

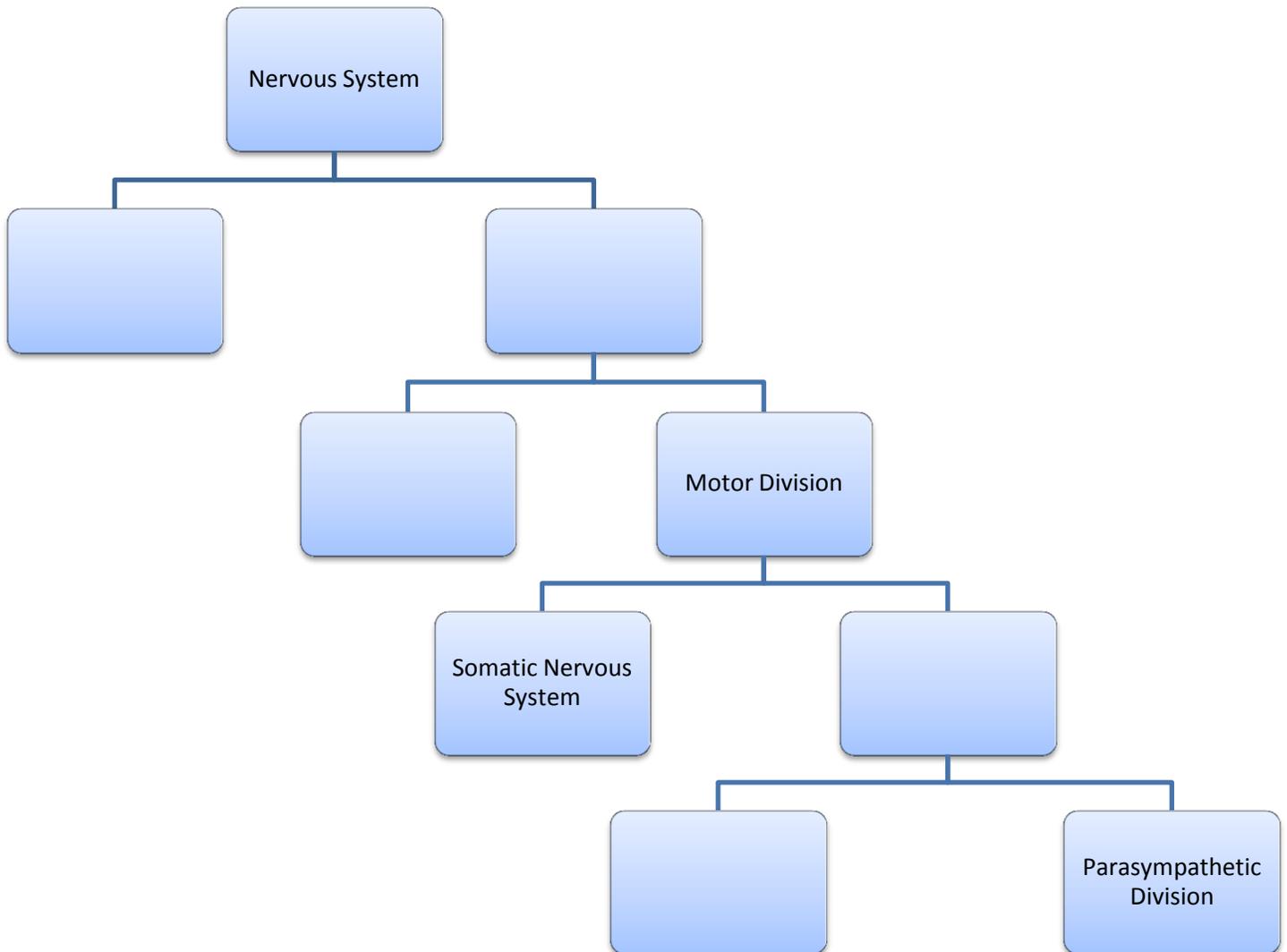
**Functions, Divisions, Cells of the Nervous System and
Electrical Signals and Neural Pathways
Honors Anatomy**

Functions of the Nervous System

1. List the 5 functions of the nervous system.

Divisions of the Nervous System

Using the list below, create a tree map illustrating the divisions of the nervous system.

