



Western  
UNIVERSITY • CANADA

# Tutorial 4

## Sections 009/010

TA: Greydon Gilmore  
Physiology 2130  
Oct 1<sup>st</sup>, 2019

# Your TA reminding you...

- **1<sup>st</sup> Peerwise assignment (1.5%)**
  - **Post 2 MC questions:** due Oct 16<sup>th</sup> @ midnight
  - **Answer 5 MC questions:** due Oct 18<sup>th</sup> @ midnight
    - Currently 12 inactive users
    - Only 17 students completed
- **1<sup>st</sup> Quiz (1%)**
  - **Opens:** Oct 21<sup>st</sup> @ 4pm
  - **Closes:** Oct 22<sup>nd</sup> @ 4pm
- **1<sup>st</sup> Midterm** - Oct 25<sup>th</sup> @ 6pm-7pm **(15%)**

# Today

- Group work
- Learning Catalytics Quiz
- Action potential

# Group Work

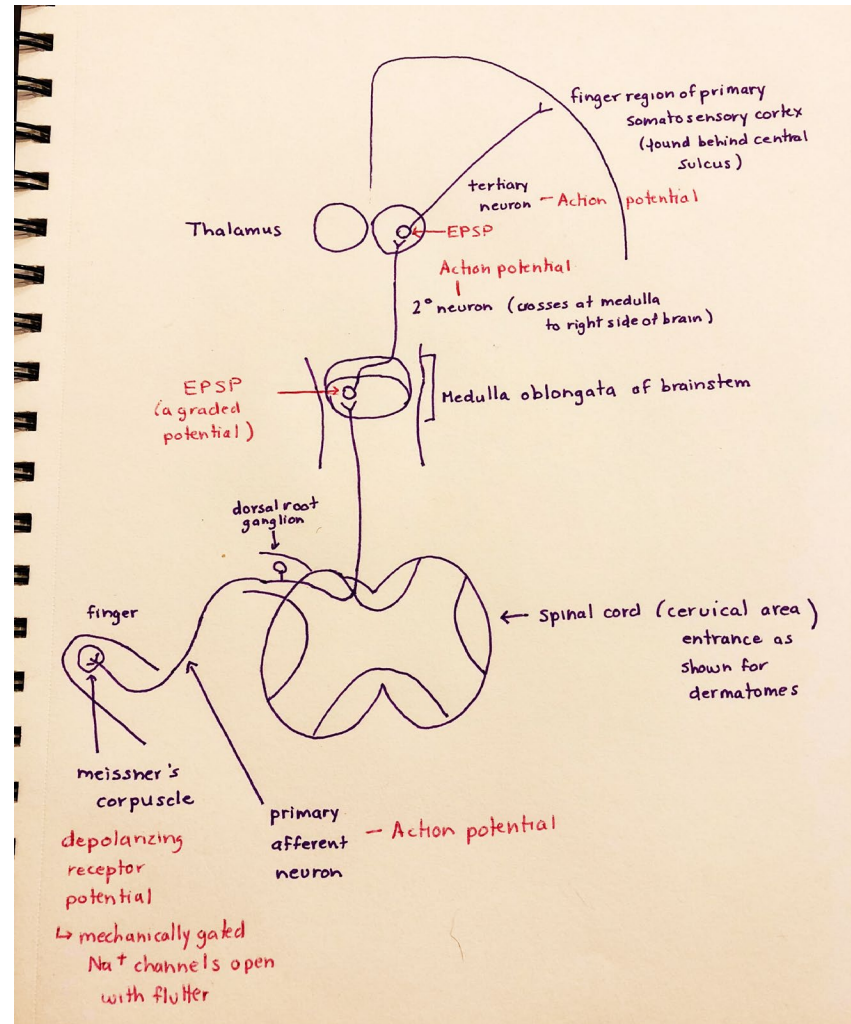
# Activity #1: Drawing Sensory Pathway

**There is a butterfly fluttering on your left finger.**

- a) On the paper provided, first draw the pathway that the information would take to reach the primary somatosensory cortex. Think about the various neurons (i.e. 20 neuron), where they synapse, and where they cross.
- b) After you have drawn the pathway, please indicate what electrical events occur in each neuron, starting with the receptor.
  - Be specific, what electrical event will occur in each area of the neuron?
  - If it is a post-synaptic potential, is it inhibitory?
- c) Which touch receptor is this? What channels open in the receptor to cause us to feel the flutter?

