

Exam 1 Study Guide

Membrane Transport (Lecture 1, Chapter 6)

- **Understand the processes of diffusion and osmosis, and the mechanisms of carrier-protein mediated transport across the cell membrane.**
 - Diffusion: Due to random movement (thermal energy), solute molecules will show net movement from region of **high concentration to region of low concentration**; solute moves down concentration gradient.
 - Rate of Diffusion:
 - increases with temperature
 - increases with concentration gradient
 - increases with surface area of membrane
 - decreases with distance
 - Osmosis: Diffusion of water across a semipermeable membrane, water moves from **low solute concentration solution to high solute concentration solution**. (from regions with high water concentration to low water concentration)
 - Carrier-protein mediated transport:
 - Facilitated diffusion: Transported molecule is moved down its concentration gradient. **Does not** require extra energy from the cell (uses potential energy of concentration gradient), transport is regulated by increasing or decreasing the number of transporters in a cell.
 - Primary active transport: Membrane carrier protein is an ATPase that breaks down ATP to release energy. **Energy is used** to transport molecule against its concentration gradient.
 - Ca²⁺ ATPase pump and Na⁺/K⁺ ATPase pump
 - Secondary active transport (coupled transport): Co-transporter allows molecule 1 to move down concentration gradient, couples energy of first molecule to co-transport molecule 2 up its gradient.
 - **Be able to recognize if transport is mediated by carrier proteins, and whether it is active or passive transport.**
 - Passive transport is diffusion or osmosis
 - Active transport are mediated by carrier proteins and are facilitated diffusion, active transport and coupled transport.
 - **Be sure to understand how to determine the net flow of water during osmosis.**
 - Net flow of water during osmosis is determined by osmotic pressure
 - Osmotic Pressure is how strongly a concentrated solution pulls water by osmosis across the membrane.
 - Pure Water: osmotic pressure = 0
 - Equal osmotic concentration on each side: isotonic
 - less concentrated solution: lower osmotic pressure = hypotonic

- More concentrated solution: higher osmotic pressure = hypertonic
- o Determine osmotic pressure with osmolality
 - Osmotic concentration is measured in Osmolality (Osm) (number of particles in moles / liter water) Osmosis is diffusion of water from: low osmolality to high osmolality.
 - If the osmolality of the inside of the cell is higher than the solution than the flow of water is into the cell and it is hypertonic.
 - Remember particles suck!

Membrane Potential (Lecture 2, Chapter 6)

- Memorize the Nernst Equation as given in the textbook (p. 148).

