Cell and Tissue Engineering

Molecular Transport

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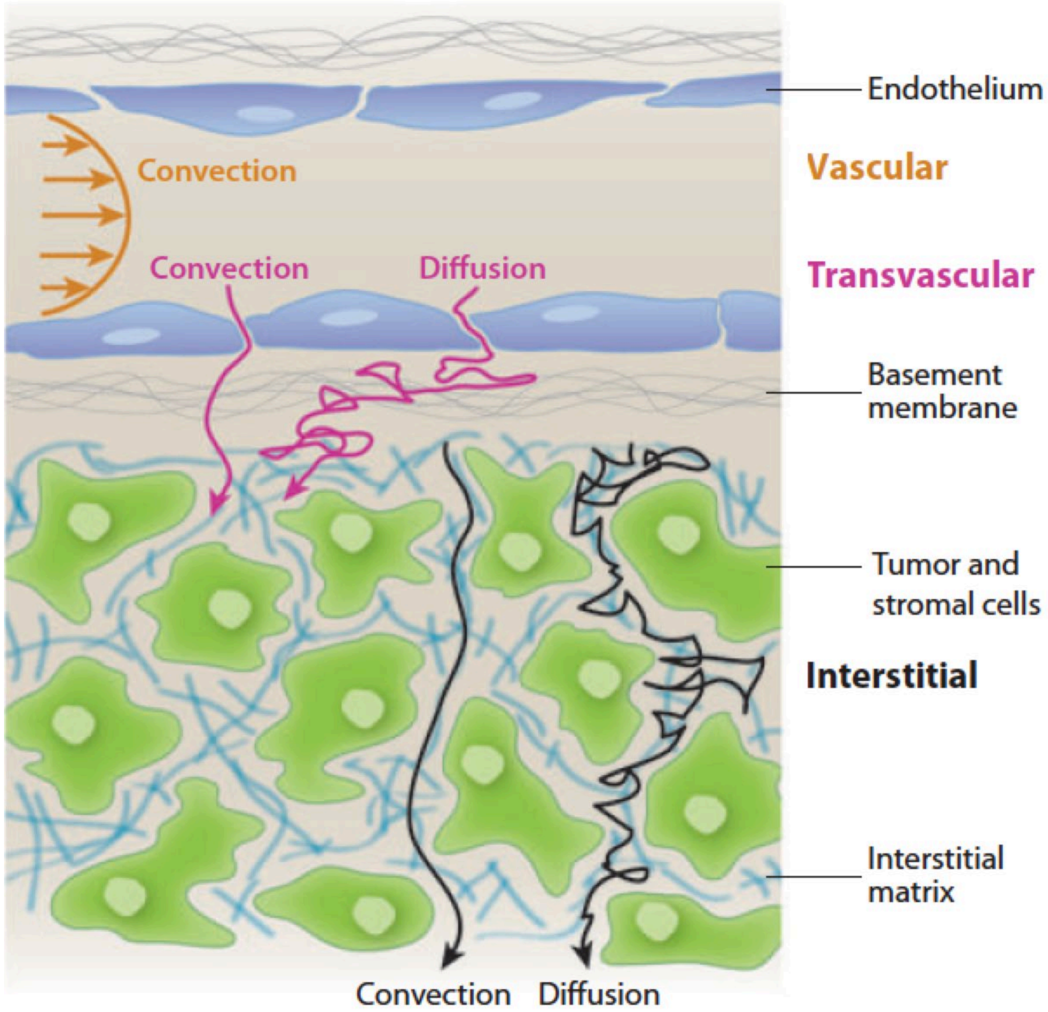
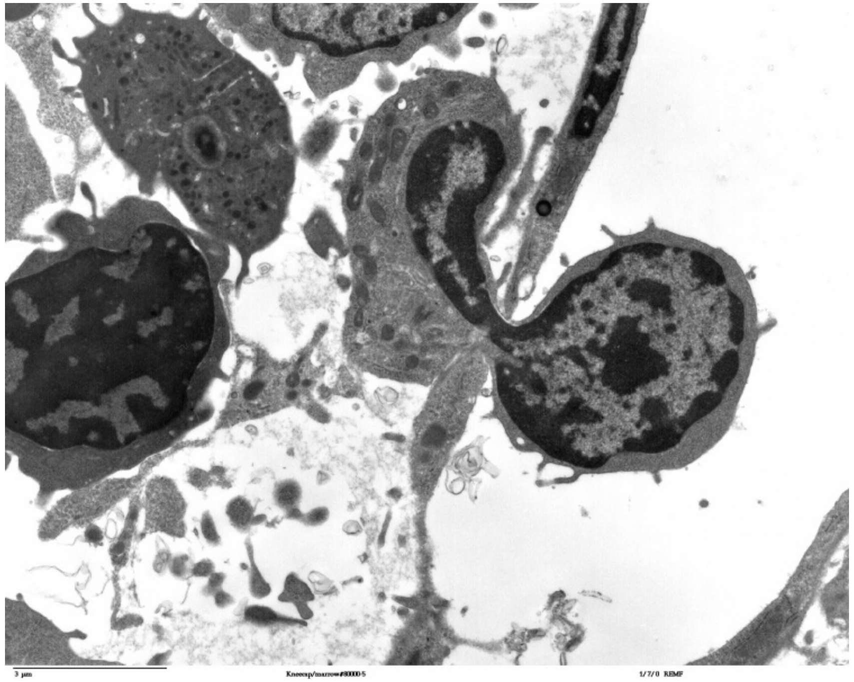
When Do We Need to Consider Transport Barriers?

