



Dr Phil Holland

**Topic 1:**

**Action potentials and  
Synaptic transmission**

Part 3 of 5

**Module:**

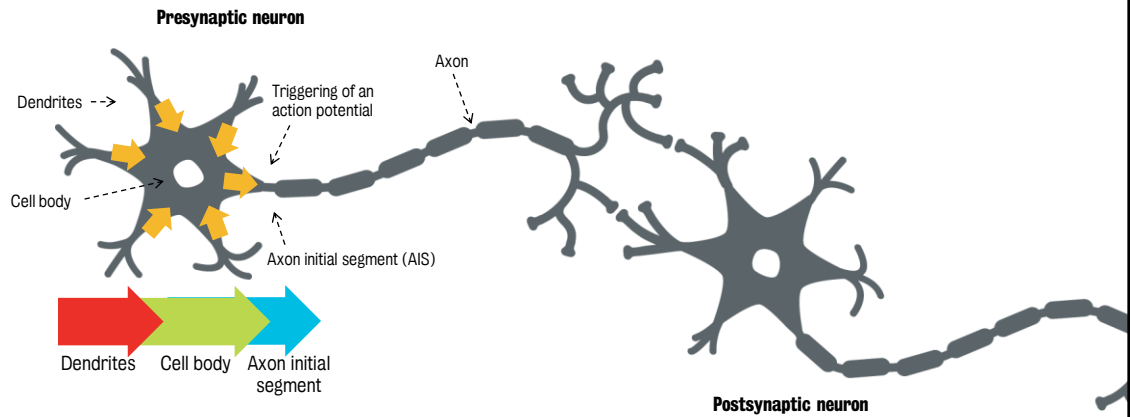
**Biological Foundations of Mental Health**

**Week 3:**

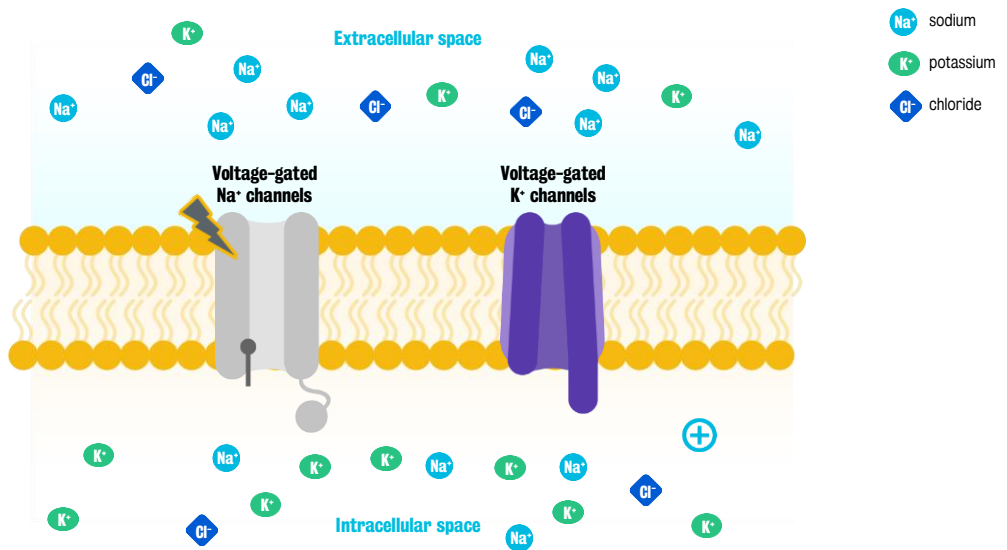
**Synaptic transmission and neurotransmitter systems**

