

## Chapter 4 : Neurons

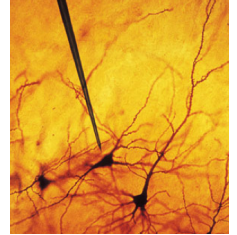
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## Case Report : Single Cell Recording

- 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



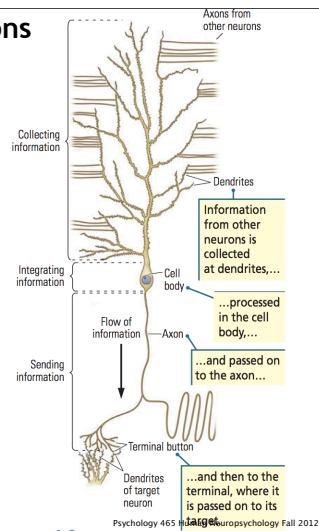
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## Neurons

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



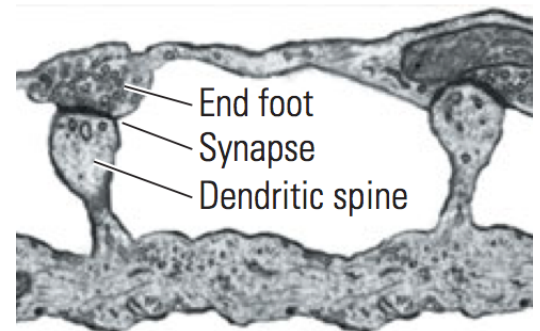
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## Synapse

- Gap between dendrite and axon



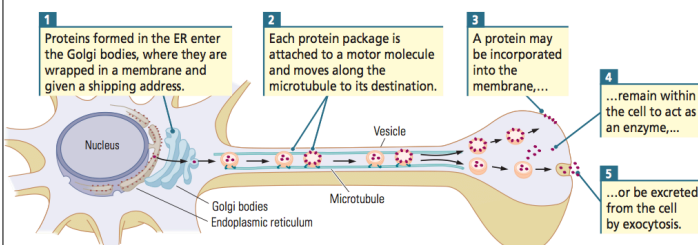
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## Vessicles and Neurotransmitters

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



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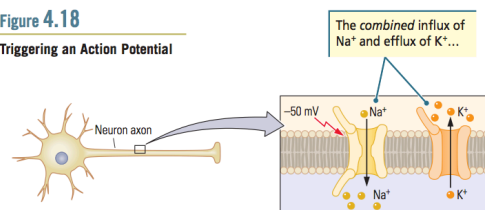
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## The Action Potential

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

Figure 4.18  
Triggering an Action Potential



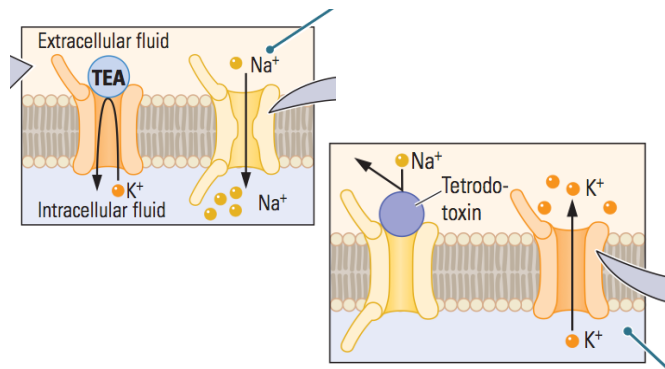
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## Research methods

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



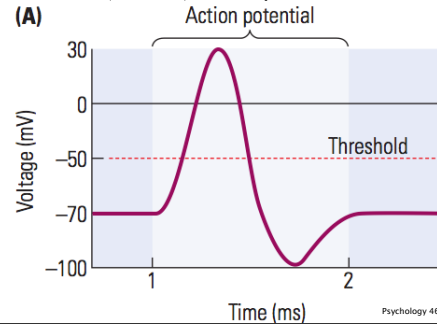
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## Axons are Electro-Chemical computers

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



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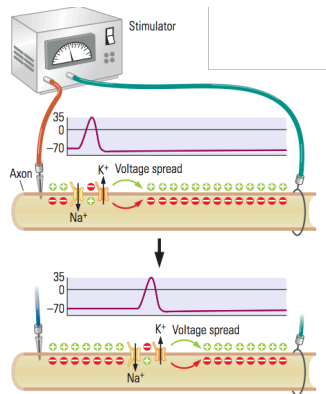
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## The Nerve Impulse

- Action Potentials travel along the axon
- aka "propagation"

- Domino Analogy



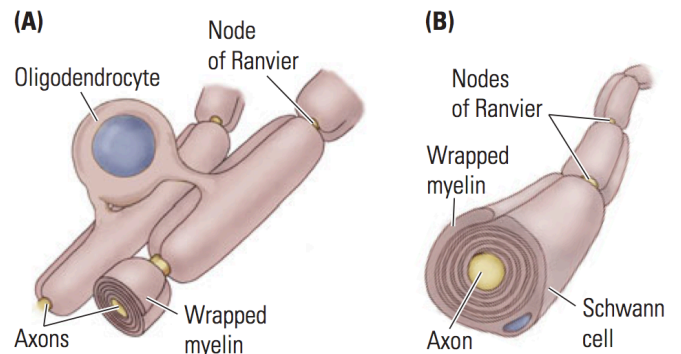
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## Going Faster

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



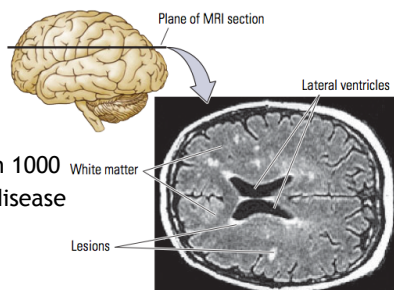
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## Disease: Multiple Sclerosis

- 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



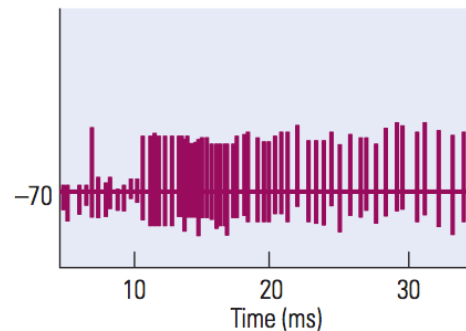
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## Information is coded in Spike Trains

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



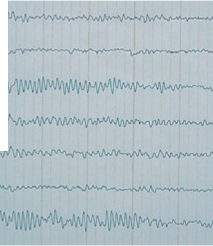
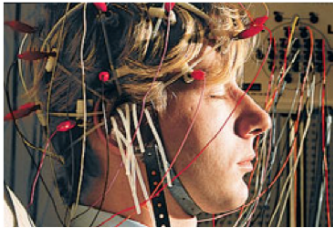
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## Multiple neurons are synchronized

- 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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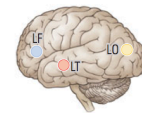
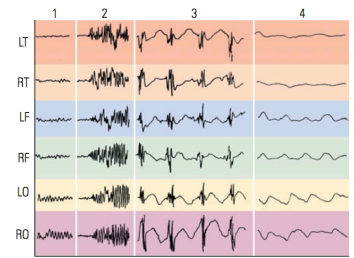
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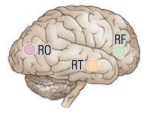
## Epilepsy

- 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



Left



Right

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