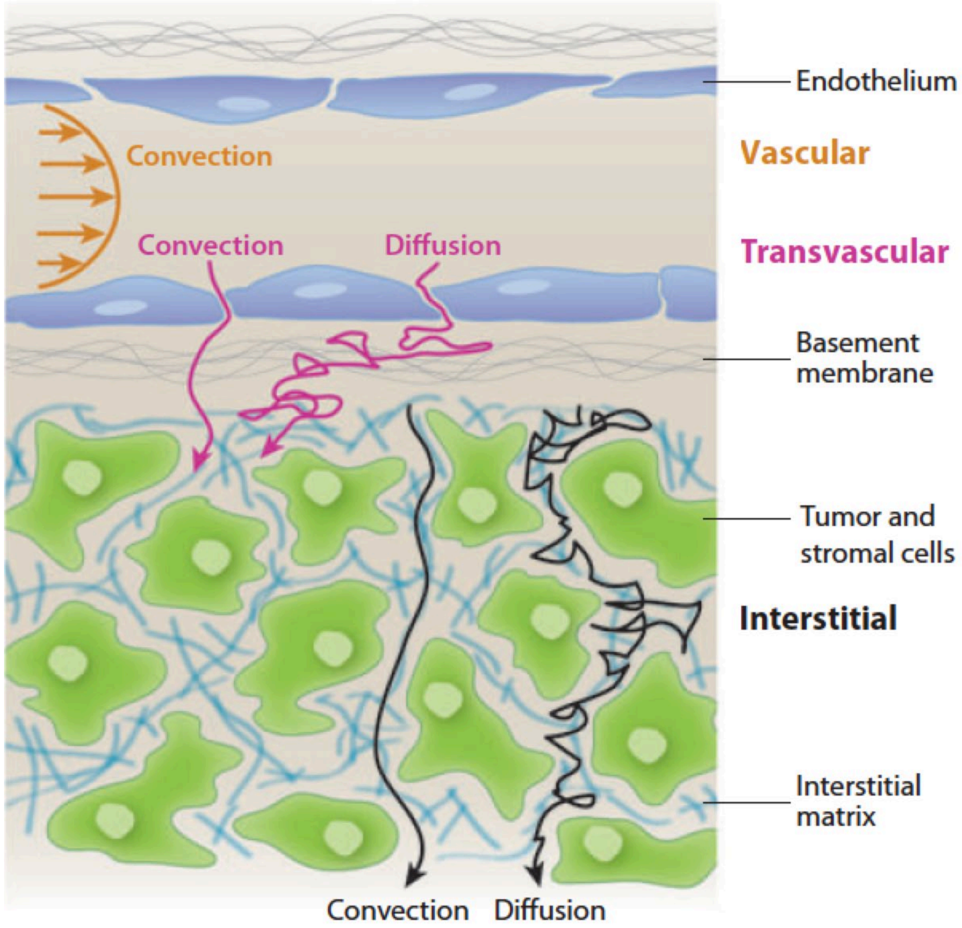
- **How do we deliver cells and molecules to the body successfully?**
- **How do we deliver molecules and cells in the lab to 3D constructs?**



