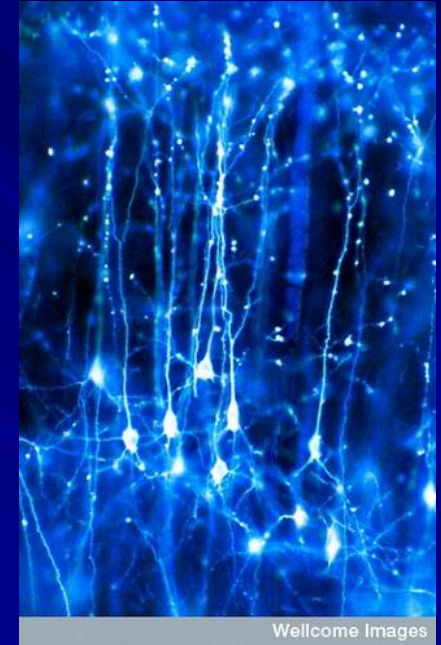
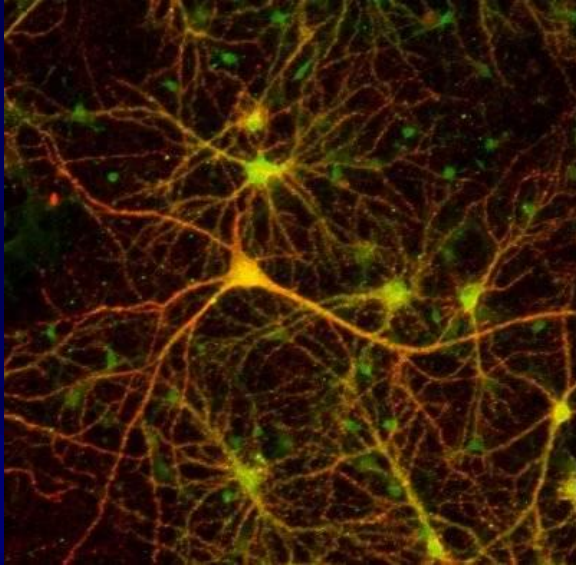




Neurons



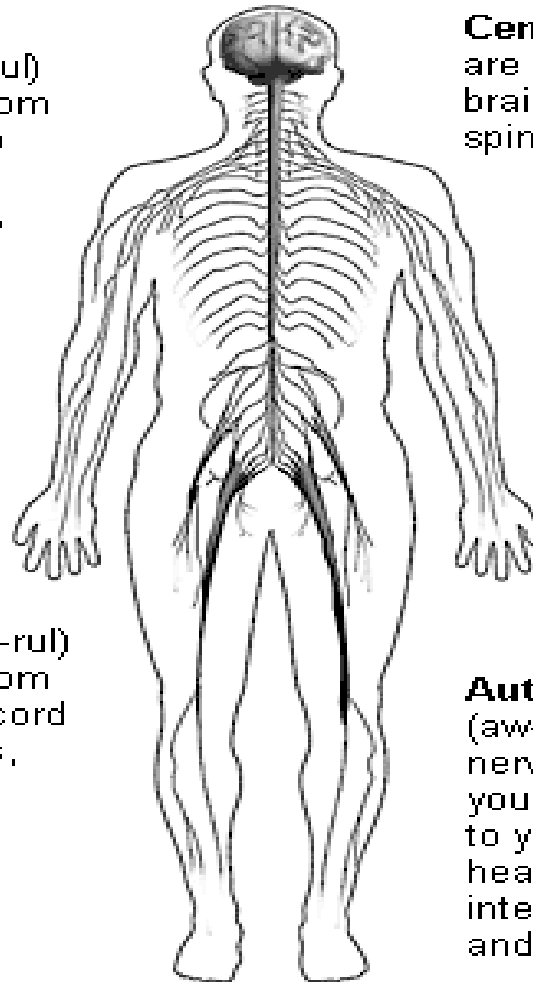
Nervous system

Cranial
(KRAY-nee-u)
nerves go from
your brain to
your eyes,
mouth, ears,
and other
parts of
your head.

Central nerves
are in your
brain and
spinal cord.

