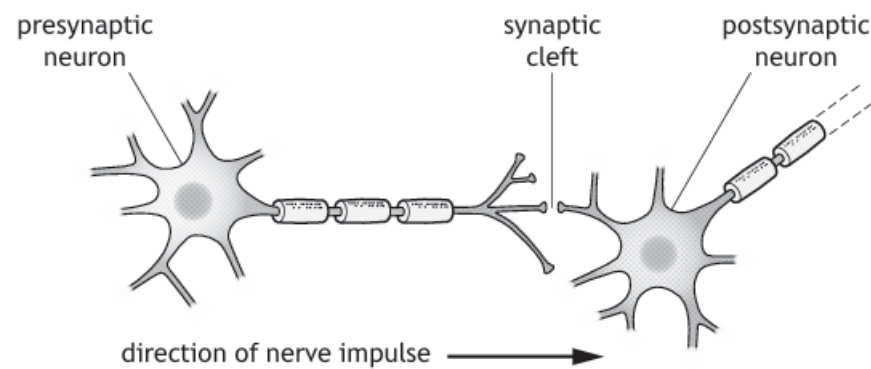


1

The diagram shows two neurons and a synapse.



The following events occur during the transmission of a nerve impulse from one neuron to the next:

1. The neurotransmitter binds to its receptor.
2. Voltage-gated sodium channels open and sodium ions diffuse into the cell causing local depolarisation.
3. Vesicles containing the neurotransmitter fuse with the membrane.
4. Ligand-gated ion channels open.
5. The neurotransmitter diffuses across the synaptic cleft.

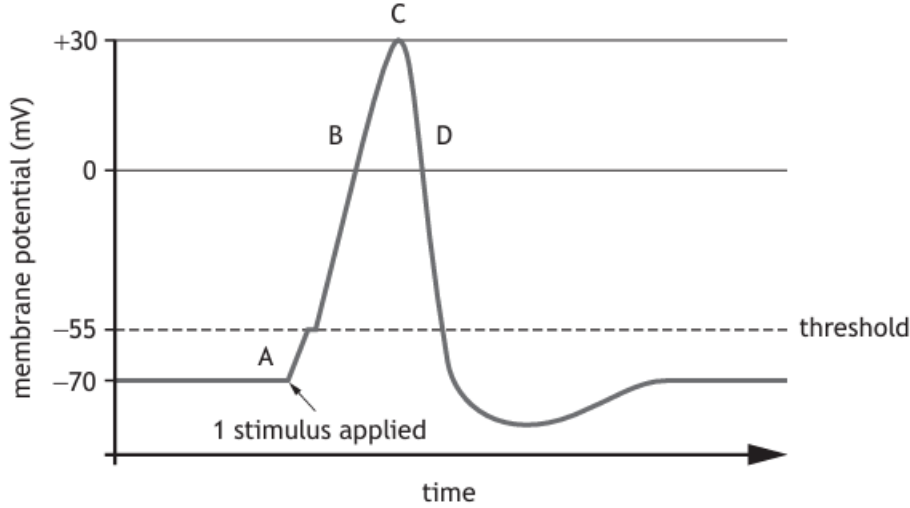
The correct order of events is

- A 5, 3, 4, 1, 2
B 3, 5, 1, 4, 2
C 3, 5, 1, 2, 4
D 5, 3, 1, 4, 2

2

The diagram shows the changes in membrane potential during the transmission of a nerve impulse.

Which letter represents the time when the voltage-gated potassium ion channels are open?



3

The list shows some events that occur in the cell membrane of a neuron during nerve transmission.

1. Binding of neurotransmitter to neuron
2. Closure of voltage-gated ion channels
3. Opening of ligand-gated ion channels
4. Opening of voltage-gated ion channels

Which events contribute to the depolarisation of the resting potential of a neuron?

- A 1 and 2 only
B 2 and 3 only
C 1, 2 and 3 only
D 1, 3 and 4 only

4 The following list refers to events that contribute to an action potential in a post synaptic neuron.

1. voltage-gated channels open
2. protein conformation change
3. sodium ions enter
4. neurotransmitter binds to receptor

The correct order is

- A 2 → 3 → 4 → 1
- B 4 → 1 → 3 → 2
- C 2 → 3 → 1 → 4
- D 4 → 2 → 1 → 3.