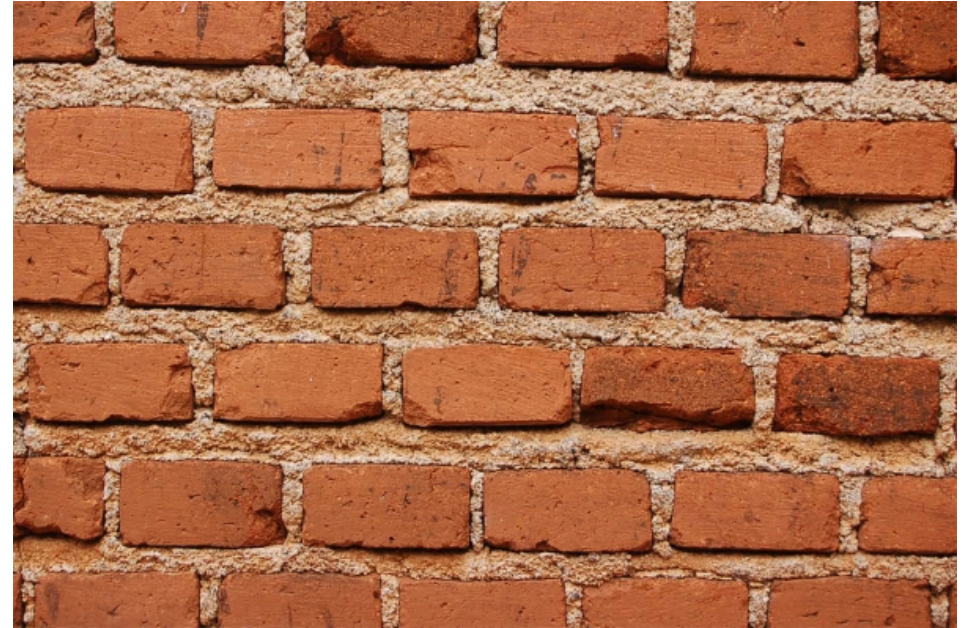
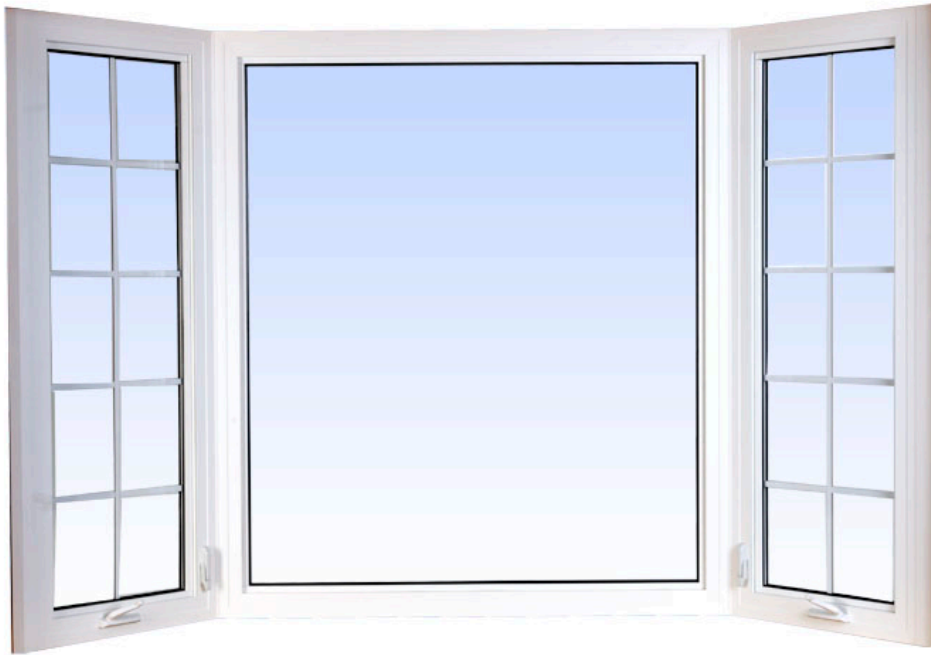


# Activity #1: Answer Key



# Activity #2: Discussion Time

Imagine rubbing your finger across a pane of smooth glass and then across a brick. What kinds of skin receptors help you distinguish the two surfaces?





