Edexcel (B) Biology A-level

9.5 - Nervous transmission

Flashcards

What is resting potential?

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Potential difference (voltage) across neuron membrane when not stimulated (50 to -90 mV, usually about -70 mV in humans).

How is resting potential established?

How is resting potential established?

1. Membrane is more permeable to K^+ than Na^+.
2. Sodium-potassium pump actively transports $3Na^+$ out of cell & $2K^+$ into cell.

Establishes electrochemical gradient: cell contents more negative than extracellular environment.

Name the stages in generating an action potential.

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1. Depolarisation
2. Repolarisation
3. Hyperpolarisation
4. Return to resting potential

What happens during depolarisation?

What happens during depolarisation?

1. Stimulus → facilitated diffusion of Na^+ into cell down electrochemical gradient.
2. p.d. across membrane becomes more positive.
3. If membrane reaches threshold potential (-50mV), voltage-gated Na^+ channels open.
4. Significant influx of Na^+ ions reverses p.d. to +40mV.

What happens during repolarisation?

What happens during repolarisation?

1. Voltage-gated Na^+ channels close and voltage-gated K^+ channels open.
2. Facilitated diffusion of K^+ ions out of cell down their electrochemical gradient
3. p.d. across membrane becomes more negative.

What happens during hyperpolarisation?

What happens during hyperpolarisation?

1. ‘Overshoot’ when K^+ ions diffuse out = p.d. becomes more negative than resting potential.
2. Refractory period: no stimulus is large enough to raise membrane potential to threshold.
3. Voltage-gated K^+ channels close & sodium-potassium pump re-establishes resting potential.

Explain the importance of the refractory period.

Explain the importance of the refractory period.

No action potential can be generated in hyperpolarised sections of membrane

- Ensures unidirectional impulse.
- Ensures discrete impulses.
- Limits frequency of impulse transmission.

How is an action potential propagated along an unmyelinated neuron?

How is an action potential propagated along an unmyelinated neuron?

1. Stimulus leads to influx of Na+ ions. First section of membrane depolarises.
2. Local electrical currents cause sodium voltage-gated channels further along membrane to open. Meanwhile, the section behind begins to repolarise.
3. Sequential wave of depolarisation.

Describe the structure of a motor neuron.

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Cell body: contains organelles & high proportion of RER.

Dendrons: branch into dendrites which carry impulses towards cell body.

Axon: long, unbranched fibre carries nerve impulses away from cell body.

Describe the additional features of a myelinated motor neuron.

Describe the additional features of a myelinated motor neuron.

Schwann cells: wrap around axon many times.

Myelin sheath: made from myelin-rich membranes of Schwann cells.

Nodes of Ranvier: very short gaps between neighbouring Schwann cells where there is no myelin sheath.

Explain why myelinated axons conduct impulses faster than unmyelinated axons.

Explain why myelinated axons conduct impulses faster than unmyelinated axons.

Saltatory conduction: Impulse 'jumps' from one node of Ranvier to another. Depolarisation cannot occur where myelin sheath acts as electrical insulator.

So impulse does not travel along whole axon length.

What is the function of synapses?

What is the function of synapses?

- Electrical impulse cannot cross junction.
- Neurotransmitters send impulses between neurons/ from neurons to effectors for excitatory or inhibitory response.
- Summation of sub-threshold impulses.
- New impulses can be initiated in several different neurons for multiple simultaneous responses.

Describe the structure of a synapse.

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- Presynaptic neuron ends in **synaptic knob:** contains lots of mitochondria, endoplasmic reticulum & vesicles of neurotransmitter.
- **Synaptic cleft:** 20-30 nm gap between neurons.
- Postsynaptic neuron: has complementary receptors to neurotransmitter (**ligand-gated Na^+ channels**).

Explain the role of acetylcholine.

Explain the role of acetylcholine.

- Causes muscle contraction at motor end plate.
- Causes excitation at preganglionic neurons. Causes inhibition at parasympathetic postganglionic neurons (e.g. of heart or breathing rate).

What happens to acetylcholine from the synaptic cleft?

What happens to acetylcholine from the synaptic cleft?

1. Hydrolysis into acetyl and choline by acetylcholinesterase (AChE).
2. Acetyl & choline diffuse back into presynaptic membrane.
3. ATP is used to reform acetylcholine for storage in vesicles.

Explain the role of noradrenaline.

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Catecholamine primarily released from sympathetic neurons.

- Increases force of skeletal muscle contraction.
- Increases rate & force of heart contraction.

What happens in the presynaptic neuron when an action potential is transmitted between neurons?

What happens in the presynaptic neuron when an action potential is transmitted between neurons?

1. Wave of depolarisation travels down presynaptic neuron, causing voltage-gated Ca^{2+} channels to open.
2. Vesicles move towards & fuse with presynaptic membrane.
3. Exocytosis of neurotransmitter into synaptic cleft.

How do neurotransmitters cross the synaptic cleft?

How do neurotransmitters cross the synaptic cleft?

via simple diffusion

What happens in the postsynaptic neuron when an action potential is transmitted between neurons?

What happens in the postsynaptic neuron when an action potential is transmitted between neurons?

1. Neurotransmitter binds to specific receptor on postsynaptic membrane.
2. Ligand-gated Na^+ channels open.
3. If influx of Na^+ ions raises membrane to threshold potential, action potential is generated.

What happens in an inhibitory synapse?

What happens in an inhibitory synapse?

1. Neurotransmitter binds to and opens Cl^- channels on postsynaptic membrane & triggers K^+ channels to open.
2. Cl^- moves in & K^+ moves out via facilitated diffusion.
3. p.d. becomes more negative: hyperpolarisation so no action potential is generated.