HST.410J/6.021J **Lecture 3**

February 13, 2007

Escherichia Coli (E. Coli)

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Photograph of an E. coli cell.

Culture Medium

NH_4Cl	**1.0 g**
$MgSO_4$	**0.13 g**
KH_2PO_4	**3.0 g**
Na_2HPO_4	**6.0 g**
Glucose	**4.0 g**
Water	**1.0 L**

Generic Eukaryotic Animal Cell

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Culture Medium

Essential Amino Acids (a dozen)
Vitamins (eight)
Salts (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, PO_4^{3-}, HCO_3^-)
Glucose
Serum

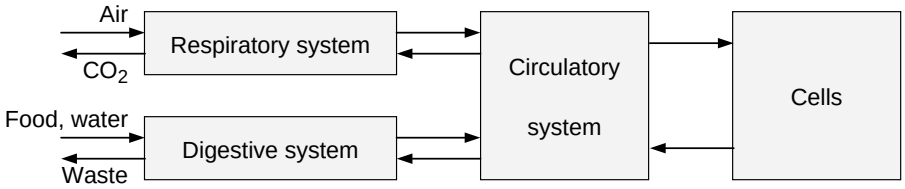

Figure from Weiss, T. F. *Cellular Biophysics, Vol. I.* Cambridge, MA: MIT Press, 1996. Courtesy of MIT Press. Used with permission.

Inputs to Organism
- air
- water
- food
  - carbohydrates
  - fats
  - proteins

Inputs to Cells
- oxygen
- water
- ions
- building block molecules
  - sugars
  - lipids
  - amino acids

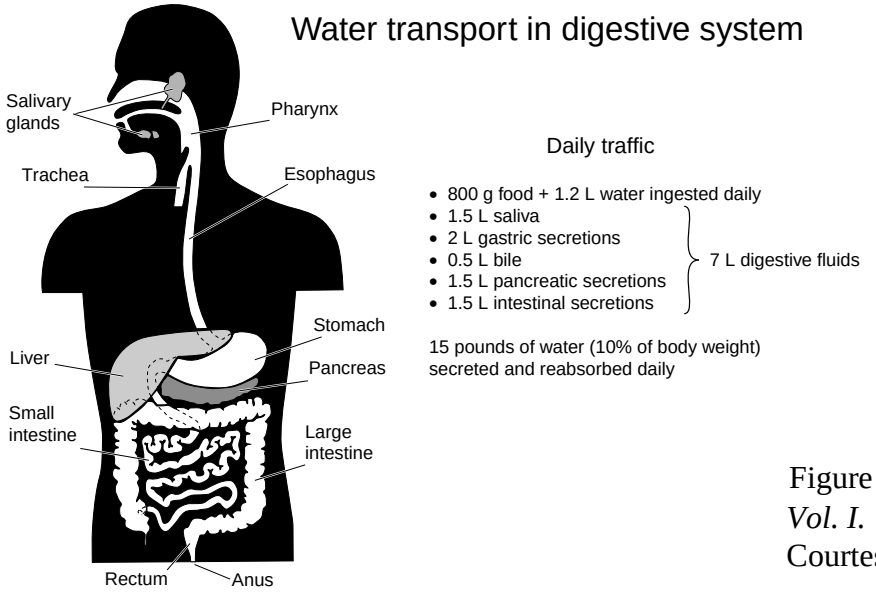

Figure from Weiss, T. F. *Cellular Biophysics*, *Vol. I.* Cambridge, MA: MIT Press, 1996. Courtesy of MIT Press. Used with permission.

