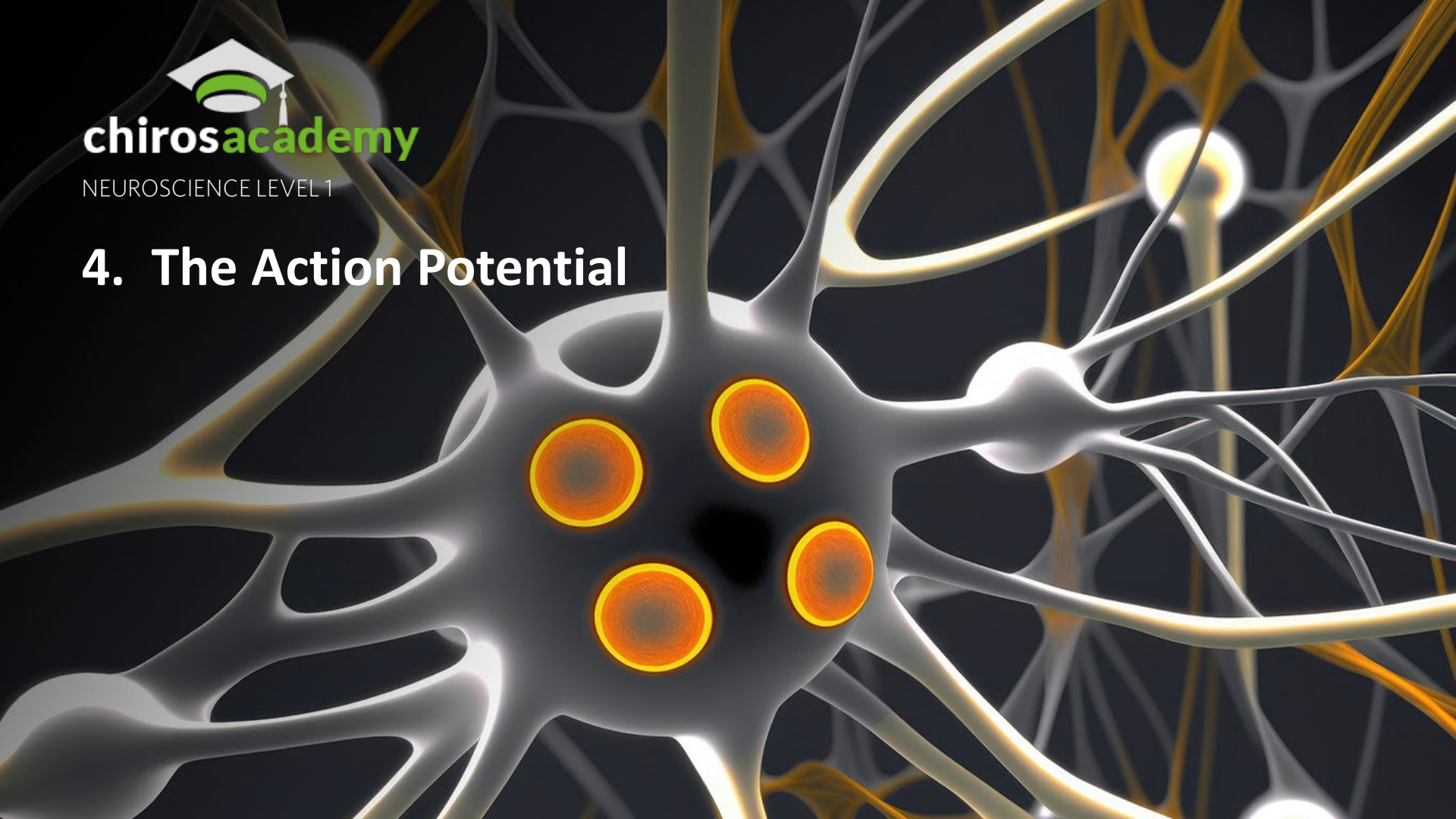


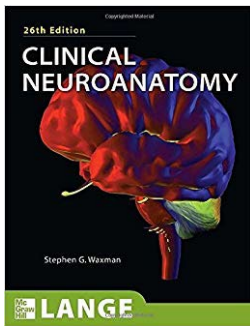
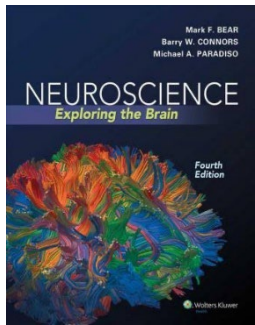


chirosacademy

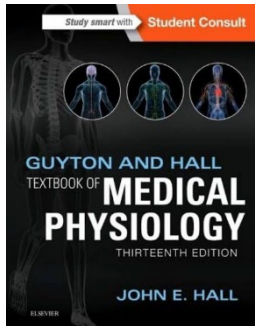
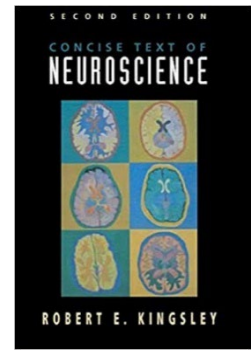
NEUROSCIENCE LEVEL 1

4. The Action Potential

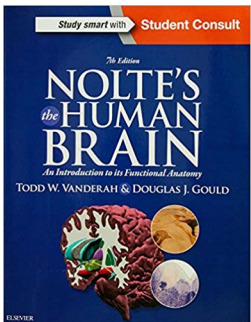
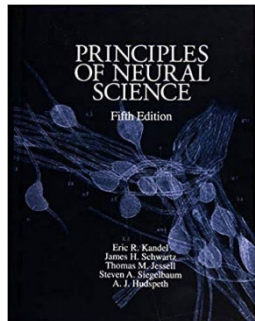
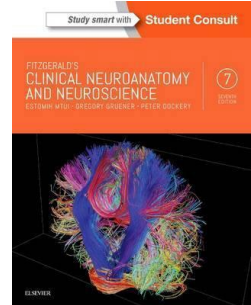




Book References to Support Power Points



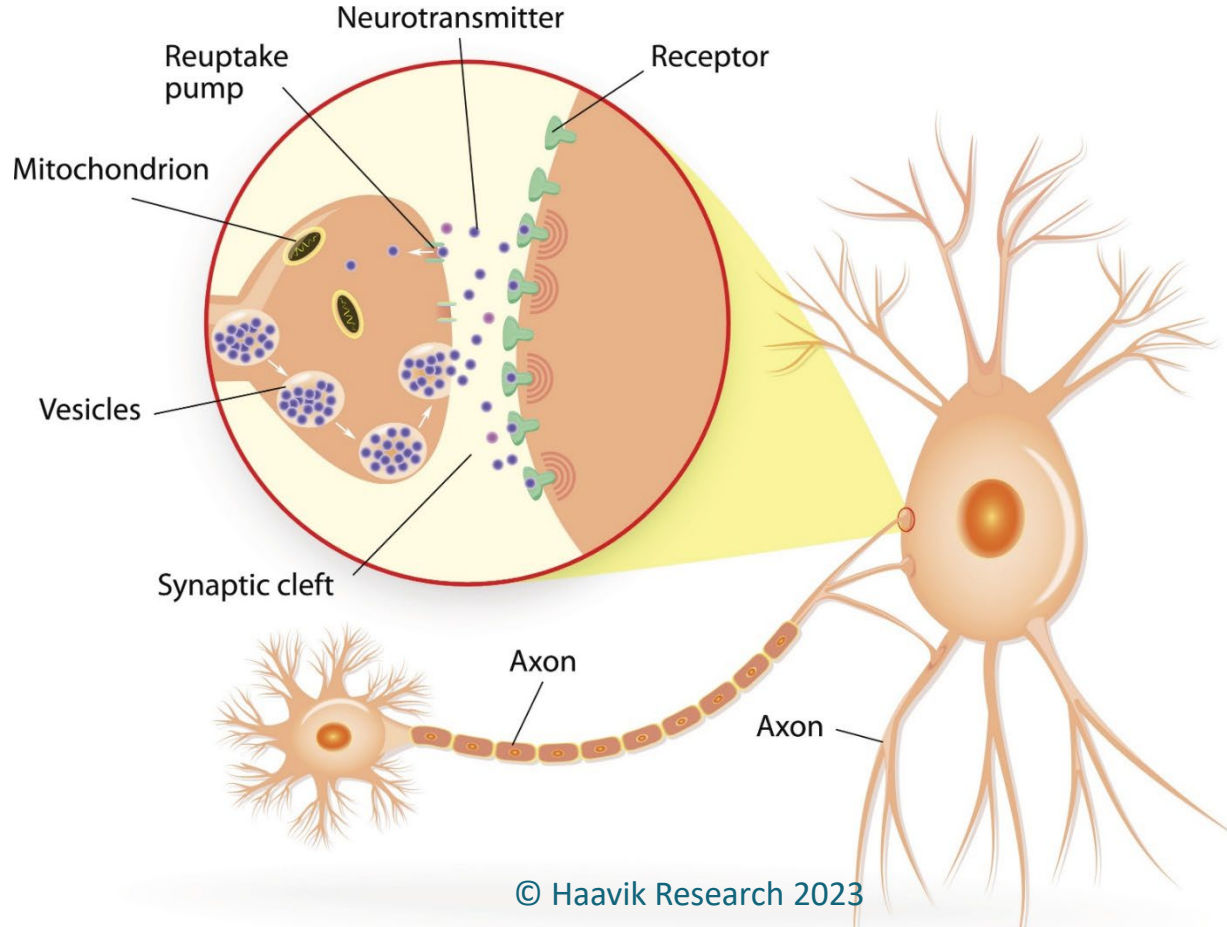
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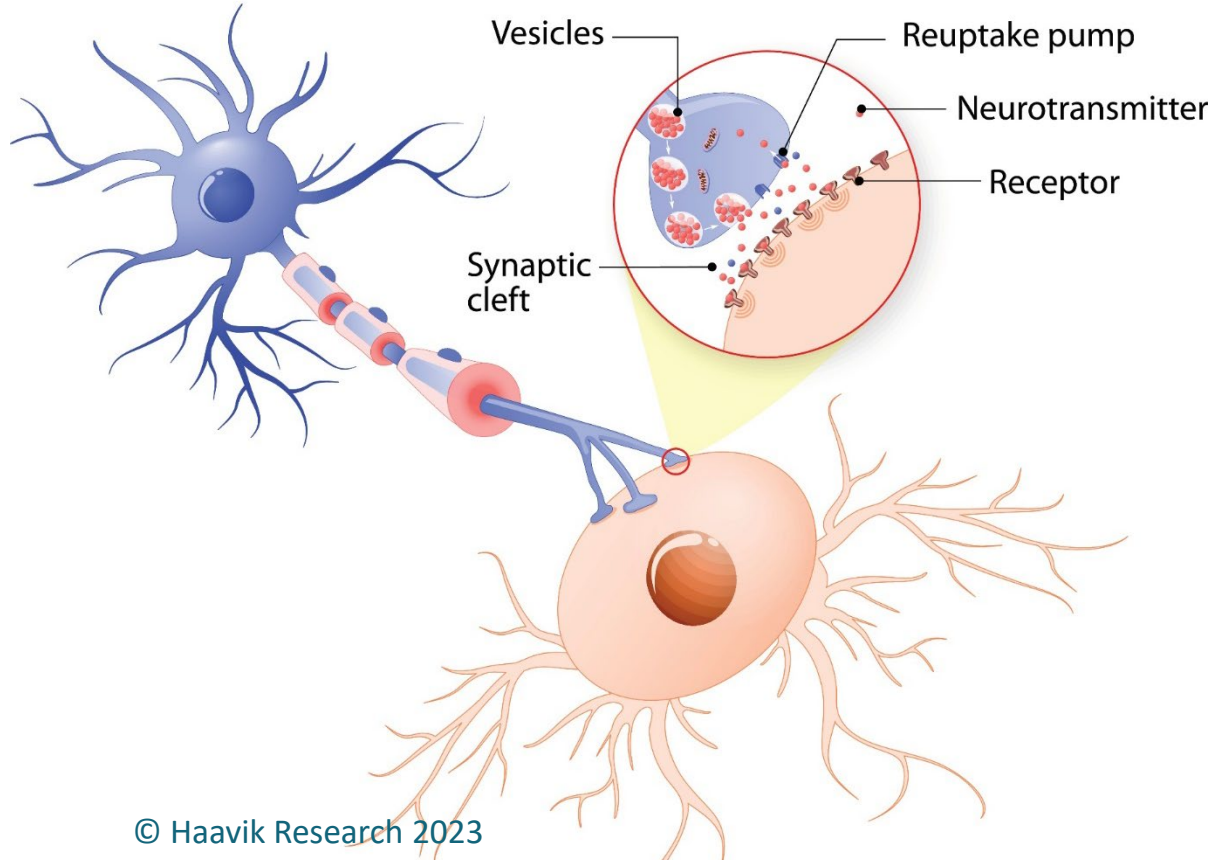
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Chemical vs Electrical Communication



