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# Neurophysiology: Neurons & Synapses

**Printable Flashcards — Pre-Med Biology**

Neuron structure, resting potential, action potentials, ion channels, synapses, and neurotransmitters.

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**154 cards — Printable Flashcards**

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1

Nervous system in one line: what does it do?

2

CNS vs PNS: what's CNS?

3

CNS vs PNS: what's PNS?

4

Sensory (afferent) vs motor (efferent): which goes TO the CNS?

5

Sensory (afferent) vs motor (efferent): which goes FROM the CNS to muscles/glands?

6

Neuron vs glial cell: who sends the action potentials?

7

Neuron's job in one sentence?

8

Dendrites do what?

2

Brain + spinal cord.



1

Fast communication + fast control.



4

Sensory (afferent) goes TO the CNS.



3

All nerves outside the brain and spinal cord.



6

Neurons.



5

Motor (efferent).



8

Receive signals from other neurons.



7

Receive signals, process them, and send an electrical signal down the axon.

9

Cell body (soma) does what?

10

Axon does what?

11

Axon hillock (trigger zone): why is it important?

12

Myelin is basically...

13

Nodes of Ranvier are...

14

Schwann cells vs oligodendrocytes: who myelinates where? (high school version)

15

Resting membrane potential: inside of the neuron is overall...

16

Why is the inside negative at rest (big idea, not a lecture)?

10

Carries the action potential away from the cell body.



9

Houses nucleus and integrates incoming signals.



12

Insulation around axons.



11

It's where the action potential usually starts (threshold zone).



14

Schwann = PNS. Oligodendrocytes = CNS.



13

Gaps in the myelin where the action potential 'jumps'.



16

Because $K^+$ leaks out more than $Na^+$ leaks in, and proteins inside are negative.



15

Negative compared to outside.

17

$Na^+/K^+$ pump: what does it do in one line?

18

Classic trap: 'The $Na^+/K^+$ pump directly causes the action potential spike.' True or false?

19

What does 'polarized' mean at rest?

20

Graded potential vs action potential: which is all-or-none?

21

Graded potentials get weaker as they spread. True or false?

22

Action potentials get weaker as they travel down the axon. True or false?

23

Threshold means...

24

What does a stronger stimulus do to an action potential: bigger spike or more spikes?

18

False.



17

Uses ATP to pump $Na^+$ out and $K^+$ in (maintains gradients).



20

Action potential.



19

There is a voltage difference across the membrane (inside negative).



22

False.



21

True.



24

More spikes (higher frequency), not a bigger spike.



23

The membrane voltage where enough $Na^+$ channels open to trigger an action potential.

25

If you see 'all-or-none', what concept should you immediately think of?

26

Action potential step 1: what happens at threshold?

27

Depolarization phase: which ion moves which way?

28

Repolarization phase: which ion mainly moves which way?

29

Hyperpolarization (undershoot): why does it happen?

30

Depolarization means the membrane potential becomes...

31

Hyperpolarization means the membrane potential becomes...

32

Voltage-gated $Na^+$ channels have two states people confuse: open and...

26

Voltage-gated $Na^+$ channels open.



25

Action potentials.



28

$K^+$ moves OUT (as $K^+$ channels open).



27

$Na^+$ rushes IN.



30

Less negative (more positive).



29

$K^+$ channels close slowly, so extra $K^+$ leaves for a bit.



32

Inactivated (closed but not ready to reopen).



31

More negative than resting.

33

Absolute refractory period: can you fire another action potential?

34

Relative refractory period: can you fire another AP?

35

Why do action potentials usually travel only one way down an axon?

36

Another common trap: '$K^+$ enters the cell during repolarization.' True or false?

37

Another common trap: '$Na^+$ leaves the cell during depolarization.' True or false?

38

Action potential: depolarization = {{c1::$Na^+$}} in; repolarization = {{c2::$K^+$}} out.

39

Action potentials are {{c1::all-or-none}}: stimulus strength changes firing {{c2::frequency}}, not spike {{c3::amplitude}}.

40

Myelin makes signals travel... faster or slower?

34

Yes, but it needs a stronger stimulus.



33

No.



36

False. $K^+$ leaves the cell during repolarization.



35

Because the region behind the spike is refractory.



38

Action potential: depolarization = $Na^+$ in; repolarization = $K^+$ out.



37

False. $Na^+$ enters the cell during depolarization.



40

Faster.



39

Action potentials are all-or-none: stimulus strength changes firing frequency, not spike amplitude.