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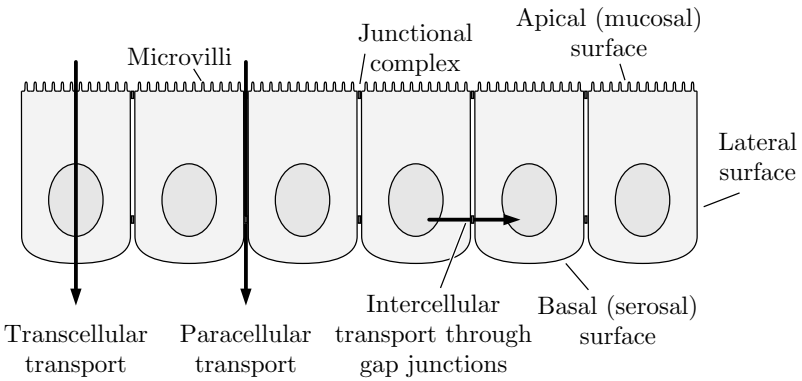
Images of inside an intestinal tract and an endothelial cell.



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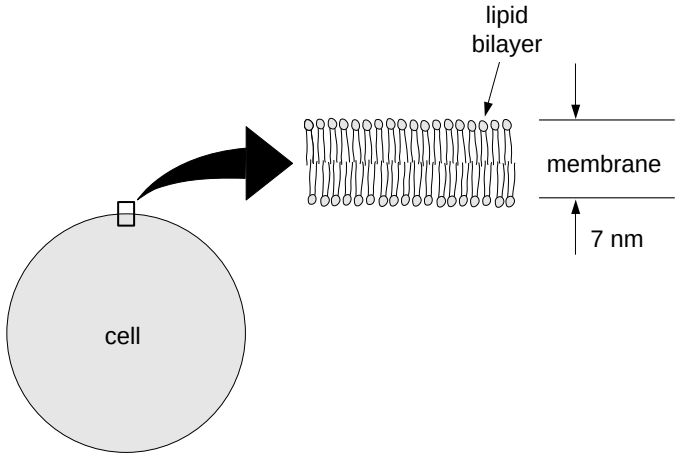
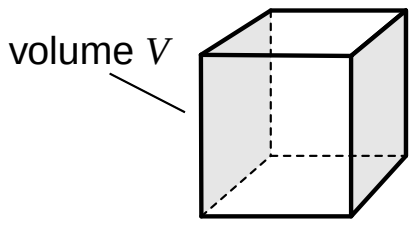
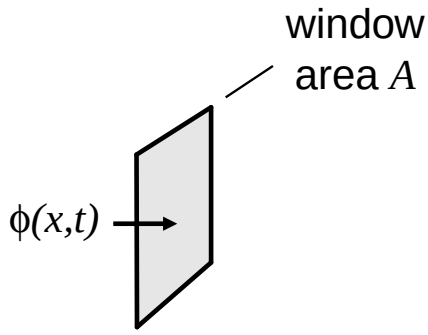


Concentration at a point in space and time



$$\text{concentration } c(x,t) = \lim_{V \to 0} \frac{\text{amount of substance in } V}{V}$$

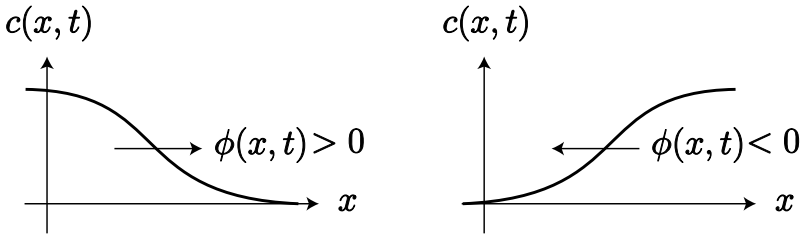
Flux at a point
in space and time



$$\text{flux } \phi(x,t) = \lim_{\substack{A\to 0 \\ \Delta t\to 0}} \frac{\text{amount of substance flowing through test window } A \text{ in } \Delta t}{A\Delta t}$$