Three Types of Neuronal Information Transmission

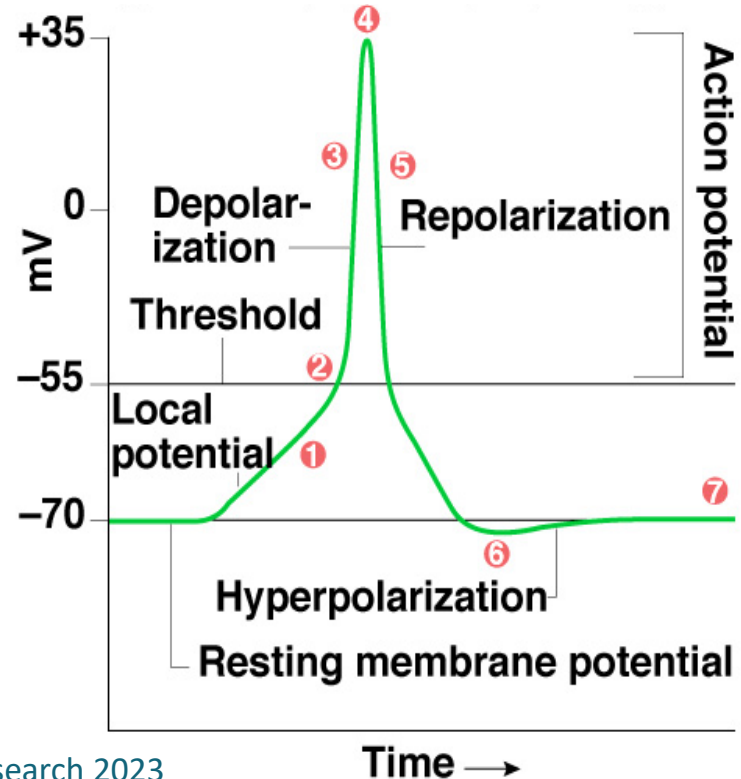
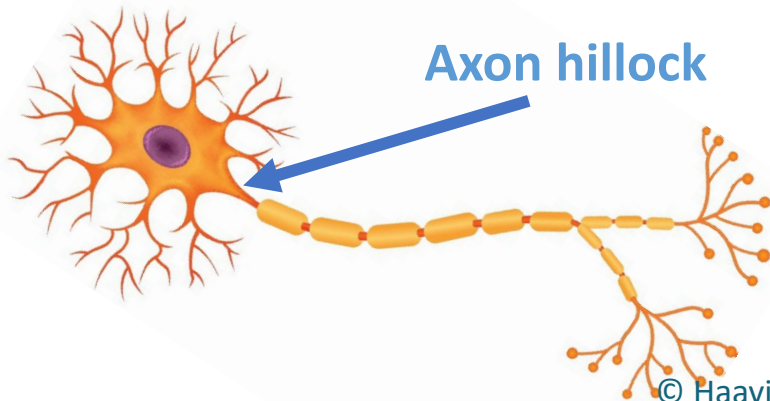
1. Chemical signals are mainly involved in the transmission of information between neurons.
2. Transient electrical (electrochemical) signals are important for transferring information over long distances rapidly within the neuron (down the axon).
3. Intra-axonal transport of chemicals up and down the axon.