Chauhan et al, 2011

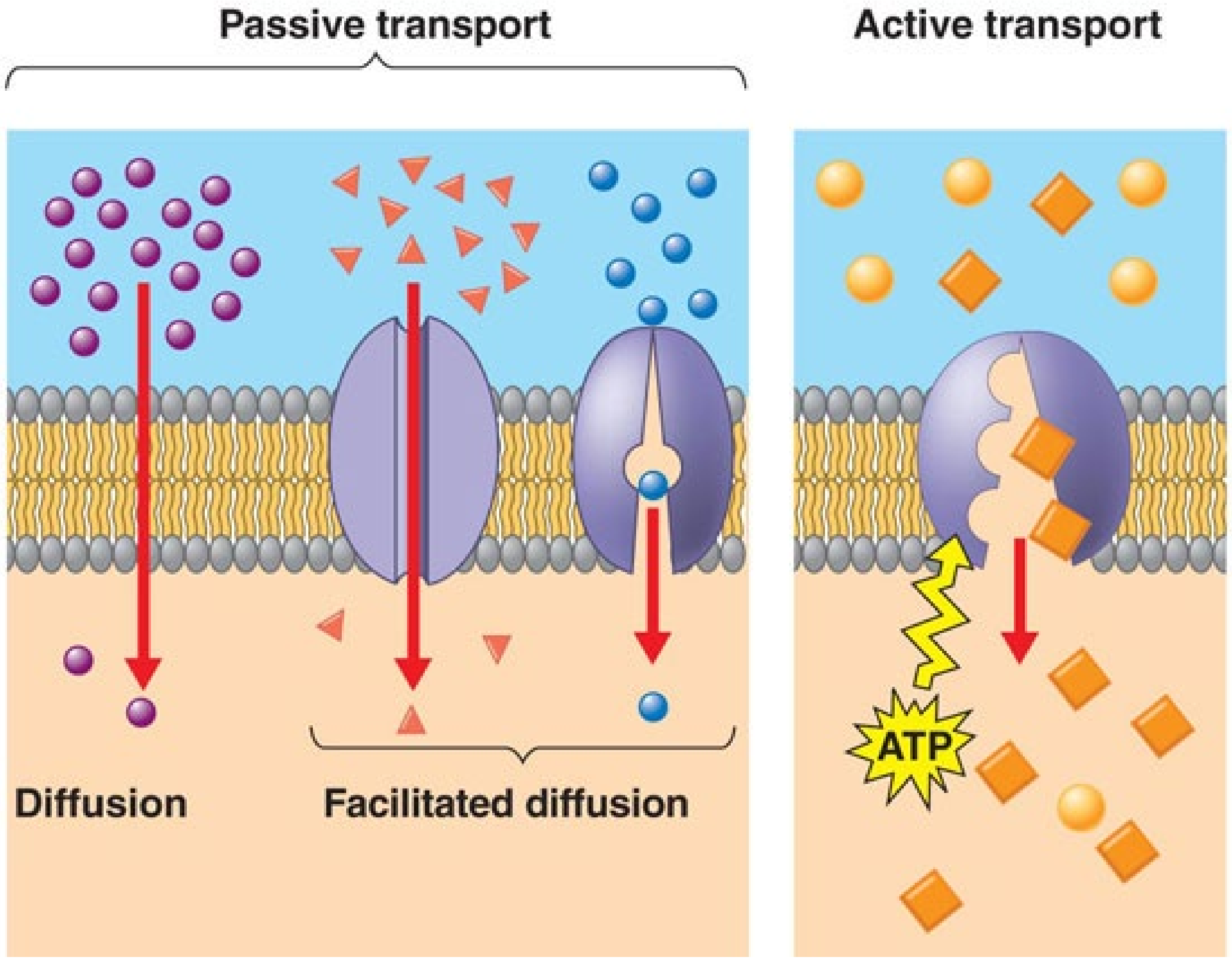
Molecular Delivery Across a Cell Membrane





Chauhan et al, 2011

Molecular Delivery Across a Cell Membrane Cont.



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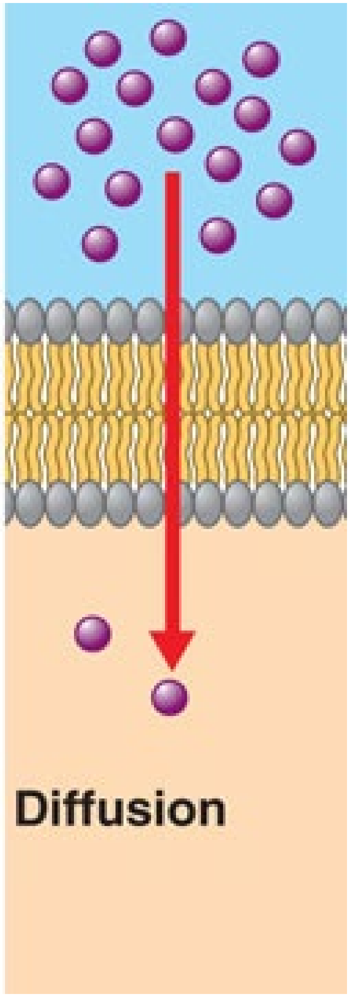
Simple Diffusion using Fick's Law



