Macromolecules/Organic molecules – large molecules that are necessary for life

Organic means that they contain Carbon

There are 4 types of organic molecules

- Carbohydrates
- Lipids
- Proteins
- Nucleic Acids We will hold off talking about nucleic acids until we get to DNA.

All of these are large molecules that are usually made up of repeating units of smaller molecules.

The large molecule with repeating units is called a polymer (many parts) while each single unit is called a monomer (single unit) or subunit.

For the rest of this video I will talk only about Carbohydrates. Go on to the next videos to learn about lipids and proteins.

Carbohydrates – sugars

Consist of Carbon (C), Hydrogen (H), and Oxygen (O)

A sugar that everyone is familiar with is glucose – it has a formula of $C_6H_{12}O_6$ – this means that in every molecule of glucose, there are 6 carbons, 12 hydrogens, and 6 oxygens. They must be arranged in a very specific way to be considered glucose.

The polymer name for carbohydrates is a polysaccharide.

Poly = many

Sacchar = sugar

Literally means many sugars

The monomer for carbohydrates is a monosaccharide.

Mono = one/single

Means single sugar

There are also disaccharides. Di means two so a disaccharide is composed of two sugars.

Examples of each

Monosaccharide – glucose, ribose, fructose

Disaccharide – sucrose, maltose

Polysaccharide – starch, cellulose, glycogen

notice the –ose ending; anytime you see this, it is likely a sugar

Functions:

Primary source of energy, quick energy (think kid with a candy = hyper)

Structural component

Cellulose – component of plant cell walls, provide rigidity

Chitin – component of lobster and cockroach exoskeleton

Storage component

Glycogen – storage of glucose in the livers of animals

Starch – storage of glucose in plants

Lipids – fats, waxes

Consist of Carbon, Hydrogen, and very few Oxygens

Lipids are not considered polymers because they are not made up of repeating monomers, but they do have subunits (smaller units)

Glycerol backbone

Fatty acids

Fatty acids can vary in length and composition.

Saturated means that each carbon has as many hydrogens as it can hold.

Solid at room temperature - butter

Unsaturated means that there are some places where there could be hydrogens, but instead there are two bonds holding two carbons together rather than the usual one.

Liquid at room temperature - oil

Lipids are hydrophobic – they do not like water, this is particularly important for when we talk about the structure of a cell, especially the cell membrane.

Functions of Lipids:

Long term energy storage

Insulation

Waterproof barriers/membranes

Proteins

Consist of Carbon, Hydrogen, Oxygen, and Nitrogen

Monomer: amino acid

There are 20 different naturally occurring amino acids. Proteins can vary widely depending on the number and arrangement of these amino acids.

Every amino acid has 3 major parts: an amino group NH_2, a carboxyl group COOH, and an R group.

The R group (radical group) is what makes each of the 20 amino acids unique.

Polymer: polypeptide

The bond holding amino acids together is called a peptide bond

Proteins have a huge variety in function:

Hormones, regulation, antibodies/immunity, build tissue, structure (hair, nails), enzymes

Examples: Insulin, hemoglobin

The function of a protein is determined by its structure. If a protein loses its structure (is denatured), then it will no longer function. Think: scissors

Enzymes

These are a subgroup of PROTEINS

Enzymes speed up chemical reactions by lowering the amount of Activation Energy required to get the reactions started. They are considered "biological catalysts"

Properties of Enzymes:

They are specific

Every enzyme works on a specific substrate (the molecule that is changed)

Ex: peptidase is an enzyme that breaks down peptides; lipase is an enzyme that breaks down lipids. That does not mean that enzymes only break down lipids, they can also build molecules and change them.

They are reusable

Enzymes are not altered by the reaction. Once they catalyze a reaction, they can do it again. Enzymes are NOT used up in a reaction.

They are affected by temperature

Higher temperatures speed up reactions (because molecules are moving around more and are more likely to collide with each other)

TOO HIGH temperatures can denature the enzyme – once it loses its shape, it loses its function

TOO LOW temperatures can cause reactions to slow down significantly

They are affected by pH

Every enzyme has an optimal pH at which it works.

Ex: stomach enzymes work in **acidic** conditions

Most enzymes work in neutral conditions. If the conditions are too acidic or too basic, the enzyme may denature.

They are affected by concentration

Efficiency of an enzyme depends on how easily it can find its substrate. Speed is limited by

- low concentrations of enzyme
- low concentration of substrate
- high concentration of product