

Chapter 4 : Neurons

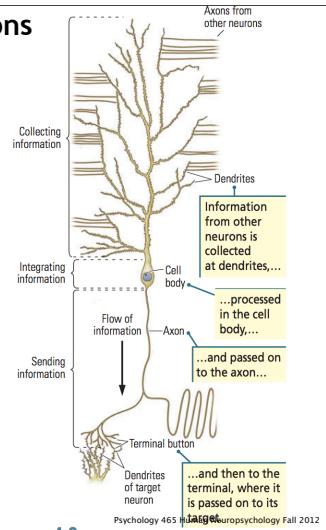
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Neurons

- Function
 - information processing
- Structure
 - Dendrite
 - inputs
 - Cell Body
 - calculation
 - Axon
 - output



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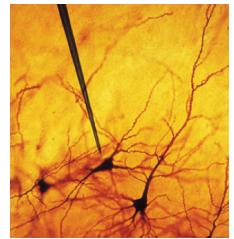
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Case Report : Single Cell Recording

• History:

- Subject with epilepsy volunteered for research study
- Goal: find location where seizure originates and remove it
- Recordings of electrical potential on surface of skull failed to find location
- Single Cell recordings were used



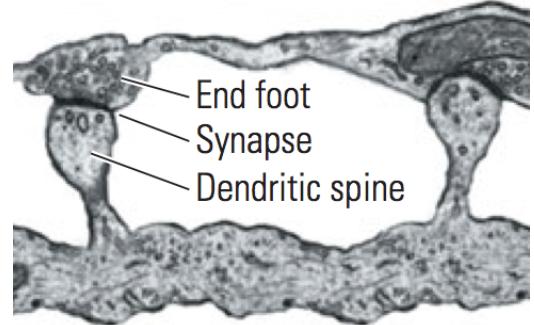
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Synapse

- Gap between dendrite and axon

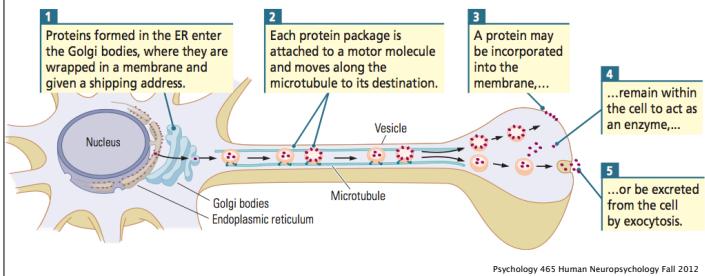


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Vessicles and Neurotransmitters

- Neurotransmitters bridge the synapse between axon and dendrite
- Vessicles are created in cell body and hold neurotransmitters

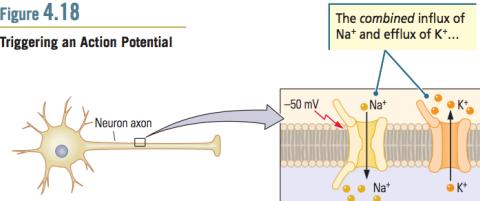


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The Action Potential

- Sodium ions enter cell, Calcium ions exit
- Cell voltage changes

Figure 4.18
Triggering an Action Potential



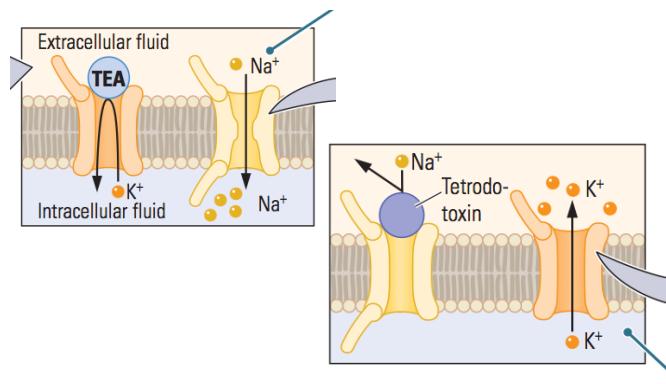
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Research methods

- TEA (tetra-ethyl-ammonium) blocks K channels
- Tetrodotoxin blocks Na channels



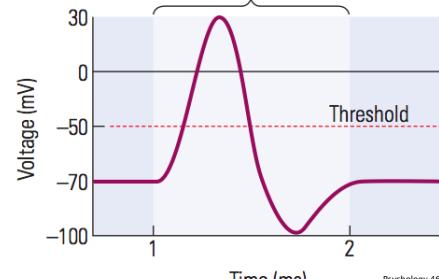
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Axons are Electro-Chemical computers