$$\frac{dn}{dt} = P \cdot A \cdot \left(\frac{dC}{dx} \right)$$

$\frac{dn}{dt}$ Rate of diffusion

P Permeability

A Area of membrane

$\left(\frac{dC}{dx} \right)$ Concentration Gradient

$$\left(\frac{dC}{dx} \right) = \frac{C_{out} - C_{in}}{dx}$$

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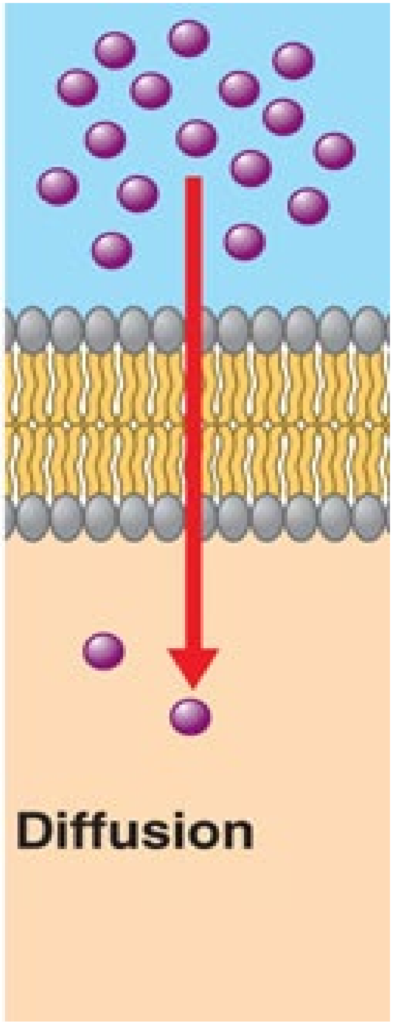
Simple Diffusion using Fick's Law Cont.



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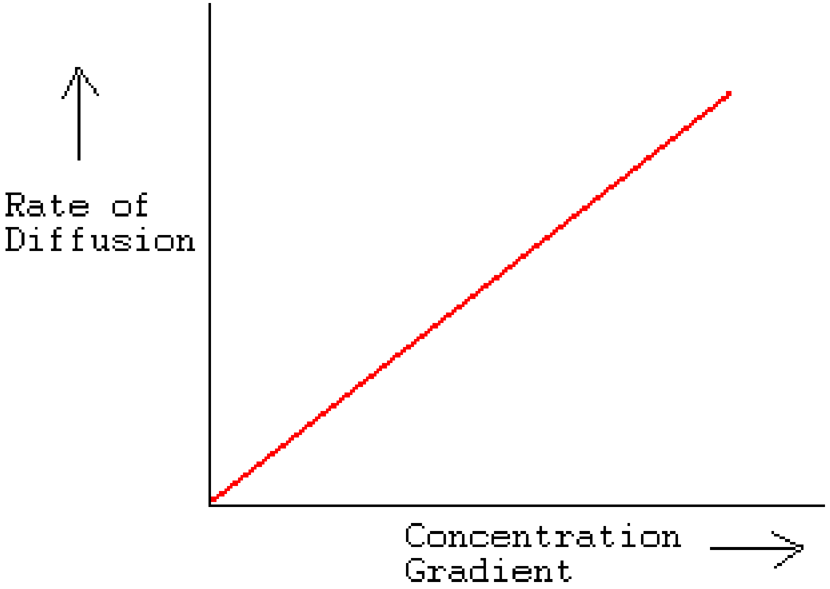

