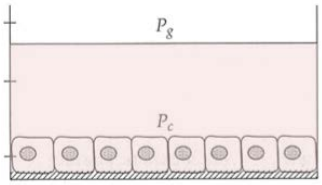
Assignment 9: Cell Trafficking and Molecular Transport

Cell and Tissue Engineering

Problems

1. Understanding and analyzing molecular transport mechanism is necessary when designing basic cell culture experiments and perfusion of biomaterials using a bioreactor. Oxygen delivery to cells in culture can by modeled using Fick's Law. Transport of oxygen from the gas phase (P_g) to the cell phase (P_c) is driven by the oxygen gradient across the height of the medium. The rate of oxygen uptake by cells however can be modeled with Michaelis-Menten kinetics (what we use for facilitated diffusion) (from P_c into the cell).



a) In lecture, we graphed dn/dt as a function of dC/dx for simple diffusion. What is the slope of this line? What do increases or decreases in the slope mean biologically?

b) Now assume the concentration gradient is a constant. How does the rate of diffusion (dn/dt) change with the surface area of the cell and the permeability of the diffusing molecule? Graph dn/dt as a function of A or P and describe the function.

2. Describe 3 principles of bioreactor design used in bioreactors for creating functional tissues – one of your three may be from Dr. Grayson's lecture (improved mass transfer or biostimulation), and the other two you will need to independently research. In each description explain what the principle is, why it is important and some ways that bioreactors are being designed to meet that principle.

3. In the paper *Engineered cell homing*, by Sarkar et al. researchers describe a new method to enhance homing of mesenchymal stem cells (MSCs) to inflamed tissue. In 250 words or less please compare this method to adoptive cell therapy. What are the pros and cons of each?

Rubric

Question	Component	Total Point Value
1	**a**	**4**
	b	**4**
2		**12**
3		**10**
	Total Points	30