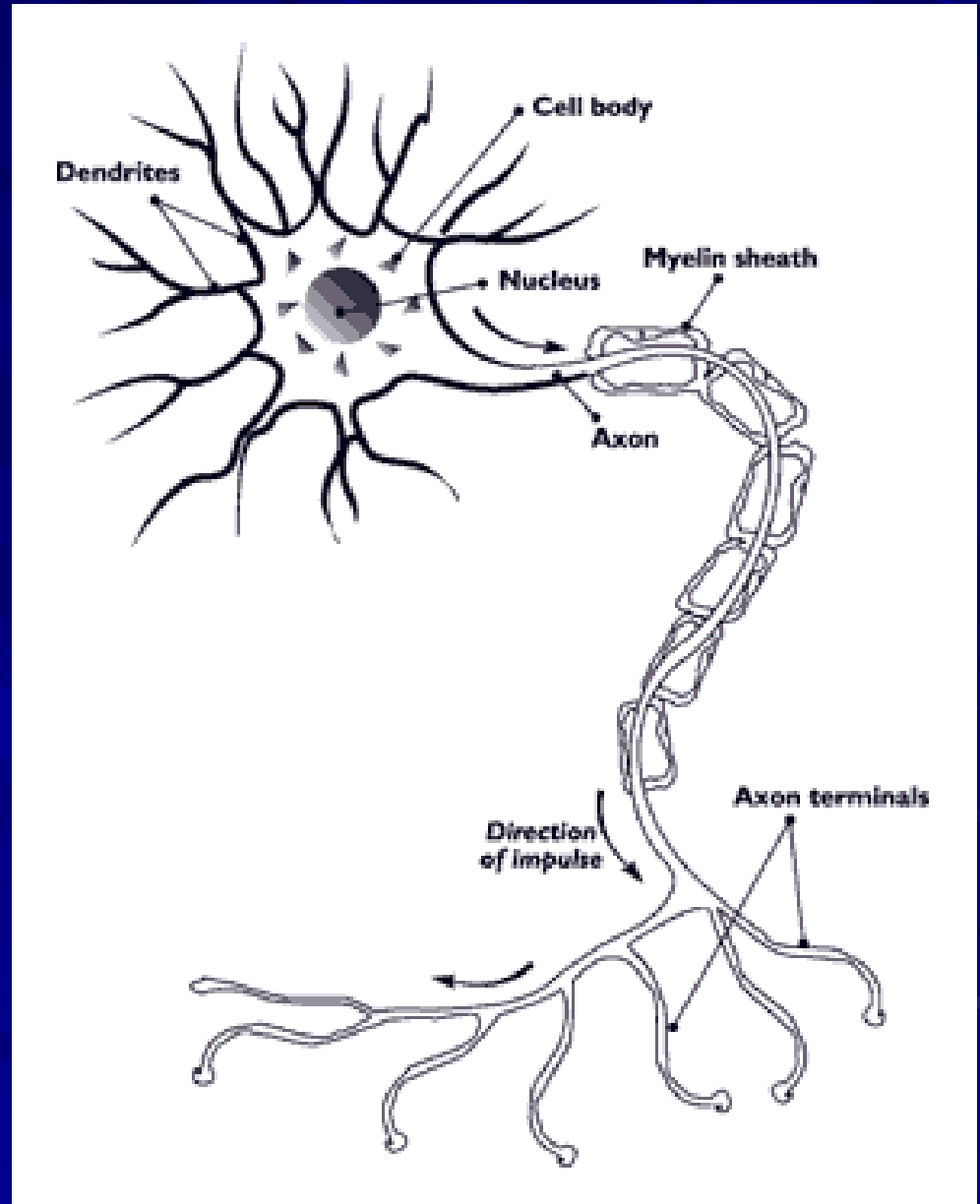
Peripheral
(puh-RIF-uh-rul)
nerves go from
your spinal cord
to your arms,
hands, legs,
and feet.

Autonomic
(aw-toh-NOM-ik)
nerves go from
your spinal cord
to your lungs,
heart, stomach,
intestines, bladder,
and sex organs.



Nervous system composed of cells

- Most important – *neurons*
- Neurons are cells – contain the usual cellular components:
 - Mitochondria
 - Nucleus
 - Ribosomes



Neurons.

- 100 – 150 billion neruons.
- Making approximately.....
 - 1, 000,000,000,000,000
 - 1 quadrillion connections.
- Responsible in all humanities achievements.

1 quadrillion.

- 1 000 000 000 000 000
000 gallons?

- Close to 2.73 times
the estimated total
earth water reserves !



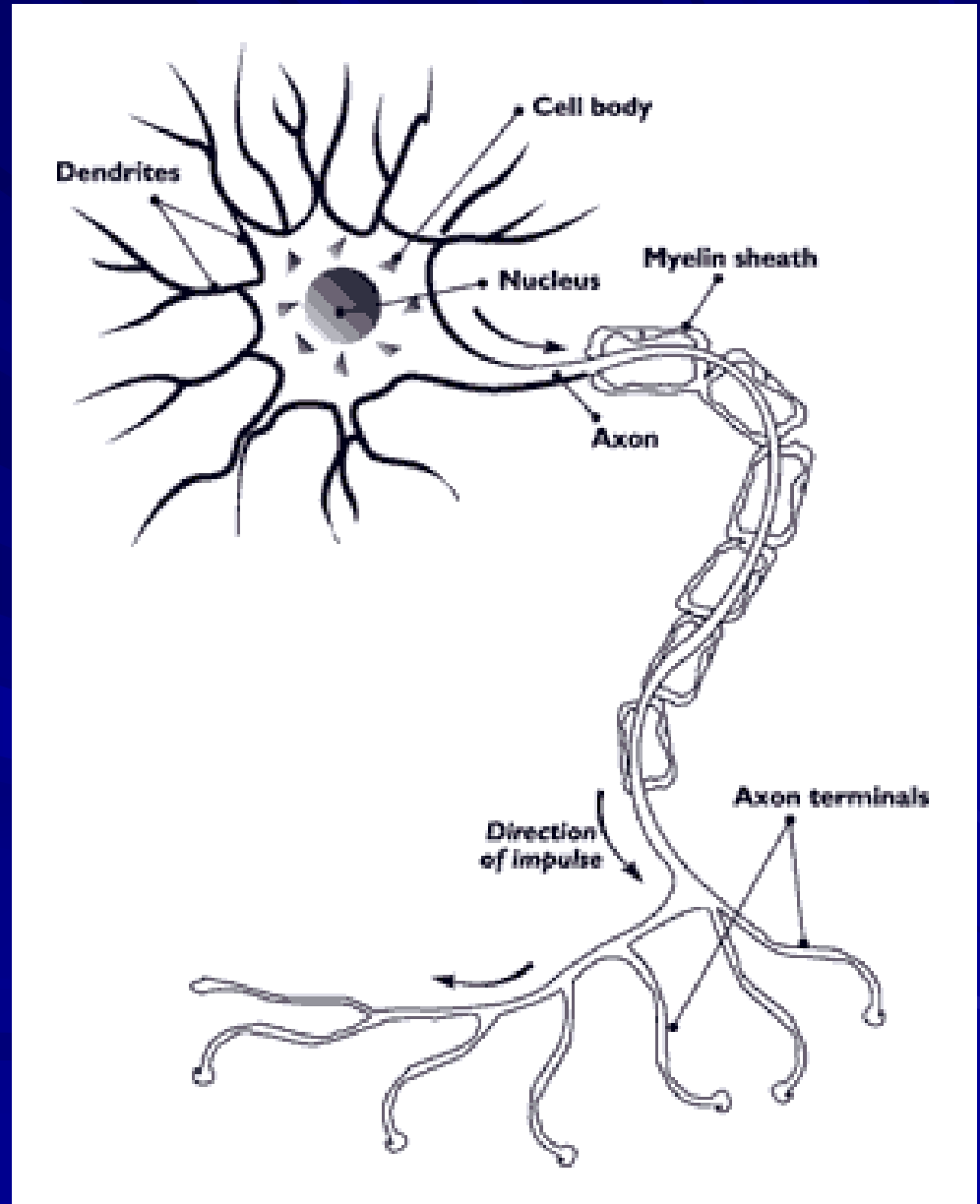
1 Quadrillion.