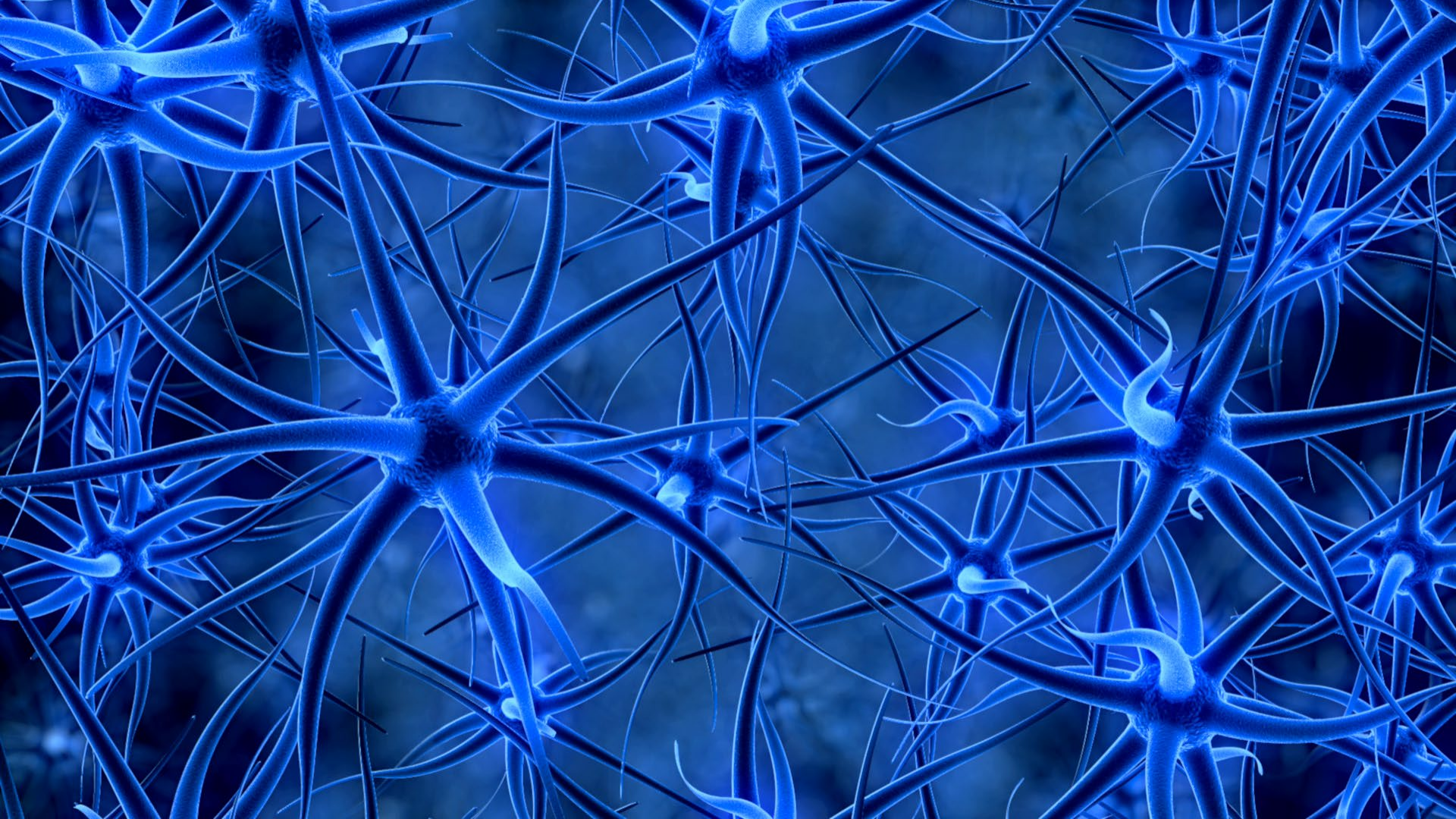


Action Potentials

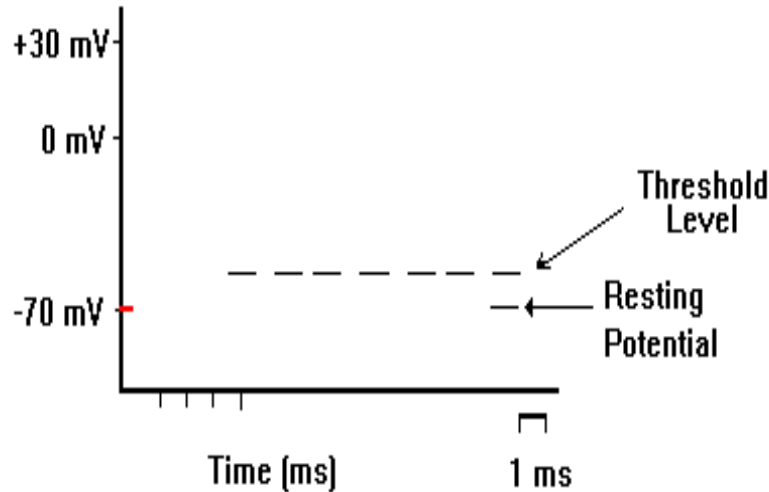
- Two phases;
 - Depolarization
 - Repolarization

- Action potentials start at axon hillock;
 - Trigger zone has 500 channels/ μm^2 (normal is 75)





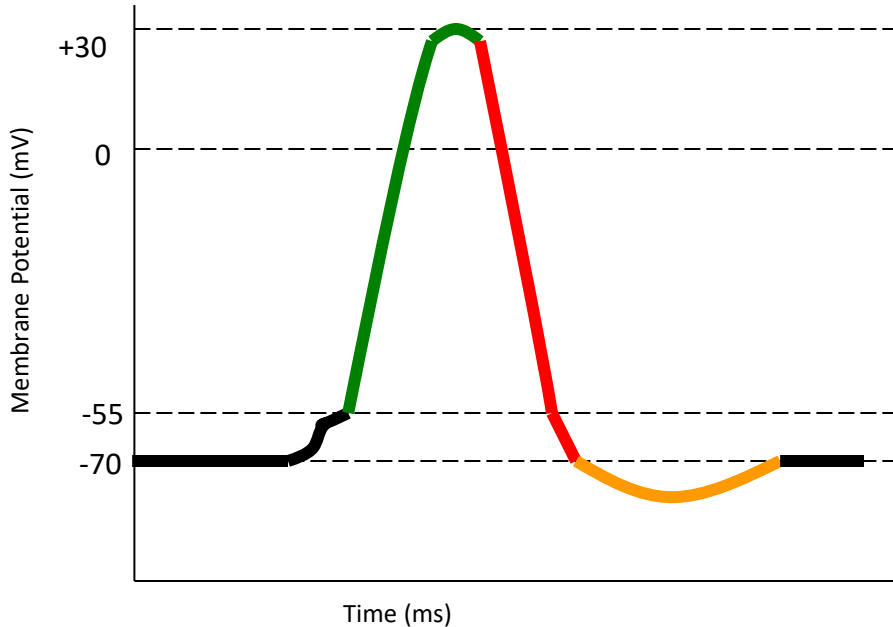
Action Potential-Sequence



The depolarization is caused by the opening of voltage-sensitive sodium channels that allow sodium ions to flow into the cell.

The sodium channels only open in response to a partial depolarization, such that a **threshold voltage** is exceeded.

Action Potential



Normal resting potential - 70mV
Na⁺ and K⁺ channels closed.

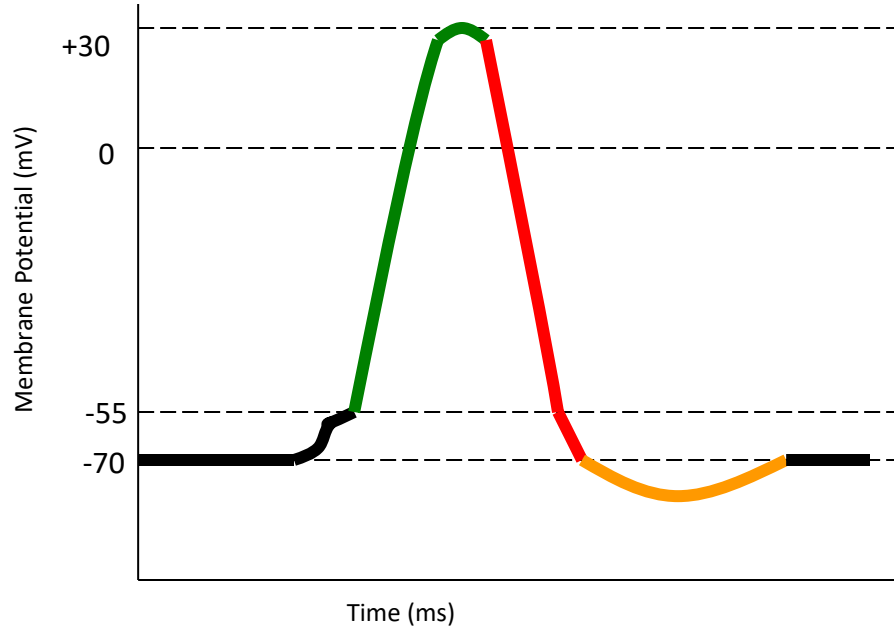
Stimulus causing depolarization to threshold.

At - 55mV voltage gated Na⁺ Channels open, causing Depolarization.

At + 30mV voltage gated K⁺ channels open, causing Repolarization.

Before getting back to normal you end up with a hyperpolarized state.

Action Potential



Normal resting potential - 70mV
Na⁺ and K⁺ channels closed.

Stimulus causing depolarization to threshold.

At - 55mV voltage gated Na⁺ Channels open, causing Depolarization.

At + 30mV voltage gated K⁺ channels open, causing Repolarization.

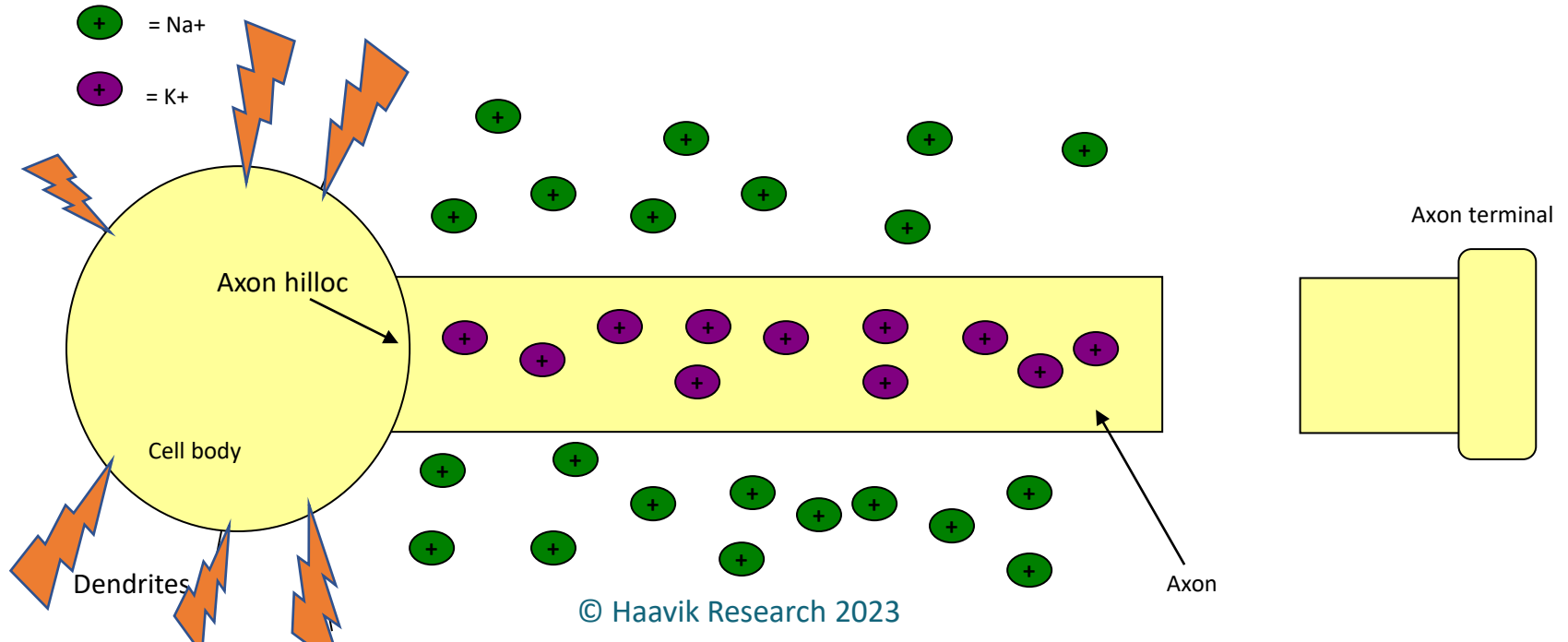
Before getting back to normal you end up with a hyperpolarized state.

