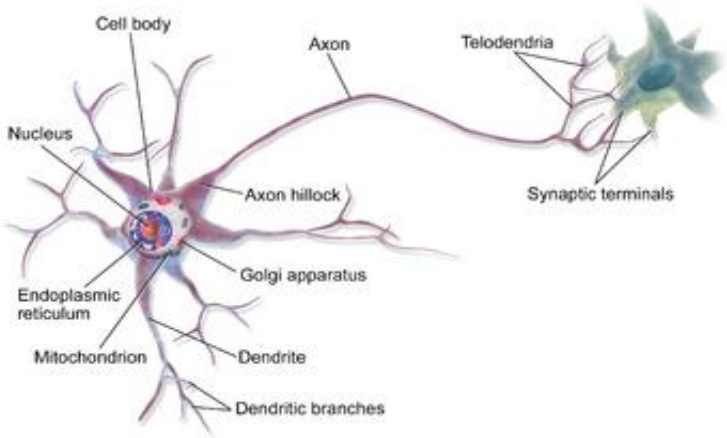
BMED2402 (Muscle and Cells)

Neurohistology is the histology of the nervous system

- The nervous system can be divided into the **central nervous system (CNS), peripheral nervous system (PNS)** and the **enteric nervous system (ENS**, sometimes included in the PNS)

A **neuron** is a group of cells found in the human nervous system. The three characteristics that define a neuron are:

- Extensive, long processes (axons, dendrites, etc…)
  - Other cells have extensive processes as well but not as much so as neurons
- Excitable membranes (action potentials)
  - Neurons can propagate electrical signals
  - Other cells can carry charge but not as much as neurons
- Network formation
  - They can "talk" to each other from across a gap (synapse)



Processes are things such as dendrites and axons (usually only 1 axon per neuron)

Dendrite tree surrounds the body and are usually 50microns long

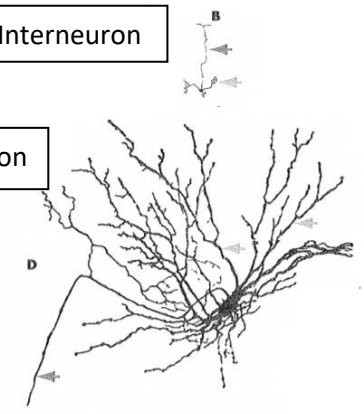
Microtubules are found in nerve cells (axons). Things travel using these and they form the synapses

Variations in a neuron

- Cell body changes size and shape
  - Can be ellipsal, globule
- Number of processes can change **(polarity)**
  - Unipolar, bipolar, multipolar
- Axon size
  - **Interneurons (GOLGI TYPE 2)** are **short axons**
    - They generally do not leave the grey matter!
  - **Projection neurons (GOLGI TYPE 1)** are **long axons**
    - They generally leave the grey matter

Interneuron

Projection Neuron



Interneurons are 100x more prevalent than projection neurons. However, projection neurons create the pathways that we want to study!

Ultrastructure (what's inside) **of a neuron cell**

- Normal organelles
  - Have nucleolus, endoplasmic reticulum, ribosomes, mitochondria, Golgi apparatus, etc…
- Nucleus
  - The nucleus is **euchromatic** (made of dispersed DNA)
- Nissl Bodies (Rough Endoplasmic Reticulum)
  - Have **very extensive and developed nissl bodies** (can be seen as black dots all around the neuron cell
- Microtubules
  - Have **extensive cytoskeleton** with many microtubules in their axons for intercellular transport
  - Form specialised structures called **synapses**

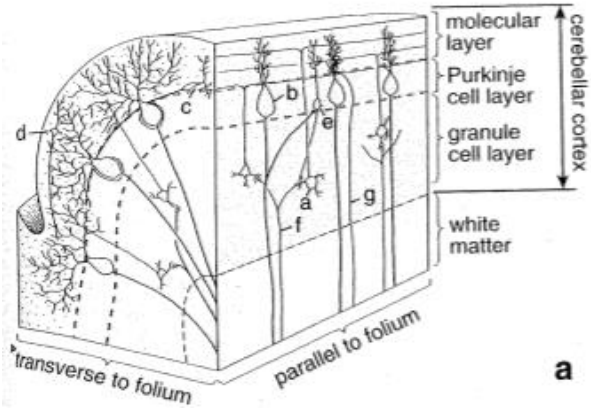
White matter vs. Grey Matter

	Macroscopic Specimen.	Major Components.	General Function.	Histological Section, Fibre Stain
Grey Matter.	Greyish.	Neuronal cell bodies (projection, interneuron), dendrites (projection, interneuron), synapses, interneuron axons, projection neuron proximal, distal, intransit axons, protoplasmic astrolglia, many capillaries.	Information processing.	Pale (unless counterstained).
White Matter.	Whitish.	Axons (myelinated and unmyelinated), oligodendroglia, fibrous astroglia.	Information transfer.	Usually dark, often black or green.

