Diffusion processes in the extracellular space

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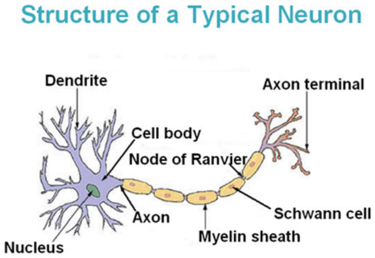
Contents

Brief introduction to the brain

Cells in the brain

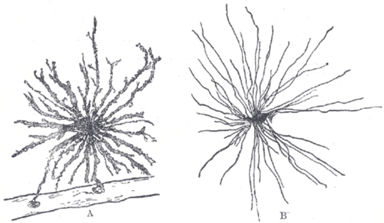
Neurons:

- Signal processing



Neuroglia:

- Janitorial tasks



The extracellular space

- Space surrounding neurons and neuroglia
- Accounting for $\sim 20\%$ of total brain volume
- Important for transport of nutrients, medicines etc.

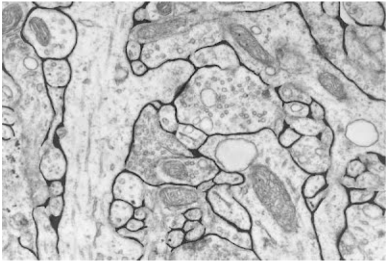


Figure: Extracellular space marked as dark grey.

Basic diffusion

The basic diffusion equation reads

$$\frac{\partial C}{\partial t} = D \nabla^2 C \tag{1}$$

Einstein relations

$$D = \frac{k_B T}{6 \pi \eta r} \tag{2}$$

$$\langle r^2 \rangle = 2dDt \tag{3}$$

Diffusion in ECS

Network simulations:

- Verification against experimental results
- Local field potential
- Extracellular conductance

$$\sigma = \frac{cq}{k_B T} D \tag{4}$$

$$\nabla \cdot (\sigma(\mathbf{r}) \nabla \phi(\mathbf{r}, t)) = -C(\mathbf{r}, t)$$

Optical measurements

TMA$^+$ measurements

Radiotracer measurements

Diffusion Tensor Imaging

Molecular dynamics

Random walks

Random walks