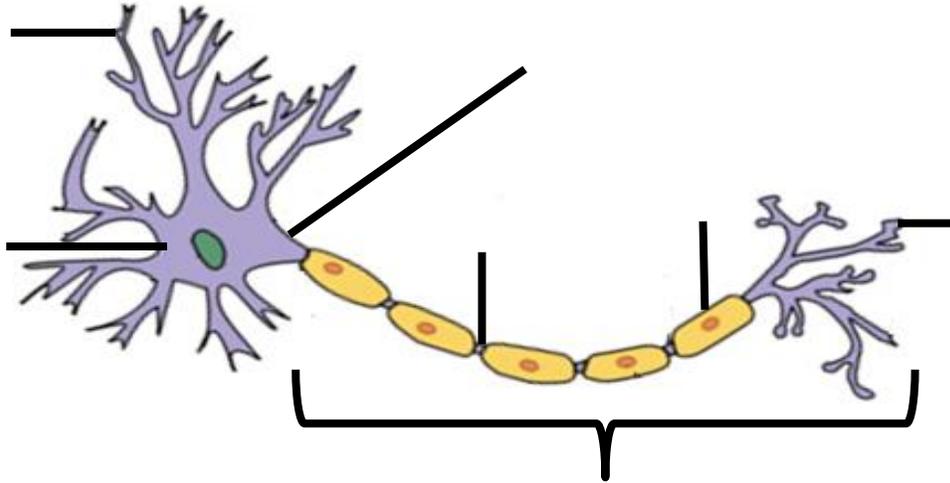


Cells of the Nervous System- Neurons and Neuroglia

Match the given terms of the parts of a neuron to its function or description.

- | | |
|--------------------------|---|
| _____ 1. Axon | A. Receives signals from sensory receptors or other neurons. |
| _____ 2. Axon hillock | B. Location where an action potential (nerve impulse) is created. |
| _____ 3. Axon terminal | C. A white covering that surrounds and insulates an axon. |
| _____ 4. Cell body | D. Contains the nucleus and other organelles. |
| _____ 5. Dendrite | E. The end of an axon. |
| _____ 6. Myelin sheath | F. Gaps between the myelin sheath of an axon. |
| _____ 7. Node of Ranvier | G. Conducts action potentials (nerve impulses). |

Identify the different parts of a neuron.



8. The type of cell of the nervous system that transmits action potentials is called a _____.

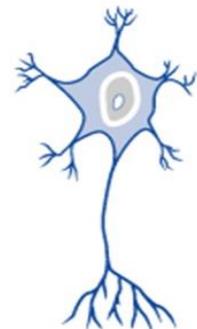
Classify each type of neuron by its function.

- | | |
|--------------------------|--|
| _____ 9. Interneuron | A. Transmits action potentials from the peripheral nervous system to the central nervous system. |
| _____ 10. Motor neuron | B. Transmits action potentials between motor neurons and sensory neurons. |
| _____ 11. Sensory neuron | C. Transmits action potentials from the central nervous system to the peripheral nervous system. |

Using the list below, write the structural classification of each of the given neurons.





