

Module:

Biological Foundations of Mental Health

Week 1:

Introduction to brain anatomy



Dr Sarah Mizielska

Topic 3:

Microanatomy of the nervous system

Part 1 of 3

Topic list



This week, we will be looking at the following topics:

- Topic 1: Overview of CNS development
- Topic 2: Neuroanatomy, neural systems and brain function
- **Topic 3: Microanatomy of the nervous system**

Click **Next** to continue

Part 1

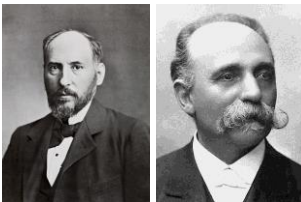
Neurons and glia

Week 1 Introduction to brain anatomy

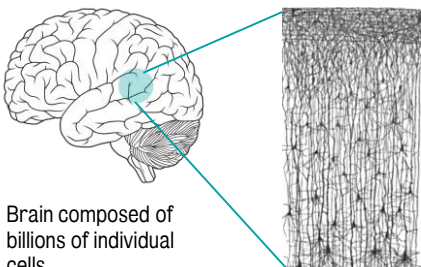
Topic 3: Microanatomy of the nervous system

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The cell types of the brain

Santiago Ramón
y Cajal

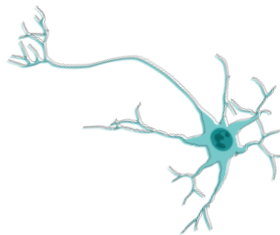
Camillo Golgi



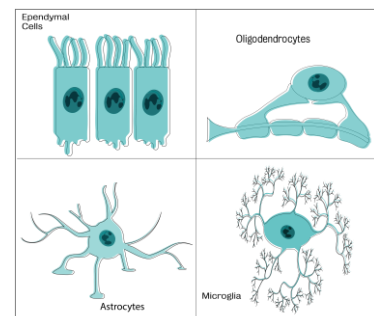
Brain composed of
billions of individual
cells

During development, the cells of the nervous system differentiate into:

Neurons



Glia



Week 1 Introduction to brain anatomy

Topic 3: Microanatomy of the nervous system

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Neurons and neuronal communication



Electrical signal



Chemical signal



Electrical signal

Within neurons information travels at different speeds ranging from:



1 mph...



...to 268 mph.

Types of neurons

Neurons come in many forms specialised for their particular function within the nervous system.

Model neuron

Sensory neuron

Motor neuron

Local interneuron

Flow of
information



Secretion



Muscle

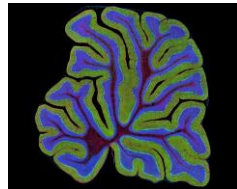


Neuronal variation within brain regions

Even neurons within the same brain structure can vary.



cerebellum



Cerebellar lobe in cross section

Example

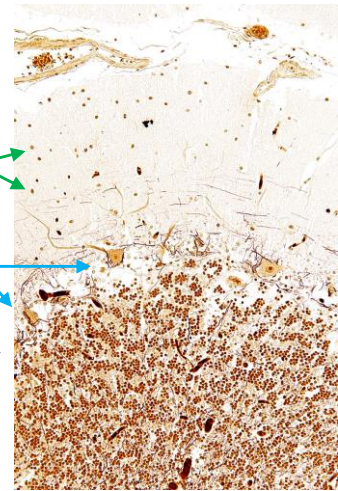
The cerebellum contains:

- a dense layer of small granule cell neurons
- large Purkinje neurons at edge of granule cell layer
- interspersed basket and Golgi neurons

basket and Golgi neurons

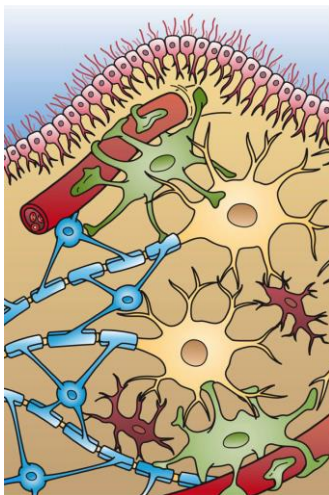
Purkinje cells

granule cell layer



Edge of a cerebellar lobe

Glial subtypes



Ependymal cells

These glia line the ventricles of the brain and the central canal of the spinal cord.

