

Module:

Biological foundations of mental health

Week 1:

Introduction to brain anatomy



Prof Sarah Guthrie

Topic 1
Overview of CNS development

Part 2 of 3

Differentiation

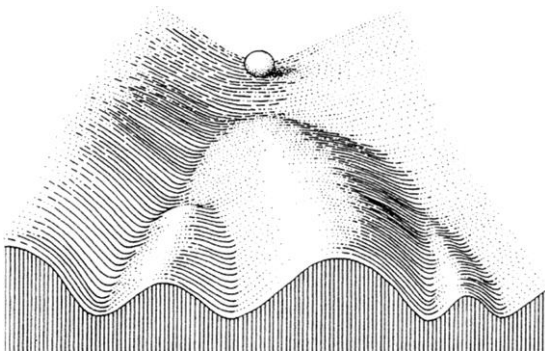


Figure 15: Waddington's epigenetic landscape, a metaphor for development and how cells make 'decisions' to arrive at their 'fates'

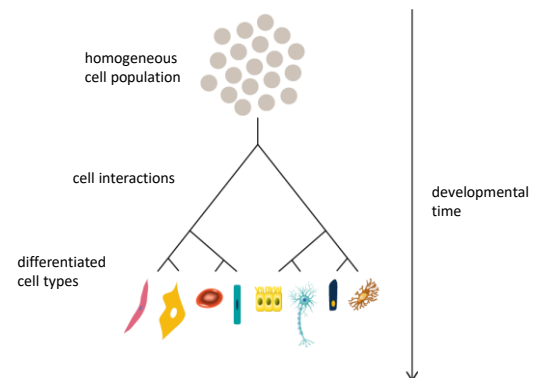


Figure 16: Differentiation – the process over developmental time whereby an initially homogeneous cell population gives rise to different cell types

Aspects of neuronal differentiation

- Morphology
- Gene expression
- Neurotransmitter
- Axon projections and connections

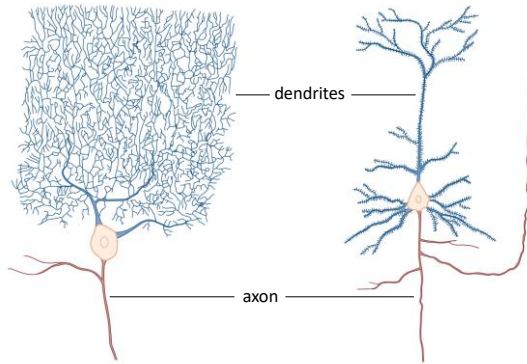


Figure 17: Cerebellar purkinje neuron

Figure 18: Cortical pyramidal neuron

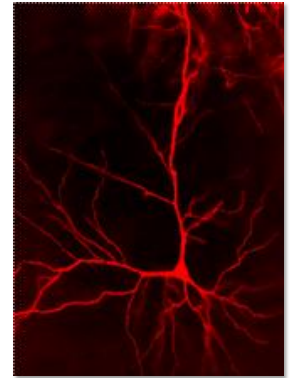
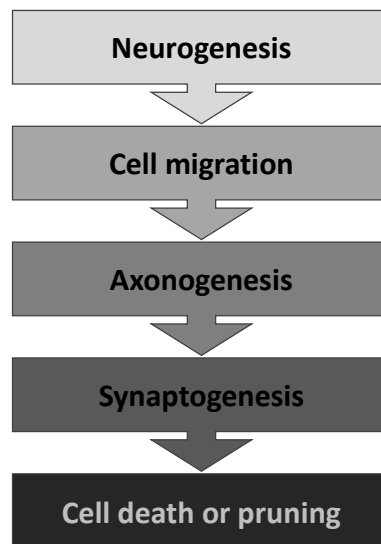