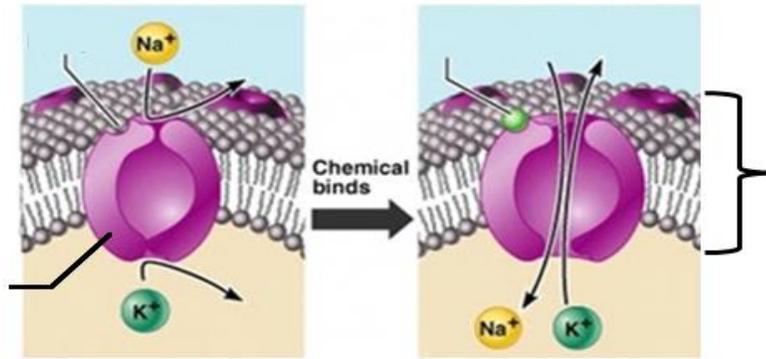


Electrical Signals

Channels and Pumps

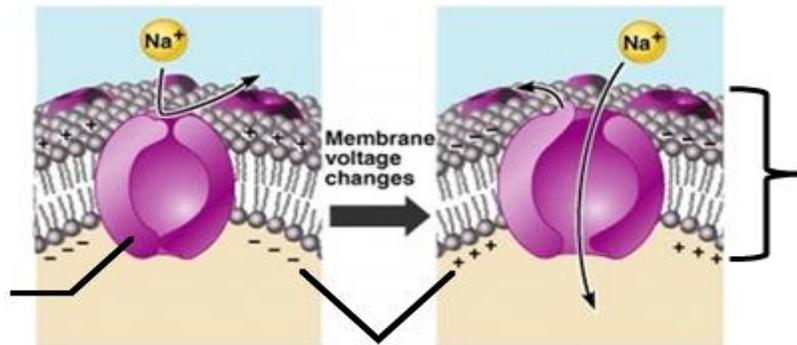
Chemical-gated Ion Channel

cell membrane
ion channel
neurotransmitter
receptor



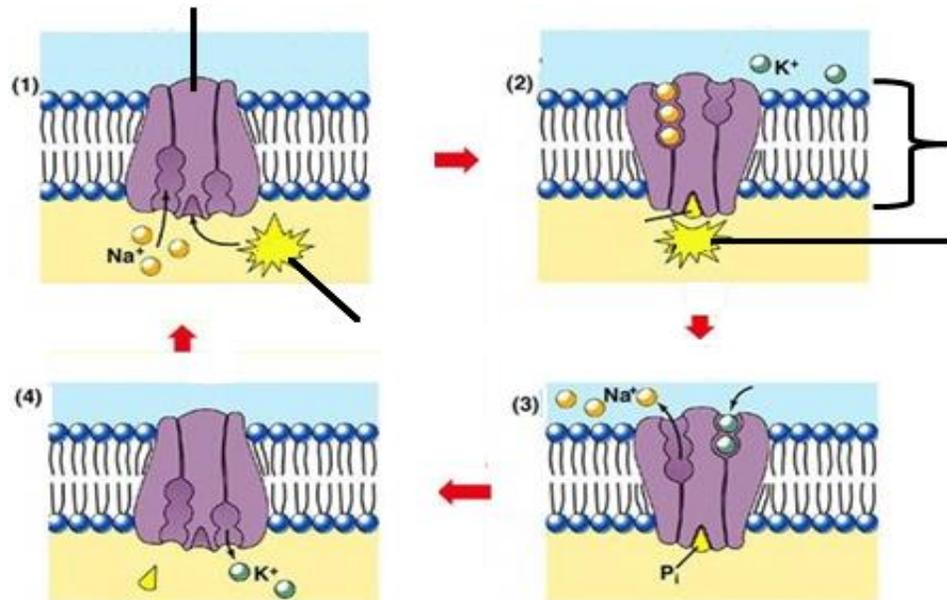
Voltage-gated Ion Channel

cell membrane
ion channel
electrical impulse



Sodium/Potassium Pump

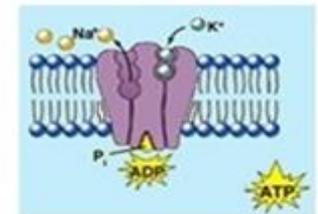
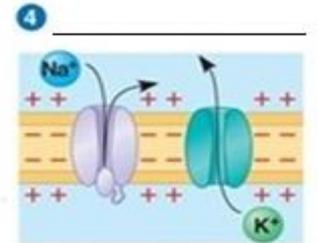
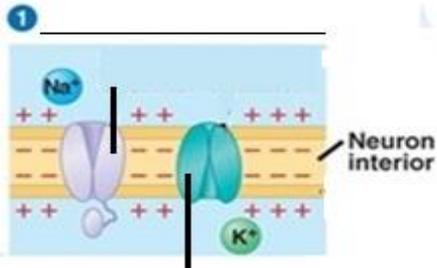
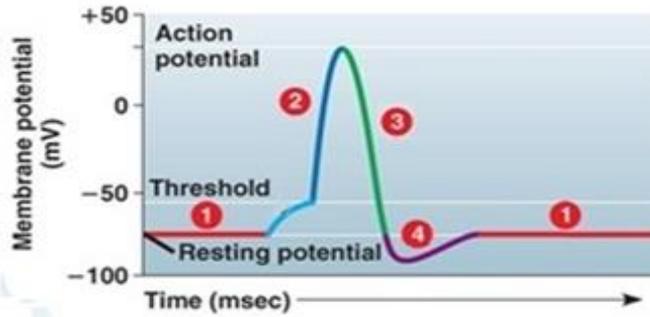
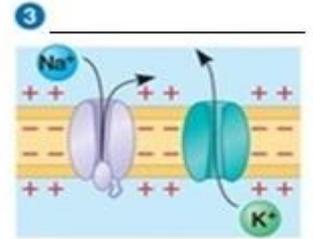
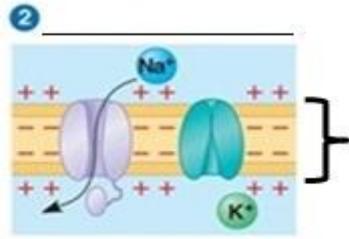
adenosine diphosphate
adenosine triphosphate
cell membrane
ion pump