Fick's First Law

$$\phi(x,t) = -D\frac{\partial c(x,t)}{\partial x}$$



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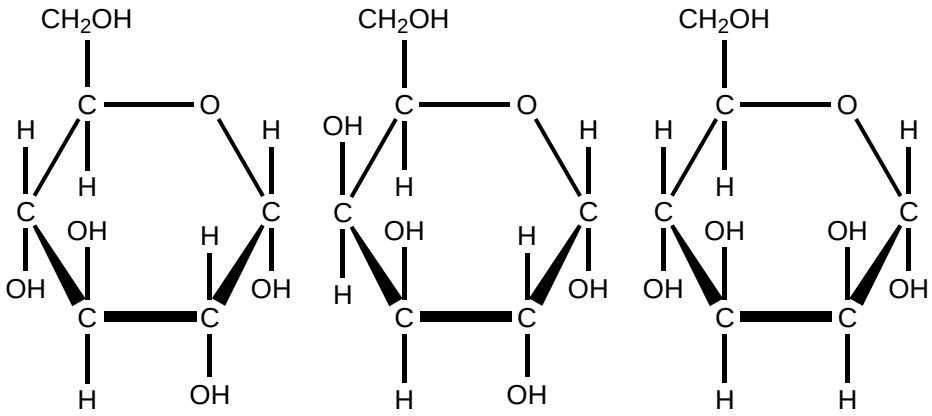

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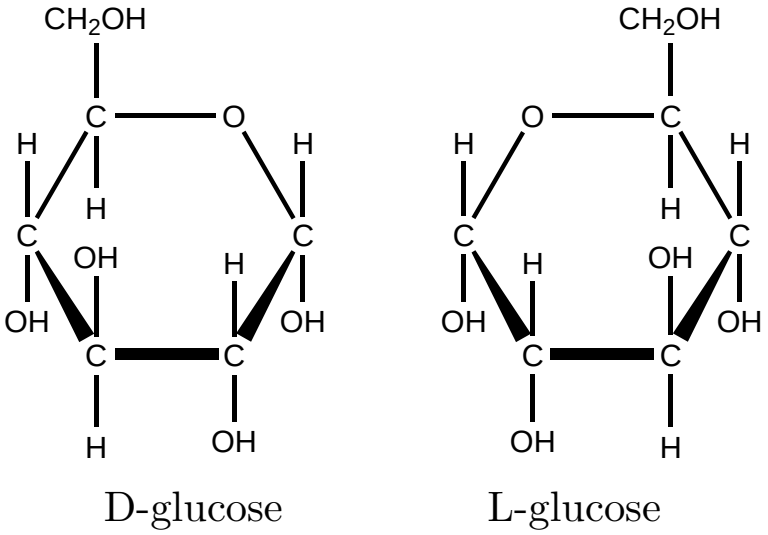

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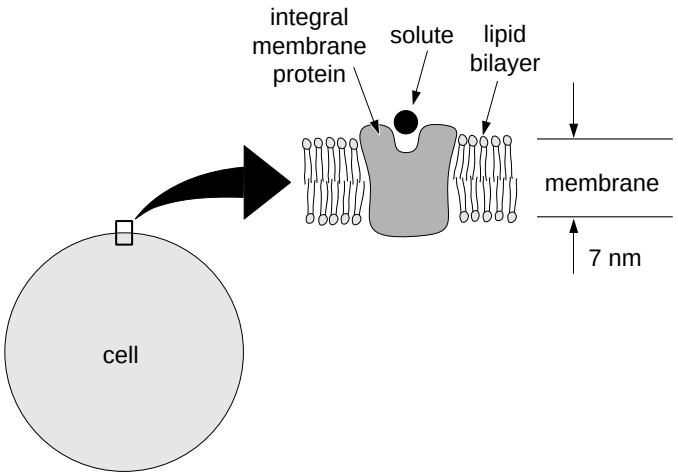