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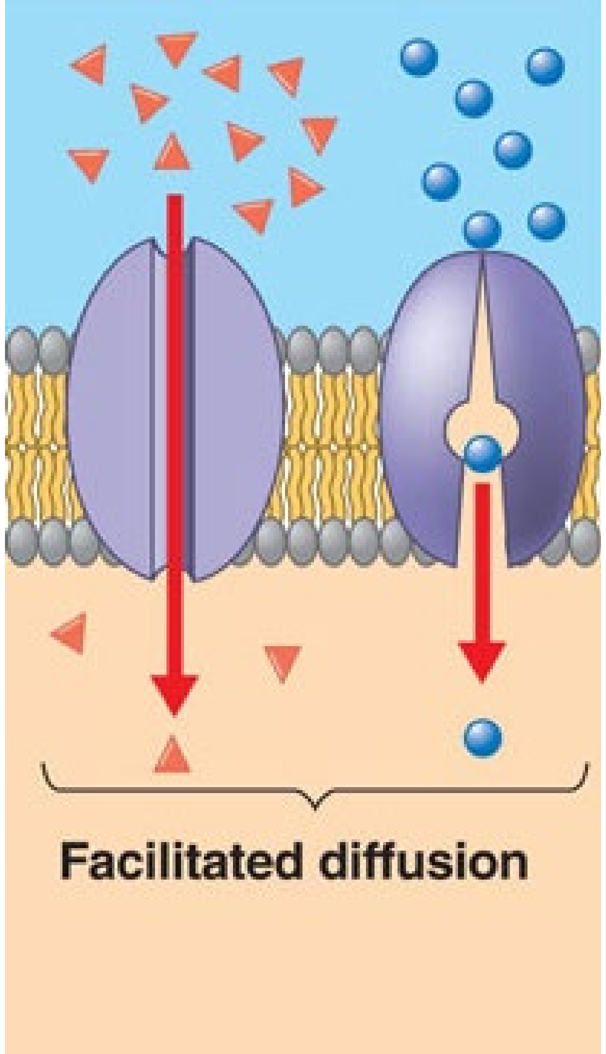
Facilitated Transport Uses Carrier Proteins



$$\frac{dn}{dt} = \frac{v_{\max}}{1 + \frac{k}{dC/dx}}$$

$\frac{dn}{dt}$ Rate of diffusion

$v_{\max}$ Saturation constant

k Constant determining Speed of saturation

$\left(\frac{dC}{dx}\right)$ Concentration Gradient

$$\left(\frac{dC}{dx}\right) = \frac{C_{out} - C_{in}}{dx}$$

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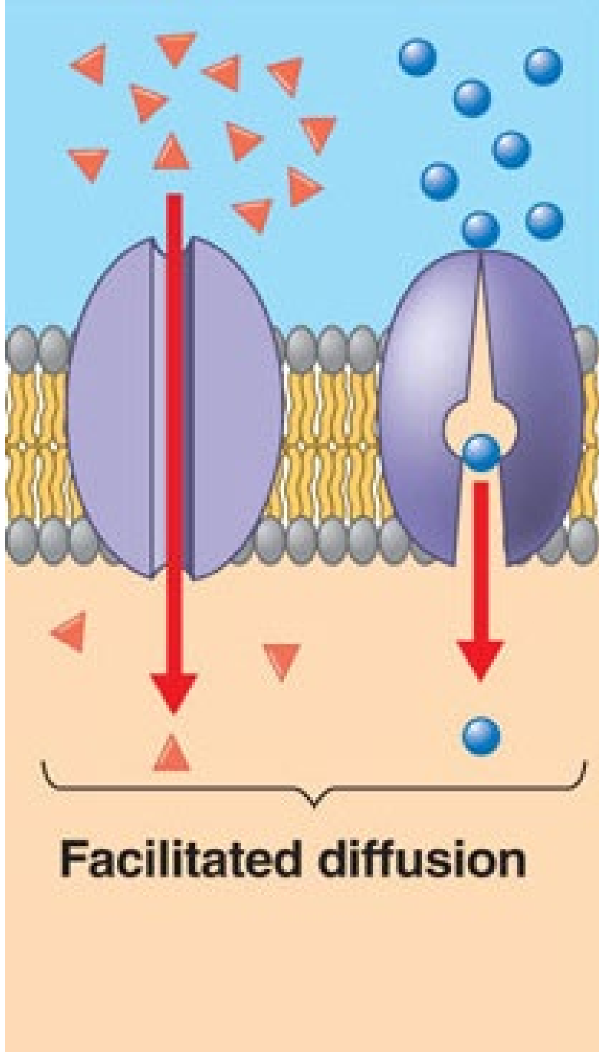
Facilitated Transport Uses Carrier Proteins Cont.