- 1 000 000 000 000 000 000 miles?
- Close to 169 light-years
- 1.1 millions times the distance between the Sun and the Earth



Nervous system composed of cells

- Most important – *neurons*
- Neurons are cells – contain the usual cellular components:
 - Mitochondria
 - Nucleus
 - Ribosomes



Neurons:

- Assembled into circuits



Receive input from other nerve cells

Integrates the input

Distributes the processed information

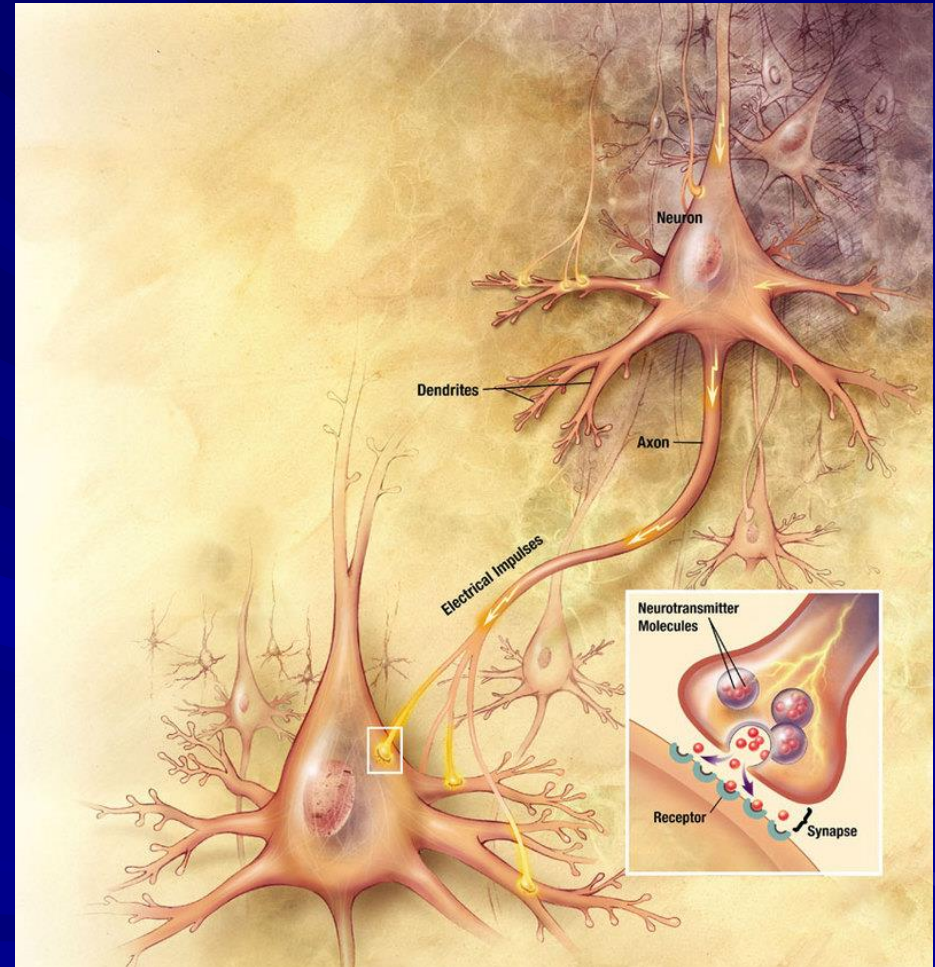
Neurons and their connections

Golgi (1843-1926) - Argued that Neurons were continuous.

Cajal (1852-1934)

- Neurons are *contiguous* - separated from each other by a miniscule gap
- Neuron Doctrine.
- Brain is made up of separate neurons and other cells that are independent from each other:
 - structurally
 - metabolically
 - functionally

- Information is transmitted from cell to cell across tiny gaps - *synapses* (Sir Charles Sherrington)
- Passes on information to other cells by means of *electrochemical output signals*



Structure of a Neuron.

- Collects signal
- Integrates this information.
- Distributes to other cells.
 - Electrochemical output cells.

Structure of the Neuron.

- All cells (including Neurons) have the following cellular components.
 - Mitochondria (singular Mitochondrion).
 - Cell Nucleus
 - Ribosomes.

- Mitochondrion – Organelle that provides the metabolic energy for the cell.
 - Engine of the cell.
- Cell Nucleus – Central Tenet of the cell contains genetic instructions – e.g. Chromosomes.
- Ribosomes – Translate genetic instructions into proteins.

Structural divisions

■ 1. Input zone

Dendrites - cellular extensions

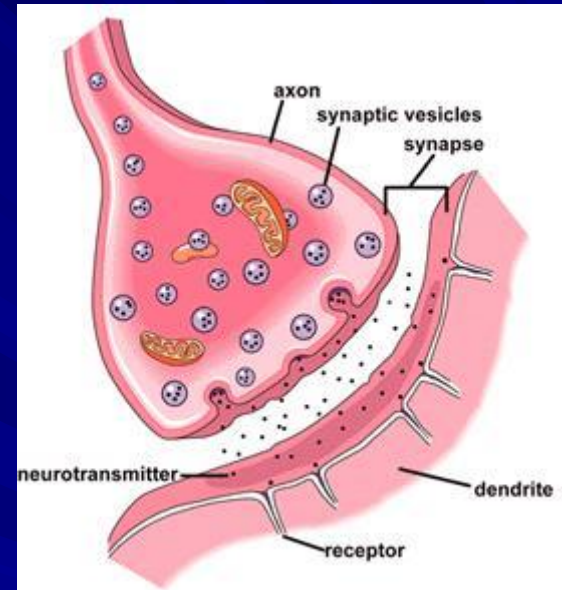
Greek - 'dendron' - tree

Can have elaborate branches

■ 2. Integration zone

The *cell body* region (soma)