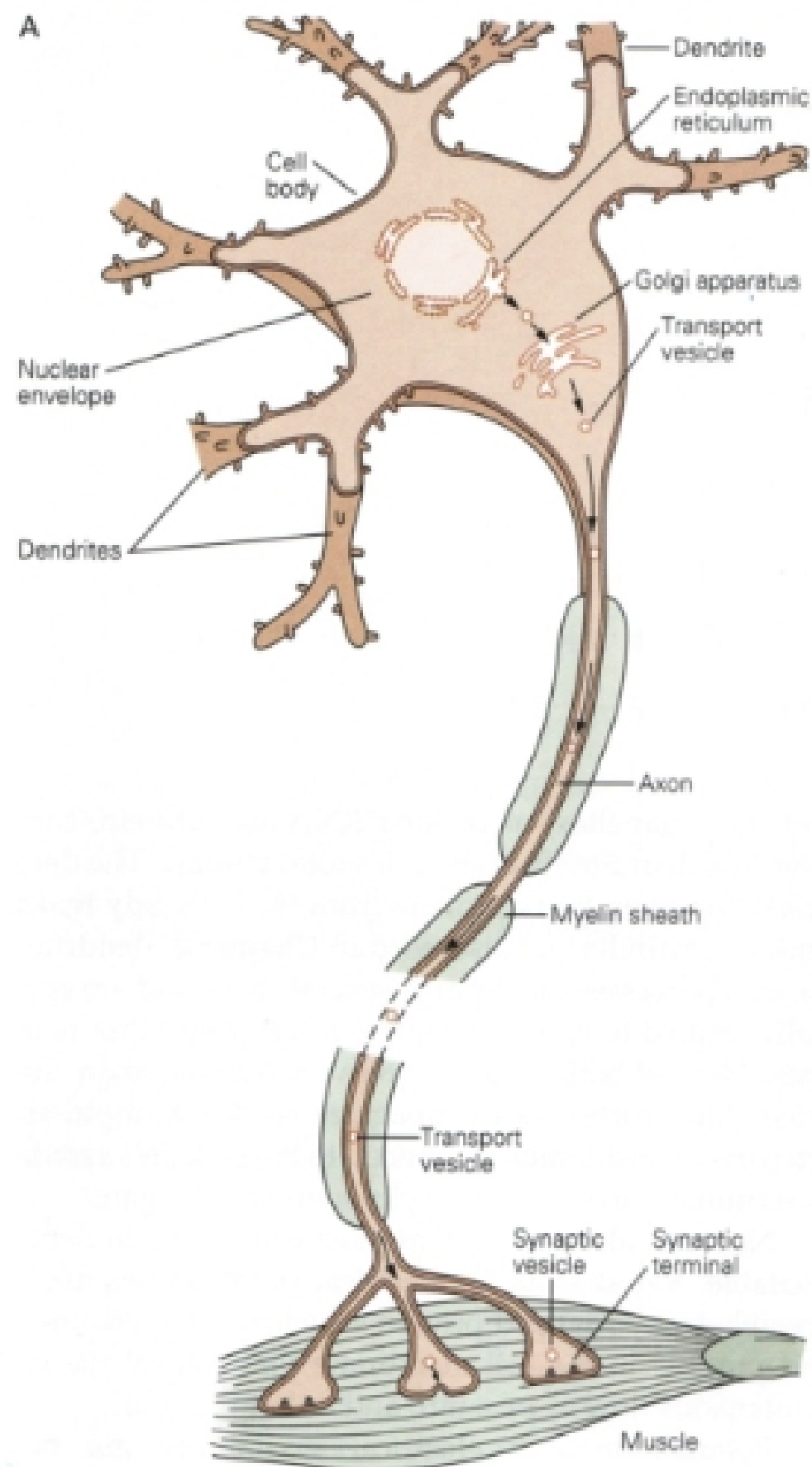
$$E_{\text{ion}} = 61 / \text{charge} \cdot \log ([\text{ion}]_{\text{out}} / [\text{ion}]_{\text{in}})$$

- Be able to calculate the equilibrium potential for an ion (you will be given the concentration of the ions on the exam, but you need to be able to apply the Nernst Equation.)
 - o E_{ion} = equilibrium potential in millivolts (mV) for ion x
 - o [ion] out = concentration of the ion outside the cell
 - o [ion] in = concentration of the ion inside the cell
 - o Charge= valence of the ion (so +1 for Na⁺)
 - Equilibrium charge for common molecules
 - $E_{\text{K}^+} = 61 / +1 \cdot \log (5 \text{ mM} / 125 \text{ mM})$
 - $= -90 \text{ mV}$
 - $E_{\text{Na}^+} = 61 / +1 \cdot \log (150 \text{ mM} / 15 \text{ mM})$
 - $= +61 \text{ mV}$
 - $E_{\text{Cl}^-} = 61 / -1 \cdot \log (125 \text{ mM} / 10 \text{ mM})$
 - $= -61 \text{ mV}$
 - $E_{\text{Ca}^{++}} = 61 / 2 \cdot \log (25 \text{ mM} / .0002 \text{ mM})$
 - $= 136 \text{ mV}$
- You do NOT need to memorize the Goldman equation, but you should understand how the membrane permeability of the different ions contributes to resting membrane potential.
 - o The resting membrane potential is dependent on the most permeable ion

- **Understand the role of the Na/K pump to maintain Na and K concentrations in and out of the cell.**
 - o The concentrations of K^+ and Na^+ are maintained constant because of the constant use of energy in active transport by the pumps. The Na^+/K^+ pumps transports 3 Na^+ out of the cell for every 2 K^+ that moves in. As a result the resting membrane potential (in absence of stimulation) in nerves and muscles is $-70mV$.

Neurons (Lecture 3, Chapter 7)

- **Know the basic anatomy (parts) of a neuron (e.g. Fig 7.2, 7.6)**



- o Cell body
 - Nucleus, endoplasmic reticulum, Golgi apparatus, etc.