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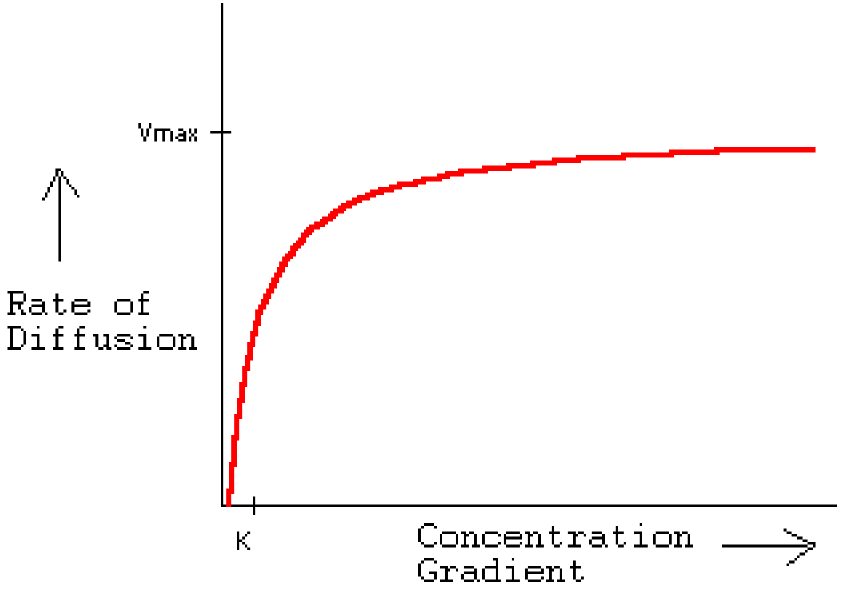
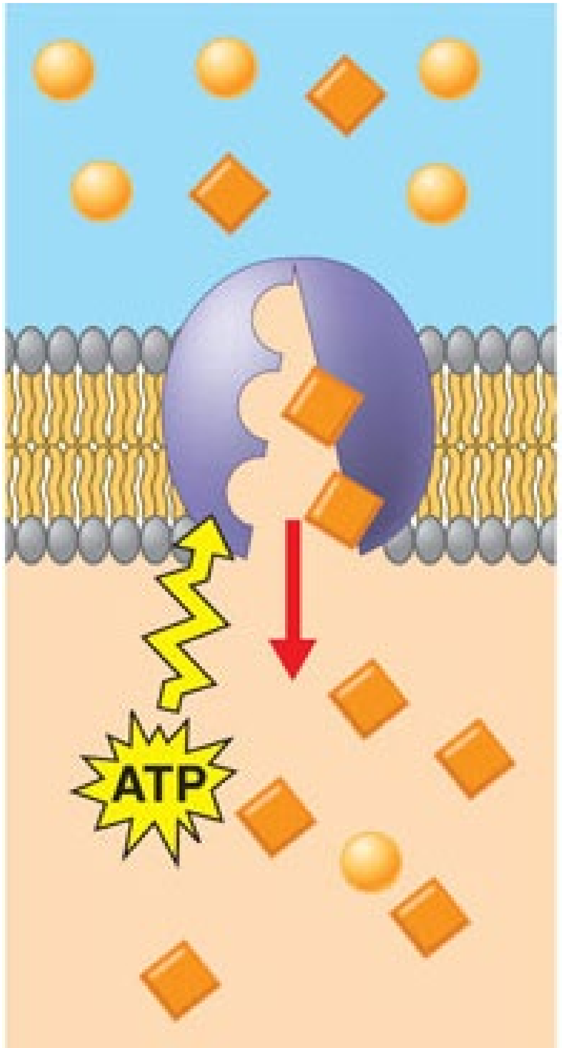
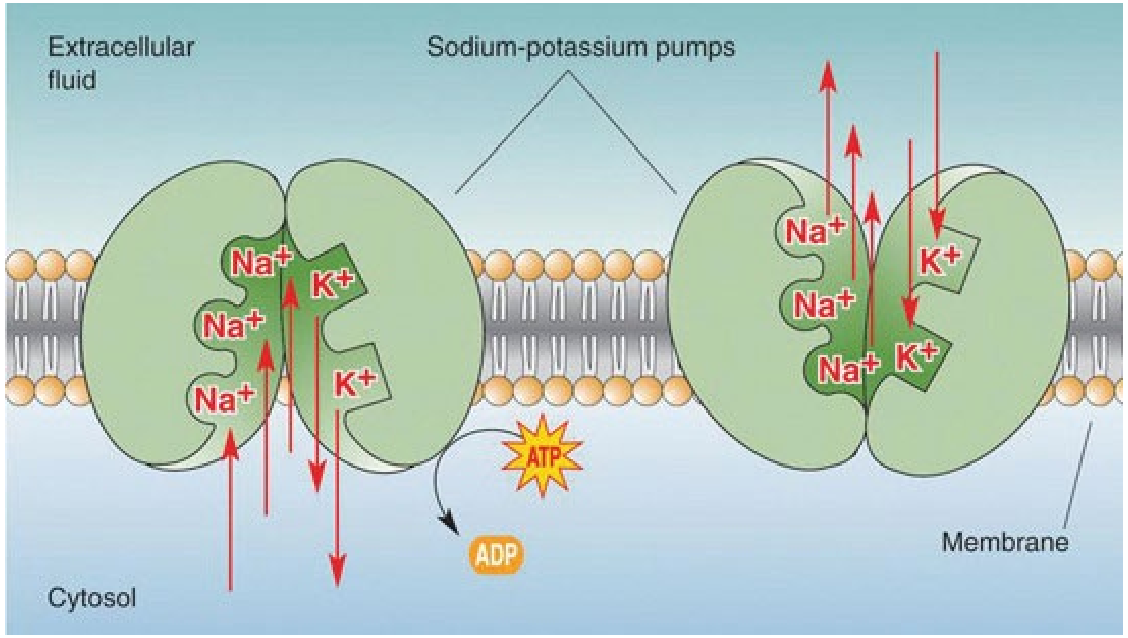


