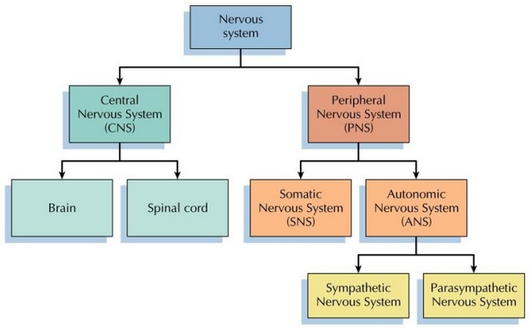
Psychology: Knowledge Organiser. Paper 2: Biopsychology

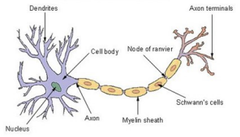
The nervous system.

- The nervous system is a specialised network of cells in the human body and is our primary internal communication system. It has 2 key functions: collect and respond to information from the environment and co-ordinate the working of different organs and cells in the body.
- Make sure you know the functions of each division.



Neurons

- Neurons typically consist of a cell body, dendrites and an axon.
- Sensory neurons: carry messages from PNS to CNS, have long dendrites and short axons. Found in receptors such as eyes, ears, tongue and skin.
- Relay neurons connect sensory neurons to the motor or other relay neurons. They have short dendrites and short axons. They are found between sensory input and motor outputs.
- Motor neurons connect the CNS to effector such as muscles and glands. They have short dendrites and long axons. Are found in the central nervous system and control muscle movements.



Localisation of function in the brain

- The theory that different areas of the brain are responsible for different functions.
- Frontal lobe: motor cortex / movement**.** Parietal lobe: somatosensory area / sensory**.** Occipital lobe: visual. Temporal lobe: auditory**.**
- Broca's area, left hemisphere: Left frontal lobe / speech production**.** Wernicke's area, left hemisphere: Left temporal lobe / language comprehension.

☺ Wealth of evidence to support functions are localised: **Petersen, Dougherty.**

☹ Functions are not localised to just one region, other regions take over following brain injury. Equipotentiality theory: higher mental functions are not localised.

☹ Beta bias: women have larger Broca and Wernicke's areas than men, which the theory ignores.

☹ Biologically reductionist: reducing complex processes to one specific brain region.

☹ More important to investigate how brain areas communicate with each other rather than focusing on specific brain areas.

Lateralisation and split brain research

- Hemispheric lateralisation: idea that the 2 hemispheres of the brain are functionally different.
- Left hemisphere: language centre of the brain, controls the right hand & receives information from right visual field. The right hemisphere: focuses on visuo-spatial tasks, controls the left hand & receives information from the left visual field.
- **Sperry**: split brain research, participants who had a surgical procedure where the corpus callosum is cut. Key findings: a number of key differences between the two hemispheres: left hemisphere is dominant in terms of visual speech and language. Right hemisphere is dominant in terms of visual-motor tasks.

☺ Identified advantages of lateralisation: increases neural processing capacity, **Rogers et al.**

☹ Lateralisation may occur in young adults.

☹ Language may not be restricted to the left hemisphere: **Turk et al.**

Ways of studying the brain

- Functional magnetic resonance imaging: (FMRI) uses magnetic field and radio waves to monitor blood flow when a person performs a task. ☺ high spatial resolution. ☹ low temporal resolution.
- Electroencephalogram (EEG): measures electrical activity within the brain via electrodes that are fixed to an individuals scalp using a skill cap—detecting neuronal activity. ☺ high temporal resolution. ☹ low spatial resolution.
- Event related potentials: (ERPS) similar equipment to EEG—key difference = stimulus is presented to a participant and researcher looks for activity related to the stimulus. ☺ Possible to determine how processsing is affected by specific experimental manipulation. ☹ Poor spatial resolution.
- Post-mortem examinations: analysis of a persons brain following their death e.g. Broca's brain. ☺ allow for a detailed analysis of the brain. ☹ lack validity as there are neuronal changes, confounding influences (e.g. drug treatment, age) and sample size.

Synaptic transmission

- Electrical impulses (action potentials) reach the presynaptic terminal. Action potentials trigger release of neurotransmitters.
- Neurotransmitters cross the synapse from vesicles. Neurotransmitters combine with receptors on the postsynaptic membrane.
- Stimulation of postsynaptic receptors by neurotransmitters result in either excitation or inhibition Excitatory: post synaptic neuron more likely to fire an impulse. Inhibitory: post synaptic neuron less likely to fire an impulse. Excitatory and inhibitory influences are summed.

