Chapter 48: Concise review

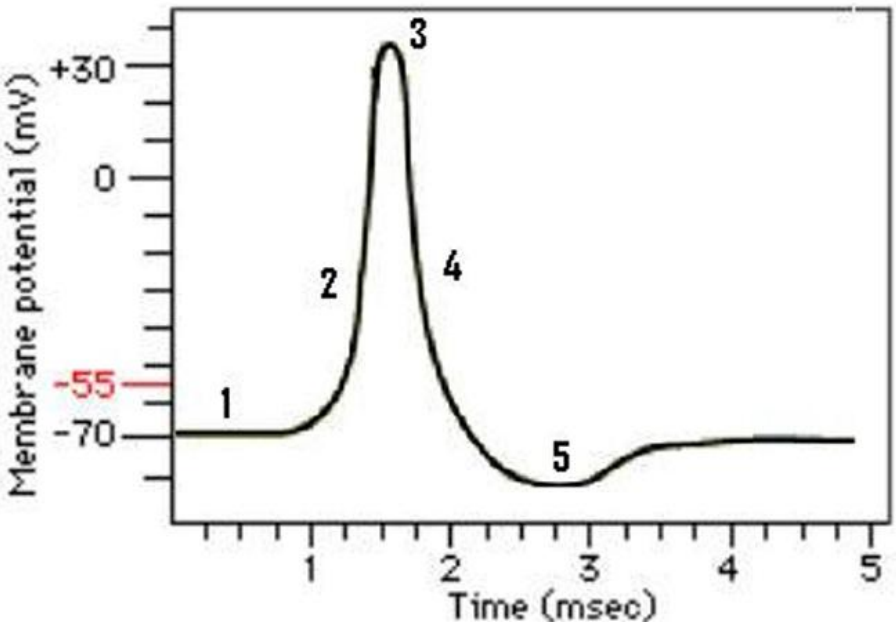
1. List the three structures of the neuron.

A. **Axon**

B. **Dendrite**

C. **Cell Body**

2. Label the parts of the neuron on the diagram.



3. What property of neurons allows them to communicate? **They are excitable.**

4. What 3 things can neurons communicate with? **Other neurons, muscles, and glands**

5-10. Choose the correct part of the neuron for each of the listed functions.

a. Receptive and integrative region of the neuron. **Cell Body and Dendrites**

b. Receives signals from other cells and sends them towards the axon. **Dendrites**

c. Integrates/sums up the incoming signals. **Dendrites and cell bodies**

d. Generates the action potential. **Axon**

e. The main nutritional and metabolic region of the neuron. **Cell Body**

f. The transmitting or conductive region of the neuron **Axon**

11. What are the junctions between neurons called? **Synapses**

12. What is the relationship between axon length and cell body size? **Longest axons are associated with the longest cell bodies**

13. In long neurons, what makes up most of the cell's volume? **Axons**

14-16. Name the appropriate part for each description:

a. The insulating material that some axons are covered with **Myelin Sheath**

b. Support cells in the peripheral nervous system that produce myelin **Schwann Cells**

c. The process of the formation of the myelin sheath is referred to as: **Myelination**

17. What actually insulates the axon?

Tightly wound cell membrane after the cytoplasm has been squeezed out

18. Why does it take many Schwann cells to insulate a single axon?

Due to axon length

19. What are the gaps between regions of myelination called? Why are they important?

Nodes of Ranvier; they aid in salutatory conduction; essential for conduction of action potential

Action Potentials

20. What does an action potential consist of?

A large change in membrane potential from a resting value of –70mV to a peak of about +30mV and a return to –70mV

21. In what part of the neuron is the action potential generated? **Axon hillock**

22. What is special about this part of the neuron? Why are action potentials generated here?

Signals from the dendrites and cell body reach axon hillock and cause depolarization

23. When does the action potential begin? **Signals from the dendrites and cell body reach the axon hillock and cause the membrane potential there to become more positive (depolarization).**

24. What happens at threshold? If the stimulus at the axon hillock causes the neuron to depolarize by about 15mV and reaches a trigger point called threshold

25. What happens if the stimulus is too weak to achieve threshold?

It does not reach threshold and does not produce an action potential

26. Do action potentials always have the same amplitude and duration, or do they vary according to the strength of the signal? **Always the same**

27. During the action potential, when does sodium permeability increase rapidly?

a. During repolarization **b. During the rising phase of the action potential**

c. During hyperpolarization d. Never

28. During the action potential, when does sodium permeability decrease rapidly?

a. During repolarization b. During the rising phase of the action potential

c. During hyperpolarization d. Never

29. During the action potential, when is potassium permeability the greatest?

a. During repolarization b. During the rising phase of the action potential

c. During hyperpolarization d. Never

30. During the action potential, when does potassium permeability decrease slowly?

a. During repolarization b. During the rising phase of the action potential

c. During hyperpolarization

31. The rapid increase in sodium permeability is responsible for:

a. Repolarization of the cell

b. Hyperpolarization

c. Rising phase of the action potential

32. The rapid decrease in sodium permeability and simultaneous increase in potassium permeability is responsible for:

a. Repolarization of the cell

b. Hyperpolarization

c. Rising phase of the action potential

33. The slow decline in potassium permeability is responsible for:

a. Repolarization of the cell

b. Hyperpolarization

c. Rising phase of the action potential

34-38. Which part of the action potential graph shown corresponds to the following?