Active Transport Requires Energy



Primary Active Transport
Carrier protein hydrolyzes ATP

Secondary Active Transport
Energy from electrochemical gradients



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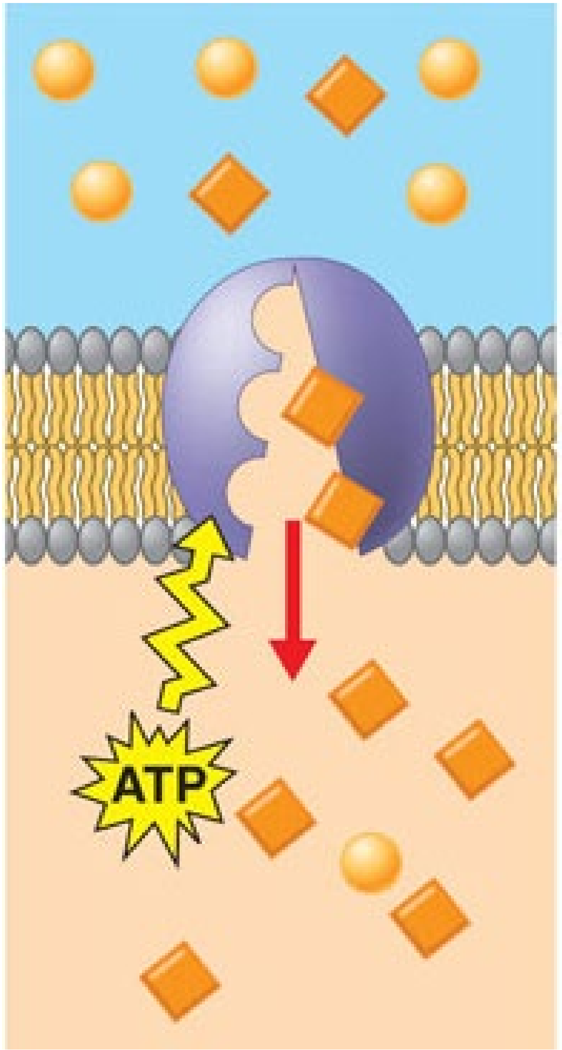
Active Transport Requires Energy Cont.



