Neurons

Structures

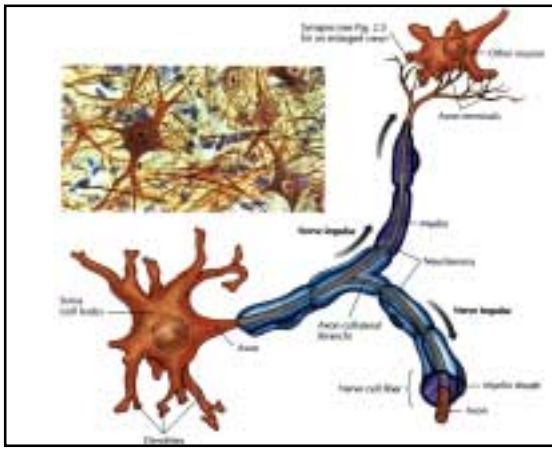
- All have
- 1. A Soma or cell body
  - .Is where cell metabolism takes place
  - .Has places where messages from other neurons can be received called a Post Synaptic Element)
  - .Contains many other structures related to metabolism such as
    - » .Mitochondria
    - » .Endoplasmic Reticulum
    - » .Golgi apparatus
    - » .Other structures
    - » The function of these structures is not important for this class.

Axons and Related Structures

- Axons are structures that send information to other neurons or muscle cells.
- Have many structures

Axon Hillock

Is the place where neurons decide to send a signal (called an action potential) to another neuron



Body of the Axon

This structure can branch (called a collateral)

– Branching continues into smaller and smaller branches called Teleodendria

Presynaptic Element

Also called terminal buttons, terminal boutons, and other names)

We will call it presynaptic element

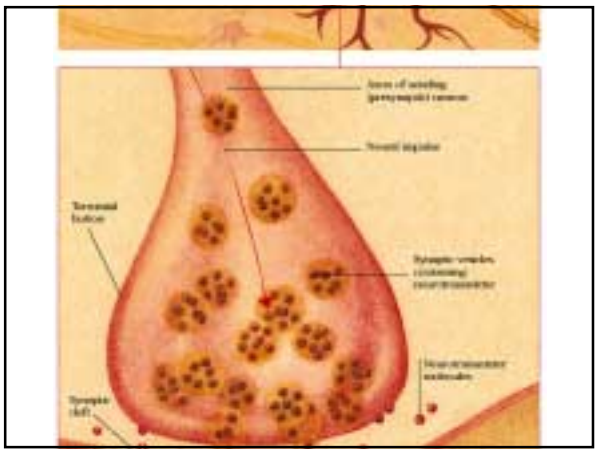
Contains Several Structures

Synaptic Vesicles (sacks)

Sacks contain chemicals called neurotransmitters

Presynaptic Membrane

Calcium Channels



Axons can be one of two types

- **Myelinated**
  - Myelin is a fatty covering over the axon
  - Helps to increase the speed of the action potential
  - The more myelin there is, the faster the speed of the action potential
-

Non Myelinated axons

Many axons do not have myelin

Are slower than myelinated axons

However, the fatter the axon is, the faster the action potential will go.

3. Dendrites

- Some neurons do not contain this structure.
  - only have soma's and axons

Dendrites only receive information

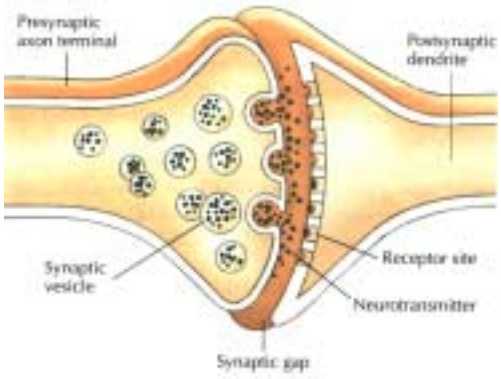
Contain a post synaptic element

Has a post synaptic membrane

Have receptor sites to receive neurotransmitters

- So, both Dendrites and Soma's can receive information. Both contain a post synaptic element.

Synapse and Related Structures



Types of Neurons

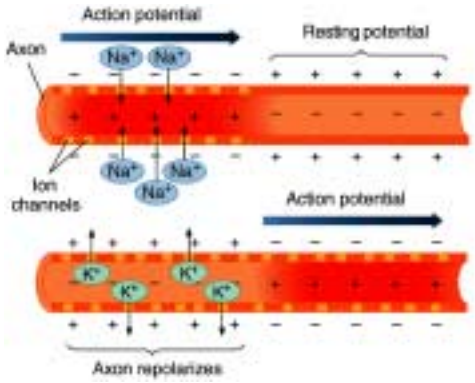
Are classified a variety of ways.

- For this class, we will only classify them by the number of processes they have. (Neurons are also classified by speed, function, and nucleus to cytoplasmic ratio.)