Normal cell resting state with Na^+ outside cell and K^+ inside cell.

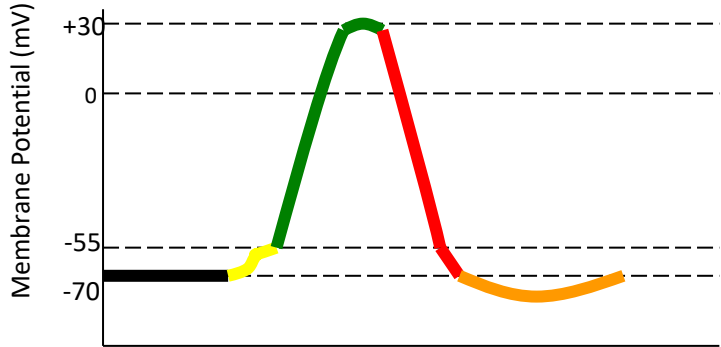
The cell body receives signals from the dendrites depolarizing cell to threshold.



At -55mV the voltage gated Na^+ channels open causing Na^+ inflow.

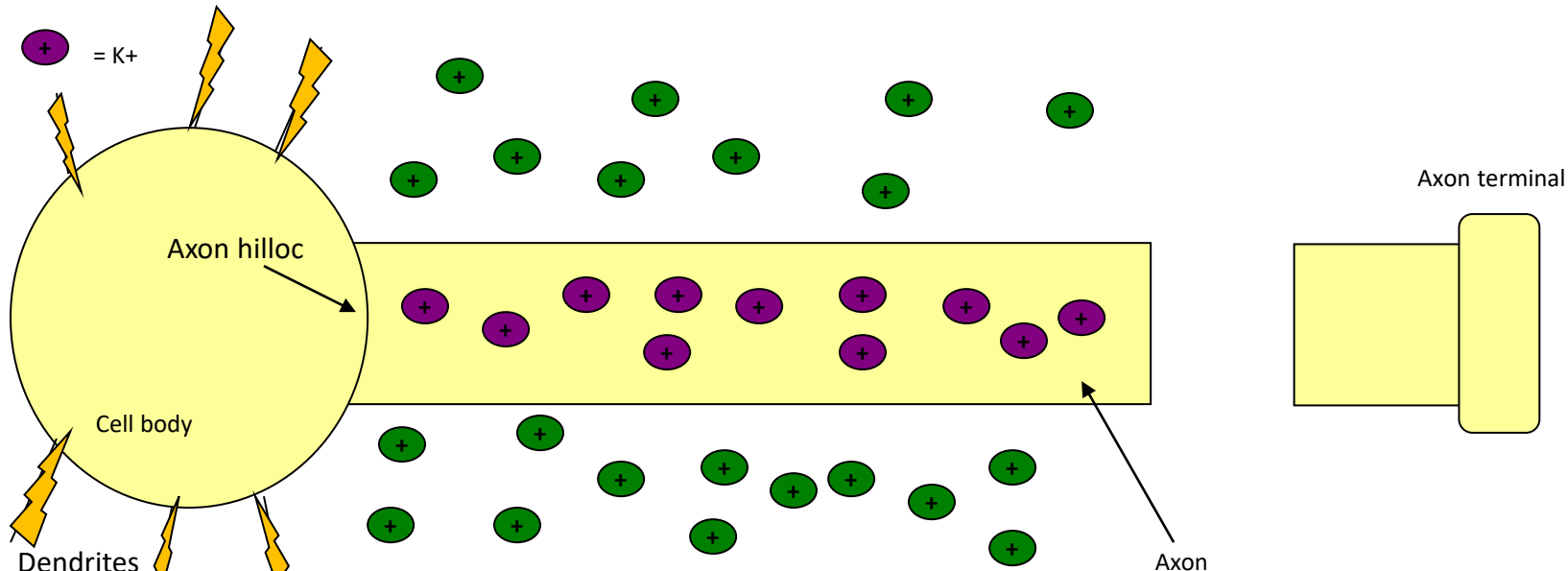
At $+30\text{mV}$ the voltage gated Na^+ channels close, and the voltage gated K^+ channels open causing K^+ outflow.



Action Potential

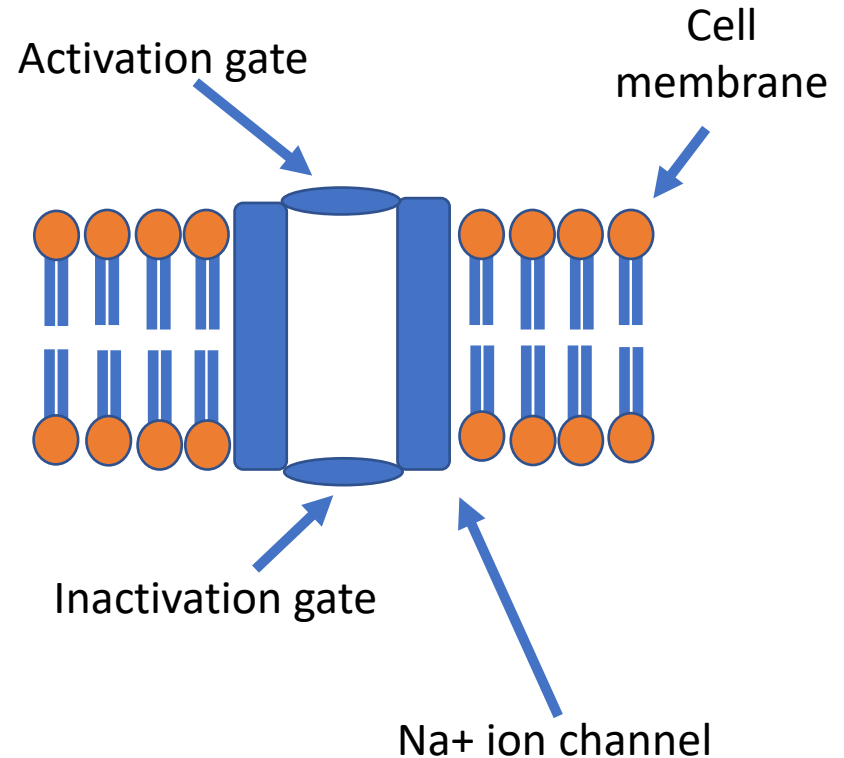


-  = Na⁺
-  = K⁺

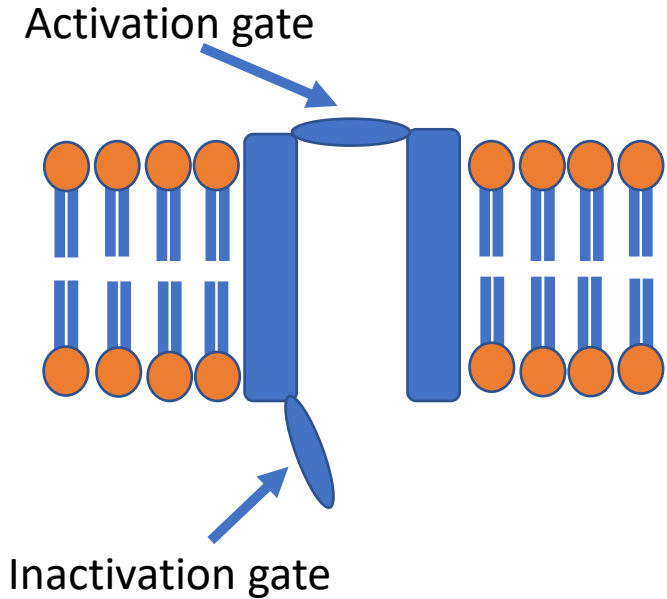


The Absolute Refractory Period

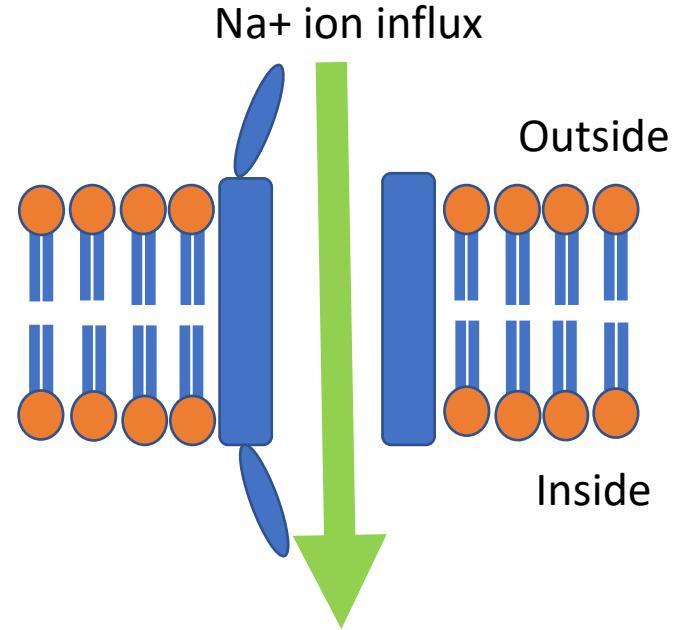
- Brief period of time between the triggering of an impulse and when it is available for another.
- **NO NEW** action potentials can be created during this time.