# Activity #2: Answer Key

- Both **Meissner's corpuscles** (stroking stimulus) and **Merkel discs** (texture stimulus) are activated when touching the brick
- Since you are moving across the rough surface of the brick, you will also activate deep **Pacinian corpuscles**
  - Due to the vibrations that are created by the rough texture of the brick
- When you are rubbing your finger against the smooth glass pane, only **Meissner's corpuscles** are activated (again stroking stimulus) because there is no texture

# Learning Catalytic Question

# Practice Question

**Your small dog is standing on your foot. This stimulus created action potentials that went to your somatosensory cortex so you feel it. But how were those action potential generated?**

**Hint: touch uses mechanoreceptors, which directly activate the dendrite(s) of a sensory neuron. Think about the type of channels these receptors open, which ions move, and how threshold is reached.**

Your small dog is standing on your foot. This stimulus created action potentials that went to your somatosensory cortex so you feel it. But how were those action potential generated?

Stimulus type?

→ **Mechanical**

Channels opened?

→ **mechanically-gated channels**

What enters/where?

→ **Na<sup>+</sup> enters at dendrites**

What happens?

→ **graded potentials summate, if threshold reached (-55mV) then AP fired at “trigger zone”**

**Your small dog is standing on your foot. This stimulus created action potentials that went to your somatosensory cortex so you feel it. But how were those action potential generated?**

**What part of spinal cord receives info?**

**→ Lumbar 5/Sacral 1**

**What spinal cord division carries info to brain?**

**→ Dorsal**

**What part of brain does this info end up?**

**→ Medial somatosensory cortex (postcentral gyrus)**

# The Action Potential

Chapter 1: Dr. Woods

pp.

# Which of the following structures are correctly associated with their function?

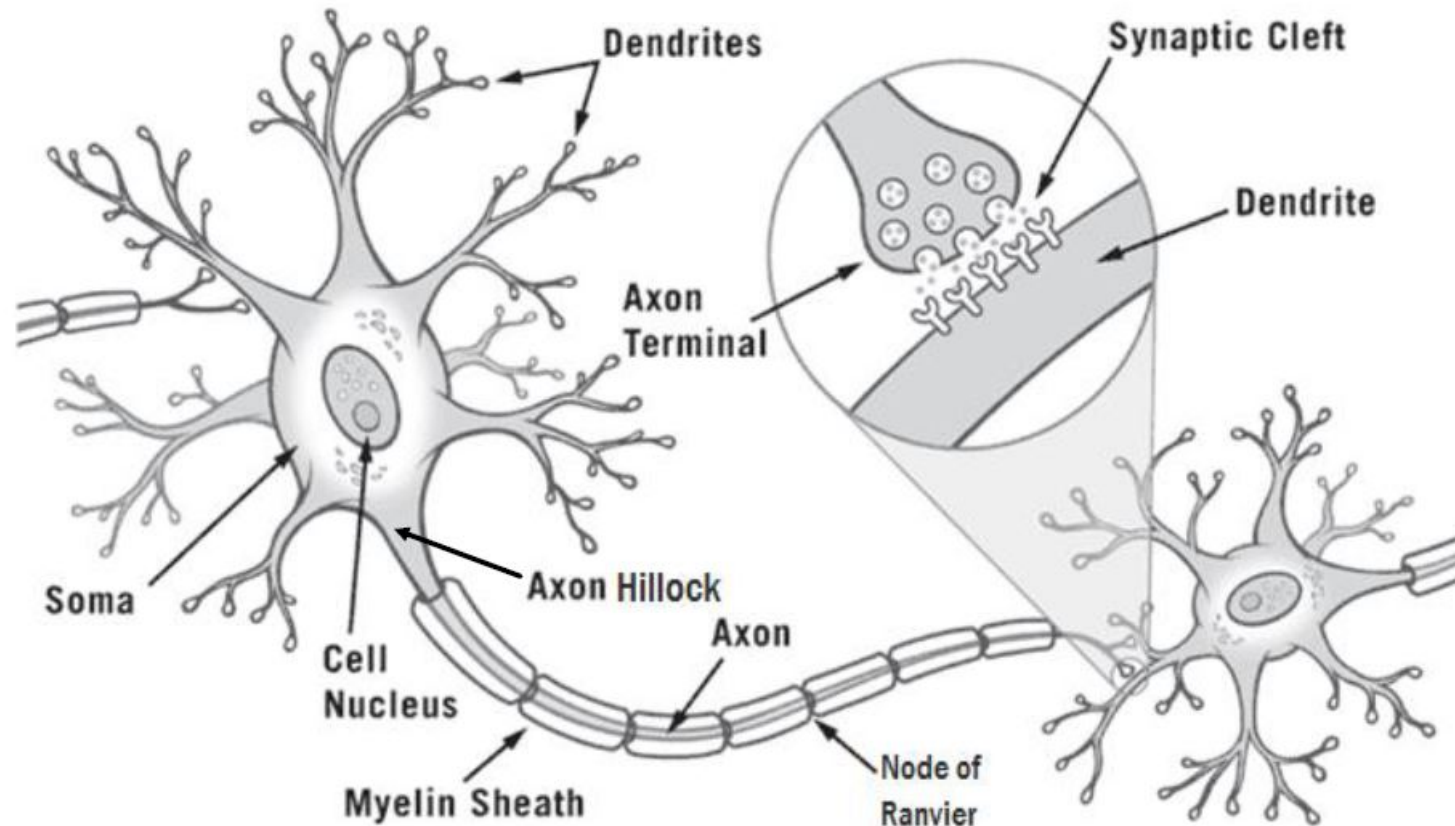
- A) Dendrites send outgoing signals
- B) Myelin insulates axons to prevent ion/current leak
- C) There are no ion channels at the Nodes of Ranvier
- D) There are no organelles at the soma

