Brain and Behaviour
Final Exam Study Notes
Western Sydney University

Molecules

Carbon

- Biological molecules contain the atom carbon
- Carbon is a versatile atom that bonds with many other types of atoms (e.g., bonds with hydrogen to make a hydrocarbon)
- Carbon and hydrogen combine through covalent bonding
- Carbon is the frame
- Carbon rings: Carbon atoms can join each other to form rings

Functional groups

- Sometimes different atoms (aside from hydrogen) connect to the carbon 'frame'
- Carbon, oxygen and hydrogen (aldehyde group) can be attached to the carbon frame
- Aldehyde - any of a class of organic compounds, in which a carbon atom shares a double bond with an oxygen atom, a single bond with a hydrogen atom, and a single bond with another atom or group of atoms

Polysaccharide composition: Long chains of carbon rings (carbon is a versatile atom). Carbon atoms join to form rings. Carbon rings contain oxygen in the ring and combine with functional groups and hydrogen to form carbohydrates.

- Carbohydrates: Chains of sugars stored by the body to break down and use as energy when required.
- Glycogen: made of a long chain of glucose

Lipid composition: Non-polar hydrocarbons.

- Fatty acid: Lipid consisting of a chain of hydrocarbons with a 'carboxyl' group on the end (carbon, oxygen, hydrogen).
- Triglycerides: Common molecules, containing 3 fatty 'tails' attached to a glycerol 'head'
- Phospholipids: Molecules with 2 fatty acid 'tails' attached to a combined glycerol/phosphide 'head'. Important in the body as they form part of the cell membrane.

Structure of DNA

- Deoxyribonucleic acids: twisted strands of nucleotides bonded together.

- Nucleotide: A molecule consisting of a sugar, a phosphate group (s), and a single/double carbon ring with nitrogen (nitrogen base – adenine, thymine, guanine, cytosine)
- Codon: A sequence of 3 DNA nucleotides that corresponds with a specific amino acid

Protein Synthesis

- Protein molecules are large, made up of many smaller molecules called amino acids (amino acid + carbon + functional group)
- Amino acids: Small molecules, 20 varieties, building blocks of protein in the body, identical structure but different functional groups

Action Potential

An Anion is a negatively charged ion, and a Cation is a positively charged ion. Anion and cation are attracted to each other due to opposite electrical charge.

Sodium: Na+
Potassium: K+
Sodium in cell = positive membrane potential.
Potassium in cell = negative membrane potential.

Depolarisation: Neuron sends electrical/chemical signal which stimulates the neighbouring cell and creates an action potential. Sodium channels open, allowing sodium ions to rush into receiving cells, changing the charge inside the cell from negative to positive, and outside the cell from positive to negative).

Repolarisation: Inside cell must be negatively charged, and outside cell must be positively charged for repolarisation. Potassium (K) is positively charged, and rushes out of cell.

The difference in charge between the inside and outside of the cell is -70 millivolts at rest. If enough neurotransmitters arrive, channels open and positive charge enters the cell, raising the voltage from -70mv to -55mv within the cell. There is a brief reversal of charge when Na+ enters the cell (outside the cell is briefly +30mv).

Action potential velocity is impacted by axon myelination. If axons are covered in a myelin sheath (bundles of fat), the rate of the action potential speeds up because myelin lumps have high resistance and the electrically changed action potential ‘jumps’ the myelin to ‘land’ in the gaps between them along the axon (Nodes of Ranvier)

Neurotransmitters

Neurotransmitter	Role in nervous system	Mechanism
GABA (gamma-amino butyric acid)	Inhibitory, calms CNS	Arrives at dendrites and couples with receptors, causing an influx of chlorine (negative charge) meaning it is less likely for an action potential to be generated (inside of cell is more negative)
Acetylcholine (Ach)	Excitatory, increases probability of activity in the post-synaptic cell	Synthesised in axon terminal, found at neuromuscular junctions (the synapse between neurons and muscles attached to bone), at CNS synapses, and at all neuron-neuron synapses in PNS. Crosses the synapse and binds to receptors on the post-synaptic cell, thus, immediately opening channels (ionotropic effect).
Monoamines	Send second messenger to transfer a message to post-synaptic cell (e.g., catecholamines, indoleamines)	Monoamine binds to a receptor, resulting in the synthesis of chemicals in the cell (the second messenger). Metabotropic effect: Activation of the second messenger affects ion channel opening/closing indirectly as it is not an ion channel.
Noradrenaline (NAd), aka norepinephrine	A type of catecholamine, excitatory, stimulant in SNS	Increases cardiovascular and respiratory activity, and increases alertness, energy, and euphoria
Dopamine (DA)	A type of catecholamine	Reward and pleasure, regulate movement and emotional responses
Serotonin	A type of indoleamine	Excitatory
Amino acids, peptides, hormones, energy compounds, dissolved gasses	Can all act as neurotransmitters	