The Absolute Refractory Period

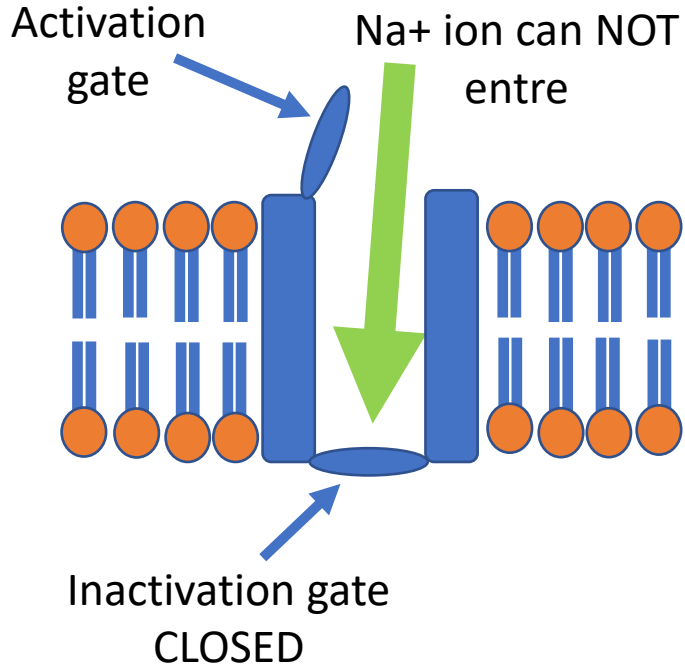


RESTING STATE
-70mV to -55mV

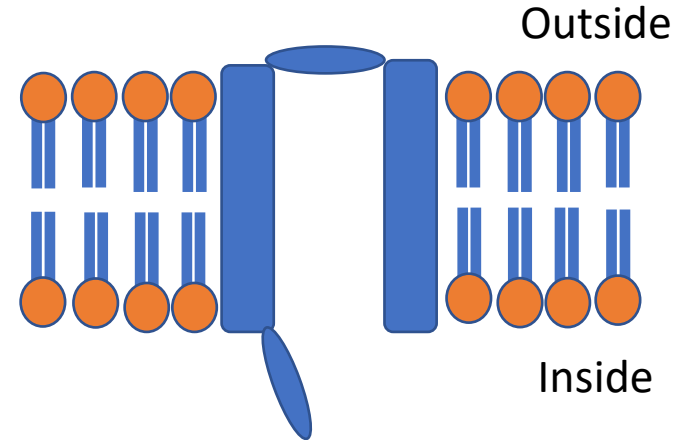


DEPOLARISATION PHASE
-55mV to +30mV

The Absolute Refractory Period



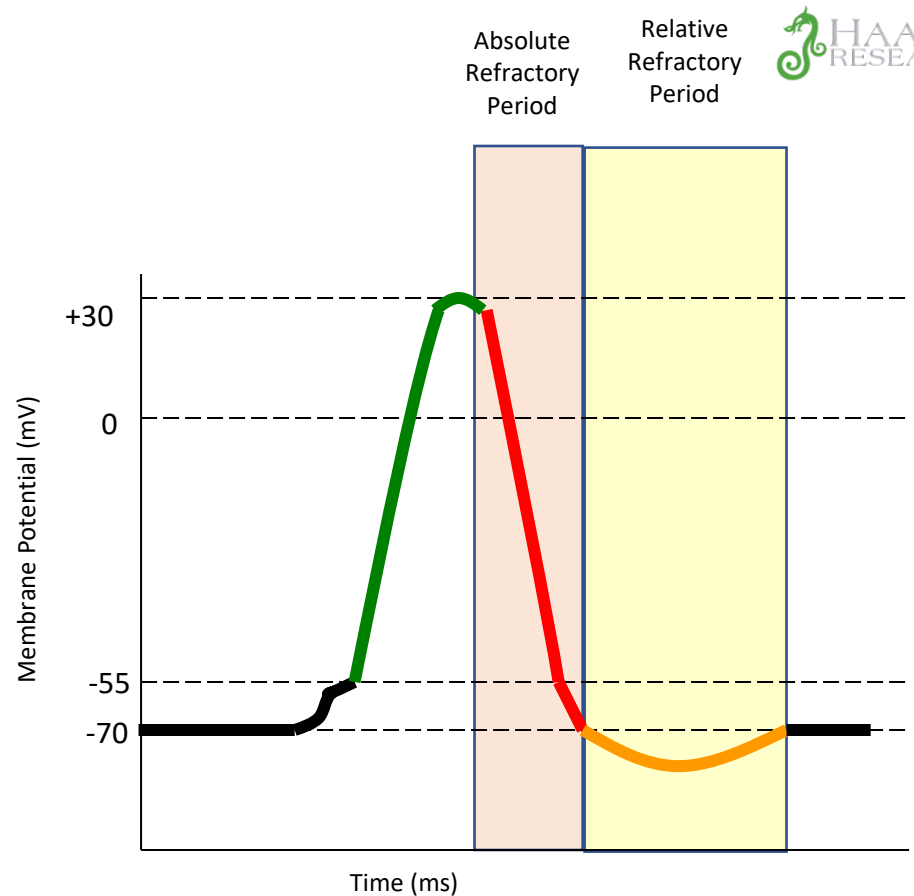
REPOLARISATION PHASE
+35mV to -70mV



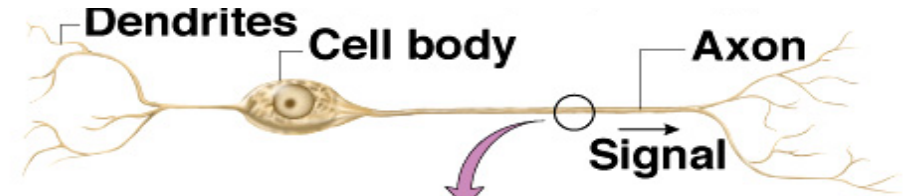
Reset and ready to go again
-70mV to -55mV

The Relative Refractory Period

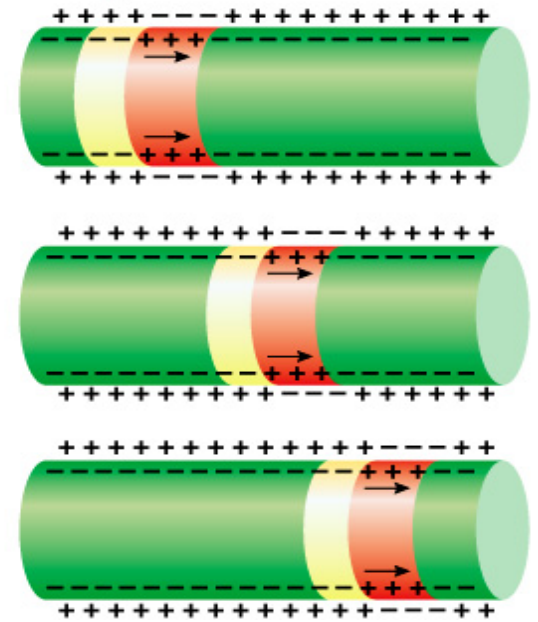
- Period of resistance to stimulation.
- Absolute refractory period;
 - As long as Na^+ gates are open and before they are "reset"
 - No stimulus will trigger AP
- Relative refractory period;
 - As long as K^+ gates are open
 - While cell is in hyperpolarized state
- The refractory period ensures the AP only moves in one direction.
 - only especially strong stimulus will trigger new AP
- Refractory period is occurring only to a small patch of membrane at one time (quickly recovers)



