

Neuron Structure and Synaptic Transmission

30 minutes, 3 stages

The nervous system controls physiological processes by transmitting signals between neurons ([Topic](#)). Understanding how individual neurons work and how they communicate across synapses is essential to explaining how your body senses its environment and responds to it. This homework focuses on the structural features of neurons and the chemical events that occur when a signal crosses a synapse ([Outcome](#)).

Stage 1: Neuron anatomy and function (10 min)

Label the following neuron diagram with these terms: axon, dendrite, soma (cell body), axon terminal, myelin sheath, node of Ranvier.

Then answer these questions in one or two sentences each:

1. Explain the function of the myelin sheath in an action potential.
2. What is the all-or-none response, and why does it matter for nerve signal transmission?
3. A neuron fires at different intensities depending on the stimulus strength. If the all-or-none principle means a neuron either fires or does not fire, how is variable intensity of response possible?

Stage 2: Synaptic transmission (12 min)

Read this scenario: A sensory neuron detects a touch on your skin. The signal travels down the axon and reaches the axon terminal, where it must cross a synapse to reach the next neuron.

Complete the following table by filling in what happens at each stage:

Stage	Structure or Process	What Happens
1	Action potential arrives at axon terminal	
2	Synaptic vesicles	
3	Neurotransmitter release	
4	Receptor binding on postsynaptic membrane	
5	Signal termination	Cholinesterase breaks down acetylcholine

Use these terms to complete the table: depolarization causes calcium influx; neurotransmitter molecules diffuse across synaptic cleft; acetylcholine binds to receptors on the postsynaptic neuron; vesicles fuse with presynaptic membrane and release neurotransmitter.

Then write one sentence explaining why the synapse is a one-way junction (signal travels from presynaptic to postsynaptic neuron only).

Stage 3: Application and synthesis (8 min)

The neurotransmitter norepinephrine is involved in the sympathetic nervous system response. When you are startled, norepinephrine is released at synapses that control heart rate and breathing.

1. Explain why blocking cholinesterase (the enzyme that breaks down acetylcholine) would cause acetylcholine to accumulate in the synapse.

2. Predict what would happen to muscle contraction if acetylcholine could not be removed from the synapse. Why would this be harmful?
3. In one sentence, explain how the structure of the synapse (the gap between neurons) supports the role of chemical messengers in nerve signal transmission.

Self-check

Answer these questions honestly to confirm your understanding:

1. Can you identify the main structures of a neuron and describe what each does during signal transmission?
2. Can you explain the sequence of events that occur when a neurotransmitter is released, crosses the synapse, and binds to a receptor on the next neuron?
3. Can you explain why the all-or-none response does not prevent the nervous system from sending signals of different intensities?