5 The list below refers to events that may result in a nerve impulse.

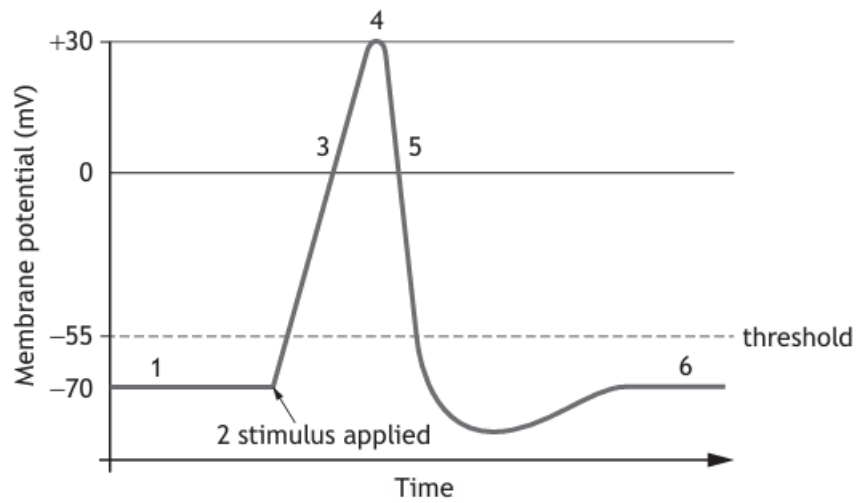
List.

1. Ligand-gated channel opens
2. Protein conformation changes
3. Sodium ions enter post synaptic neurone
4. Neurotransmitter binds to membrane receptor protein

The correct order is

- A 2 → 3 → 4 → 1
- B 4 → 1 → 3 → 2
- C 2 → 3 → 1 → 4
- D 4 → 2 → 1 → 3.

1



- 1 Membrane potential before nerve impulse initiated
- 2 Binding of a neurotransmitter to a ligand-gated sodium ion (Na^+) channel
- 3 Voltage gated Na^+ channels open
- 4 Voltage gated Na^+ channels become inactivated
- 5 Voltage gated potassium ion (K^+) channels open
- 6 Membrane potential after nerve impulse has passed

(i) State the term that describes the membrane potential at points 1 and 6.

1

(iii) Use the information in the diagram to explain the importance of K^+ channels in nerve transmission.

2

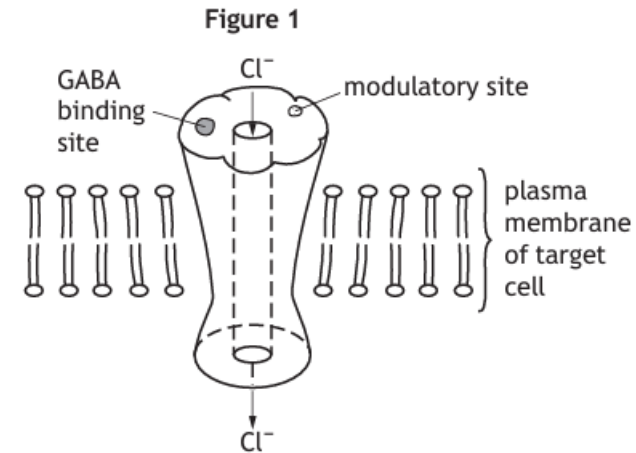
2

Tetrodotoxin is a poison found in some fish, such as the pufferfish, which has its effect at stage three of the process shown in the diagram.

Suggest a possible mechanism for the toxicity of this substance.

1

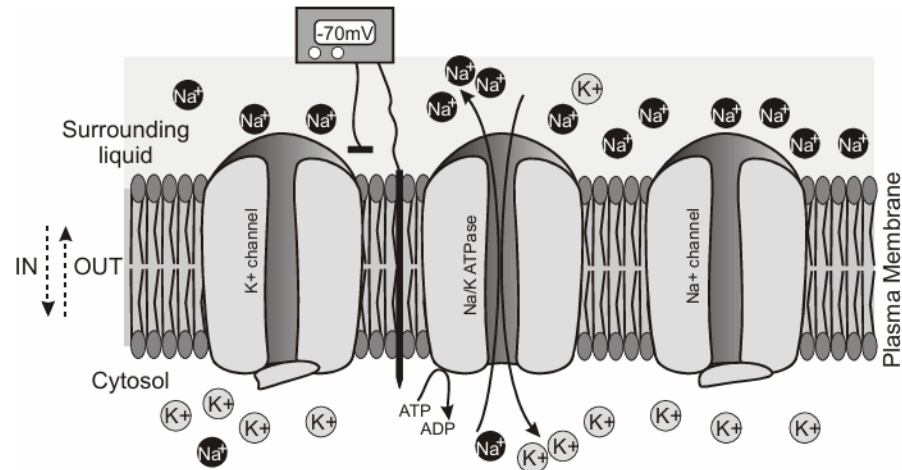
3



Explain why the opening of GABA channels would make the generation of a nerve impulse less likely.