Impulse Conduction in Unmyelinated Fibers

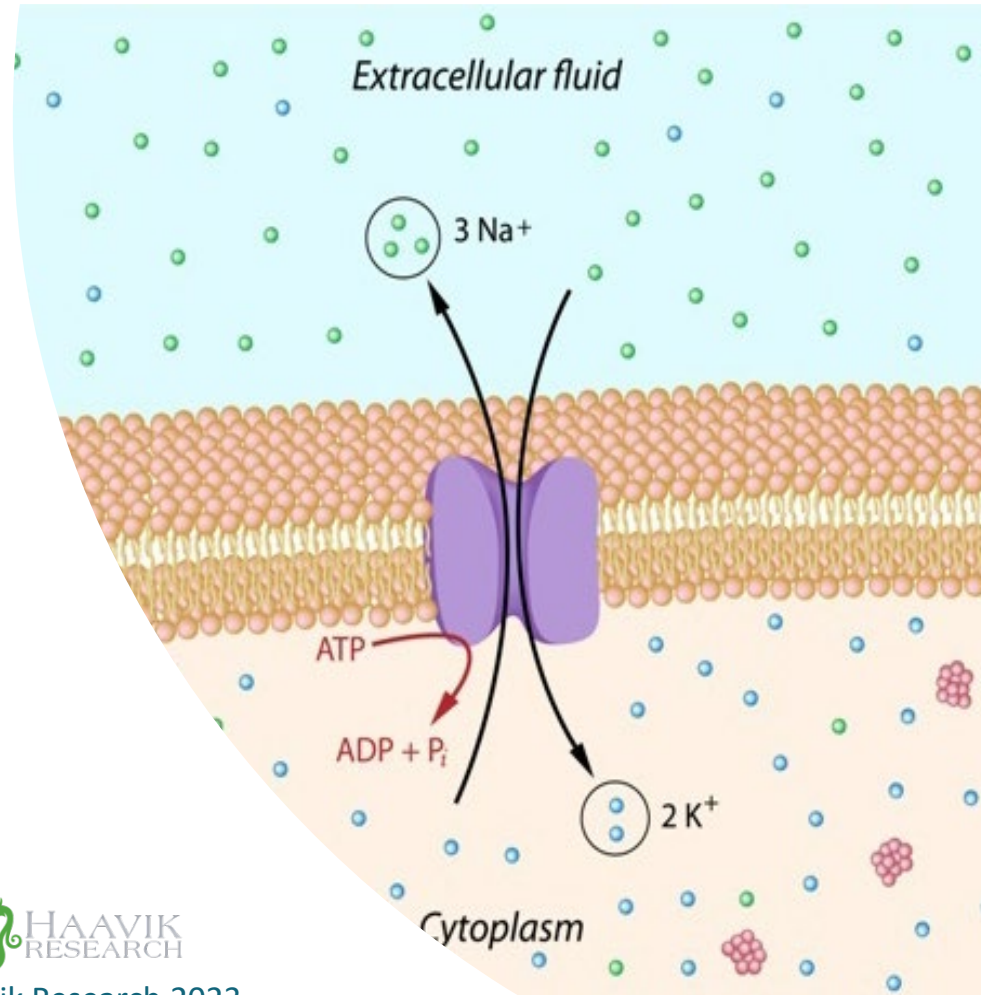


- Action potential in progress**
- Refractory membrane**
- Excitable membrane**

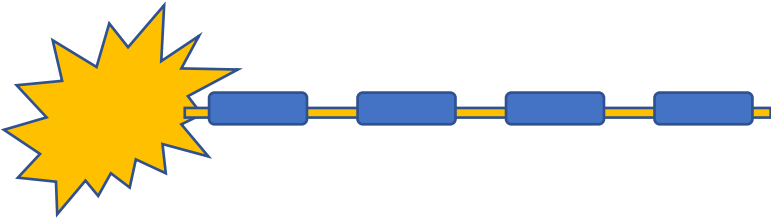
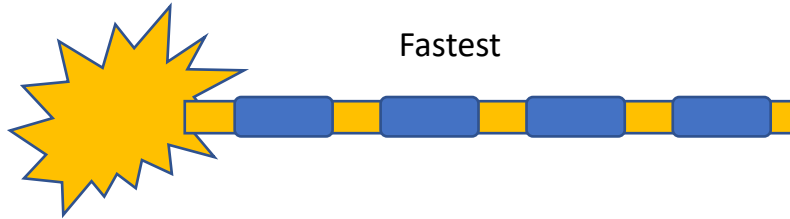


The Na⁺/K⁺ Pump

- Restores normal Na⁺ outside cell and K⁺ inside cells.
- Restores normal resting membrane potential.
- Requires ATP.

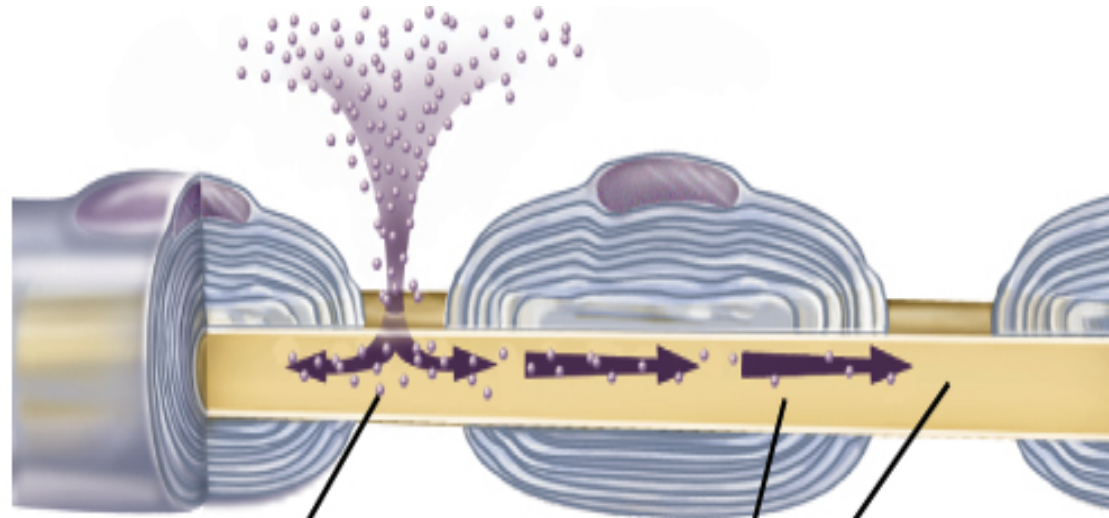


Conduction Velocity in Small, Large, Myelinated & Unmyelinated Fibers



- Speed of signal transmission along nerve fibers;
 - Depends on diameter of fiber & presence of myelin
 - Large fibers have more surface area for signals
- Speeds;
 - Large, myelinated fibers = up to 120 m/sec
 - Small, myelinated fibers = 3 - 15.0 m/sec
 - Small, unmyelinated fibers = 0.5 - 2.0 m/sec
- Functions;
 - Slow signals supply the stomach & dilate pupil
 - Fast signals supply skeletal muscles & transport sensory signals for vision & balance

Saltatory Conduction in Myelinated Fibers



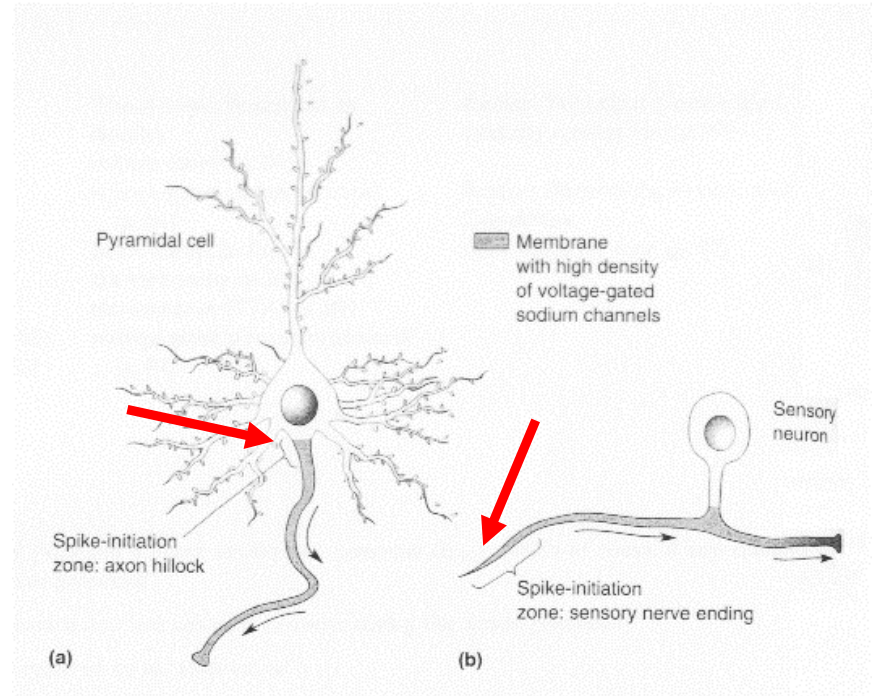
Na⁺ inflow at node generates action potential (slow but nondecremental)

Na⁺ diffuses along inside of axolemma to next node (fast but decremental)

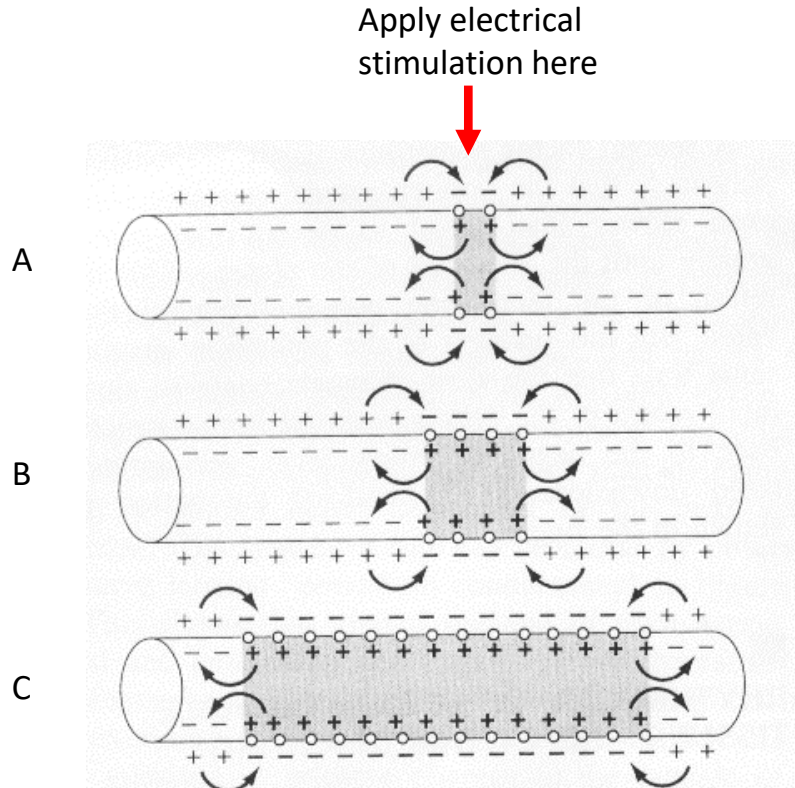
Excitation of voltage-regulated gates will generate next action potential here

Spike-Initiation Zones

- Spike-initiation zone is where action potential starts.
- Different types of neurons have different spike-initiation zones.