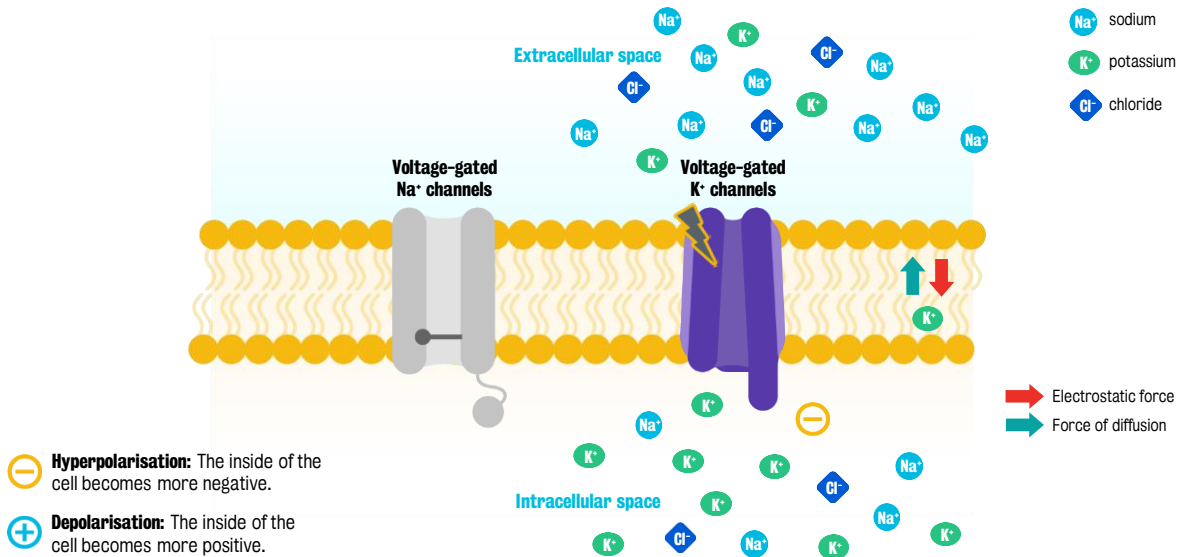
# Part 3

## Direction of travel from neuron to neuron



## Voltage gated $\text{Na}^+$ channels



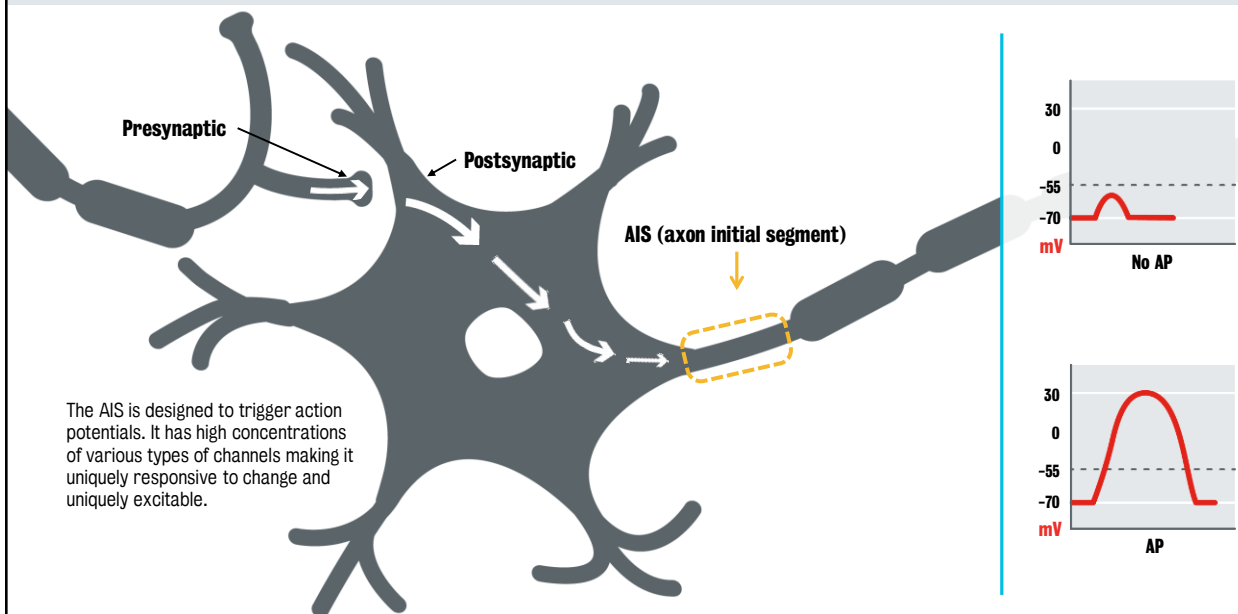
Voltage gated  $K^+$  channel

Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

5 of 12

## Triggering an action potential

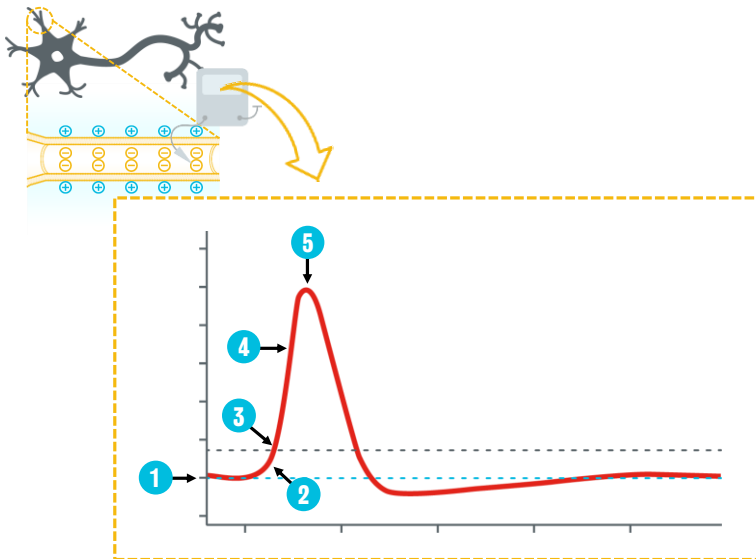


Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

6 of 12

## The action potential (1)



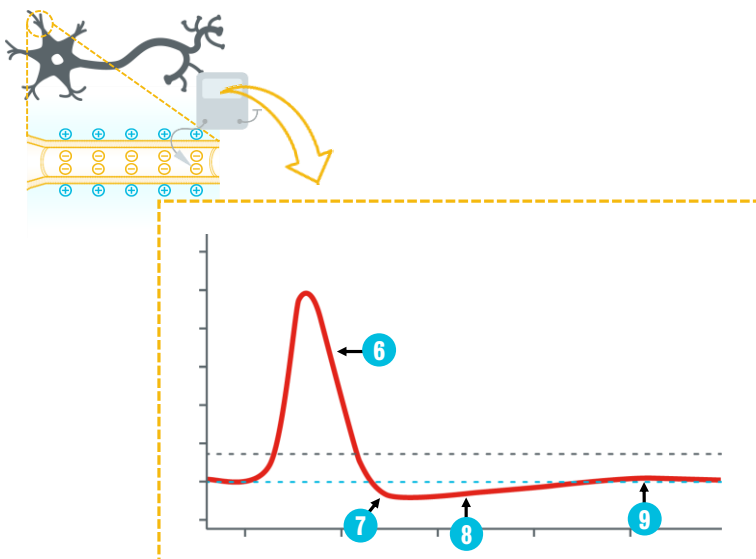
- 1 Resting membrane potential
- 2 Depolarising stimuli
- 3 Depolarisation reaches threshold: v-gated Na channels open and  $\text{Na}^+$  enters neuron
- 4 Rapid  $\text{Na}^+$  entry depolarises neuron further
- 5 Na channels inactivate (0.5 ms after open)

Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

7 of 12

## The action potential (2)



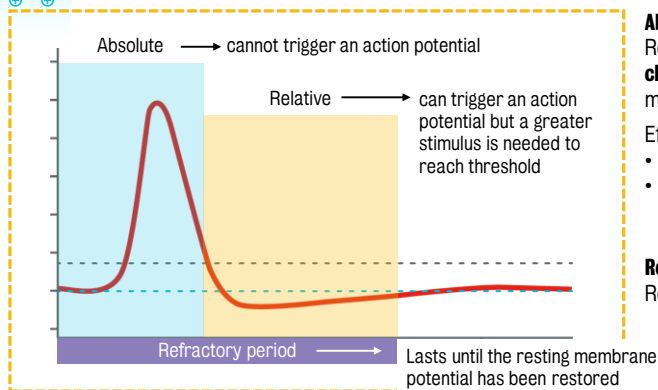
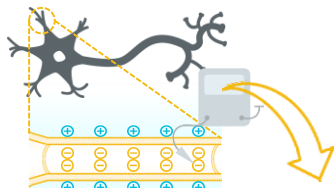
- 6 Slower responding  $\text{K}^+$  channels open and  $\text{K}^+$  moves out of the neuron
- 7 K channels remain open and more  $\text{K}^+$  leaves the neuron, hyperpolarising it
- 8 Voltage-gated K channels close, some  $\text{K}^+$  enters cell through leak channels
- 9 Normal membrane potential

Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

8 of 12

## Refractory periods



### Absolute refractory period:

Results from the **inactivation of Na<sup>+</sup> channels**, and lasts until the resting membrane potential is restored.