2

4



Describe the process by which neurotransmitters released into a synapse initiate an action potential in a connecting cell.

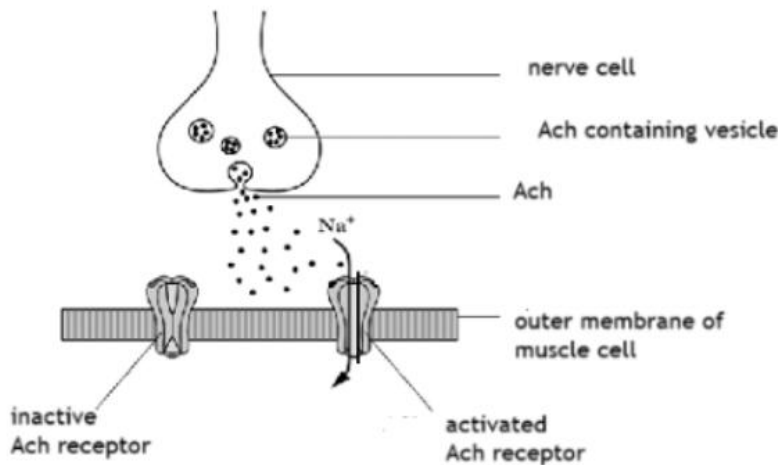
3

5. The diagram represents Na^+ / K^+ ATPase maintaining a resting potential across the membrane of a neuron.

Explain how Na^+ / K^+ ATPase restores the resting potential after an impulse.

6

Acetylcholine (ACh) works at the junction between nerve and muscle cells (neuromuscular junction) where it stimulates muscle contraction by binding to receptors in the outer membrane of muscle cells.



Describe the events during nerve transmission that follow binding of a neurotransmitter such as ACh to its receptor.

2

2

2

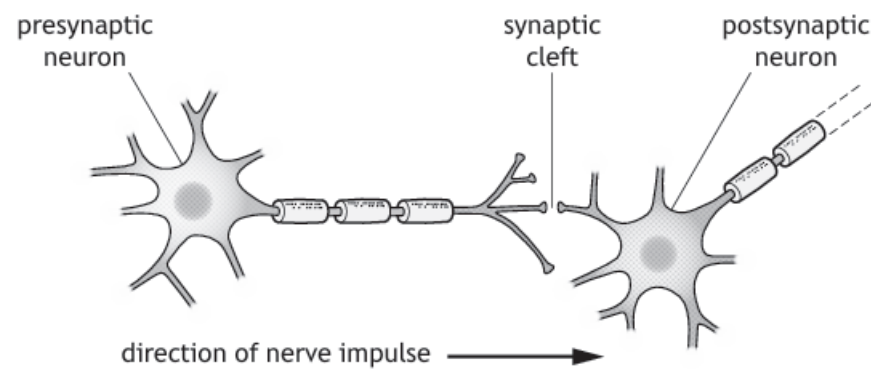
7	The black mamba, <i>Dendroaspis polylepis</i>, is a large African snake whose bite is extremely venomous and usually fatal to humans. Its venom consists of a mixture of toxins that primarily affect the nervous system. (a) One of these toxins binds to neurotransmitter receptors at synapses, preventing their activation. Describe the process by which neurotransmitters released into a synapse initiate an action potential in a connecting cell. _____ _____ _____ _____ _____ _____		
		3	
	(b) <i>Acid sensing ion channels</i> (ASICs) are involved in the perception of pain and are activated by small changes in the pH of the surrounding cellular environment. <i>Mambalgin</i> is another toxin found in black mamba venom, which is known to be able to bind to ASICs. i Laboratory experiments on mice show that mambalgin has a similar effect to that of a strong painkiller. Suggest the mechanism by which mambalgin might work as a painkiller by preventing the generation of a nerve impulse. _____ _____ _____		
		1	

8 Describe the generation and transmission of a nerve impulse in a neuron.

9

1

The diagram shows two neurons and a synapse.