Figure 19: Pyramidal neuron image

The developmental steps that lead to differentiation



Neurogenesis

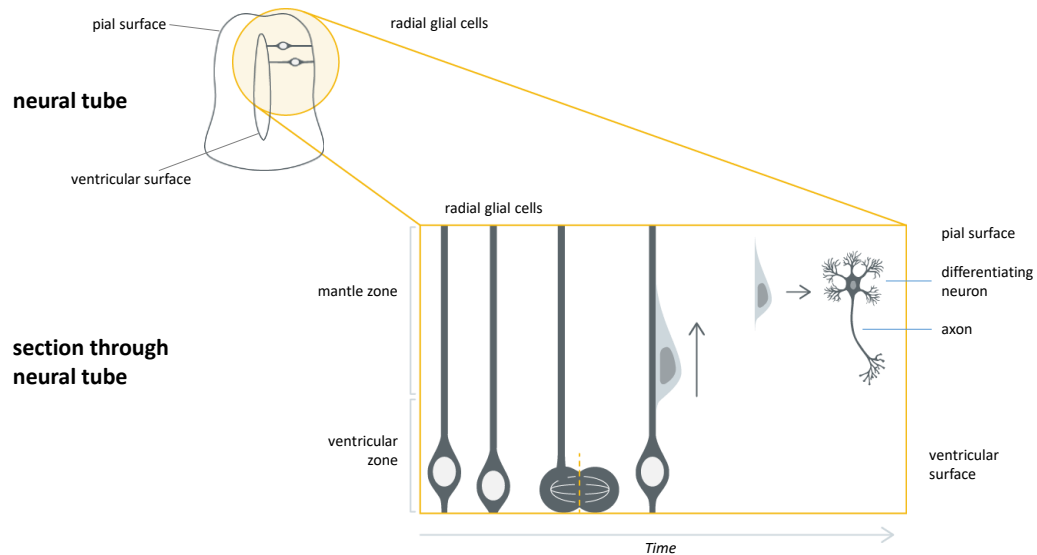
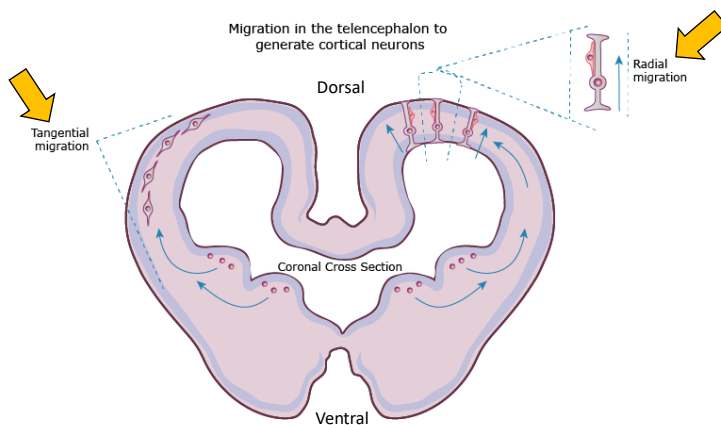


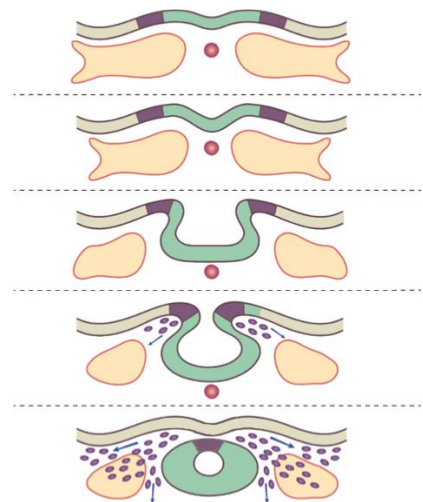
Figure 20: The generation of neurons from radial glial cells

Neuronal migration



- Radial migration gives rise mainly to *excitatory projection neurons*
- Tangential migration gives rise mainly to *inhibitory interneurons*

Figure 21: Neuronal migration in the developing telencephalon

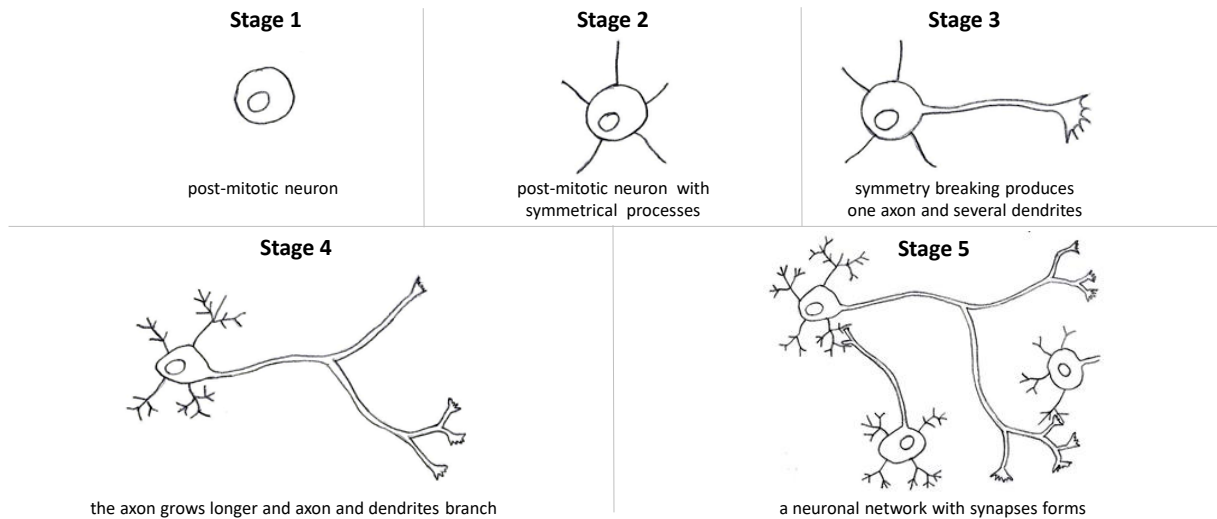


Neural crest cells migrate away from the neural tube to form dorsal root ganglia and sympathetic ganglia