Peripheral Nerve Stimulation

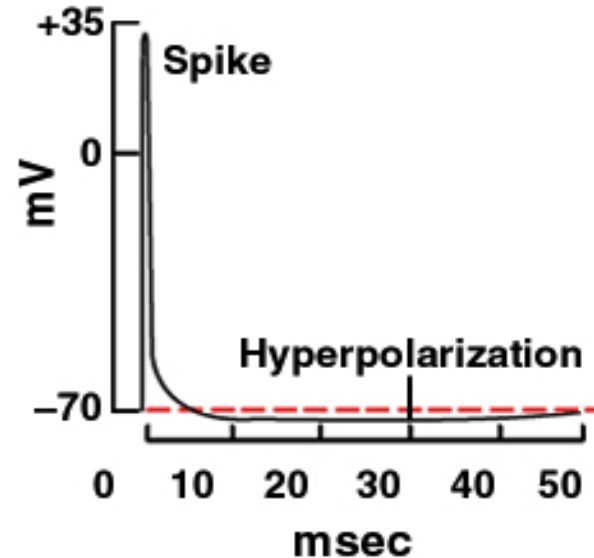


Action potential spreads in both directions from site of stimulation

- In an experimental laboratory setting it is possible to apply electricity over a nerve or muscle through two electrodes (anode and cathode).
- This can initiate the action potential by opening the voltage-gated Na channels.
- This is called peripheral nerve stimulation.
- In this case, the action potential will spread in both directions.
- This does not occur under normal physiological conditions.

Action Potentials Summary

- Called a spike
- Characteristics of AP
 - **All-or-none law**
 - Voltage gates either open or don't
 - **Non-decremental** (do not get weaker with distance)
 - **Irreversible** (once started, it goes to completion and cannot be stopped)



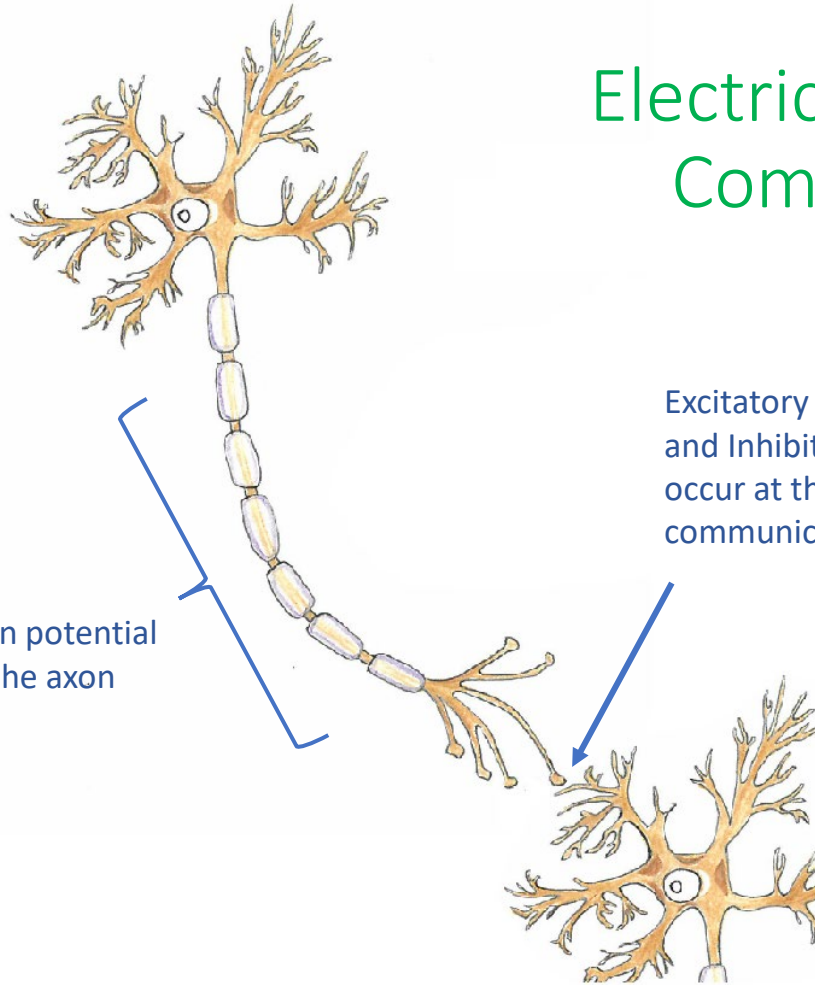
Clinical Perspective - Local Anesthesia

- **Lidocaine:**
 - Topical as jelly onto mucous membranes of mouth
 - Injected into tissue or a nerve
 - Infused into CSF in spinal cord

- Prevents action potentials by binding to voltage gated Na⁺ channels and interferes with the flow of sodium so stops action potential signaling.

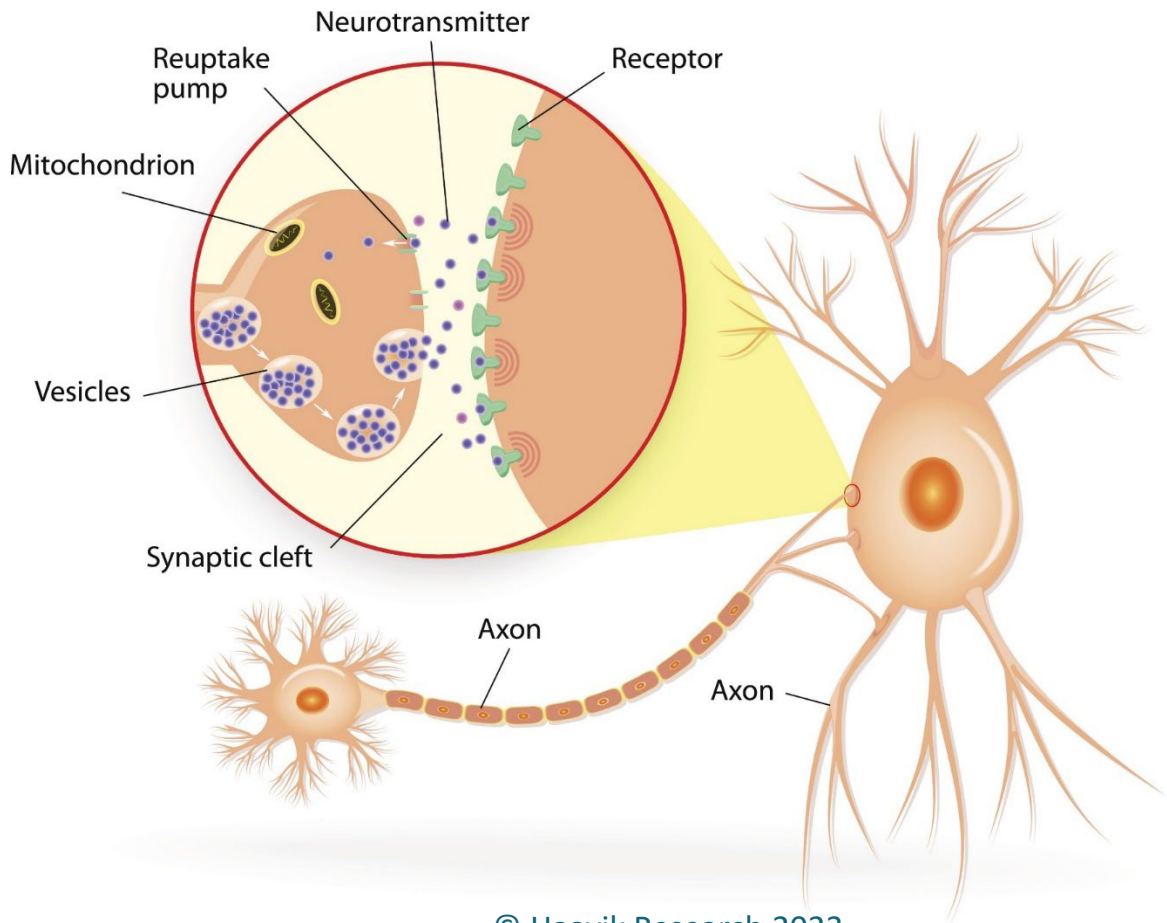


Electrical & Chemical Communication



Excitatory Post Synaptic Potentials (EPSPs) and Inhibitory Post Synaptic Potentials (IPSPs) occur at the dendrites due to chemical communication across the synapse

The electrical action potential occurs here along the axon



Thank You



DR. HEIDI HAAVIK

ENLIGHTENING THE
WORLD ABOUT THE
SCIENCE OF CHIROPRACTIC



Introduction to Chiropractic Care

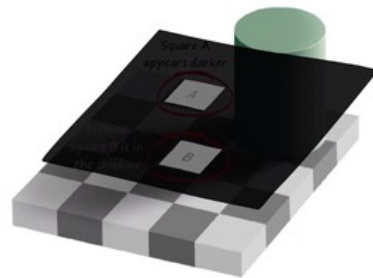
The introduction to chiropractic video series is the perfect way to gain an understanding of why chiropractic care may help you and your family.



The Beginners Guide to Chiropractic

In this first introductory video we explore what chiropractic is all about, and how it works, then we briefly explore the evidence informed effects of chiropractic care.

[View video >](#)



How the Brain Perceives the World

Did you know that your brain and central nervous system are constantly changing? It's quite amazing - from one day to the next your brain is not the same.

[View video >](#)

The Beginners Guide to Chiropractic

The Beginners Guide to Chiropractic

The word chiropractic derives from the Greek words "cheir", meaning hand, and "praktikos" meaning skilled in or concerned with. The origin of the word chiropractic can be traced back to [D.D. Palmer](#) who coined it in 1895 when he founded chiropractic.