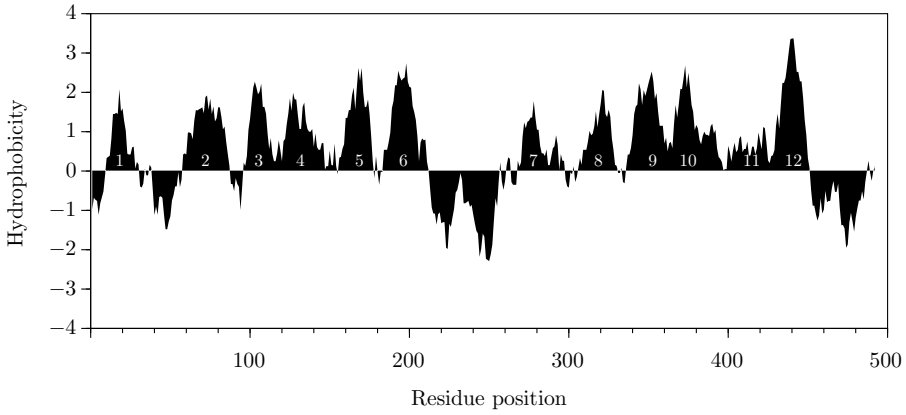

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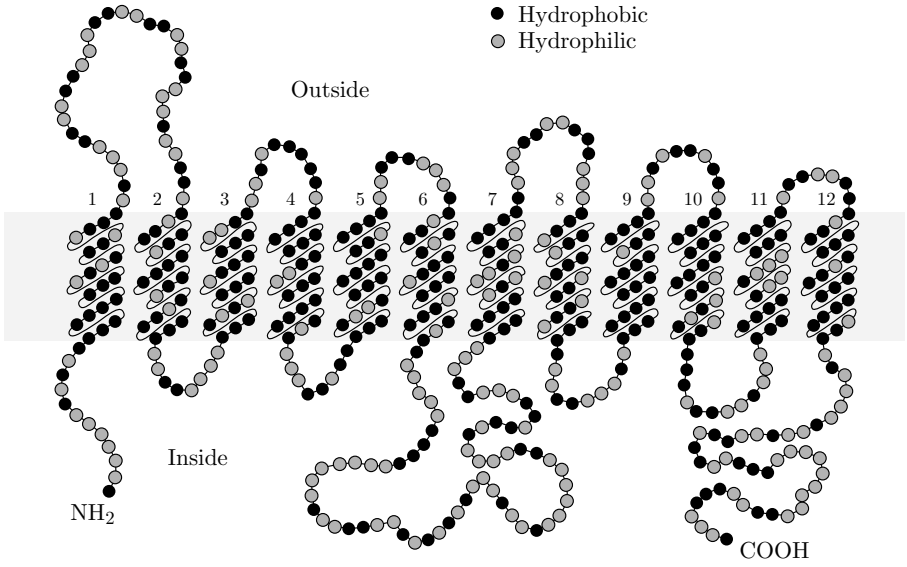

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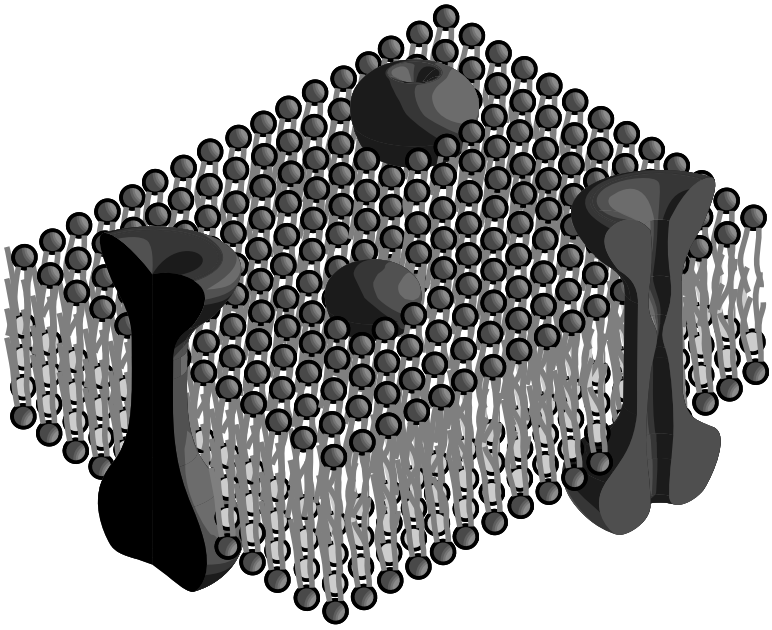