May receive additional synaptic contacts



■ 3. Conduction zone

The *axon* - a single extension

Leads away from the cell body and transmits the cell's electrical impulses away from the cell body

Axon is covered with a sheath of *myelin* - a fatty, insulating substance

Between each pair of myelinated segments - a small gap
- node of Ranvier

Both myelin and node of Ranvier increase the speed of the conduction of nerve impulses

■ 4. Output zone

Where the myelination stops

The neuron ends in lots of outgrowths

Each of these end in specialized swellings

- *axon terminals* - these communicate the cells activity to other cells

Main parts of a Neuron.

- Soma
- Dendrites
- Myelin Sheath
- Node of Ranvier
- Axon Terminal
- Axon

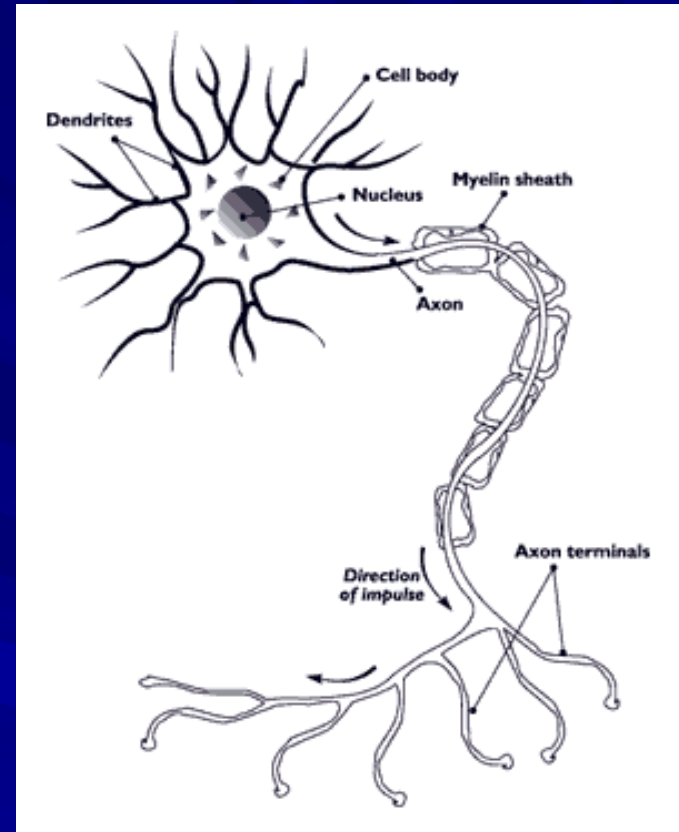
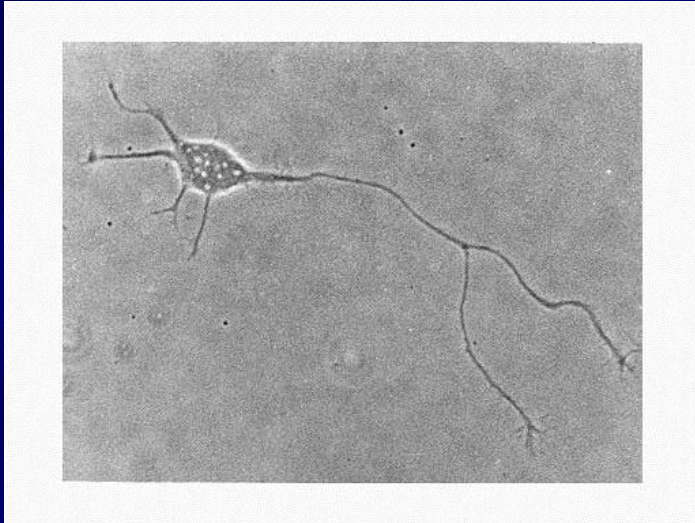
Axon

- Vary in length a great deal.
- Location and different species.
- From a few micrometers long – to more than a metre (Spinal Cord).