Figure 22: Migration of the neural crest cells to generate peripheral ganglia

Axonogenesis (1)

A single axon forms from several symmetrical processes in hippocampal neurons in vitro



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Axonogenesis (2)

Molecular cues guide axons to their targets (nerves, glands or muscles)

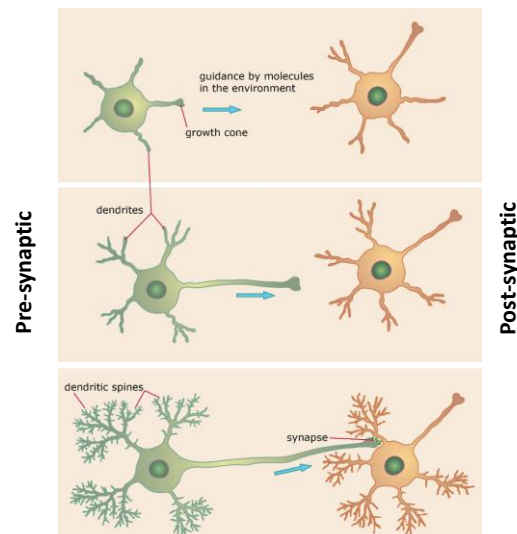


Figure 23. An axon grows towards its target neuron where it will form a synapse

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Synaptogenesis

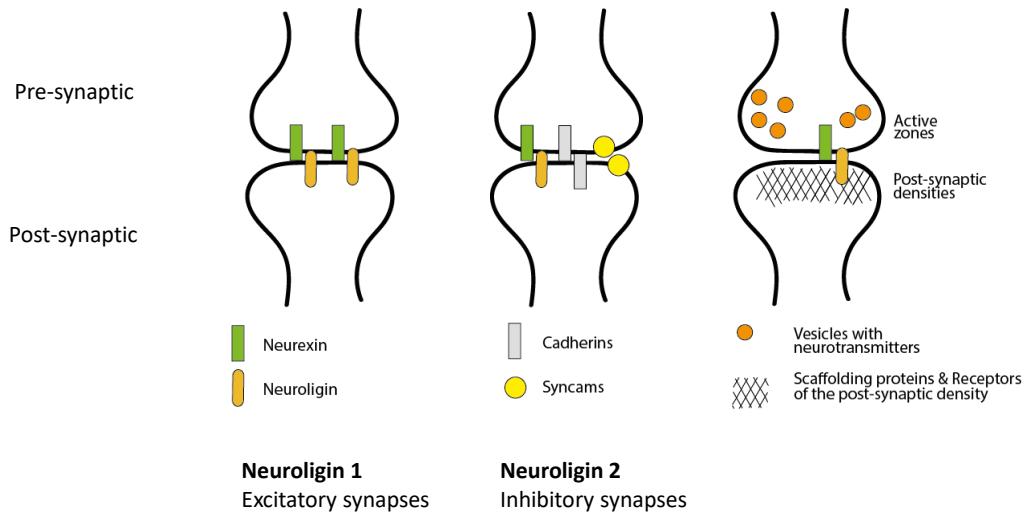


Figure 24: Stages of synaptogenesis

Cell death and pruning

- Pruning can occur to axons and dendrites, which disintegrate and the debris is cleared away
- Cell death and pruning may eliminate unwanted neurons or connections, match numbers of pre and post-synaptic cells, and ensure that synaptic transmission and circuit function is optimised

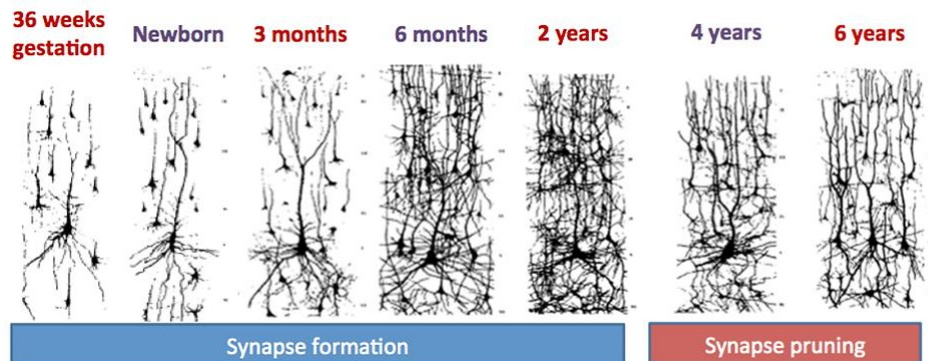


Figure 25: Synapse pruning