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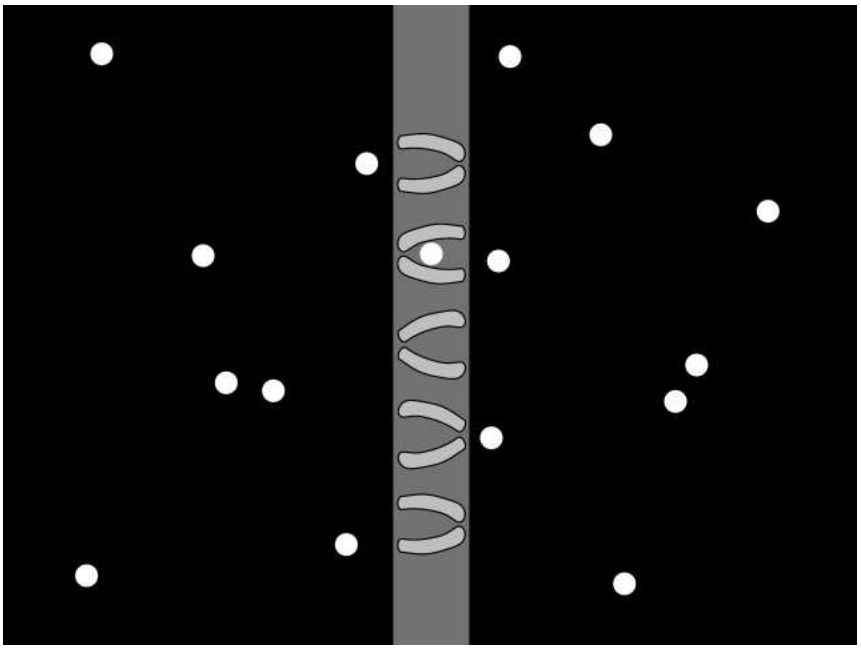
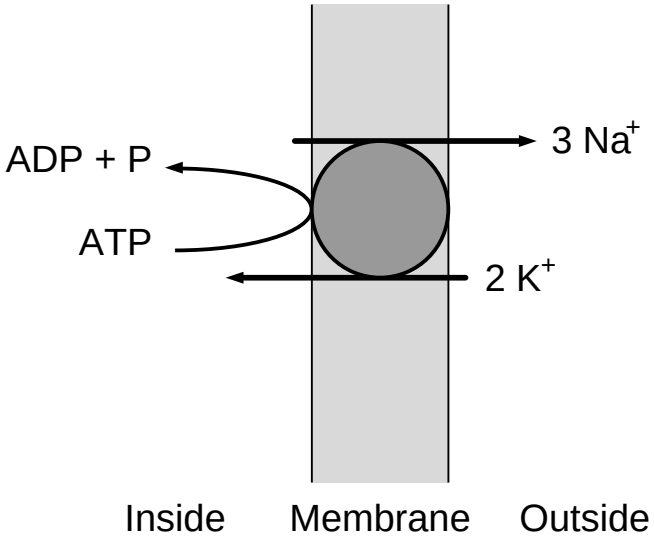
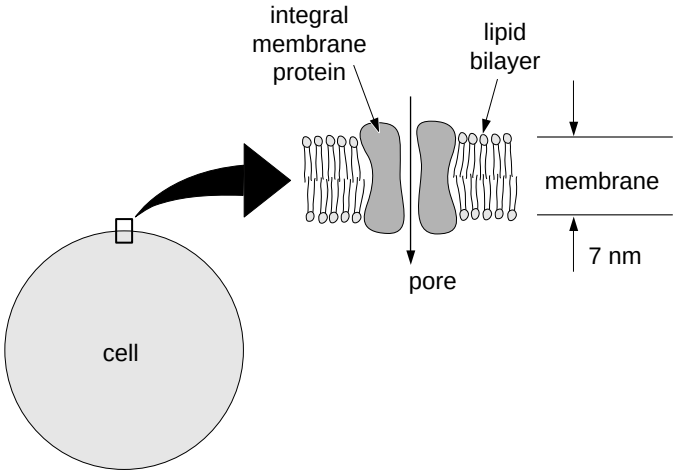
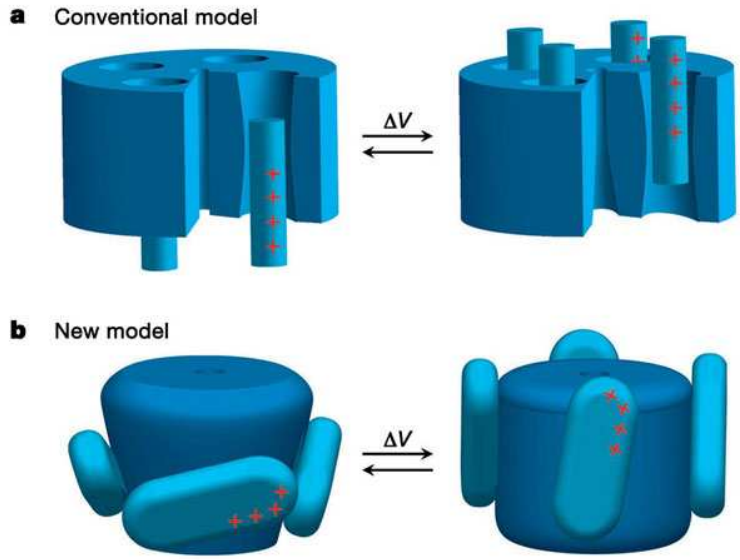
Please see figure 5 in Mueckler, Mike, and Carol Makepeace. "Cysteine-scanning Mutagenesis and Substituted Cysteine Accessibility Analysis of Transmembrane Segment 4 of the Glut1 Glucose Transporter." *J Biol Chem* 280 (2005): 39562-39568.