41

Saltatory conduction means...

42

Does myelin increase the 'strength' (amplitude) of the action potential?

43

Bigger axon diameter makes conduction faster or slower?

44

What happens in demyelination (like MS) in plain terms?

45

Two main synapse types?

46

Most synapses in the human nervous system are...

47

Chemical synapse is usually one-way or two-way?

48

Electrical synapses (gap junctions) are usually faster or slower than chemical?

42

No. It mainly increases speed and efficiency.



41

The action potential jumps from node to node.



44

Signals slow down or fail because insulation is lost.



43

Faster.



46

Chemical synapses.



45

Chemical synapses and electrical synapses.



48

Faster.



47

One-way (presynaptic -> postsynaptic).

49

Electrical synapses are usually bidirectional. True or false?

50

Synaptic cleft is...

51

At a chemical synapse, what triggers neurotransmitter release?

52

Why is $Ca^{2+}$ so important at synapses?

53

Neurotransmitters are released by...

54

What happens after neurotransmitter is released? (one line)

55

Neurotransmitter effect depends on... the neurotransmitter itself or the receptor?

56

EPSP means...

50

The small gap between neurons at a chemical synapse.



49

Usually true.



52

It's the 'release signal' that makes vesicles fuse with the membrane.



51

$Ca^{2+}$ entering the presynaptic terminal.



54

It binds receptors on the postsynaptic membrane and changes ion flow.



53

Exocytosis of synaptic vesicles.



56

Excitatory postsynaptic potential: makes the neuron more likely to fire.



55

Mostly the receptor.

57

IPSP means...

58

EPSP is usually caused by what ion movement? (pre-med level)

59

IPSP is often caused by what ion movement?

60

Graded potentials can add up. What's that called?

61

Temporal summation means...

62

Spatial summation means...

63

A neuron fires an AP when the axon hillock reaches...

64

How does the synapse stop the signal? Name 3 ways.

58

Usually $Na^+$ influx (depolarizing).



57

Inhibitory postsynaptic potential:
makes the neuron less likely to fire.



60

Summation.



59

Often $Cl^-$ influx or $K^+$ efflux.



62

Multiple synapses fire at different
locations at the same time.



61

One synapse fires repeatedly in
a short time, stacking the effect.



64

Reuptake, enzymatic breakdown, diffusion away.



63

Threshold.

65

Acetylcholine is mainly removed by...

66

Many neurotransmitters (like serotonin, dopamine) are mainly cleared by...

67

Most common excitatory neurotransmitter in the CNS (basic)?

68

Most common inhibitory neurotransmitter in the brain (basic)?

69

Acetylcholine (ACh) is famous for what synapse?

70

Dopamine/serotonin are mainly...

71

Trap check: 'A neurotransmitter is always excitatory.' True or false?

72

If membrane potential goes from -70 mV to -55 mV, is that depolarization or hyperpolarization?

66

Reuptake into the presynaptic neuron.



65

Enzymatic breakdown (acetylcholinesterase).



68

GABA.



67

Glutamate.



70

Modulatory neurotransmitters (involved in mood, reward, etc.).



69

Neuromuscular junction (motor neuron -> skeletal muscle).



72

Depolarization.



71

False.

73

If membrane potential goes from -70 mV to -80 mV, is that depolarization or hyperpolarization?

74

Why can't $Na^+$ just keep flowing forever once channels open?

75

Why does repolarization happen even if $Na^+$ concentration is still higher outside?

76

Mini boss: block voltage-gated $Na^+$ channels. What happens to action potentials?

77

Mini boss: block voltage-gated $K^+$ channels. What happens to repolarization?

78

Mini boss: remove myelin. What changes most?

79

Mini boss: lower extracellular $Na^+$ a lot. What happens to the AP?

80

Mini boss: a toxin blocks $Ca^{2+}$ channels at the presynaptic terminal. What happens to neurotransmitter release?

74

Because $Na^+$ channels inactivate quickly.



73

Hyperpolarization.



76

They don't start (or are severely reduced).



75

Because $Na^+$ channels inactivate and $K^+$ channels open, pushing voltage back down.



78

Conduction speed drops (and signals can fail).



77

Repolarization is slower; the neuron stays depolarized longer.



80

It drops a lot (or stops).



79

Depolarization is weaker/harder because the driving force for $Na^+$ influx is reduced.

81

Student says: 'Depolarization means the inside becomes more negative.' Fix it.