Primary Active Transport
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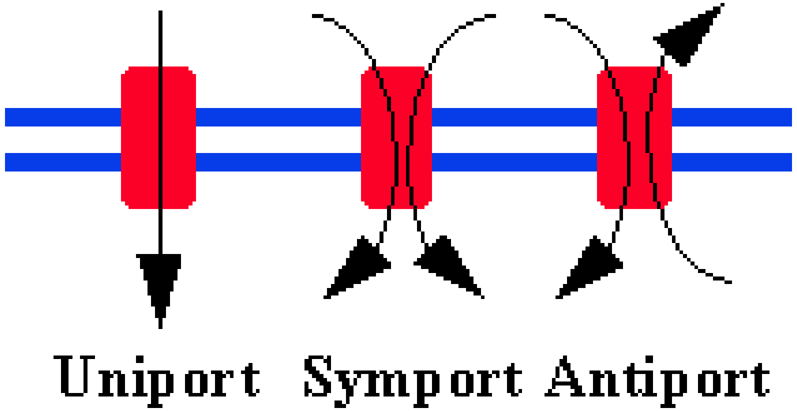
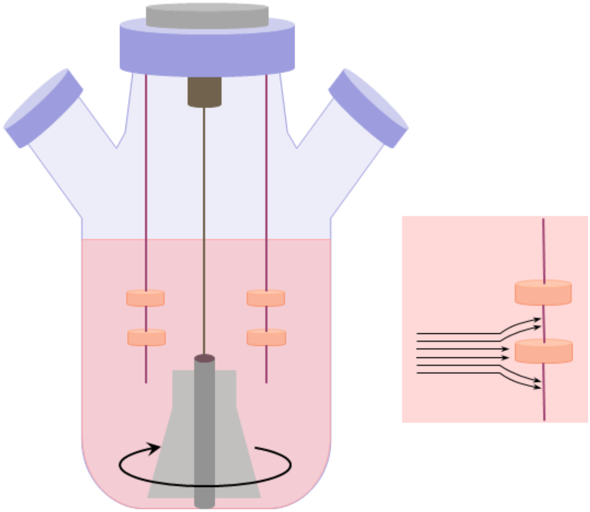
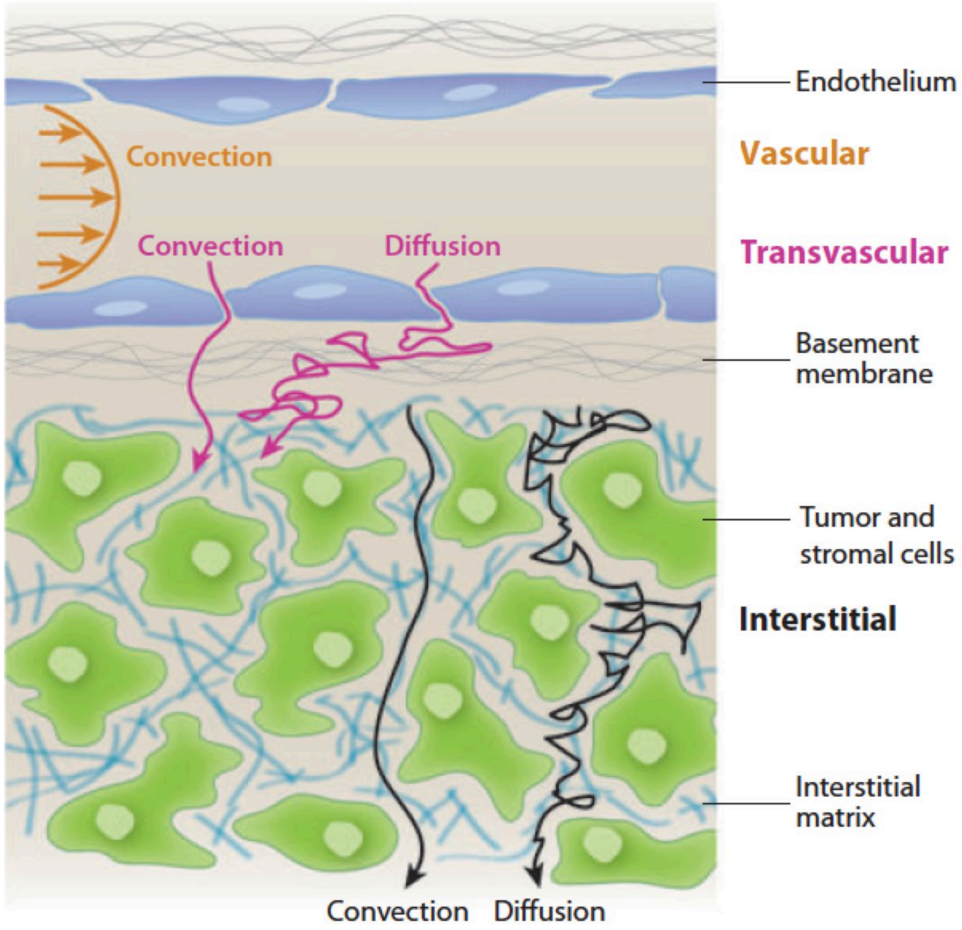


Molecular Delivery to a Tissue Construct



Warren Grayson, Ph.D.



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