- Electrical potential (Voltage)
- Resting voltage (-70mV)
- Stimulation from dendrites -> increases voltage
- Threshold (-50mV)
- Action Potential (+30mV) aka “spike”

(A) Action potential



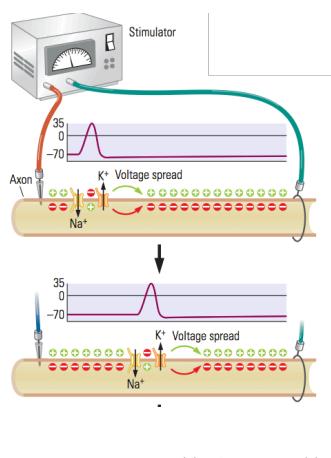
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The Nerve Impulse

- Action Potentials travel along the axon
- aka “propagation”
- Domino Analogy



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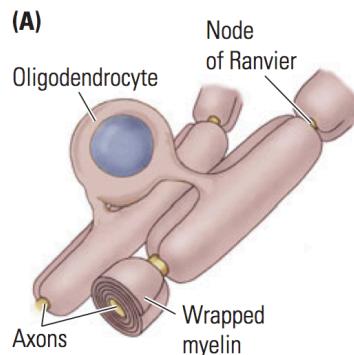
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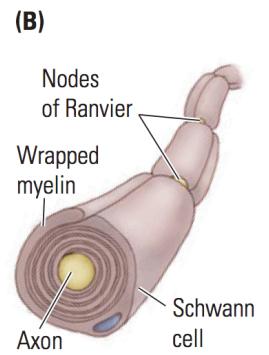
Going Faster

- Nerve impulse speed related to axon size (bigger -> faster)
- Problem: too big = too crowded. Solution: Myelination
 - “saltatory conduction” (to leap)

(A)



(B)

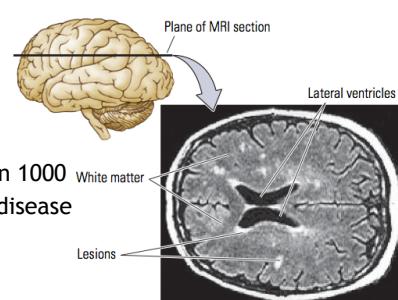


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Disease: Multiple Sclerosis

- Sclerosis = *hardness*
- MS : myelin is attacked, causing inflammation and damage / destruction of myelin
- Unpredictable / Disabling
- Remissions & Relapses
- often mis-diagnosed
- Epidemiology
 - typically age 15-40
 - 2x more F than M
 - prevalence about 1 in 1000
- Possibly auto-immune disease
- Lesions visible on MRI

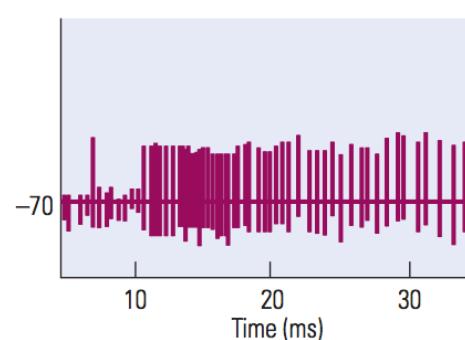


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Information is coded in Spike Trains

- Neurons can have multiple action potentials
- Information is coded in timing & pattern of spikes



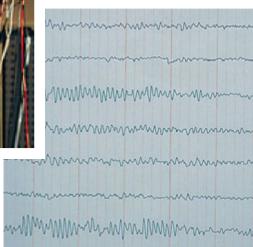
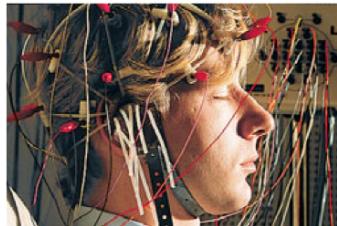
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Multiple neurons are synchronized

- Waves and patterns of thousands of neurons firing together
- Strong enough that voltage can be detected on scalp
- Electro Encephalograph (EEG)



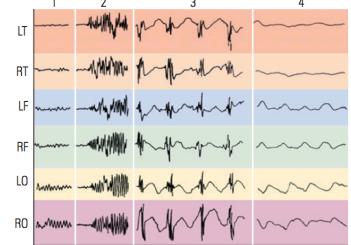
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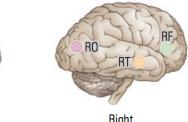
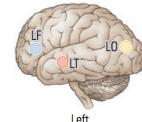
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Epilepsy

- Seizure
 - large groups of neurons firing all at once
 - out of control
 - pattern spreads
 - can involve entire brain



- Key
 - 1=pre
 - 2=onset
 - 3=clonic
 - 4=coma



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