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# The Neuron



# Key Events and Their Locations

1. Incoming information received by the dendrites
2. Graded potentials occur in the dendrites/soma
3. An action potential is fired at the axon hillock if threshold is met
4. The action potential travels along the myelinated axon via salutatory conduction
5. The action potential arrives at the axon terminal of the pre-synaptic cell and the message is passed to the post-synaptic cell

# What is a main difference between a graded potential and an action potential?

- A) Graded potentials do not experience current leak, whereas action potentials do
- B) Graded potentials travel a long distance, whereas action potentials travel a short distance
- C) Graded potentials occur at the soma, whereas action potentials start at the axon hillock
- D) The amplitude of the graded potentials is not proportional to the stimulus strength, whereas the amplitude of action potentials is proportional to the stimulus strength

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# Graded Potentials vs. Action Potentials

Graded Potentials	Action Potentials
Occur at <b>dendrites/somas</b>	Occur at <b>axon hillock</b>
Caused by <b>mechanical or chemical-gated channels</b>	Caused by <b>voltage-gated channels</b>
Can be a <b>depolarization</b> or <b>hyperpolarization</b>	Always a <b>depolarization</b>
Amplitude of potential is <b>directly proportional</b> to stimulus strength	<b>All or nothing</b> —Amplitude of potential is <b>constant</b> no matter the stimulus strength
Travel <b>short</b> distances	Travel <b>long</b> distances

