**Topic 6.5: Neurons and Synapses**

**Essential Idea: Neurons transmit the message, synapses modulate the message.**

**Statements & Objectives:**

**6.5.U1 Neurons transmit electrical impulses.**

State the function of the nervous system.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Draw the structure of a neuron.

(**Draw:** Represent by means of a labeled, accurate diagram or graph, using a pencil. A ruler (straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted(if appropriate) and joined in a smooth curve.)

Annotate a neuron drawing with the name and function of the following cell parts: dendrites, axon and cell body

**(Annotate** Add brief notes to a diagram or graph)

**6.5.U2 The myelination of nerve fibres allows for saltatory conduction.**

Outline the structure and function of myelin.

(**Outline** Give a brief account or summary.)

State the role of Schwann cells in formation of myelin.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Outline the mechanism and benefit of saltatory conduction.

(**Outline** Give a brief account or summary.)

Compare the speed of nerve impulse conduction myelinated and non-myelinated neurons.​

(**Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

**6.5.U3 Neurons pump sodium and potassium ions across their membranes to generate a resting potential.**

Define resting potential.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Explain three mechanisms that together create the resting potential in a neuron.

(**Explain**: Give a detailed account including reasons or causes)

State the voltage of the resting potential.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

**6.5.U4 An action potential consists of depolarization and repolarization of the neuron.**

Define action potential, depolarization and repolarization.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Outline the mechanism of neuron depolarization.

(**Outline** Give a brief account or summary.)

Outline the mechanism of neuron repolarization.

(**Outline** Give a brief account or summary.)

**6.5.U5 Nerve impulses are action potentials propagated along the axons of neurons.**

Define nerve impulse.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Describe how nerve impulses are propagated along the neuron axon.

**(Describe**: Give a detailed account)

Outline the cause and consequence of the refractory period after depolarization.

(**Outline** Give a brief account or summary.)

**6.5.U6 Propagation of nerve impulses is the result of local currents that cause each successive part of the axon to reach the threshold potential.**

Explain how the movement of sodium ions propagates an action potential along an axon.

(**Explain**: Give a detailed account including reasons or causes)

Explain movement of sodium ions in a local current.

(**Explain**: Give a detailed account including reasons or causes)

Describe that cause of and effect of membrane potential reaching the threshold potential.

**(Describe**: Give a detailed account)

**6.5.U7 Synapses are junctions between neurons and between neurons and receptors or effector cells.**

Define synapse, synaptic cleft and effector.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

State the role of neurotransmitters.​

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

**6.5.U8 When presynaptic neurons are depolarized they release a neurotransmitter into the synapse.**

Outline the mechanism of synaptic transmission, including the role of depolarization, calcium ions, diffusion, exocytosis, neurotransmitters, receptors, sodium ions, sodium channels, threshold potential and action potential.

(**Outline** Give a brief account or summary.)

**6.5.U9 A nerve impulse is only initiated if the threshold potential is reached.​**

Outline the role of positive feedback and sodium ions in the reaching of threshold potential.

(**Outline** Give a brief account or summary.)

​Explain why some synaptic transmissions will not lead to an action potential in a postsynaptic cell.

(**Explain**: Give a detailed account including reasons or causes)

**6.5.A1 Secretion and reabsorption of acetylcholine by neurons at synapses**

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Outline the secretion, action, reabsorption and formation of acetylcholine.

(**Outline** Give a brief account or summary.)

**6.5.A2 Blocking of synaptic transmission at cholinergic synapses in insects by binding of neonicotinoid pesticides to acetylcholine receptors.**

Outline the mechanism of action of neonicotinoids use as insecticides.

(**Outline** Give a brief account or summary.)

Define cholinergic synapse.

(**Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Compare the proportion of cholinergic synapses in insects and humans.

(**Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

State why neonicotinoids insecticides are not highly toxic to humans.​ ​

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

﻿**6.3.S1 Analysis of oscilloscope traces showing resting potentials and action potentials.**

​Outline the use of oscilloscopes in measuring membrane potential.

(**Outline** Give a brief account or summary.)

Annotate an oscilloscope trace to show the resting potential, action potential (depolarization and repolarization), threshold potential and refractory period.

**(Annotate** Add brief notes to a diagram or graph)

**6.5.NOS Cooperation and collaboration between groups of scientists-biologists are contributing to research into memory and learning.**

​Describe the effects of cooperative and collaboration between groups of scientists.

**(Describe**: Give a detailed account)

State an example of how people from multiple scientific disciplines are collaborating to understand learning and/or memory.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

Compare the growth and fixed mindsets effect on learning.

(**Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

Explain the basic biology of learning.

(**Explain**: Give a detailed account including reasons or causes)

Draw and explain the Ebbinghaus forgetting curve.

(**Draw:** Represent by means of a labeled, accurate diagram or graph, using a pencil. A ruler (straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted(if appropriate) and joined in a smooth curve.)

Outline the impact of repetition and review on learning.

(**Outline** Give a brief account or summary.)

State the impact of multitasking on memory consolidation.

**(State**: Give a specific name, value or other brief answer without explanation or calculation)

**Key Terms**

Peripheral

PNS

Dendrites

cell body

nodes of Ranvier

propagating wave

​sodium channel

presynaptic

​neonicotinoid

​refractory period

​exocytosis

​acetylcholine

nerves

neuron

motor

nerve impulse

axon

action potential

propagation

synapse

​acetylcholinesterase

​calcium ions

​sodium ions

​neonicotinoids

active transport

sodium-potassium pump

resting

depolarization

repolarization

axon

​saltatory conduction

​synaptic cleft

Schwann cells

​Diffusion

​insecticides

cholinergic synapse

neurotransmitter

voltage-gated

myelin

synapse

CNS

​ion channels

depolarization

threshold potential

​positive feedback

​local current​

impulse

​effector

terminal button

synaptic terminal

resting potential

​potassium ions

​potassium channel

receptors

​repolarization

​postsynaptic cell

​oscilloscopes