BMS1021 Exam Summary

Lecture 1 – Chemical Composition of Cells: Water

Water structure

- H_2O has **tetrahedral electron geometry** but a **bent molecular shape**.
- Water is **polar** because O is more electronegative than H.
- Partial charges allow water molecules to form **hydrogen bonds** with each other.
- Water is an excellent solvent for **ionic and polar substances**.

Why hydrogen bonding matters

Property	Importance
Cohesion	Water molecules stick together → surface tension/capillary effects
High heat capacity	Large amount of energy required to change water temperature → stabilises body/cell temperature
High heat of vaporisation	Considerable energy required for liquid → gas; enables evaporative cooling
Ice less dense than liquid water	Ice floats and insulates water underneath
Solvent properties	Allows ions and polar molecules to dissolve and be transported

Water and pH

Water can behave as both:

- Proton **donor**
- Proton **acceptor**

pH is biologically important because small changes can alter:

- Protein structure
- Enzyme activity
- Metabolism

Therefore cells use **buffer systems** to resist changes in pH.

Exam takeaway: Water's unusual biological properties largely arise from **polarity + hydrogen bonding**.

Lecture 2 – Proteins & Carbohydrates

Proteins

Major functions:

- **Enzymes** → catalyse reactions.
- **Structural** → provide support.
- **Receptors** → cell signalling.
- **Antibodies** → immune defence.
- **Transporters** → move substances.
- **Hormones/signalling molecules**.
- **Contractile/motor proteins** → movement.

Protein organisation

Remember the four levels:

Primary
→ amino acid sequence.

Secondary
→ α-helices and β-sheets.

Tertiary
→ overall 3D structure of one polypeptide.

Quaternary
→ interaction of multiple polypeptide subunits.

Structure determines function.

Carbohydrates

Major functions:

- Important source and store of **energy**.
- Components of larger biological molecules.
- Can spare protein and fat from being used as immediate fuel.

Major categories:

- Monosaccharides
- Disaccharides
- Polysaccharides

Examples:

- Glucose → metabolic fuel.
- Glycogen → animal glucose storage.
- Starch → plant storage.

- Cellulose → structural carbohydrate.

Lecture 3 – Nucleic Acids & Lipids

Nucleic acids

DNA and RNA are polymers of **nucleotides**.

Each nucleotide contains:

1. Nitrogenous base
2. Pentose sugar
3. Phosphate group

DNA

- Nucleotides linked by **phosphodiester bonds**.
- Sugar-phosphate backbone.
- Two complementary strands.
- Hydrogen bonds between complementary bases.
- Forms a **double helix**.
- Stores genetic information.

RNA

Major role → **gene expression/protein production**.

Lipids

Lipids are largely **hydrophobic molecules**.

Important types:

Lipid	Main function
Triacylglycerol	Energy storage
Phospholipid	Cell membranes
Steroids	Signalling/membrane functions

Membrane structure

Phospholipids are amphipathic:

Hydrophilic heads → water