I. The Synthesis and Breakdown of Polymers

**Dehydration** or **condensation** reaction: a chemical reaction in which two molecules covalently bond to each other with the removal of a water molecule.

**Hydrolysis**: a chemical process that lyses, or splits, molecules by the addition of water.

Q: How many molecules of water are needed to completely hydrolyze a polymer that is 5 monomers long? Answer: 4

II. Carbohydrates

**Monosaccharides** - monos: single, sacchar: sugar

- **Aldose** - aldehyde sugar: ribose (pentose sugar), glucose, galactose (hexose sugar)
- **Ketose** - ketone sugar: fructose (hexose sugar)

**Disaccharide**: a double sugar, consisting of two monosaccharides joined by dehydration synthesis.

\[
\text{Glucose} + \text{glucose} = \text{maltose} \\
\text{Glucose} + \text{fructose} = \text{sucrose} \\
\text{Glucose} + \text{galactose} = \text{lactose}
\]

**Glycosidic linkage**: covalent bond formed between two monosaccharides by a dehydration reaction.

**Polysaccharide**: a polymer of up to over a thousand monosaccharides joined by glycosidic linkages.

- **Starch**: a storage polysaccharide in plants consisting entirely of glucose.
- **Glycogen**: an extensively branched glucose storage polysaccharide found in the liver and muscle of animals.
- **Cellulose**: is a major component of the tough walls that enclose plant cells.
- **Chitin**: a structural polysaccharide of an amino sugar found in many fungi and in the exoskeletons of all arthropods.

Q: A dehydration reaction joins two glucose molecules to form maltose. The formula for glucose is C₆H₁₂O₆. What is the formula for maltose? Answer: C₁₂H₂₂O₁₁.

III. Lipid:

**Fats** (triacylglycerol): is constructed from two kinds of smaller molecules: glycerol and fatty acids.

- **Saturated fatty acid**: all carbons in the hydrocarbon tail are connected by single bonds, and maximize the number of hydrogen atoms attached to the carbon skeleton.

- **Unsaturated fatty acid**: possessing one or more double bonds between the carbons in the hydrocarbon tail. Such bonding reduces the number of hydrogen atoms attached to the carbon skeleton.
**Phospholipid:** is a constituent of the inner bilayer of biological membranes, having a polar (hydrophilic) head and a nonpolar (hydrophobic) tail.

**Steroid:** characterized by a carbon skeleton consisting of four rings with various functional groups attached.

**Cholesterol:** is a common component of animal cell membranes and is also the precursor from which other steroids are synthesized. Many hormones, including vertebrate sex hormones, are steroids produced from cholesterol.

Q: Why are human sex hormones considered to be lipids?

IV. Proteins

**Enzymes/catalyst:** a chemical agent that changes the rate of a reaction without being consumed by the reaction.

**Polypeptide:** a polymer (chain) of many amino acids linked together by peptide linkages.

*Be able to distinguish peptide linkage and glycosidic linkage.*

**Protein:** consists of one or more polypeptides folded and coiled into specific conformations.

**Protein Conformation and Function**

- **Primary:**
- **Secondary:** alpha helix and beta sheet.
- **Tertiary:**
- **Quaternary:**

**Denaturation:** when protein loses its native conformation, thereby becoming biologically inactive, occurs under extreme conditions of pH, salt concentration, and temperature.

V. Nucleic acids

**Nucleic acid:** a polymer (polynucleotide) consisting of many nucleotide monomers; serves as a blueprint for proteins and, through the actions of proteins, for all cellular activities. The two types are DNA and RNA.

- **DNA** (*deoxyribonucleic* acid): a double–stranded, helical nucleic acid molecule capable of replicating and determining the inherited structure of a cell’s proteins.
- **RNA** (*ribonucleic* acid): single–stranded, a type of nucleic acid consisting of nucleotide monomers with a ribose sugar and the nitrogenous bases adenine (A), cytosine (C), guanine (G), and uracil (U); usually single–stranded.

The flow of genetic information: DNA → mRNA → protein

Q: In a DNA double helix, a region along one DNA strand has this sequence of nitrogenous bases: $5'-$TAGCAATGCT–$3'$. List the base sequence along the other strand of the molecule, clearly indicating the 5’ and 3’ ends of this strand.

*Answer:* $3'$-ATCGTTACGT-5’