Hyperpolarization __5__

Depolarization __2__

Rest __1__

Initiation of repolarization __3__

Repolarization __4__

39-43. Which part of the above graph corresponds to:

A time when voltage-gated sodium channels are inactivated, then reset to the closed state while potassium channels open? __4__

A time when voltage-gated sodium and potassium channels are closed? __1__

A time when voltage-gated sodium channels begin to inactivate and voltage-gated potassium channels begin to open? __3__

A time when some voltage-gated potassium channels remain open, resulting in movement of potassium out of the cell? __5__

A time when voltage-gated sodium channels open rapidly, resulting in movement of sodium into the cell? __2__

44. What kind of feedback occurs when an action potential is generated? Describe this feedback loop.

Positive feedback; Threshold is a special membrane potential where the process of depolarization becomes regenerative, that is, where a positive feedback loop is established.

45. Briefly describe how this feedback loop is terminated.

Voltage-gated sodium channels begin to close. The potassium-gated channels open. At the peak of the action potential, voltage-gated sodium channels begin to inactivate. As they inactivate, the inward flow of sodium decreases, and the positive feedback loop is interrupted.

Ion Channels

46. What type of proteins are ion channels? **They are integral membrane proteins.**

47. List the four properties of ion channels.

Selective, Passive or Active, Regionally Located, Functionally Unique

48. What does it mean to say that ion channels are "selective?"

They select ions for passage based on the charge on the ion, the size of the ion, and how much water the ion attracts and holds

49. List the three factors that can determine the selectivity of an ion channel. **Charge of ion, size of ion, and how much water the ion attracts and holds**

50. What are the two types of ion channels? **Passive and Active**

51. Explain the difference between the ion channels.

Active channels have gates that can open or close the channel, while passive channels are always open and ions pass through them

52. When the neuronal membrane is at rest, are the voltage-gated channels open or closed? **Closed**

53. What happens to voltage-gated channels when there is a nerve impulse (or action potential) in the neuronal membrane? **Causes channels to open (and then close)**

54. When the Na^+ voltage-gated channel opens, why does the membrane potential go from -70 mV to a less negative value? **Sodium ions rush into the cell due to its electrochemical gradient and cause an increase in positive charge inside the cell, thereby raising the membrane potential.**

55. When the K^+ voltage-gated channel opens, why does the membrane potential go from +30 mV to more negative values? **The concentration gradient of potassium causes it to leave the cell, thereby leaving a negative charge inside the cell causing the membrane to become more negative.**

56. What causes chemically-gated ion channels to open in neurons? **The binding of specific neurotransmitters**

57. When acetylcholine binds its receptor, which ions will move, and in which direction will they move? **Sodium moves into the cell, and potassium moves out**

58-60. Match each of the following channel types to their functions listed below.

A. Passive channels __**3**__

B. Chemically-gated channels __**2**__

C. Voltage-gated channels __**1**__

1. Responsible for the generation of action potentials
2. Responsible for synaptic potentials
3. Responsible for the resting membrane potential

61. On what 3 places are passive ion channels located? **Dendrites, Cell bodies, and Axons**

62. Where are chemically-gated ion channels found? **Dendrites and Cell body**

63. Where on the neuron are voltage-gated ion channels located? **Axon Hillock, Unmyelinated azons, and at nodes of Ranvier on myelinated axons**

64. What determines the direction that ions move through a channel? **Ions move passively from higher concentration** to lower concentration down the **concentration gradient.**

Membrane Potential

65-66. Which of the following have concentrations that are high intra-cellularly, and which have high extra-cellular concentrations? Na^+ K^+ Cl^-

Cl^- and Na^+ have high concentrations outside the cell, while K^+ has a high intracellular concentration

67. What is the only way that ions can get across the cell membrane? **Through watery pores called ion channels**

68. What two factors affect the permeability of a cell to a particular ion? **The number of channels for the ion, and the ease with which ions pass through the channel**

69. Simple, non-excitable cells are permeable to one ion. What is it? **K^+**

70. What type of force is the concentration gradient? **Chemical force**

71. Why is the cell membrane more positive outside and more negative inside? **Potassium exits the cell through leak channels due to its concentration gradient**

72-74. As potassium diffuses out of the cell, the outside becomes more **_positive_**, and the inside becomes more **_ negative _**. Since the opposite charges attract each other, and potassium is positive, the potassium will be **_pulled back into the cell_**.

75. What is the force that is responsible for the movement of positive potassium ions back into the cell, where it is more negative? **Electric potential**

76. What are the two parties of the electrochemical gradient? **Concentration gradient and Electric potential**

77-78. Neurons are slightly permeable to sodium ions.

a. In which direction is the chemical force for sodium? Why? **The direction of the chemical force is into the cell because it has a higher concentration outside the cell and diffuses down its concentration gradient.**

b. In which direction is the electrical force for sodium? Why? **The electrical force is also into the cell because due to the negative charge on the interior of the cell. This attracts the positively charged sodium ion.**

79. What does the term "resting membrane potential" in a neuron mean? What is a typical value for the resting membrane potential? **It is the potential difference across the membrane due to normal sodium and potassium movement when the cell is at rest. The value is –70mV.**

80. At -70 mV, why does potassium leak out of the neuron? **The chemical force pushing potassium out of the cell is greater than the electrical force pulling it back into the neuron.**

81. At the resting membrane potential, why does sodium slowly leak into the neuron?

The electrical and chemical force pull sodium into the cell, but the cell is only slightly permeable to this ion. Therefore, it only leaks into the cell slowly.

82. Does the sodium-potassium pump move sodium and potassium with or against their gradients? **Against**

83. What chemical provides the energy for the pump? **ATP**

84-85. The sodium-potassium pump pumps out __**3**__ sodium ions for every __**2**__ potassium ions that are pumped into the cell.

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