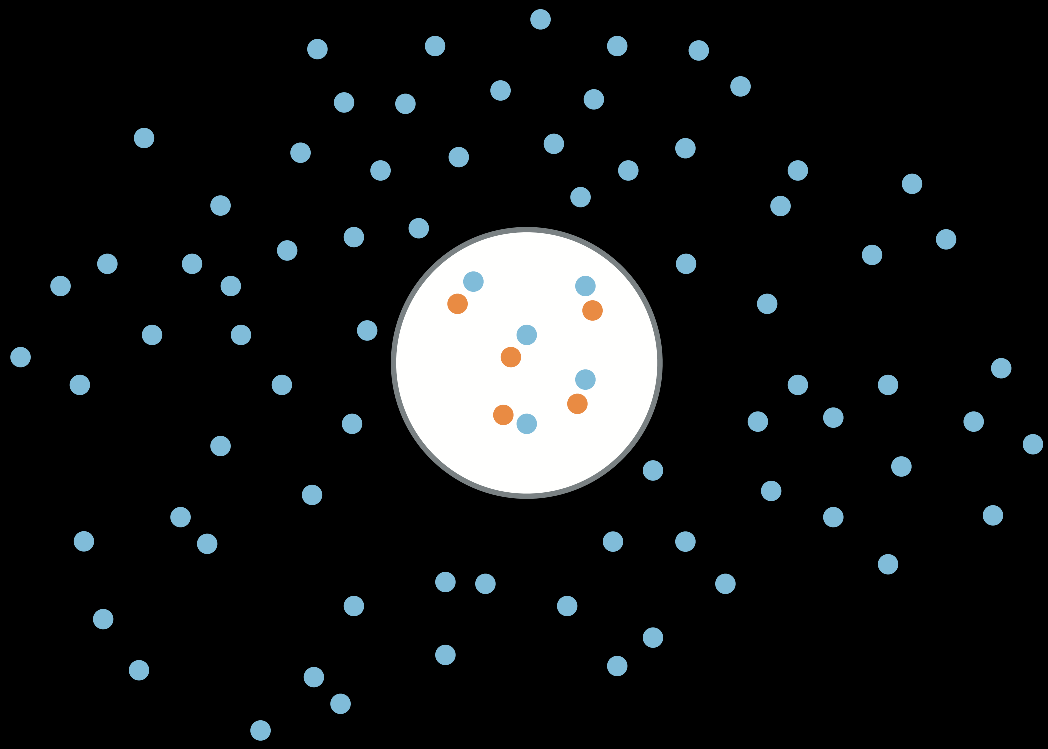
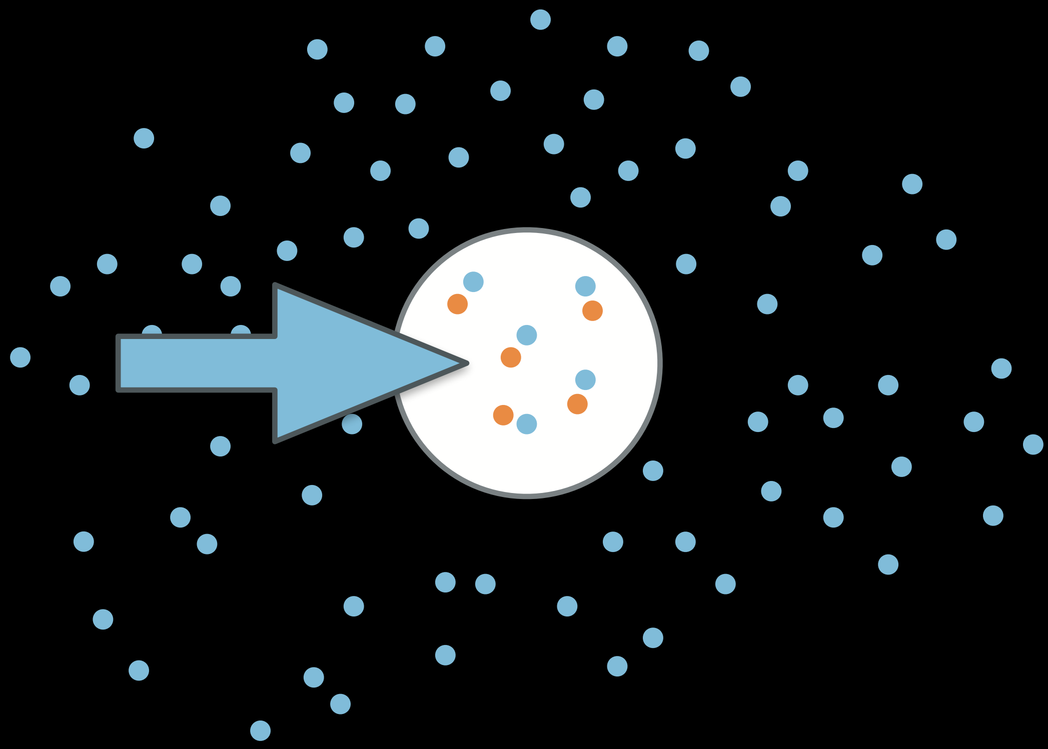
- What can be said about encapsulation in general?

Metabolism in “Cells”



Metabolism in “Cells”



Diffusion Equation

$$\frac{\partial C}{\partial t} = D\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial C}{\partial r}\right)$$

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Diffusion Equation

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Diffusion Equation

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$$dC = \frac{A}{r^2}dr$$

Diffusion Equation

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$$r^2\frac{\partial C}{\partial r} = A$$

$$dC = \frac{A}{r^2}dr$$

$$C = B - \frac{A}{r}$$

Diffusion Equation

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Diffusion Equation

$$r = \infty$$

$$C = C_\infty$$

$$B = C_\infty$$

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$$C = C_\infty - \frac{A}{r}$$

$$C = C_\infty \left(1 - \frac{a}{r}\right)$$

Diffusion Equation

$$C = C_\infty \left(1 - \frac{a}{r}\right)$$

$$J = -D\frac{\partial C}{\partial r}$$

Diffusion Equation

$$C = C_\infty \left(1 - \frac{a}{r}\right)$$

$$J = -D\frac{\partial C}{\partial r}$$

$$J = DC_\infty \frac{a}{r^2}$$

Diffusion Equation

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Total Flux:

$$J 4\pi a^2$$

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$$J = DC_\infty \frac{a}{r^2}$$

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$$\boxed{4\pi D a C_\infty}$$