82

Student says: 'Stronger stimulus makes a bigger action potential.' Fix it.

83

Student says: 'The $Na^+/K^+$ pump is what makes the action potential spike.' Fix it.

84

Student says: 'Synapses are always electrical.' Fix it.

85

Student says: 'Neurotransmitters always excite.' Fix it.

86

Action potential happens mainly in the...

87

EPSPs/IPSPs happen mainly on the...

88

Action potentials use mainly which type of channels?

82

Stronger stimulus makes MORE action potentials per second (higher frequency), not a taller spike.



81

Depolarization means less negative (more positive).



84

Most synapses are chemical and use neurotransmitters.



83

Voltage-gated $Na^+$ and $K^+$ channels make the spike; the pump maintains gradients long-term.



86

Axon (starting at axon hillock).



85

Effect depends on the receptor; a transmitter can excite or inhibit.



88

Voltage-gated channels.



87

Dendrites and cell body.

89

Synaptic potentials use mainly which type of channels?

90

Axon terminal -> dendrite synapse is called...

91

Axon terminal -> cell body synapse is called...

92

Fast receptors that directly open ion channels are called...

93

Slower receptors that trigger internal signaling are called...

94

Somatic vs autonomic nervous system: what's somatic?

95

Somatic vs autonomic: what's autonomic?

96

Sympathetic vs parasympathetic: which is 'fight or flight'?

90

Axodendritic synapse.



89

Ligand-gated channels (receptor-operated).



92

Ionotropic receptors (ligand-gated ion channels).



91

Axosomatic synapse.



94

Voluntary control of skeletal muscle.



93

Metabotropic receptors.



96

Sympathetic.



95

Involuntary control of organs (smooth muscle, cardiac muscle, glands).

97

Sympathetic vs parasympathetic: which is 'rest and digest'?

98

Ion mainly responsible for the depolarization phase of an action potential:

99

Ion mainly responsible for repolarization:

100

Ion that triggers neurotransmitter release at a synapse:

101

Name for the gaps in myelin where the AP is regenerated:

102

The voltage where an AP starts is called:

103

Most common type of synapse in the CNS:

104

Resting membrane potential: inside is {{c1::negative}} compared to outside.

98

Sodium ($Na^+$)



97

Parasympathetic.



100

Calcium ($Ca^{2+}$)



99

Potassium ($K^+$)



102

Threshold



101

Nodes of Ranvier



104

Resting membrane potential: inside is negative compared to outside.



103

Chemical synapse

105

Depolarization is mainly {{c1::$Na^+$ influx}} through {{c2::voltage-gated}} channels.

106

Repolarization is mainly {{c1::$K^+$ efflux}} through {{c2::voltage-gated}} channels.

107

Neurotransmitter release: AP -> {{c1::$Ca^{2+}$}} in -> vesicle {{c2::exocytosis}}.

108

EPSP makes firing {{c1::more likely}}; IPSP makes firing {{c2::less likely}}.

109

If a neuron is hyperpolarized, is it easier or harder to reach threshold?

110

If $Na^+$ channels are inactivated, can opening them again immediately trigger another spike?

111

Why doesn't the action potential 'fade out' halfway down the axon?

112

Synaptic delay exists because...

106

Repolarization is mainly $K^+$ efflux through voltage-gated channels.



105

Depolarization is mainly $Na^+$ influx through voltage-gated channels.



108

EPSP makes firing more likely; IPSP makes firing less likely.



107

Neurotransmitter release: AP -> $Ca^{2+}$ in -> vesicle exocytosis.



110

No.



109

Harder.



112

Chemical synapses take time to release and bind neurotransmitter.



111

Because it is regenerated continuously by voltage-gated channels.

113

Why are chemical synapses still useful if they're slower?

114

Neurotransmitters travel long-distance in blood like hormones. True or false?

115

What is the 'synaptic vesicle' literally?

116

If a neuron receives equal EPSPs and IPSPs at the same time, what happens?

117

Scenario: you touch a hot pan. Which pathway happens first: sensory in or motor out?

118

Scenario: why do reflexes feel 'automatic'?

119

Scenario: a neuron fires faster and faster. What limits the maximum firing rate?

120

Three basic neuron roles:

114

False.



113

They can amplify, inhibit, and modulate signals (more control).



116

They can cancel out (sum to near zero).



115

A tiny membrane bubble storing neurotransmitter.



118

Because many reflex arcs are handled by the spinal cord without waiting for conscious brain processing.



117

Sensory (afferent) in first, then motor (efferent) out.



