

BMS1052 Summary:

Neurons: (nerve cell)

- Sense and respond to changes in the environment
- Communicate with other neurons via electrical and chemical signals
- Control behaviour and moment
- Processes or transmits information via axons and dendrites

Major function of neuron: mechanisms for electrical and chemical communication

Structure of a neuron:

- **Soma (cell body)**
- **Nucleus (DNA)**
- **Nissl bodies (RER):** protein synthesis in ribosomes
- **Membrane bound proteins:** important for neuron function as they form pores or channels, gap junctions and even active pumps that can transport lines between the inside and outside of the neuron → **critical for information transmission**
- **Smooth ER:** regulations calcium concentration levels
- **Golgi:** sorting of proteins to be delivered to axon/dendrite
- **Mitochondria:** cellular respiration, yielding ATP, provides energy source for the membrane bound ion pumps
- **Secretory vesicles:** contain neurotransmitters which is used to communicate information to other neurons
- **Neuronal membrane:** separates intra and extracellular space.
- **Neurites:** axons and dendrites

Neuronal cytoskeleton:

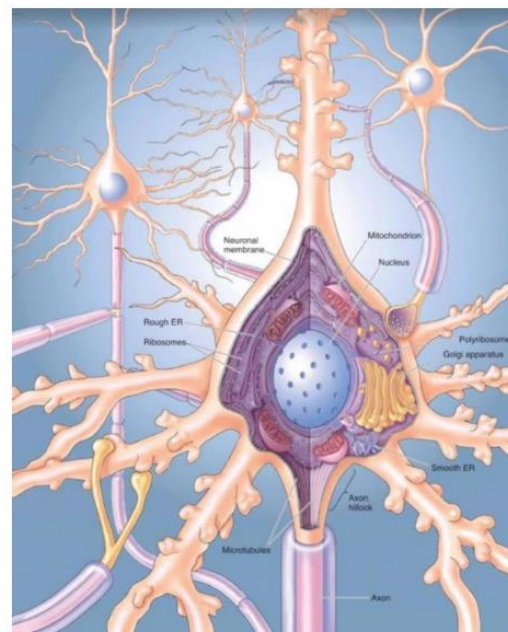
Cytoskeleton: maintain shape and control of neuron

Microtubules: run longitudinally down neurites, controls intracellular transport and MAPS (protein) helps stabilise microtubules and regulate function

Microfilaments: actin filaments and closely associated with membrane and microtubules

Neurofilaments: provides structural support (strong) and dictates the diameter of axons.

Major structure of a neuron: neural processes that extend away from the cell body



▲ FIGURE 2.8
The internal structure of a typical neuron.

Axons:

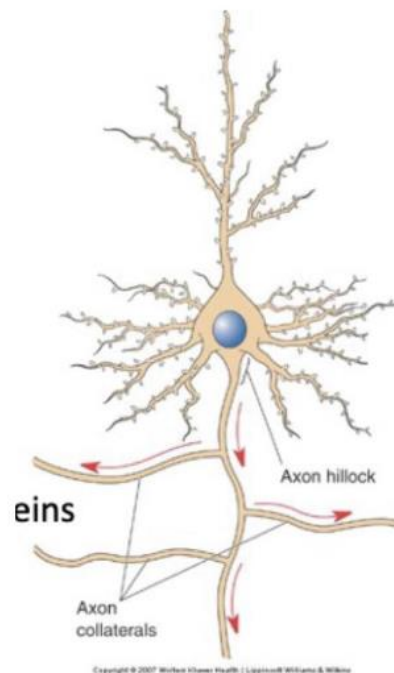
- no protein synthesis (due to no ribosomes) → protein is transmitted through soma
- electrical signals are transmitted **away** from the cell body via **axons**
- transmit or communicate information to other neurons
- information is transferred not TRANSPORTED down the axon

Structure of an axon:

1. **Axon hillock (AP generated)**
2. **Axon proper (middle)**
3. **Axon terminal:** Axon can transfer information to another cell and forms a synapse (**connects synapse to dendritic spine**)

Axon terminal Structure:

- Contains lots of internal vesicles containing neurotransmitters
- Membrane is protein dense
- Lots of mitochondria
- No microtubules
- Neurotransmitters are released from the Axon terminal travel across the synaptic cleft spine where they are modulated by the Astrocyte



Action potential: electrical signals used to transfer information down the axon

- Action potential involves the movement of ions across the membrane in order to communicate information
- AP are signals of fixed size and duration
- Excitable membranes generate and conduct AP
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Membrane of Axon contains specialised proteins

- contains ion channels and ion pumps
- allows electrical communication

Characterising and naming neurons:

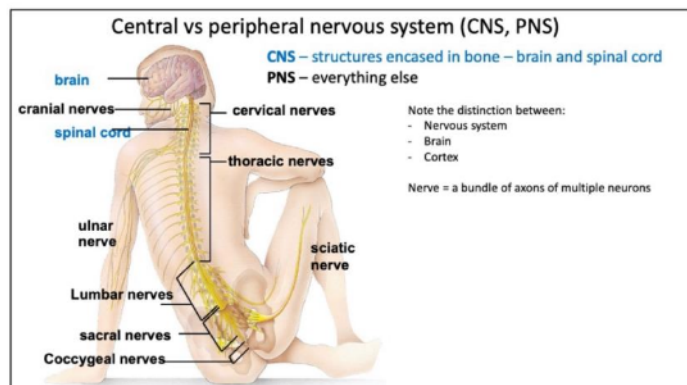
- Number of neurites (unipolar (touch), bipolar (retina) and multipolar (most))
- Shape and dendrites: stellate (collect info, within brain region) and pyramidal cells (send info. To other brain regions)
- Axon length:
- Connections: primary sensory neurons: **afferent** (skin and eye) , motor neurons: **efferent** (muscle and movement) and interneurons (connection with other neurons)

- AP jump from node to node: diffusion acts quickly over short distances within the axon (0.2-2mm)
 - Myelin: prevents AP to occur, passive diffusion of ions
 - No myelination: reliability of the timing of signals is lost, passive diffusion of ions but greater no. of AP are required over a certain distance.
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- **Oligodendroglia (CNS): wraps around many axons**
 - **Schwann cells (PNS): wraps around one Axon**
 - **Astrocytes: (CNS):** support synaptic signalling, regulates neurite growth, controls chemical content of the extracellular space (K⁺ buffering)
 - Modulate blood flow
 - provide metabolic support for neurons
 - involved in neural communication
 - regulates neurotransmitters in synapse
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- **Microglia: (CNS)** macrophages and remove debris and inflammation within the brain
 - **Ependymal cells: (CNS):** fluid filled ventricles that produce CSF fluid
 - Important in directing cell migration during brain development

Organisation of the brain:

- Neurons with similar roles are physically adjacent
- Lots of different regions
- Hierarchical connectivity between areas

Central vs Peripheral system:



PNS: Somatic and Autonomic components:

Somatic component:

- All the spinal nerves that innervate the skin, joints and muscles
- Under voluntary control
- somatic motor axons control muscle contractions