The following events occur during the transmission of a nerve impulse from one neuron to the next:

- 1. The neurotransmitter binds to its receptor.
- 2. Voltage-gated sodium channels open and sodium ions diffuse into the cell causing local depolarisation.
- 3. Vesicles containing the neurotransmitter fuse with the membrane.
- 4. Ligand-gated ion channels open.
- 5. The neurotransmitter diffuses across the synaptic cleft.

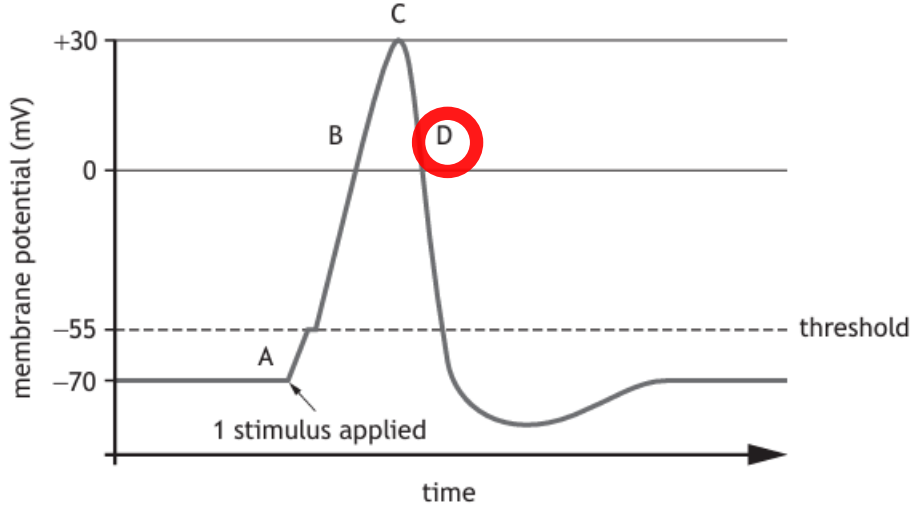
The correct order of events is

- A 5, 3, 4, 1, 2
- B 3, 5, 1, 4, 2**
- C 3, 5, 1, 2, 4
- D 5, 3, 1, 4, 2

2

The diagram shows the changes in membrane potential during the transmission of a nerve impulse.

Which letter represents the time when the voltage-gated potassium ion channels are open?



3

The list shows some events that occur in the cell membrane of a neuron during nerve transmission.

- 1. Binding of neurotransmitter to neuron
- 2. Closure of voltage-gated ion channels
- 3. Opening of ligand-gated ion channels
- 4. Opening of voltage-gated ion channels

Which events contribute to the depolarisation of the resting potential of a neuron?

- A 1 and 2 only
- B 2 and 3 only
- C 1, 2 and 3 only
- D 1, 3 and 4 only**

4 The following list refers to events that contribute to an action potential in a post synaptic neuron.

- 1. voltage-gated channels open
- 2. protein conformation change
- 3. sodium ions enter
- 4. neurotransmitter binds to receptor

The correct order is

- A 2 → 3 → 4 → 1
- B 4 → 1 → 3 → 2
- C 2 → 3 → 1 → 4
- ☒ D 4 → 2 → 1 → 3.

5 The list below refers to events that may result in a nerve impulse.

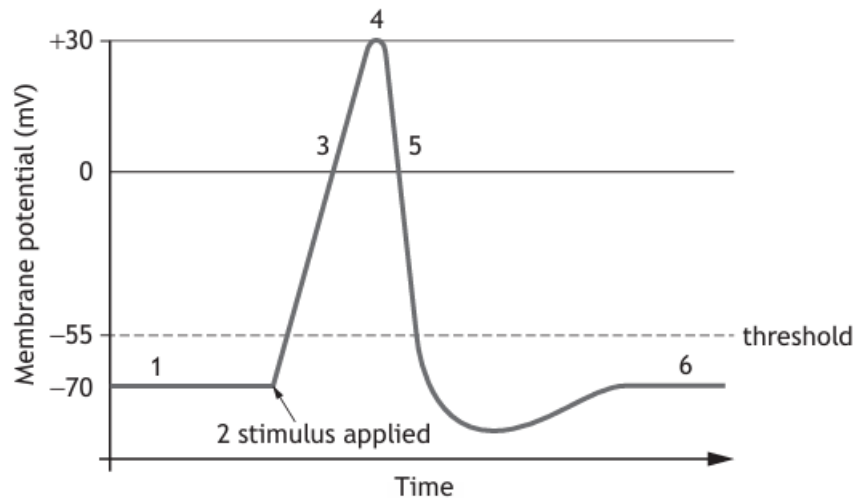
List.