Classifying neurons

Shape



■ Multi-polar neurons

Lots of dendrites and a single axon

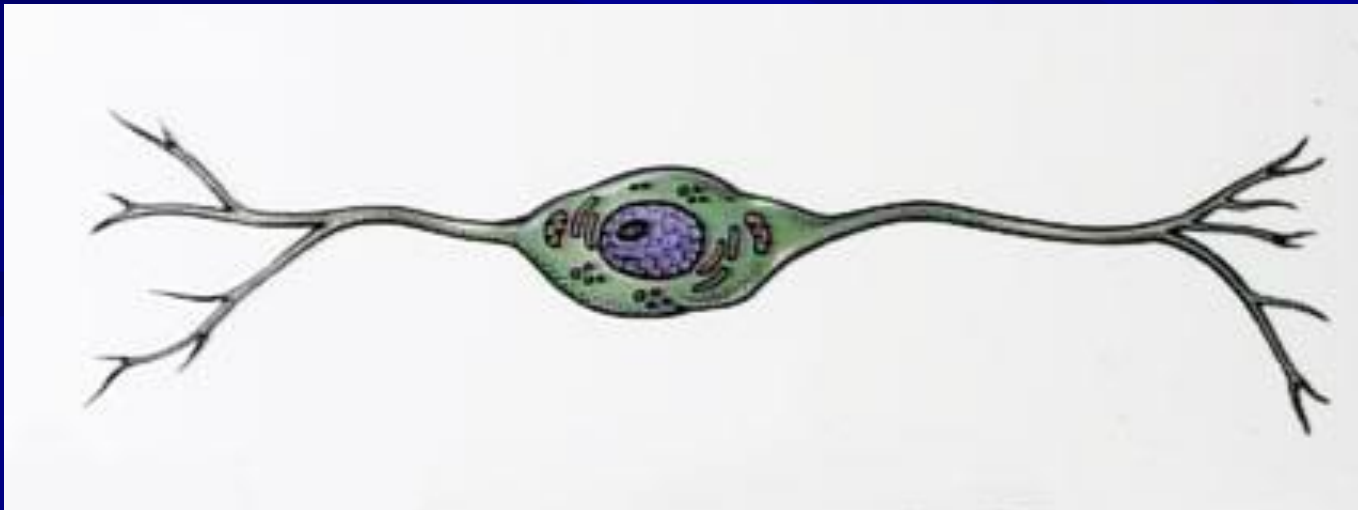
The most common form of neuron

2. Bipolar neuron

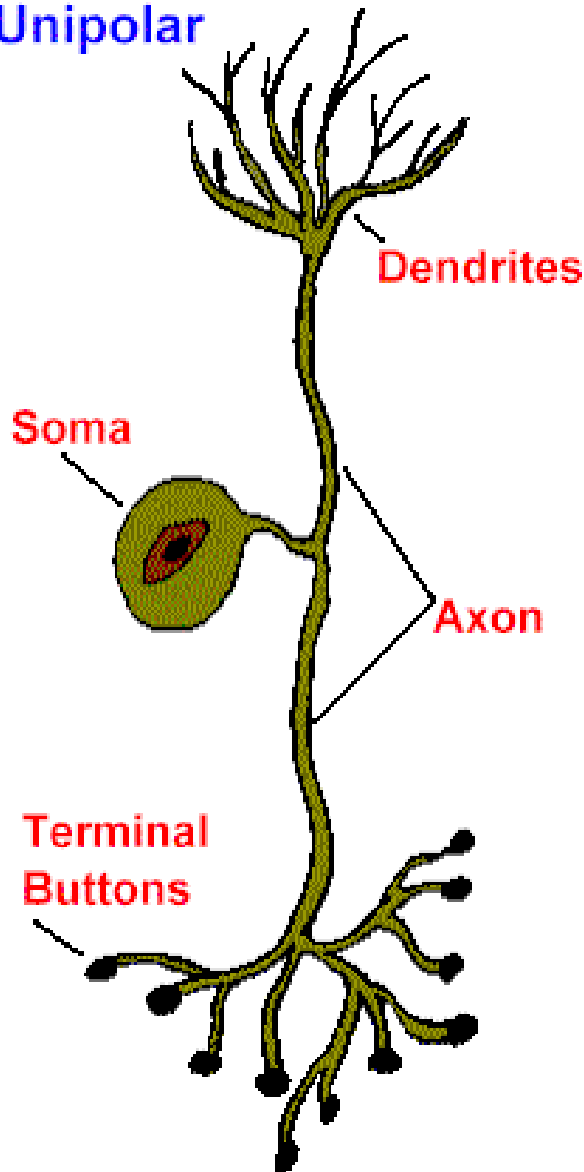
Single dendrite at one end of the cell
Single axon at the other

In all neurons the dendrites are in the input zone

In multi-polar and bipolar neurons the cell body is also in this zone



Unipolar



Monopolar (unipolar) neuron

Single extension (or process)
- axon

Branches off in two directions
after leaving the cell body

One end is the input zone
Other end is the output zone

These cells transmit touch
information from the body to the
spinal cord

Size

Nerve cell bodies range from 10 micrometres to 100 micrometres or more in diameter

Larger neurons tend to:

- have more complex inputs and outputs cover greater distances
- convey information more rapidly than smaller neurons

Function

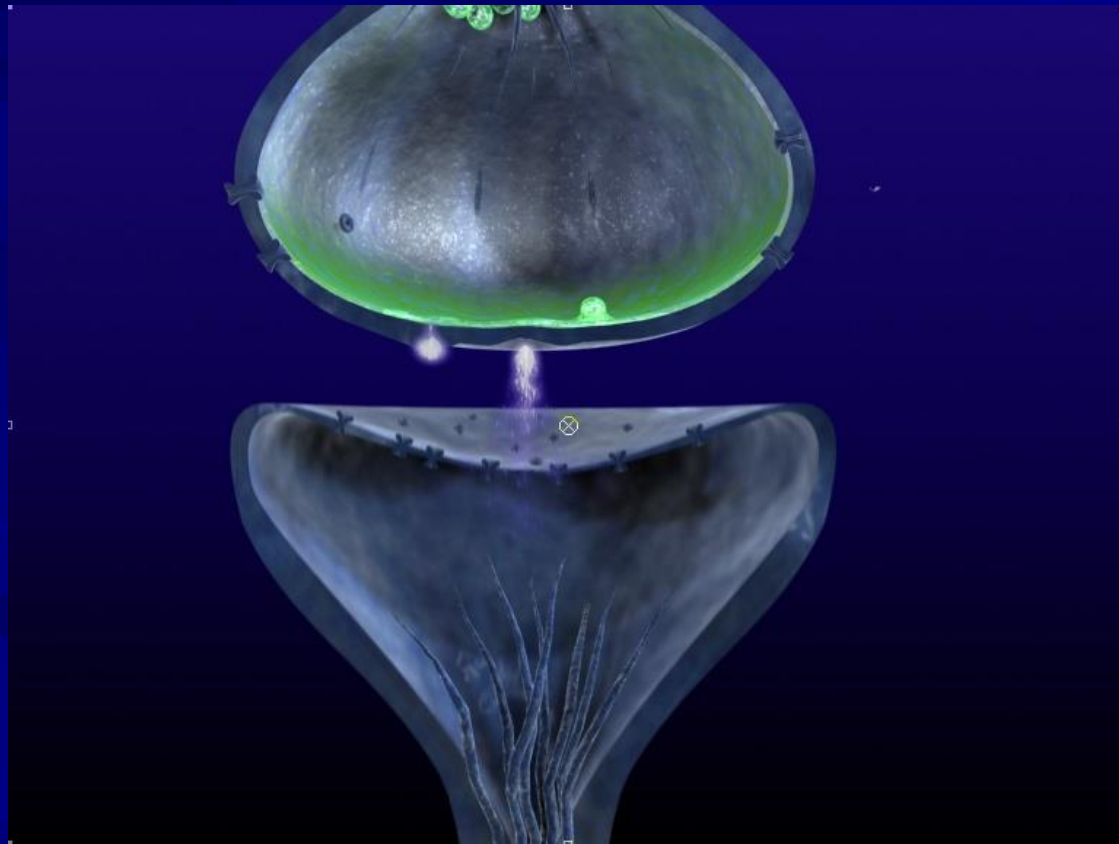
- ***Motor neurons*** - large axons
 - interact with muscles or glands
 - provide a pathway for the brain
 - contact and control body movements or organ function
- ***Sensory neurons*** - directly affected by/respond to environmental stimuli
 - Activated by sensory input - sight, hearing, touch etc.
 - Project information to parts of brain and spinal cord
- ***Interneurons*** - the majority of neurons
 - receive input from other neurons and
 - pass the information along the connection through neighbouring neurons