Chiropractic care is really about total health and wellbeing

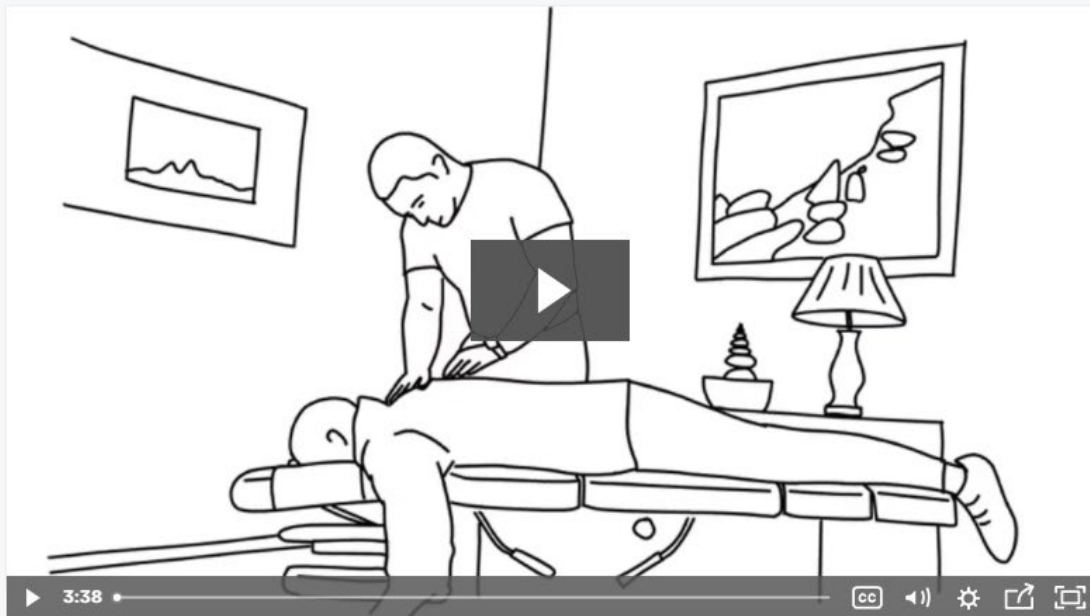
What does a Chiropractor do?

A chiropractor is a healthcare professional who specializes in the health and [function of the spine](#) and nervous system. Because of this focus on the spine, many people think chiropractors can only help with problems such as back pain, [neck pain](#) and [headaches](#). They can often help with these issues but there is much more to chiropractic than just pain.

This is the first video in our animated series "Introduction to Chiropractic". In this video, we outline what a chiropractor does, then we briefly explore the effects of care. It is a perfect one to watch for anyone that is curious about chiropractic care, and how it can help their family.

Video References

1. Rosner AL. Chiropractic Identity: A Neurological, Professional, and Political Assessment. *J Chiropr Humanit* 2016;23(1):35-45.
2. de Souza R, Ebrall P. Understanding wellness in a contemporary context of chiropractic practice. *Chiropr J Aust* 2008;38(1):12-16.
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5. Haavik H, Murphy B. The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control. *J Electromyogr Kinesiol* 2012;22(5):760-76.
6. Haavik Taylor H, Holt K, Murphy B. Exploring the neuromodulatory effects of the vertebral subluxation and chiropractic care. *Chiropr J Aust* 2010;40(1):37-44.
7. Herzog W, Zhang YT, Conway PJ, et al. Cavitation sounds during spinal manipulative treatments. *Journal of Manipulative & Physiological Therapeutics* 1993;16(8):523-6.

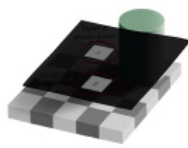




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[View video >](#)



How the Brain Perceives the World

Did you know that your brain and central nervous system are constantly changing? It's quite amazing - from one day to the next your brain is not the same.

[View video >](#)



Break the Pain Cycle

Did you know that pain is created in your brain to let you know that something is not ok within your body? Feeling pain is good because it is actually helpful and informative.

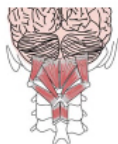
[View video >](#)



Chiropractic Care and Migraines

Did you know that 1 in 6 people in the world experience migraines regularly? The World Health Organisation consider them to be the most debilitating of all neurological disorders.

[View video >](#)



Chiropractic Affects your Brain

Your brain receives information about your body from the environment and your organs. Did you know that the muscles in your body are also sensory organs?

[View video >](#)



What is that Pop?

If you have been adjusted before by a chiropractor you may have noticed a strange popping sound. Don't worry - it is just the formation of gas within a joint.

[View video >](#)



Lower Back Pain

Scientists have worked out that at any one time, over 500,000,000 people around the world are suffering from low back pain and it is now the leading cause of disability worldwide.

[View video >](#)



Growing Pains

We've all heard of growing pains right? But did you know that what we call growing pains aren't associated with growing? So they're not actually growing pains at all.

[View video >](#)



Pain and the Immune System

Research studies have shown that the way you feel pain all depends on what's going on for you - and most importantly - what you think and feel about the situation.

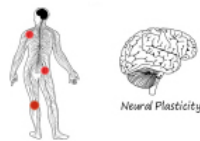
[View video >](#)



Chiropractic and Headaches

Headaches are a sign that something is not right. Your brain will create for you the sensation of pain if it thinks there is something wrong or if there is a potential problem.

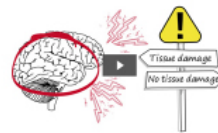
[View video >](#)



Pain is Created in Your Brain

Did you know that the scientists now know that the feeling of pain is something your brain decides that you should experience - if it believes that there is a problem?

[View video >](#)



Chronic Pain

Chronic pain is the second-most common reason people see a doctor and miss work. More than one-third of people with chronic pain become disabled by their pain to some degree.

[View video >](#)

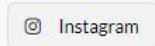
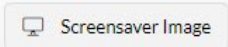
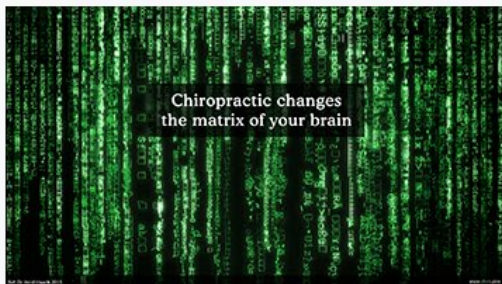
Print & Digital Assets

High-resolution images, A4 print brochures and A3 sized posters for you to download and share.

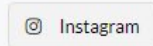
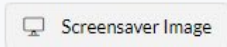


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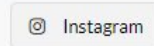
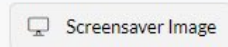
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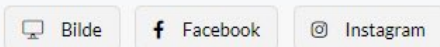
Trykte og digitale ressurser

Bilder med høy oppløsning, A4-trykte brosjyrer og plakater i A3-størrelse som du kan laste ned og dele.

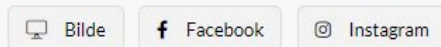


For å laste ned de digitale eiendelene, klikker du bare på den aktuelle knappen under bildet.

1.



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Chiropractic Research

Research summary articles to read, download and print (members only) all backed by the latest scientific research studies.



Chronic Pain

Chronic pain that has persisted for more than 3 months is no longer protective, nor informative. So, what is chronic pain and what can you do about it?

[Read more »](#)



Pain is in the Brain

Sometimes pain persists long after tissue damage has actually healed. When pain persists for more than three months we call this chronic pain.

[Read more »](#)



Neck Pain

Up to half the world's population suffers from neck pain at some stage. For some, one big problem is that it just keeps coming back, or becomes chronic.

[Read more »](#)

Neck Pain

Pain is Created in the Brain

Understanding Pain

Maintenance Care

The Opioid Epidemic

Lower Back Pain

...that 50% of patients visit a chiropractor to maintain their health and well-being!

Up to half of all people around the world suffer from neck pain at some stage in their lives. For some people, one problem with neck pain is it just becomes chronic, and may even increase their risk of other health problems.

Chiropractic care is an effective care option, and it's also cost-effective compared to other common treatments for neck pain. We know from many research studies that chiropractic care is an effective care option, and it's also cost-effective compared to other common treatments for neck pain.

We've all heard about the opioid epidemic, but what are opioids and why are they such a big problem? Opioids are basically a type of pain killing drug. No-one likes pain right? Why wouldn't you want to take drugs to help relieve it?



Do you think Heroin (an opioid drug) is good for you? In case you're unsure how to answer that question lets discuss some of the actual side effects from taking heroin - nausea, vomiting, itching, insomnia, infections, abscesses, constipation, liver, kidney and lung disease, mental problems, problems with sexual function, and death. Not just a few deaths, Heroin kills thousands of people every single year and it is a highly addictive drug!

Did you know that pain is not damage to feel pain. The interesting thing is that you can have damage to feel pain. And you can have pain and not feel any pain.

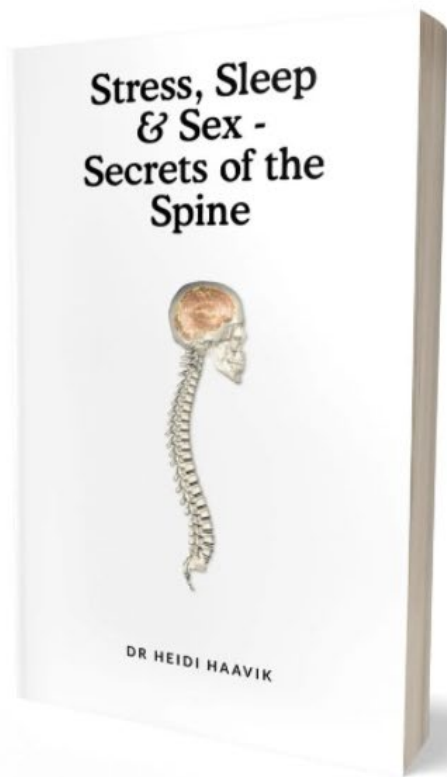


Do you suffer from lower back pain? It is now the leading cause of disability worldwide. Back pain guidelines recommend seeing a chiropractor or other form of healthcare before e. medications such as relaxants or opioid based pain relief.

Back pain can be frustrating and debilitating. With so many suffering from back pain, when doctors don't know what's causing the pain, as most of the time back pain isn't due to something like a fracture or an infection. It's often due to a change in the way your back is moving and functioning which changes the way your brain senses what is going on in your back.



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