- 1. Ligand-gated channel opens
- 2. Protein conformation changes
- 3. Sodium ions enter post synaptic neurone
- 4. Neurotransmitter binds to membrane receptor protein

The correct order is

- A 2 → 3 → 4 → 1
- B 4 → 1 → 3 → 2
- C 2 → 3 → 1 → 4
- ☒ D 4 → 2 → 1 → 3.

1



- 1 Membrane potential before nerve impulse initiated
- 2 Binding of a neurotransmitter to a ligand-gated sodium ion (Na^+) channel
- 3 Voltage gated Na^+ channels open
- 4 Voltage gated Na^+ channels become inactivated
- 5 Voltage gated potassium ion (K^+) channels open
- 6 Membrane potential after nerve impulse has passed

- (i) State the term that describes the membrane potential at points 1 and 6.

Resting

- (iii) Use the information in the diagram to explain the importance of K^+ channels in nerve transmission.

Prevents Na^+ channel opening.

2

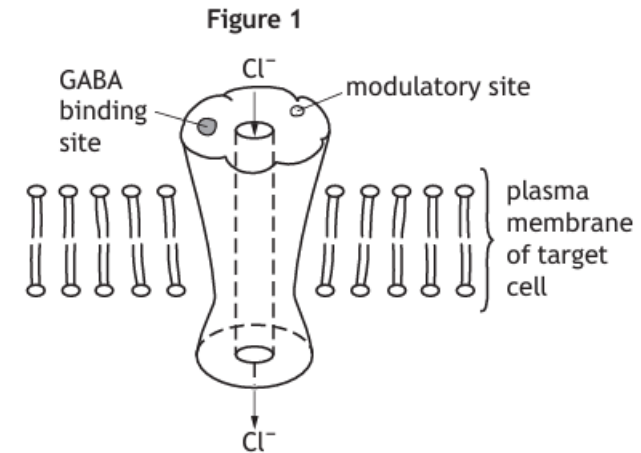
Tetrodotoxin is a poison found in some fish, such as the pufferfish, which has its effect at stage three of the process shown in the diagram.

Suggest a possible mechanism for the toxicity of this substance.

Blocks/damages Na^+ channel OR
prevents Na^+ channel opening.

1

3

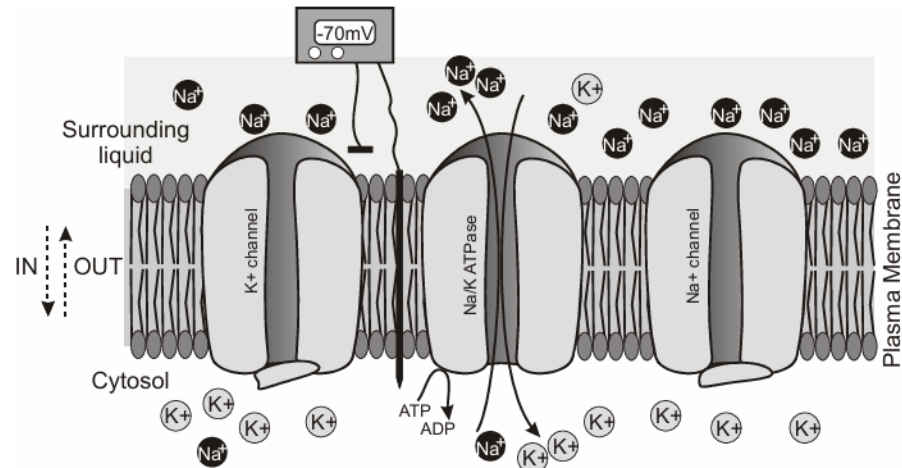


Explain why the opening of GABA channels would make the generation of a nerve impulse less likely.