Motor Neurone Disease.



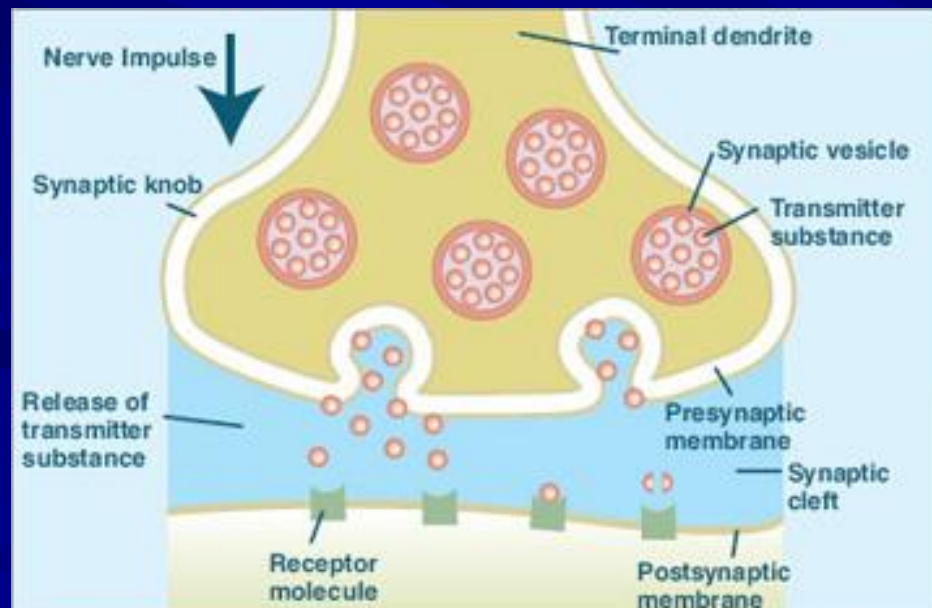
Synapses

- On surface of dendrite
- Information transmitted from *pre-synaptic* neuron to *post synaptic* neuron

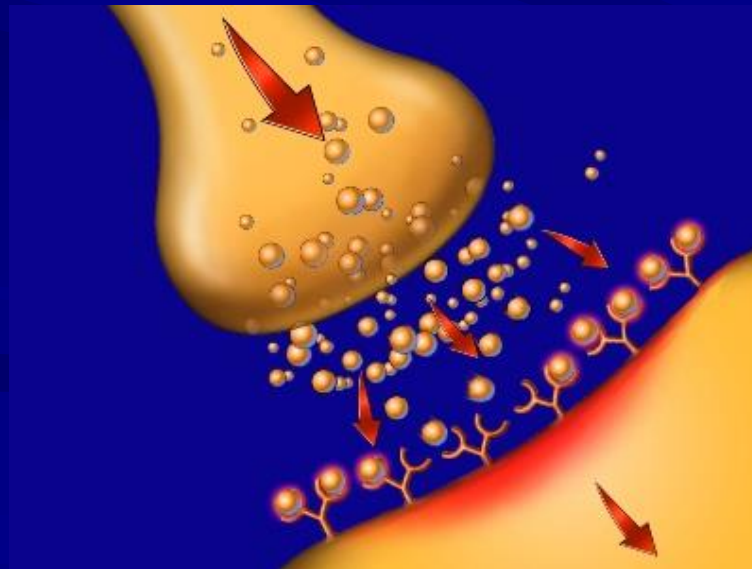


Three major components:

- The *presynaptic membrane* - on axon terminal of presynaptic neuron
- A specialized *postsynaptic membrane* on the surface of the dendrite or cell body of the postsynaptic neurone
- *Synaptic cleft* - this is tiny gap that separates the presynaptic and postsynaptic membranes - [between 20 and 40 nanometres]



- Axon terminals of the presynaptic neurons have lots of small spheres -
 - *synaptic vesicles* (30 - 140nm in diameter)
- Each vesicle contains a *neurotransmitter* - specialised chemical substance - Communication.
- Vesicles respond to electrical activity in the axon by fusing to the presynaptic membrane and releasing molecules of neurotransmitter into the cleft



- The neurotransmitter flows across cleft and produces electrical changes in the postsynaptic neuron
- Changes might be *excitatory* or *inhibitory*
- That is, they either turn the other neuron on or off
- Postsynaptic neuron adds and subtracts input and will become active only if the excitatory inputs exceed the inhibitory inputs

Glial cells

Thought to provide structure, by holding neuronal system together (Glia = Glue).