Resting Potential vs. Action Potential

1. The electrical charge outside the cell membrane is _____, whereas the electrical charge inside the cell membrane is _____. The difference in charges across the cell membrane of an unstimulated cell is called the _____.
2. A reversal of a cell's membrane potential from resting membrane potential thus creating an electrical impulse is called an _____.

Using the list below, label the different parts and phases, 1-4, of an action potential.



cell membrane
depolarization

repolarization
resting state

threshold
undershoot

voltage-gated potassium ion channel
voltage-gated sodium ion channel

Match the phase of an action potential to its description.

- _____ 3. Depolarization
- _____ 4. Repolarization
- _____ 5. Resting state
- _____ 6. Undershoot

- A. All voltage-gated ion channels are closed, no ions moving across the cell membrane.
- B. Voltage-gated potassium ion channels are open, voltage-gated sodium ion channels are closed; potassium ions are moving out of the cell across the cell membrane, sodium ions are not moving.
- C. Voltage-gated potassium ion channels remain open, activation of the sodium-potassium pump; potassium ions are still moving ^{out of} into the cell, both sodium and potassium ions are being returned back to their resting concentrations.
- D. Voltage-gated sodium ion channels are open, voltage-gated potassium ion channels are closed, sodium ions are moving into the cell across the cell membrane, potassium ions are not moving.

- 7. _____ is the minimal amount of stimulus needed to create an action potential.
- 8. If a cell reaches threshold, an action potential occurs. If a cell does not reach threshold, and action potential does not occur. This principle is known as the _____ - _____ - _____ principle.