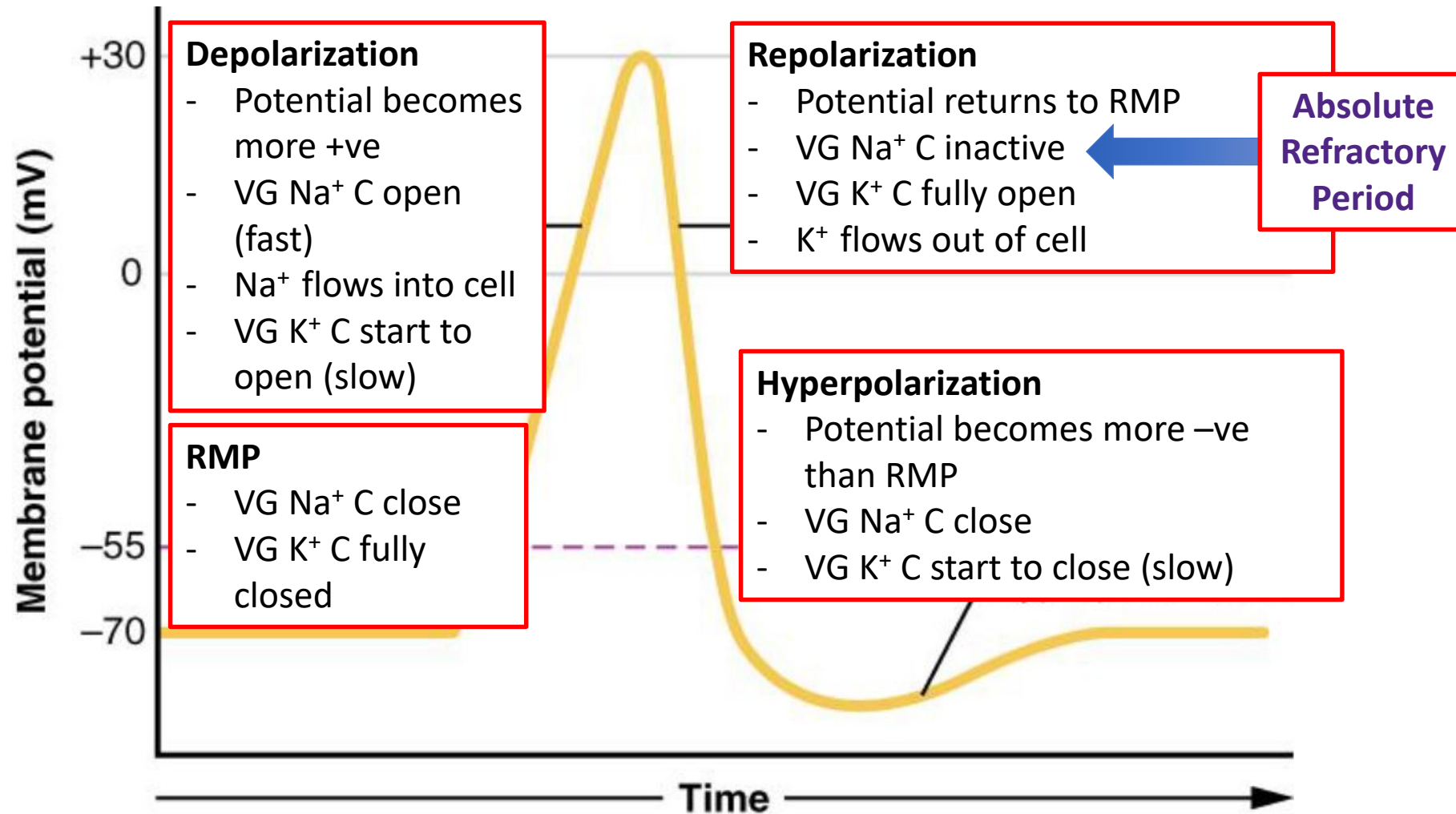
**Depolarization is caused by the opening of \_\_\_\_\_, causing \_\_\_\_\_ to flow \_\_\_\_\_ the cell.**

- A) VG Na<sup>+</sup> channels; Na<sup>+</sup> ions; into
- B) VG Na<sup>+</sup> channels; Na<sup>+</sup> ions; out of
- C) VG K<sup>+</sup> channels; K<sup>+</sup> ions, into
- D) VG K<sup>+</sup> channels; K<sup>+</sup> ions, out of