Endocrine system

- Works alongside the nervous system. Is a network of glands that secrete hormones. Uses blood vessels to deliver hormones to target sites.
- Adrenal glands: secretes adrenaline/controls the sympathetic division in the fight or flight response.
- Pineal gland: releases melatonin which is responsible for important biological rhythms including the sleep-wake cycle. When released melatonin causes drowsiness and lowers body temperature, helping to induce sleep.

Fight or flight response

- Example of endocrine system and autonomic nervous system working together.
- Stressors trigger the sympathetic nervous system: prepares body for fight or flight. Signals adrenal medulla to release adrenaline into the blood stream. Adrenaline causes: heart to beat faster, pushing blood to muscle and other vital organs. Breathing rapid, release of blood glucose. Parasympathetic branch returns the body to its normal 'rest and digest' state.

☺ Valuable knowledge and shows how systems work together.

☹ Limits our behaviour to 2 responses: what about 'freeze'?

☹ Beta bias: females have a different stress response to males (**Taylor).**

Plasticity & functional recovery

- Brain plasticity: brain has the ability to change throughout life e.g. synaptic pruning and new neural connections.
- **Maguire:** experience (driving a taxi) can change the structure of the brain (enlarged hippocampus).
- **Draganski:** learning induced changes in the brains of medical student—in the posterior hippocampus, following final exams.
- Functional recovery: form of plasticity, brains ability to redistribute or transfer functions. Structural changes can include: axonal sprouting, reformation of blood vessels, recruitment of homologous areas on opposite side of brain.

☺ Supporting evidence to support brains considerable plasticity: **Khun et al.**

☺ Supporting evidence for functional recovery: **Tajiri et al.**

☹ Plasticity is greater in children than adults: **Elbert et al.**

☺ Real world: neurorehabilitation.

Circadian rhythms

- 24 hour cycle. Example: sleep/wake cycle.
- Sleep/wake cycle: driven by body clock, synchronised by the suprachiasmatic nuclei (SCN). Light = primary input.
- **Siffre** study: 2 months underground, sleep/wake cycle increased by lack of external cues.

☺ Support for importance of light: **Aschoff et al**

☺ Practical applications to shift work.

☹ Does not account for individual differences: **Duffy et al.**

☹ Problems with research methodology.

Infradian and ultradian rhythms

- Infradian rhythms: less than one cycle in 24 hours. Menstrual cycle about 28 days, governed by hormones (oestrogen/progesterone). Exogenous zeitgebers synchronise cycle, menstrual cycles synchronised using pheromones from armpits **(Stern and McClintock).**

☺ Evolutionary basis: synchronisation may have adaptive function.

☹ Methodological limitations: many factors affect menstrual cycle.

- Ultradian rhythms: more than one cycle in 24 hours. Sleep: 90 minute cycle of 5 stages. 1&2 light sleep, alpha waves and sleep spindles. 3&4 deep sleep, slow wave sleep, delta waves. 5 REM sleep (dreams), theta waves.

☺ Supporting evidence for distinct stages of sleep (**Dement et al**).

☹ Individual differences & 'sleep lab' generalisability.

Endogenous pacemakers & exogenous zeitgebers

- Endogenous pacemakers (EPs) & the sleep/wake cycle. Primary EP: suprachiasmatic nucleus (SCN), receives information about light from optic chiasm. SCN indicates day length to pineal gland which secrete melatonin when dark. Sleep/wake cycle stopped in chipmunks when SCN destroyed.

☺ Supporting evidence for importance of SCN: **Ralph et al.**

☹ Need to look beyond the 'master clock': **Damiola et al.**

- Exogenous zeitgebers (EZs) and the sleep/wake cycle. Time givers': reset EPS by entrainment. Light the key EZ, entrains SCN to 24 hours, even via backs of knees (**Campbell et al**). Social cues: babies circadian rhythms and jet lag entrained by bedtimes and mealtimes.

☺ Supporting evidence: **Skene et al,** blind people with some light perception have normal circadian rhythms those without have abnormal circadian rhythms.

☹ Case study: man blind from birth with sleep/wake cycle of 24.9 hours could not adjust despite social cues (**Miles et al).**