

Indraprastha Institute of Information Technology Delhi (IIITD)

Department of Computational Biotechnology

BIO211 – Cell Biology and Biochemistry

Quiz-3 (December 15, 2021)

Duration: 15 mins

Total marks: 20

1. Which of the following statements are correct? (3 marks)
Give explanation for the incorrect statement.
 - A. The extracellular signal molecule acetylcholine has different effects on different cell types in an animal and often binds to different cell-surface receptor molecules on different cell types.
Correct
 - B. After acetylcholine is secreted from cells, it is long-lived, because it has to reach target cells all over the body.
Incorrect. Acetylcholine is short-lived and exerts its effects locally. Indeed, the consequences of prolonging its lifetime can be disastrous. Compounds that inhibit the enzyme acetylcholinesterase, which normally breaks down acetylcholine at a nerve–muscle synapse, are extremely toxic: for example, the nerve gas sarin, used in chemical warfare, is an acetylcholinesterase inhibitor.
 - C. Tyrosine phosphorylation serves to build binding sites for other proteins to bind to RTKs.
Correct
 - D. Channels have specific binding pockets for the solute molecules they allow to pass.
Incorrect. Channels do not have binding pockets for the solute that passes through them. Selectivity of a channel is achieved by the size of the internal pore and by charged regions at the entrance of the pore that attract or repel ions of the appropriate charge.
2. Insulin enzyme produced in pancreas regulates the glucose uptake by cells in the body. (1 marks)
3. Give one similarity and one difference between the following: (4 marks)
 - A. Symport and antiport
Both couple the movement of two different solutes across a cell membrane. Symports transport both solutes in the same direction, whereas antiports transport the solutes in opposite directions.
 - B. Membrane potential and electrochemical gradient
Both terms describe gradients across a membrane. The membrane potential refers to the voltage gradient; the electrochemical gradient is a composite of the voltage gradient and the concentration gradient of a specific charged solute (ion). The membrane potential is defined independently of the solute of interest, whereas an electrochemical gradient refers to the particular solute.
4. State whether the following statements are incorrect? Explain your answer. (4 X 1.5 marks)
 - A. The plasma membrane is highly impermeable to all charged molecules.
Incorrect. The plasma membrane contains transport proteins that confer selective permeability to many but not all charged molecules. In contrast, a pure lipid bilayer lacking proteins is highly impermeable to all charged molecules.
 - B. Both the GTP-bound α subunits and nucleotide-free $\beta\gamma$ complexes—but not GDP-bound, fully assembled G proteins—can activate other molecules downstream of GPCRs.
Correct
 - C. Transporters allow solutes to cross a membrane at much faster rates than do channels.
Incorrect. Transporters are slower. They have enzymelike properties, i.e., they bind solutes and need to undergo conformational changes during their functional cycle. This limits the maximal

rate of transport to about 1000 solute molecules per second, whereas channels can pass up to 1,000,000 solute molecules per second.

- D. The membrane potential of an axon temporarily becomes more negative when an action potential excites it.

Incorrect. The peak of an action potential corresponds to a transient shift of the membrane potential from a negative to a positive value. The influx of Na^+ causes the membrane potential first to move toward zero and then to reverse, rendering the cell positively charged on its inside. Eventually, the resting potential is restored by an efflux of K^+ through voltage-gated K^+ channels and K^+ leak channels.

5. Match the following: (3 marks)

- | | |
|----------------------------|----------------------------------|
| A. Nerst Equation | i. Excitatory neurotransmitter |
| B. Auditory hair cell | ii. Lateral inhibition |
| C. Glutamate | iii. Resting potential |
| D. Gamma-aminobutyric acid | iv. Relaxation of smooth muscles |
| E. Delta-Notch | v. Mechanically-gated channels |
| F. Nitroglycerine | vi. Inhibitory neurotransmitter |

- a. A-iii, B-v, C-vi, D-i, E-ii, F-iv
b. A-iii, B-ii, C-vi, D-i, E-v, F-iv
c. A-iii, B-ii, C-i, D-vi, E-v, F-iv
d. **A-iii, B-v, C-i, D-vi, E-ii, F-iv**

6. Na^+ flowing in through open Na^+ channels **depolarize** (depolarize/repolarize) the neighboring region of the membrane in the nerve cell. (1 marks)

7. Match the following drugs with their associated neurotransmitter: (2 marks)

- | | |
|----------------|----------------------------|
| A. Curare | i. Gamma-aminobutyric acid |
| B. Prozac | ii. Acetylcholine |
| C. Strychnine | iii. serotonin |
| D. Barbiturate | iv. Glycine |

A-ii, B-iii, C-iv, D-i