Foundations of Life Science Problem Set A: Cell Biology Topics



This study guide will go over big points covered in lectures pertaining to cell biology

- 1. Integrins are in what family of glycoproteins? Explain the extracellular and intracellular components.
- 2. Indicate whether each of the statements below is true or false.
 - a. Potassium has a low permeability, but high driving force. Sodium has a high permeability, but low driving force.
 - b. Any change in a membrane potential will alter the net diffusion of the least permeable ion first.
 - c. The most permeable ion is potassium at rest, and its Nernst potential is closest to the membrane potential.
 - d. The summation of the EPSPs and IPSPs causes the resting membrane potential to hyperpolarize, generating an action potential.

3. How does the Goldman equation account for the difference between a calculated membrane potential and a measured membrane potential?

4. Fill in the blanks for the following statements.

- a. There is a much ______ driving force for sodium, so it moves more
- b. The potassium channels open more _____ than do the sodium channels, so the rise in potassium permeability develops more _____.
- Voltage-gated sodium channels contain several important components. Match the letter to the respective component to the description. Components: Activation gate, inactivation gate, conductance pore, selectivity filter, voltage sensor
 - a. Specific placement of negative charges in the protein which can stabilize the sodium atom
 - b. Passage for ions to pass through the protein
 - c. Located near the extracellular side of the channel. It remains closed until threshold is reached
 - d. Is open at rest and is located on the intracellular side of the channel
 - e. Recognizes that charges within the protein will shift as the inside of the cell becomes less negative, but isn't a specific structure of the protein
- 6. Fill in the blanks regarding cell signaling:
 - a. Direct electrical communication uses ______ between cells and is the ______ form of communication in the body.
 - b. Chemical signals are ______ than electrical signals, but more ______ responses are possible. There are three main types of chemical signals: ______.

7. Complete the following flowchart regarding chemical signals.



8. Fill in the blanks:

The total activity of a protein X= specific activity of each molecule of protein X times the number of molecules of protein X. So, signal systems must change the total activity of certain proteins, either by altering the specific activity or by altering gene expression. Hydrophilic signals primarily change the _____, whereas lipophilic signals primarily change the _____.

9. Fill in the blanks for a calcium neurotransmitter system.



10. Fill in the blanks for a tyrosine kinase system.



- 11. The following steps relate to G-protein signaling. For each step, write Y (yes) or N (no) indicating whether or not the beta and gamma subunits are attached to the alpha subunit. Also indicate if GDP or GTP is bound.
 - a. Resting state
 - b. Activation of G-protein
 - c. Activation of effector
 - d. Inactivation
- 12. In a phospholipase C cascade, A and B are second messengers. A is hydrophobic and remains in the cell membrane, and B is hydrophilic and enters the cytosol. What are A and B?
- 13. Fill in the blanks: When Phospholipase C is activated, _____ is cleaved to _____, which causes ______, which can activate Protein Kinase C. This, in turn, causes the joining of protein and phosphate to form a complex. Phospholipase C can cleaves ______ into _____, which can be broken down into monoacylglyceride and arachidonate, which acts on ______ to produce
- 14. Write the chemical reaction involved with nitric oxide synthase. What enzyme does NO activate to convert GTP to cGMP?