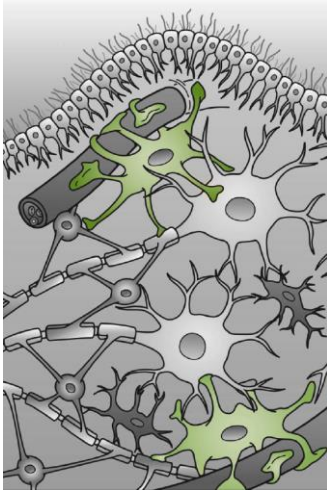
Astrocytes

Microglia

Oligodendrocytes

Neurons do not function in isolation, they are supported by different types of glia.

Astrocyte function



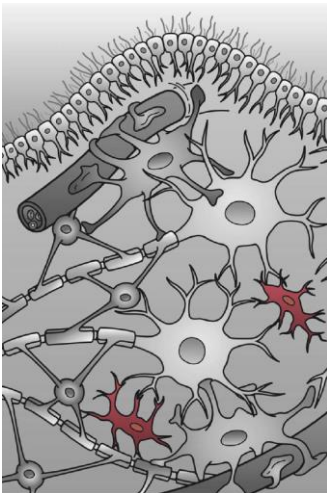
Astrocytes

- distribute nutrients from the blood supply to neurons
- maintenance of extracellular ionic balance
- tissue repair
- regulation of synaptic activity by direct contact with synapses
- astrocyte-astrocyte signalling via gap junctions



Santello et al., 2019 Nature Neuroscience

Microglia function



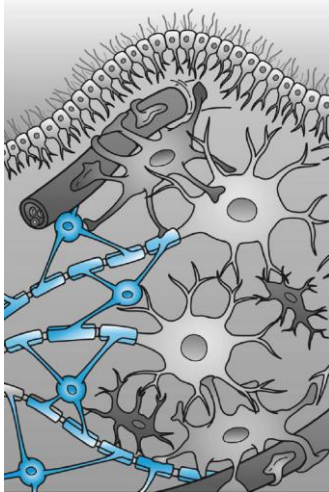
Microglia

- resident immune cells of brain
- clear debris → Can also degrade synapses
- recruit other cells to sites of damage
- aid in tissue repair



Lannes et al., 2017 Oncotarget

Oligodendrocytes



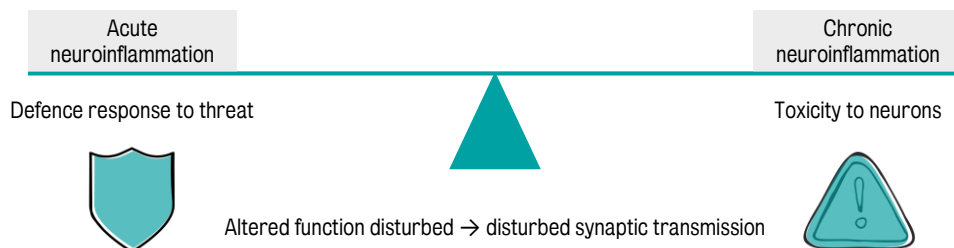
Oligodendrocytes

- equivalent to Schwann cells in the periphery
- support and insulate neuronal axons by generation of myelin sheath
- increase speed of neuronal signalling through saltatory conduction
- also provide metabolic support

Multiple sclerosis causes degeneration of the myelin sheath, which prevents the brain from communicating properly with the body.

Dysfunction of any cell type can cause disease

A delicate balance



Dysfunction can result in vulnerability to neurodevelopmental and neurodegenerative diseases.

Figures

Slide 4

Camillo Golgi:

https://commons.wikimedia.org/wiki/File:Camillo_Golginobel.jpg

Ramon y Cajal:

<https://commons.wikimedia.org/wiki/File:Cajal-Restored.jpg>

Slide 5

Neuron gif:

https://commons.wikimedia.org/wiki/File:Saltatory_Conduction.gif

Slide 7

<https://www.flickr.com/photos/nihgov/26647148341>

https://commons.wikimedia.org/wiki/File:Cerebellum_-_biel_-_high_mag.jpg

Slides 8-11

https://commons.wikimedia.org/wiki/File:Glial_Cell_Types.png#filelinks

End of part 1