Can also communicate with each other and with neurons

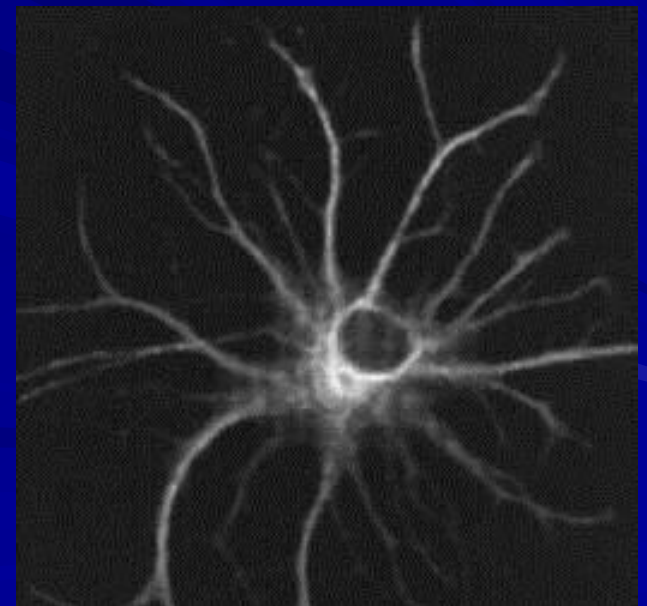
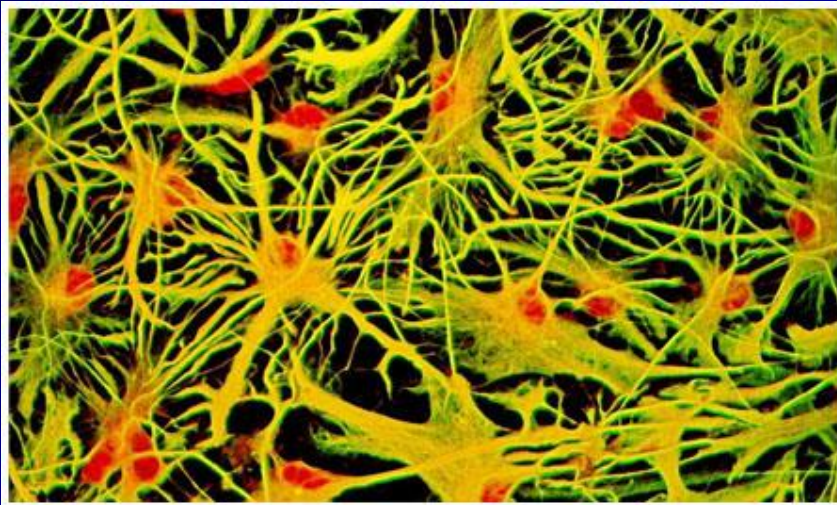
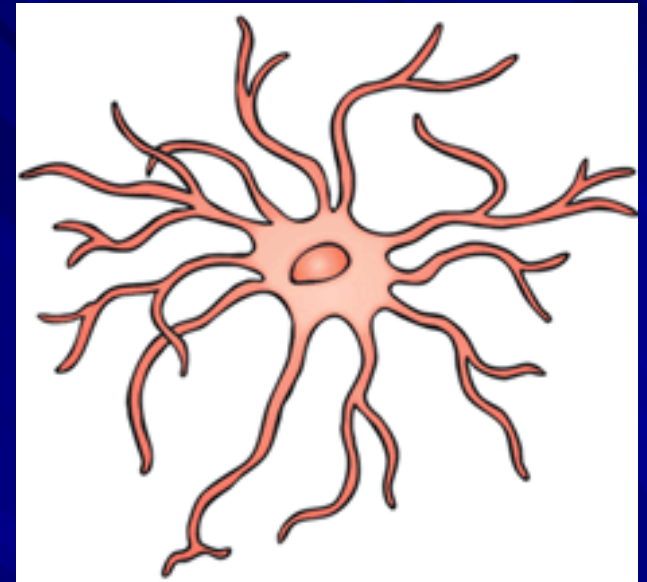
Can directly affect neuronal functioning by providing neurons with raw materials and chemical signals that alter neuronal structure and excitability

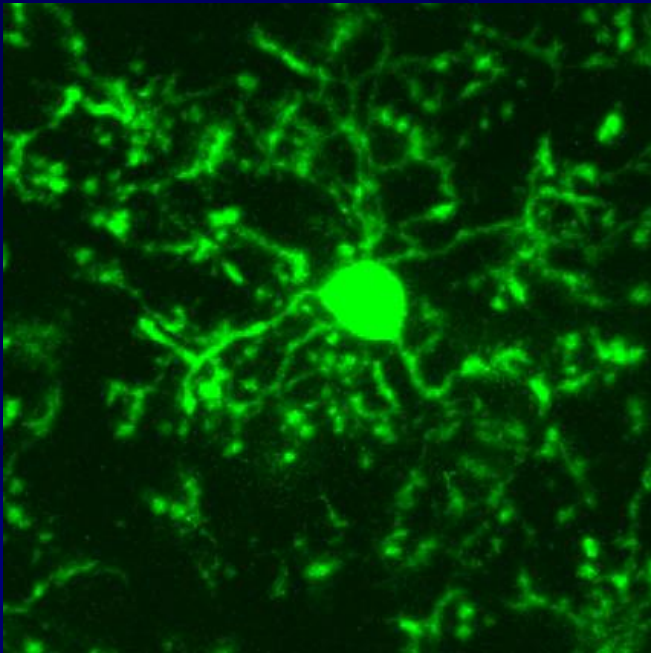
Four basic glial forms

Astrocytes (Greek Astrom - Star)