Cell will become more negative inside
Membrane will be more difficult to depolarize

2

4



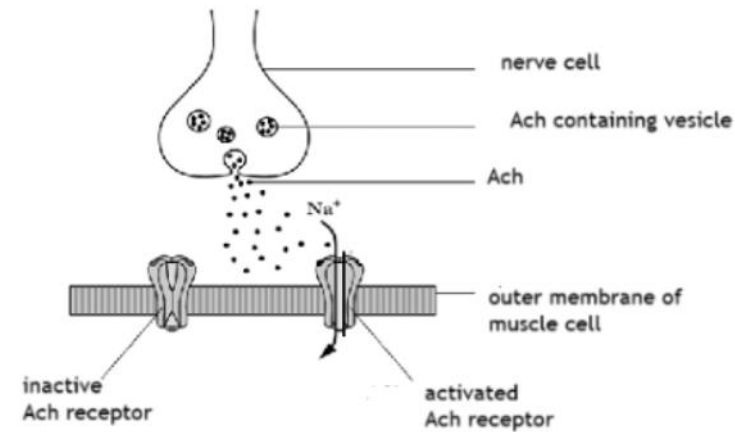
Describe the process by which neurotransmitters released into a synapse initiate an action potential in a connecting cell.

1. Neurotransmitters bind to their receptors which are ligand gated channels
2. Binding allows an influx of positive/sodium ions
3. If sufficient ion movement occurs the threshold is reached
4. Voltage gated sodium channels open
5. Resulting in further depolarisation

3

6

Acetylcholine (ACh) works at the junction between nerve and muscle cells (neuromuscular junction) where it stimulates muscle contraction by binding to receptors in the outer membrane of muscle cells.



Describe the events during nerve transmission that follow binding of a neurotransmitter such as ACh to its receptor.

1. Allows an influx of positive/sodium ions OR the membrane depolarise
2. If sufficient ion movement occurs/the threshold is reached
3. Voltage gated sodium channels open
4. Resulting in further depolarisation

11

5

The diagram represents Na^+ / K^+ ATPase maintaining a resting potential across the membrane of a neuron.

Explain how Na^+ / K^+ ATPase restores the resting potential after an impulse.

More Na^+ pumped out than K^+ pumped in (1)
 Inside cell becomes negative compared to outside (1)

7	The black mamba, <i>Dendroaspis polylepis</i>, is a large African snake whose bite is extremely venomous and usually fatal to humans. Its venom consists of a mixture of toxins that primarily affect the nervous system. (a) One of these toxins binds to neurotransmitter receptors at synapses, preventing their activation. Describe the process by which neurotransmitters released into a synapse initiate an action potential in a connecting cell. 1. Neurotransmitters bind to ligand gated channels 2. Allows an influx of positive/sodium ions OR the membrane depolarise 3. if sufficient ion movement occurs/the threshold is reached 4. voltage gated sodium channels open 5. resulting in further depolarisation (Any 3)	3	
	(b) <i>Acid sensing ion channels</i> (ASICs) are involved in the perception of pain and are activated by small changes in the pH of the surrounding cellular environment. <i>Mambalgin</i> is another toxin found in black mamba venom, which is known to be able to bind to ASICs. Laboratory experiments on mice show that mambalgin has a similar effect to that of a strong painkiller. Suggest the mechanism by which mambalgin might work as a painkiller by preventing the generation of a nerve impulse. mambalgin binds to receptors preventing them from opening which prevents sufficient depolarise/initiation of an action potential	1	
8	Describe the generation and transmission of a nerve impulse in a neuron.		9
	- Resting membrane potential is no net flow of ions across membrane - Neurotransmitter released into synapse/initiate response. OR vesicles containing neurotransmitter fuse with membrane - Neurotransmitters bind to specific/their receptors (at synapse) - Neurotransmitter receptors are ligand-gated (ion) channels OR Binding of neurotransmitter opens (ligand-gated) channels - Sodium ions enter neuron/cell OR Sodium ions move down electrochemical/concentration gradient - Initial depolarisation of plasma membrane - sufficient ion movement/ membrane depolarised beyond a/reaches threshold - Opening of voltage-gated sodium channels triggered More sodium ions enter cell OR further depolarisation - sodium channels close/ inactivated (Then voltage-gated) potassium channels open - Potassium ions move out of cell OR Membrane repolarises - Resting membrane potential restored OR Ion gradients re-established by sodium-potassium pump		