120

Sensory neurons, motor neurons, and interneurons.



119

The refractory periods.

121

Interneurons are found mostly in the...

122

In a typical neuron, signals usually flow:

123

Grey matter vs white matter (high-level): what's white matter mostly?

124

Grey matter (high-level) is mostly...

125

Leak channels are...

126

Voltage-gated channels open when...

127

Ligand-gated channels open when...

128

If a question says 'channel opens due to neurotransmitter binding', it's...

122

Dendrites -> cell body -> axon -> axon terminals.



121

CNS (brain/spinal cord).



124

Neuron cell bodies, dendrites, and synapses.



123

Myelinated axons.



126

The membrane potential changes (voltage changes).



125

Always open channels that set the resting potential.



128

Ligand-gated.



127

A chemical ligand (neurotransmitter) binds.

129

If a question says 'channel opens due to membrane depolarization', it's...

130

During an action potential, can the inside become positive (overshoot)?

131

What stops the depolarization from just staying high? (two things)

132

$K^+$ channels are slower than $Na^+$ channels. Why does that matter?

133

After one AP, do ion gradients instantly disappear?

134

So why do we even need the $Na^+/K^+$ pump if one AP barely changes gradients?

135

Under the myelin (between nodes), do you get a full action potential spike?

136

Why is saltatory conduction energy-efficient?

130

Yes, briefly.



129

Voltage-gated.



132

It creates the shape: $Na^+$ opens fast (spike up), $K^+$ opens later (brings it down).



131

$Na^+$ channels inactivate and $K^+$ channels open.



134

Because neurons fire many times; over time gradients would slowly drift without the pump.



133

No.



136

Fewer membrane areas need ion pumping because fewer areas have big ion flow.



135

Not really. The big regeneration happens at nodes.

137

Why are synapses closer to the axon hillock often more powerful?

138

An IPSP near the axon hillock can be a 'veto'. Why?

139

Neurotransmitter vs hormone: what's the clean difference?

140

At the neuromuscular junction, the neurotransmitter is...

141

At the neuromuscular junction, is ACh excitatory or inhibitory?

142

Sympathetic vs parasympathetic neurotransmitter idea (big picture):

143

Big autonomic trap: sympathetic ALWAYS uses norepinephrine everywhere. True or false?

144

If acetylcholinesterase is blocked, what happens to the ACh signal?

138

Because it can block depolarization right at the trigger zone.



137

Because graded potentials decay with distance.



140

Acetylcholine (ACh).



139

Neurotransmitter = local signal across a synapse.
Hormone = blood-borne signal to distant targets.



142

Sympathetic mainly uses noradrenaline (norepinephrine); parasympathetic mainly uses acetylcholine.



141

Excitatory (it triggers muscle contraction).



144

It lasts longer (ACh isn't broken down fast).



143

False (there are exceptions).

145

If ACh receptors at the neuromuscular junction are blocked, what happens to muscle contraction?

146

If neurotransmitter reuptake is blocked, what happens to signaling?

147

Reflex arc pieces in order (simple):

148

Why are reflexes protective?

149

In a resting neuron, {{c1::$K^+$}} leak channels contribute a lot to the negative resting potential.

150

Myelin increases conduction {{c1::speed}} via {{c2::saltatory}} conduction at nodes of Ranvier.

151

Chemical synapses are typically {{c1::unidirectional}} and use {{c2::neurotransmitters}}.

152

If you picked 'depolarization = more negative', what did you mess up?

146

Signal is stronger/longer because transmitter stays in the synaptic cleft.



145

It weakens or stops (paralysis).



148

They happen fast and reduce damage (like pulling away from heat).



147

Receptor -> sensory neuron -> CNS (interneuron) -> motor neuron -> effector.



150

Myelin increases conduction speed via saltatory conduction at nodes of Ranvier.



149

In a resting neuron, $K^+$ leak channels contribute a lot to the negative resting potential.



152

You messed up the sign. Depolarization means LESS negative.



151

Chemical synapses are typically unidirectional and use neurotransmitters.

153

If you picked 'myelin makes the AP bigger', what did you mix up?

154

If you picked '$Ca^{2+}$ causes the AP spike', what did you mix up?

154

You mixed up AP vs synapse. In neurons, the AP spike is mainly $Na^{+}/K^{+}$. $Ca^{2+}$ is the synaptic release trigger.



153

You mixed speed with amplitude. Myelin speeds conduction; amplitude stays all-or-none.