Neurons and axons working together coordinate

- communications
- formation of new synapses
- control of local blood flow



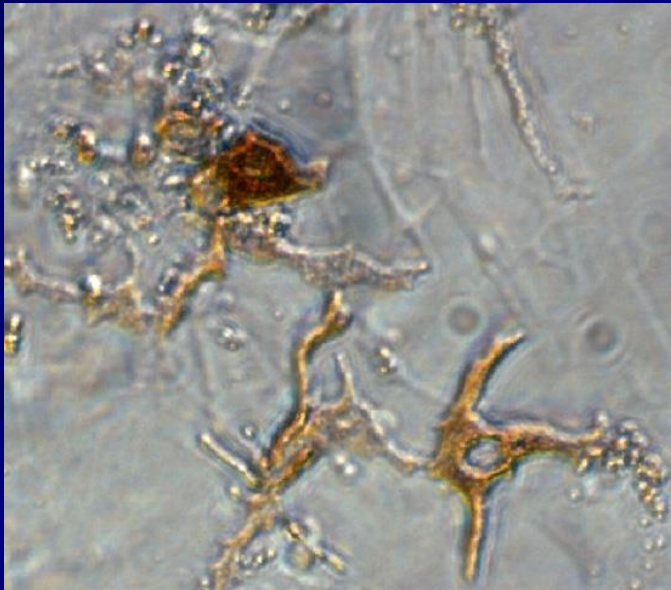


Microglial cells

Very small

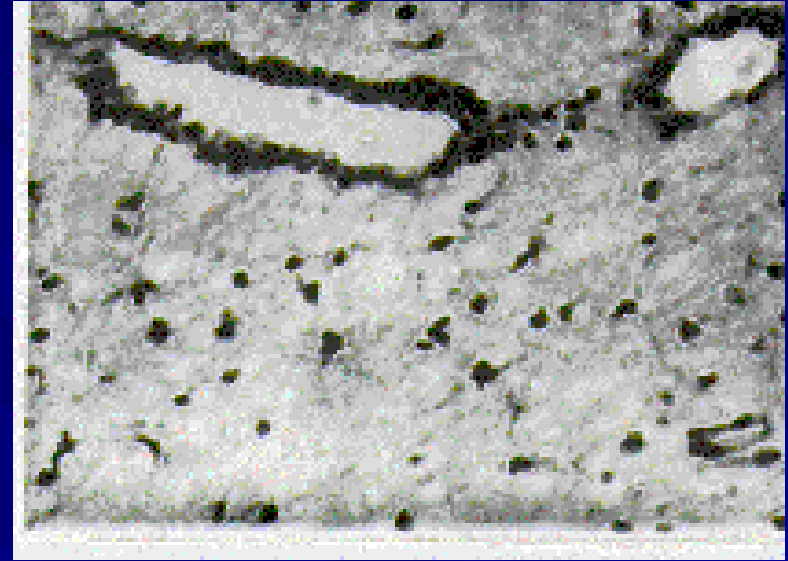
Very active

Form a cover over injury



Thought that they remove
debris from injured or dead
cells

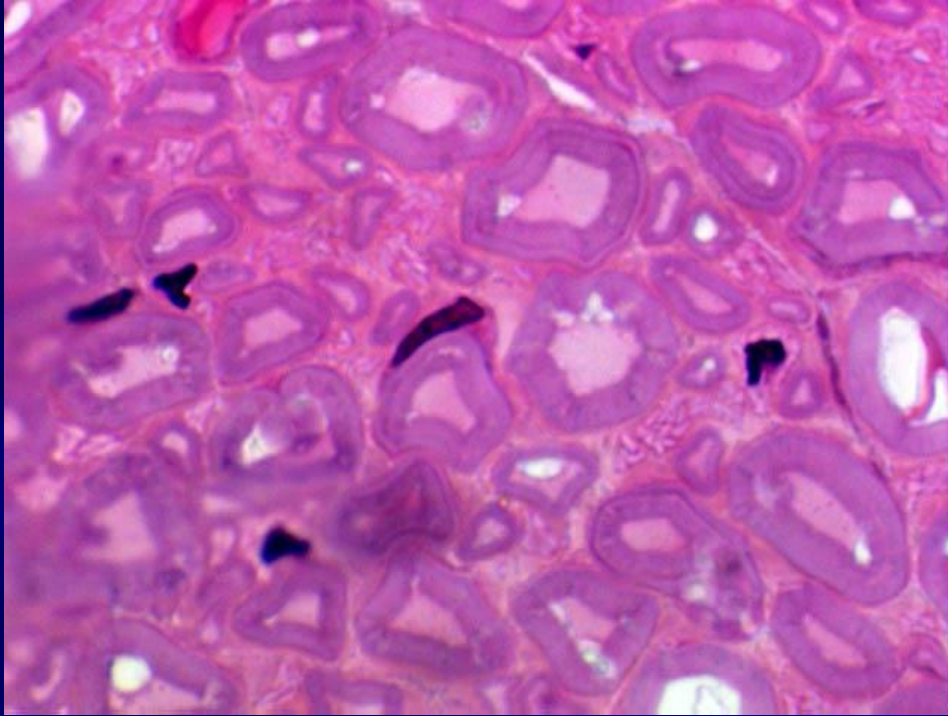
Oligodendrocytes



Myelin sheath is formed by oligodendrocytes

Smaller than an astrocyte and has fewer extensions
(Greek Olgios = few).

A single oligodendrocytes contributes to the myelination
of
numerous surrounding neurons



Schwann cells

Produces myelin and sheaths axons outside the brain and spinal cord - Peripheral Nervous System.

Oligodendrocytes and Schwann cells also care for certain thin short axons that don't have myelin by segregating them from those that do

Test.

- What is a Neuron Doctrine?
- What is a Synapse?
- Explain the role of Glial Cells?
- What are Mitochondria?

Test.

- What is the cell nucleus.
- What are Ribosomes?
- What is a Dendrite?
- Describe the Input Zone?

Test

- What is the Cell Body (Soma)?
- Describe the integration Zone?
- What is an Axon?
- Describe the Conduction Zone?

Test

- What is the Axon Terminal.
- Describe the Output Zone.
- What is Myelin?
- What is Myelination?

- What is the Node of Ranvier.
- What are Schwann Cells.
- What is presynaptic Membrane?
- What is Postsynaptic Membrane?
- What is the Synaptic Cleft?
- What is Synaptic Vesicle?