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# The Action Potential





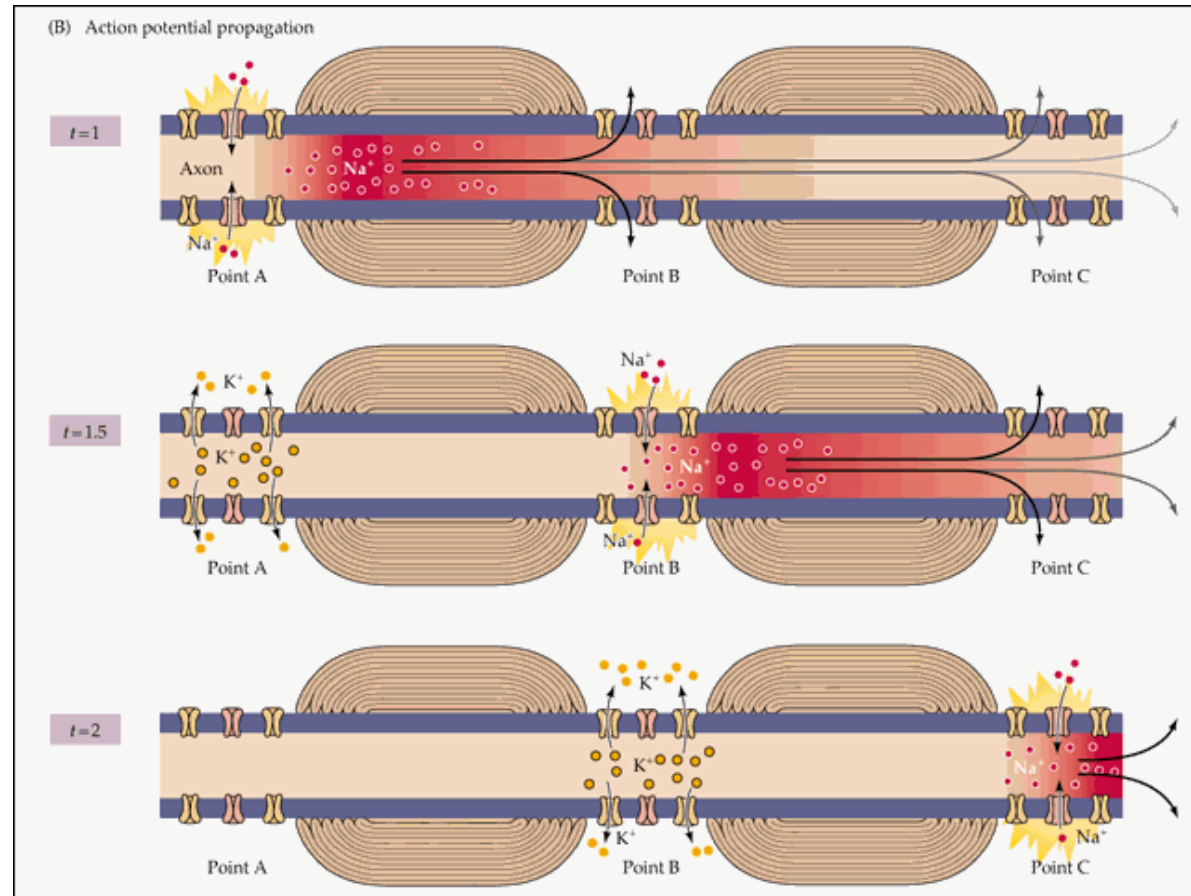
# Propagation of The Action Potential

Chapter 1: Dr. Woods

pp.

# Propagation of the AP

- Myelin prevents ion/current leakage and allows for rapid saltatory conduction
- Ion channels are concentrated at Nodes of Ranvier
- The  $\text{Na}^+$  ions flow down the axon (like charges repels and opposites charges attract)
- This brings the next segment of the axon to threshold and an AP is fired