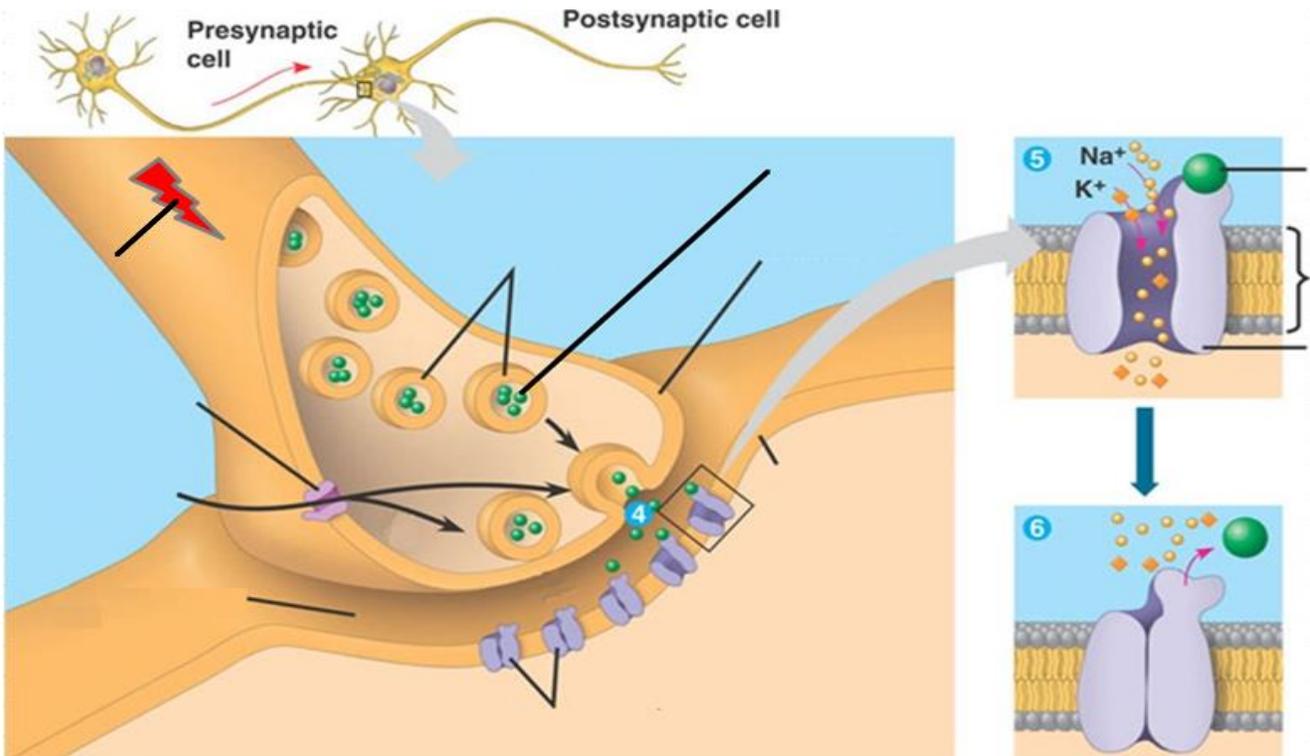
The Synapse

Match the parts of a synapse with its description or function.

- _____ 9. Calcium ions
- _____ 10. Chemical-gated sodium ion channel
- _____ 11. Neurotransmitter
- _____ 12. Postsynaptic membrane
- _____ 13. Presynaptic membrane
- _____ 14. Sodium ions
- _____ 15. Synaptic cleft
- _____ 16. Synaptic vesicle
- _____ 17. Voltage-gated calcium ion channel

- A. Chemical that binds to the receptor of the chemical-gated sodium ion channel.
- B. Ion that passes through the postsynaptic membrane.
- C. Gap between presynaptic membrane and postsynaptic membrane.
- D. Ion channel on presynaptic membrane that opens in when stimulated by an action potential.
- E. The dendrite of a synapse.
- F. Stores neurotransmitter
- G. Ion that passes through the presynaptic membrane.
- H. Ion channel that opens when a neurotransmitter binds to its receptor.
- I. The terminal end (axon terminal) of a synapse.

Using the list below, color and label the different parts of a synapse. Some labels may be used more than once.



Action potential

Axon

Calcium ions

Chemical-gated sodium ion channel

Neurotransmitter

Postsynaptic membrane

Presynaptic membrane

Synaptic cleft

Synaptic vesicle

Voltage-gated calcium ion channel

18. The summing up of graded potentials through dendrites is called _____.

Complete the paragraph about the creation and propagation of an action potential.

The creation of an action potential begins when receptors on dendrites are stimulated. Tiny electrical impulses called graded potentials are created and are transmitted to the cell body. Just after the cell body and before the axon, is an area called the 1 where these graded potentials are summated in a process called 2 . If the summation of these graded potentials reaches 3 , the minimal amount of stimulus needed to create an action potential, then an 4 will be created. The action potential then travels down the 5 , which is insulated by a 6 . The gaps between the myelin sheath are called 7 . The axon membranes between the Nodes of Ranvier contain voltage-gated ion channels and pumps. The two main ion channels are the 8 ion channel and the 9 ion channel. The graph of an action potential can be broken down into 4 phases. The first phase is 10 . During this phase, no voltage-gated ion channels are open and no ions are moving across the axon membrane. The second phase is 11 . During this phase, 12 ion channels are open allowing 13 ions to diffuse into the axon while 14 ion channels are closed not allowing 15 ions to diffuse out of the axon. The third phase is called 16 . During this phase, 17 ion channels are open allowing 18 ions to diffuse out of the axon while 19 ion channels are closed no longer allowing 20 ions to diffuse into of the axon. The final phase is called the 21 . During this phase, 22 ion channels remain open allowing 23 ions to move out of the axon. Eventually, the voltage-gated potassium ion channels will close and the activation of the 24 will begin pumping sodium and potassium ions back to their resting concentrations and locations. The continuation of the transmission of an action potential to another neuron occurs at the 25 . A synapse is composed of three parts: the 26 (terminal end), the 27 (dendrite), and the 28 (gap). As an action potential approaches the presynaptic membrane, 29 ion channels are stimulated to open allowing 30 ions to diffuse across the presynaptic membrane. Calcium ions bind to 31 filled with 32 , such as acetylcholine. The binding of calcium causes synaptic vesicles to fuse to the presynaptic membrane causing them to release neurotransmitter into the 33 . The neurotransmitter then binds to receptors on 34 ion channels causing them to open allowing 35 ions to diffuse across the 36 . The diffusion of sodium ions across the postsynaptic membrane creates a graded potential., thus continuing the transmission of an action potential.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
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24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____
36. _____