Three types of neurons

- Unipolar Neurons
  - Have no dendrites, only have a soma and axon
  - Have all the structures contained in the soma and axon.
  - Occurs in newborns and in the spinal cord (called T cells)

- **2. Bipolar Neurons**
  - Has one dendrite and all its structures
  - Has one axon and all its structures
  - Has one soma and all its structures
  - Are found in the retina of the eye
- **3. Multipolar**
  - Have many dendrites
  - Has only one axon and all its structures
  - Has one soma and all its structure
  - Are found in a variety of locations but mostly in the brain.



How Neurons Work

- Based on concentration gradients of four ions
- Sodium (Na), Potassium (K), Chloride (Cl), and Structures inside the axon called Anions (A)
- Sodium and Potassium are positively charged and are balanced out by chloride and anions

- Normally some sodium leaks into the axon.
- But cells don't like sodium, so they have pumps that remove sodium called sodium potassium pumps.
- The pumps remove sodium to the outside.

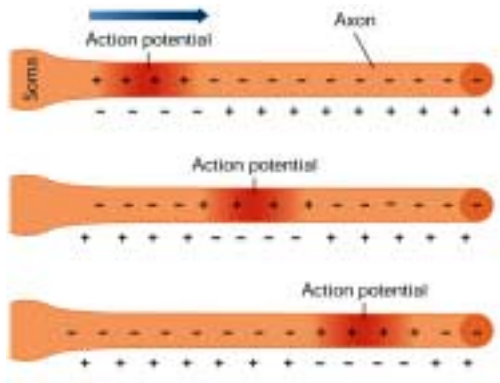
- The inside of axons have lots of potassium and anions and are negatively charged.
- The outside of axons have lots of sodium and chloride and are positively charged.
- So when an axon is at rest, the outside of the axon is positively charged and the inside is negatively charged.

When a Stimulus Occurs

- 1. When a stimulus enters a receptor on a dendrite, it causes a small electrical charge (change in polarity).
- 2. Causes a change in the chemical concentration gradients.
- 3. Allows sodium to enter in small amounts and thus makes the neuron more positive.
- 4. The change from negative to positive travels down the dendrite to the soma and to the axon hillock. If the charge is strong enough, it results in an action potential.
- 5. If the charge is not strong enough, the signal stops.
- Reason why it is called all or nothing

- 6. If the signal is strong enough, it causes sodium gates in the axon to open.
- 7. When the gates open, sodium pours into the inside of the axon.
- 8. Result, the axon goes from negative on the inside to positive on the inside.
- 9. This change goes down the axon like a wave.

- After the sodium enters, the sodium potassium pumps turn on and begin removing sodium.

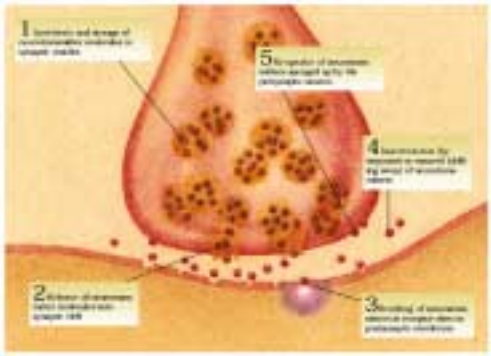


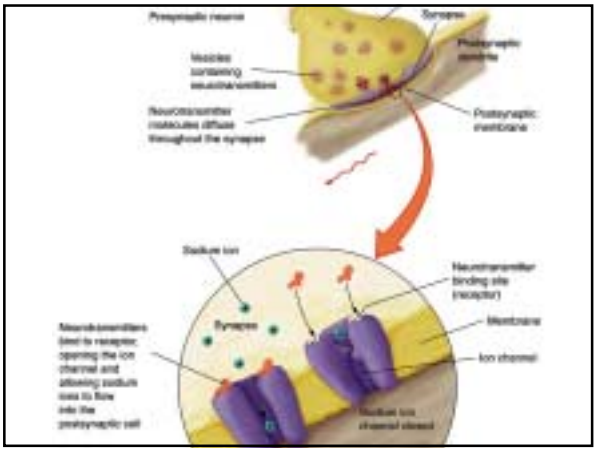
- So we have two waves going down the axon,
- The sodium entering the axon
- The sodium being pumped out

- Ultimately the result is a negative undershoot

When the axon potential reaches the presynaptic element

- 1. It causes calcium (Ca) to enter the presynaptic element.
- Calcium causes the synaptic vesicles to bind with the presynaptic membrane
- The neurotransmitter is then released into the synaptic cleft.
- The neurotransmitter crosses the cleft and binds on receptors in the post synaptic element on either the dendrite or soma.





- This causes a small electrical charge and the process repeats itself.

How neurotransmitters (NT) are removed from the receptors

- NT is removed two ways
- 1. It is degraded by enzymes made by glial cells or within the post synaptic membrane
- 2. It is reabsorbed into the presynaptic element.

- Different drugs can block the degradation or reabsorption (Prozac, Cocaine)
- There are lots of neurotransmitters and neuropeptides. Each is involved with a variety of activities. (e.g., Dopamine is used to control muscle movement by the basal ganglia. Acetylcholine is involved with muscle movement at your muscle).