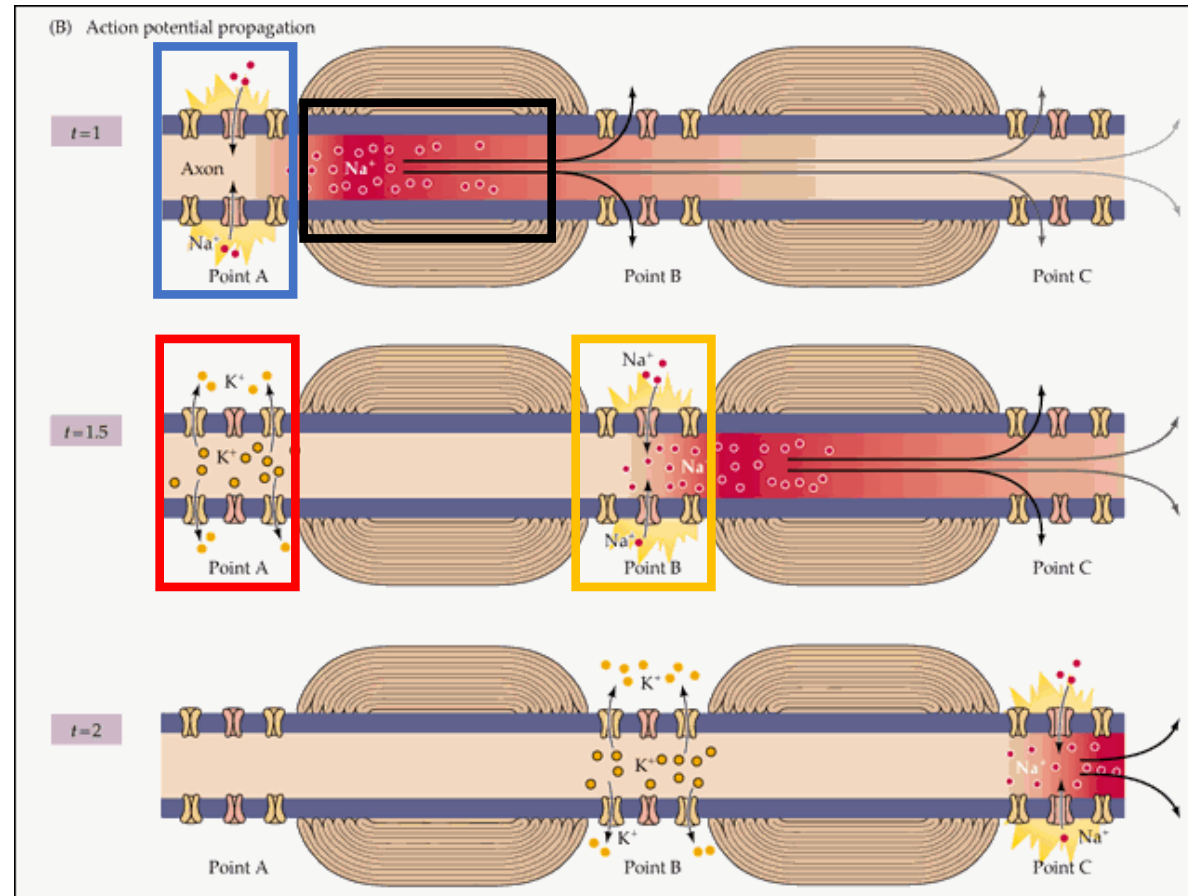
# Propagation of the AP

Initial stimulus @ soma  
Threshold is met @ axon  
hillock and AP is fired  
Depolarization ( $\text{Na}^+$  flows  
into the cell)

$\text{Na}^+$  flows along the axon

That  $\text{Na}^+$  brings the next  
segment to threshold and  
AP is fired  
Depolarization of next  
segment  
( $\text{Na}^+$  flows into the cell)

Repolarization of initial  
segment  
( $\text{K}^+$  flows out of the cell)



# Which of the following events take place at a chemical synapse?

1. VG  $\text{Ca}^{2+}$  channels open, allowing  $\text{Ca}^{2+}$  to flow out of the cell
  2. VG  $\text{Ca}^{2+}$  channels open, allowing  $\text{Ca}^{2+}$  to flow into the cell
  3. Neurotransmitters travel from the post-synaptic cell to the pre-synaptic cell
  4. Neurotransmitters travel from the pre-synaptic cell to the post-synaptic cell
- 
- A) If only 1, 2 and 3 are correct
  - B) If only 1 and 3 are correct
  - C) If only 2 and 4 are correct
  - D) If only 4 is correct
  - E) If ALL are correct

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- A) If only 1, 2 and 3 are correct
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### What happens to extra neurotransmitters?