- **Macro circulatory transport** is sending information from grey matter to other grey matter
- **Micro circulatory transport** is processing information within the same grey matter

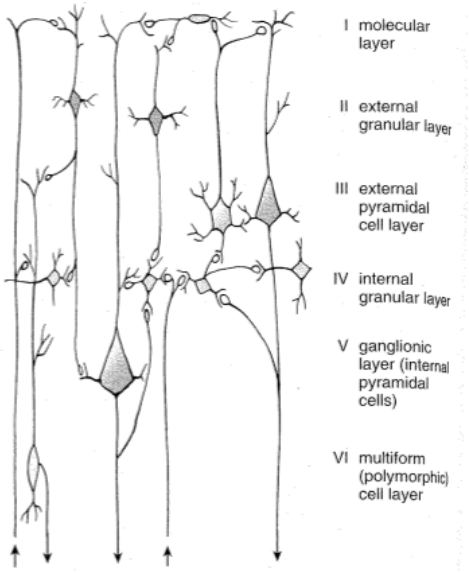
Examples of Grey Matter

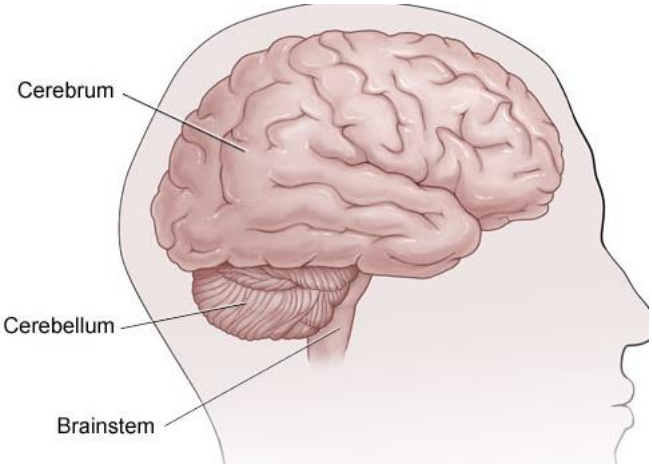
- <u>Cerebellum</u> (Cerebellar Cortex)
  - **Folded undulating** (wobbling/moving) **sheet** comprised of **three grey matter layers**:
    - **<u>Molecular layer, Purkinje cell layer, Granule cell layer</u>**
  - The **white matter** is below these layers



Purkinje Cells are projection neurons (Golgi type 1), Granule cells are interneurons (Golgi type 2)

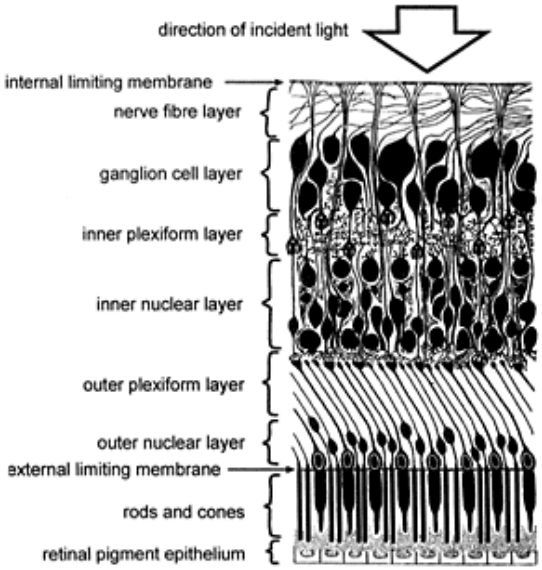
- <u>Cerebral Cortex</u>
  - Similar with some **interneurons** and some **projection neurons**
  - Has **6 layers**
  - **Undulating** (moving/wobbling) **sheet** of **grey matter**





