**6.5 Neurons and Synapses**

**Understandings:**

* Neurons transmit electrical impulses.
* The myelination of nerve fibres allows for saltatory conduction.
* Neurons pump sodium and potassium ions across their membranes to generate a resting potential.
* An action potential consists of depolarization and repolarization of the neuron.
* Nerve impulses are action potentials propagated along the axons of neurons.
* Propagation of nerve impulses is the result of local currents that cause each successive part of the axon to reach the threshold potential.
* Synapses are junctions between neurons and between neurons and receptor or effector cells.
* When presynaptic neurons are depolarized they release a neurotransmitter into the synapse.
* A nerve impulse is only initiated if the threshold potential is reached.

**Applications and Skills:**

* Application: Secretion and reabsorption of acetylcholine by neurons at synapses.
* Application: Blocking of synaptic transmission at cholinergic synapses in insects by binding of neonicotinoid pesticides to acetylcholine receptors.
* Skill: Analysis of oscilloscope traces showing resting potentials and action potentials.



**Control Systems**

What are the names of the two systems that control our bodies?

What are the two main parts of the nervous system?

What makes up the central nervous system?

*Label the CNS, brain, spinal cord and peripheral nerves on the diagram:*

**Membrane Proteins**

*Complete the table:*

|  |  |  |  |
| --- | --- | --- | --- |
| **Membrane Protein** | **Function** | **Substances transported** | **ATP needed?** **Y or N** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |



**Neuron Structure**

*Draw and label a motor neuron in the space below.*

*Go to* [*http://sites.sinauer.com/neuroscience5e/animations02.01.html*](http://sites.sinauer.com/neuroscience5e/animations02.01.html)



*Define:*

**Resting potential**

*Put the sentences in order to explain how a resting potential is achieved:*

|  |  |
| --- | --- |
| ***1*** | ***This requires ATP*** |
| ***2*** | ***Sodium and potassium cation pumps transport Na+ out and K+ in*** |
| ***3*** | ***Concentration of Na+ is high outside the neuron*** |
| ***4*** | ***This results in the inside being more negative than the outside*** |
| ***5*** | ***Concentration of K+ is high inside the neuron*** |
| ***6*** | ***Membrane is more permeable to K+ than Na+*** |
| ***7*** | ***Difference in concentration of ions maintained by active transport against concentration gradient*** |
| ***8*** | ***Concentration of K+ inside neuron 20x greater than outside so K+ ions rapidly diffuse out until equilibrium reached*** |

**How do neurons transmit a nervous impulse?**

*Watch the Action Potential animations:*

[*http://outreach.mcb.harvard.edu/animations/actionpotential\_short.swf*](http://outreach.mcb.harvard.edu/animations/actionpotential_short.swf)

[*http://highered.mcgraw-hill.com/sites/0072495855/student\_view0/chapter14/animation\_\_the\_nerve\_impulse.html*](http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter14/animation__the_nerve_impulse.html)

*Define:*

**Action potential:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can reverse the charge on a neuron (-70 to +40 mV). The membrane

becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If the stimulus exceeds a certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

value an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ results.

*Define*

***Depolarisation:***

***Repolarisation****:*

*Label the graph showing the changes in potential difference across the nerve as a nervous impulse is transmitted. Words to use:* ***Depolarisation, repolarisation, resting potential, action potential, threshold value, point of stimulus, refractory period and resting state.***

**Synaptic Transmission**

*Watch theanimation:* [*http://highered.mcgraw-hill.com/sites/0072495855/student\_view0/chapter14/animation\_\_transmission\_across\_a\_synapse.html*](http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter14/animation__transmission_across_a_synapse.html)

*Define* **Synapse:**

Why do we need synapses?

*Label this diagram of a synapse:*

*Include these labels -* **pre-synaptic neuron, post-synaptic neuron, mitochondria, vesicle, neurotransmitter, synaptic cleft, calcium ions, voltage gated calcium channels, action potential, sodium channel, neutrotransmitter receptor**

|  |
| --- |
| *Identify what is happening at each stage:***1****2****3****4****5****6** |



**Past Paper Questions**



*2. Draw and label a diagram of a motor neuron showing the direction of nerve impulse propagation (3)*

*3. Explain how a nerve impulse passes along a non-myelinated neuron (8)*

*4. Explain the principles of synaptic transmission (8)*

*5. Outline the use of four method of membrane transport in nerves and synapses (8)*