Effects:

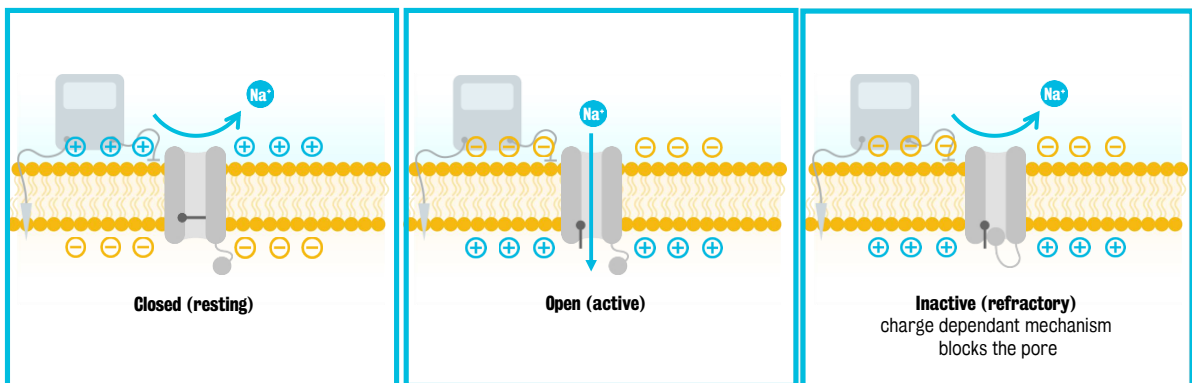
- allows the neuron to control its excitability
- prevents back propagation

### Relative refractory period:

Results from the **hyperpolarisation phase**.

## Functional states

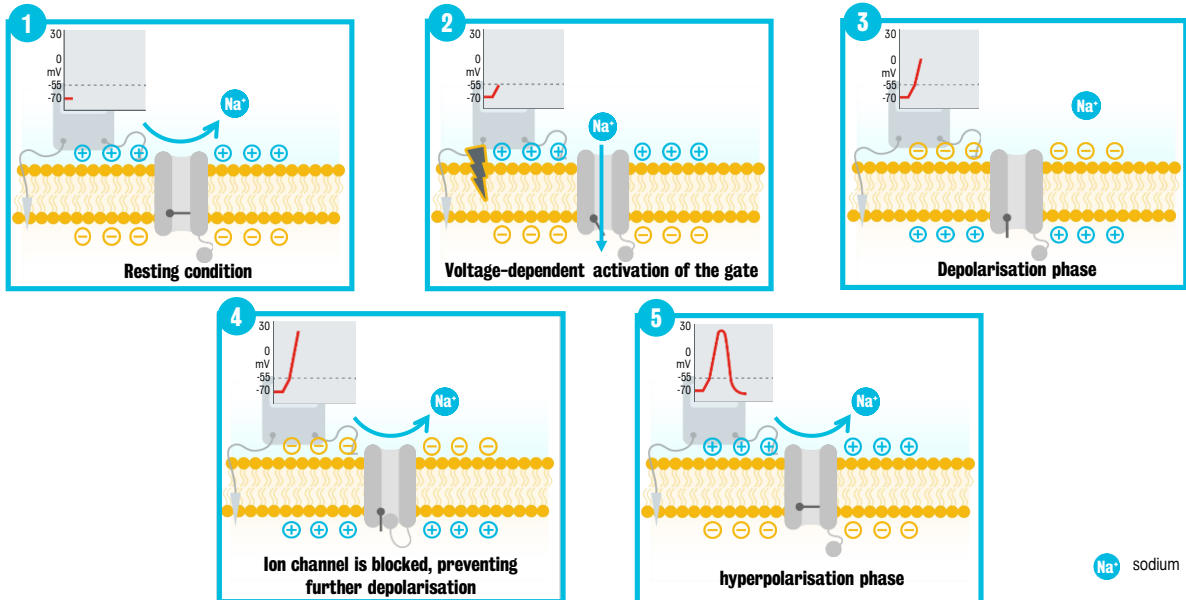
Na<sup>+</sup> sodium



Not all channels have all 3 states:

- voltage-gated Na channels have all 3
- voltage-gated K channels have no inactivation state

## Na channel changes during action potential



Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

11 of 12

# End of part 3

Week 3 Synaptic transmission and neurotransmitter systems

Topic 1: Action potentials and synaptic transmission

12 of 12