Pumps


ADP + P
ATP
3 Na+
2 K+
Inside
Membrane
Outside


integral membrane protein
lipid bilayer
membrane
7 nm
pore
cell



Y. Jiang, A. Lee, J. Chen, V. Ruta, M. Cadene, B. Chalt, and R. MacKinnon (2003), Nature 423:33-41.

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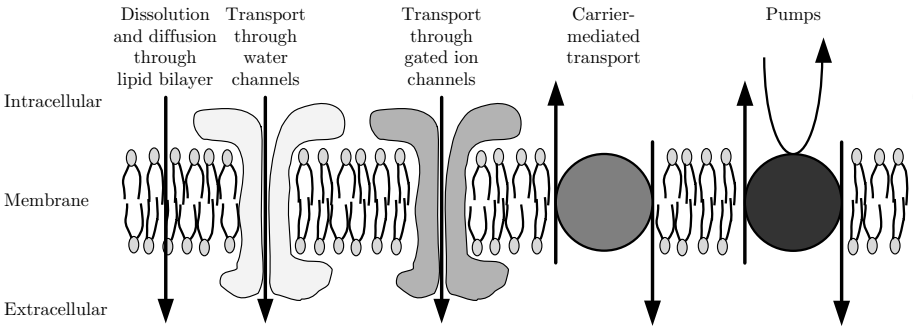

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