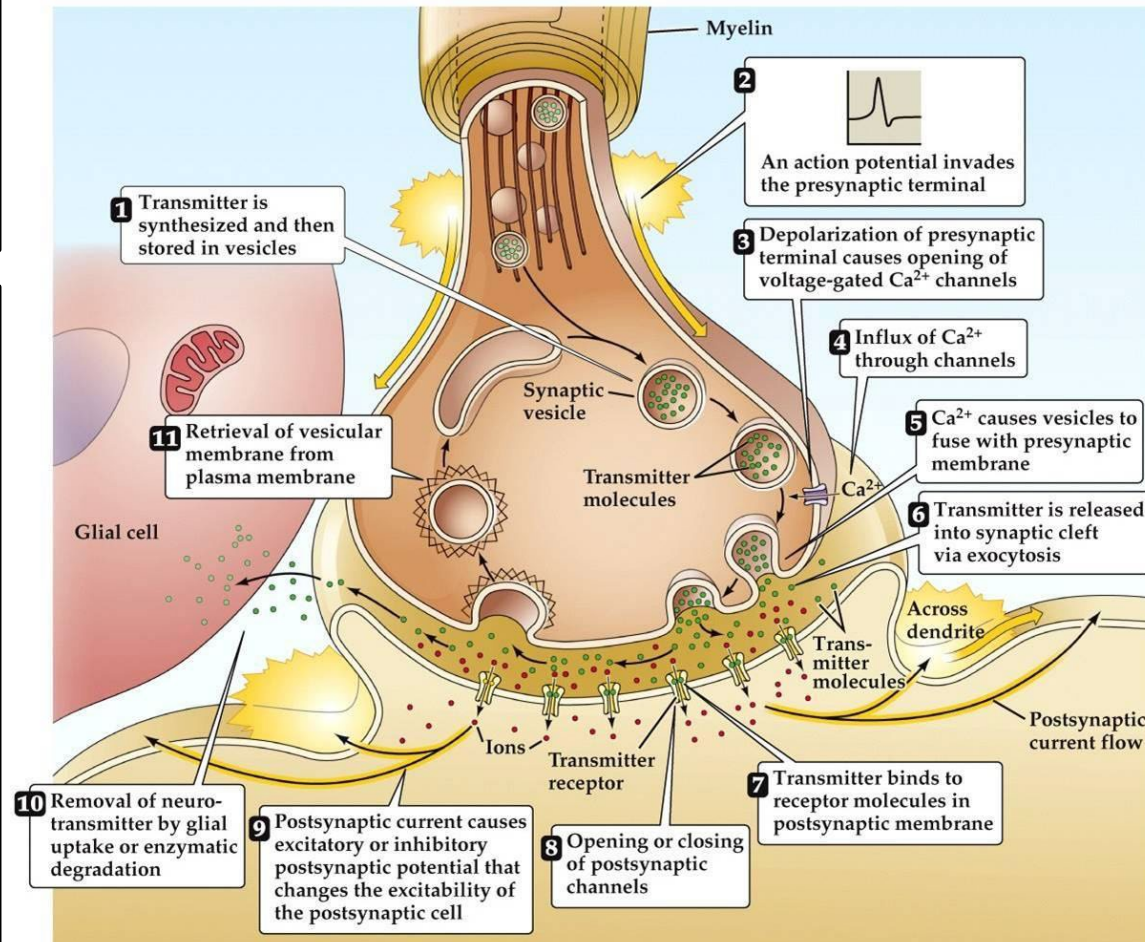
- Recycled into axon terminal
- Degraded by enzymes
- Diffuse out of cleft

### What happens to the post-synaptic cell?

If  $\text{Na}^+$  channels open: EPSP

- $\text{Na}^+$  into cell
- Depolarization of post-synaptic cell (graded potential towards threshold)
- If  $\text{K}^+$  or  $\text{Cl}^-$  channels open: IPSP
- $\text{K}^+$  out of cell or  $\text{Cl}^-$  into cell
- Hyperpolarization of post-synaptic cell (graded potential away from threshold)

# Synapse

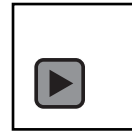


# Firing Neurons From Human Brain!

**Subthalamic Nucleus**



**Globus Pallidus Externa**



**Globus Pallidus Interna**



**What caused this sound?**



# Next Tutorial (Oct 8<sup>th</sup>)

- Nervous system overview
- Touch
- Sensory System



# What Questions Do You Have?

You can ask in the **Owl forums** as well!

Also anonymously ask questions in the **online dropbox!!**