Cerebellum controls motor activities and movements

Cerebrum controls thought processes (logic on the left and creative on the right) and movement



- Retina
    - Similar to grey matter. It has lots of **neurons** and **synapses**

The Supporting cells

- You need 10 supporting cells for every neuron present

- Astrocytes
    - Can be **fibrous astrocytes** or **plasmic astrocyte**
    - They **mop up chemicals**
    - They **hold things together** (brain is a liquid)
    - Can **form scar tissue** if some of the brain is damaged
    - Form the **blood brain barrier**

- Oligodendrites
    - Wrap around **axons and form myelin sheaths**
    - Mainly found in **white matter** with the axons
    - Many axons are not myelinated

- Microglia
    - They are **very mobile** and can move around the brain a lot
    - They act as the **immunological cells** in the brain

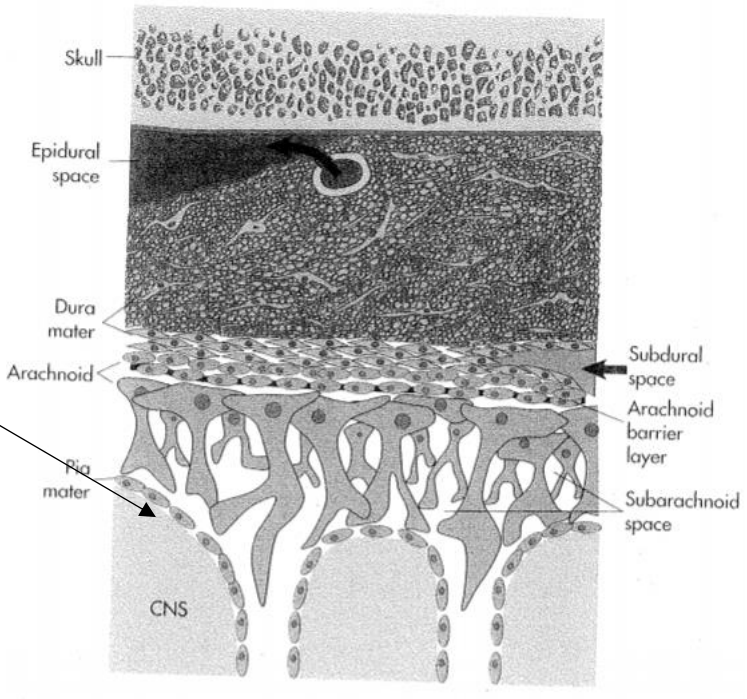
- Ependymal Cell
    - Forms **choroid plexus** with blood vessels
    - Helps with **cerebral spinal fluid creation**

- Capillaries
    - Provide blood for the brain
    - Grey matter has a lot more capillaries than white matter

- Meninges
    - Provide mechanical support
    - Makes up space between brain and skull
    - Includes the **pia matter, dura matter and arachnoid matter**

Brain Defence

- Pia Matter
  - Very thin layer that is **attached to the brain**
- Glia Limitans
  - The glia limitans is also at the **very surface of the brain with the pia matter stuck onto the top**
  - It is **made of astrocytes**



- Arachnoid Matter
  - Arachnoid **trabeculations** extend down to **join onto the pia matter**
  - Has **tight junctions** which increase strength
- Sub arachnoid space
  - Full of **Cerebral spinal fluid** and **blood vessels**
- Dura Matter
  - Has a **cellular part** and a **connective tissue part**
  - This is painful if damaged (the brain itself won't feel any pain)

There is epidural space between the bone and the dura only in the spinal cord

Miscellaneous Brian Feature

- Blood Brain Barrier
  - **Restricts the movement of substances across the brain membrane**
  - Relationship between the capillaries and the astrocytes (glial cells
  - **99% of capillaries in brain are non-fenestrated**
    - Non-fenestrated mean that they do not have holes or pores in their wales (provides a better barrier)
  - The actual barrier is in the capillaries but the **astrocytes control it**
  - **The high density of cells restricts movement of substances from the bloodstream at a much greater rate than in other capillaries of the body.**
- Choroid Plexus
  - Where the **cerebral spinal fluid is made**
  - Fluid found in the **third and fourth ventricles**
  - Mixture of **capillaries, pia matter, and ependyma**
  - The **capillaries of the choroid plexus are fenestrated!!**