

Neurons, synapses and brain systems

Supported GRE teaching and original transfer practice

Identify the evidence

Identify the evidence

Trace the action potential from trigger to synaptic release

Use the overview measurement lesson VI for research inference.

Concepts 1 (1)

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The action potential begins at the axon hillock, where graded inputs sum; once the threshold is reached the neuron fires a complete spike (the all-or-none principle), and during the absolute refractory period it cannot fire again. Stimulus intensity is coded by firing rate and by how many neurons fire, not by spike size. Myelin insulates the axon and speeds conduction by saltatory conduction between the nodes of Ranvier; demyelinating disease slows or blocks conduction.

Concepts 1 (2)

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At the synapse, the arriving spike opens calcium channels, vesicles release neurotransmitter into the cleft, and receptors on the postsynaptic cell convert binding into a new graded potential. Reuptake and enzymatic breakdown clear the transmitter. A drug can be an agonist (mimicking or enhancing a transmitter) or an antagonist (blocking receptors); SSRIs block serotonin reuptake, leaving more in the cleft.

Concepts 2

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Structure-function anchors: the amygdala supports emotion and fear learning; the hippocampus is needed to form new episodic memories; the hypothalamus regulates drives and homeostasis; the cerebellum coordinates movement; Broca's area supports speech production and Wernicke's area comprehension; the prefrontal cortex supports planning and control. Localisation is real but partial: most behaviours involve distributed networks.

Dopamine illustrates specificity: it supports movement and reward, its loss produces Parkinson's disease, and excessive dopaminergic signalling is linked to positive symptoms of schizophrenia, which many antipsychotics treat by blocking D2 receptors. One transmitter serves many systems, so a drug's behavioural effect depends on the pathway, not the molecule alone.

Reason through the worked case

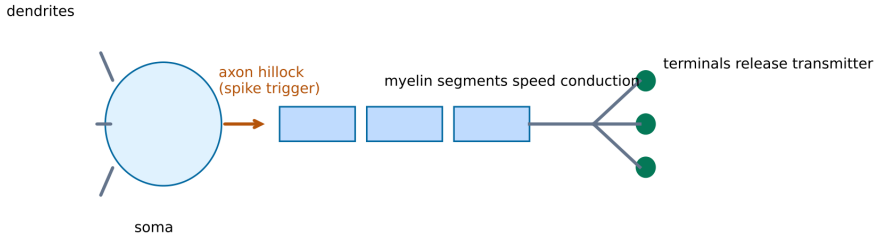
Reason through the worked case

A fictional substance blocks receptors without activating them. Another slows transmitter reuptake. Predict their immediate actions with qualifications.

The receptor blocker acts as an antagonist at the stated receptor. Slower reuptake can prolong or increase transmitter availability in the cleft. Neither description establishes an overall behavioural effect: receptor subtype, feedback and affected pathways matter. Do not infer a drug recommendation.

Read the reviewed representation

Signal flows dendrites → hillock → axon → terminals



Original schematic for Neurons, synapses and brain systems. Illustrative relationships and numbers are not research results.

Attempt an unfamiliar case

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A stronger stimulus produces more spikes of unchanged height. A pupil calls this evidence against all-or-none firing. Correct the inference.

Pause and write the explanation before continuing.

Check the transfer argument

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Unchanged spike amplitude fits all-or-none action potentials. Firing rate can carry information about input strength, and more neurons may also be recruited. Separate spike amplitude from number of spikes per second and population activity. A diagram must label which quantity is plotted before being interpreted.

Accept a different explanation when its evidence and limits are justified.

Limit the conclusion

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Describing a stronger stimulus as producing a bigger spike, or naming a single brain centre as the whole basis of a complex behaviour.

Original classroom cases are not official questions or personal clinical advice.

Check yourself

Independent retrieval

An imaging region is active during two different tasks. Why is one activation insufficient to identify a unique function?

Write your reasoning before comparing it with the methods and limits taught in this lesson.