**Biological molecules** (Chapters 2, 3, and 4)

Organic molecules

 Molecules containing carbon atoms

Biological Macromolecules

 Large organic molecules that are vital components of all living things

• The four major types are lipids, carbohydrates, proteins, and nucleic

 acids

• Each of the four macromolecule types is a polymer:

 Macromolecule Monomers

 Lipids Fatty acids and glycerol

 Carbohydrates Monosaccharides

 Proteins Amino acids

 Nucleic acids Nucleotides

Monomer

 Any small organic molecule that can become linked to another

monomer

Polymer

A chain of linked monomers

Carbohydrate (saccharide)

A monosaccharide (simple sugar), a disaccharide (two monosaccharides linked together), or a polysaccharide (many monosaccharides linked together)

 • The body uses carbohydrates for energy

Monosaccharide (simple sugar)

Any small molecule with the general formula CnH2nOn­

 • Most simple sugar names end in “-ose”

 √ Examples: Glucose, fructose, galactose, ribose

 • Glucose is the most abundant simple sugar

 √ Glucose is our “blood sugar”

 √ Cells use glucose as their main fuel

 • Glucose is usually shown as a hexagon:

Fig 2.12

Disaccharide

 A carbohydrate made from two monosaccharides joined together

 • Maltose = glucose + glucose

 • Sucrose (table sugar) = glucose + fructose

 • Lactose (milk sugar) = glucose + galactose

Fig 2.13

## Polysaccharides

 A large number of glucoses joined together

• Made to store glucose (to store energy)

• Starch = The glucose polysaccharide in plants

 √ Bread, pasta, rice, corn, and potatoes are high in starch

• Glycogen = The glucose polysaccharide in our body

√ Glycogen is stored mostly in the liver and the muscles

Fig 2.13

Lipids

Hydrophobic macromolecules

• Examples: Fat, oil, grease, wax

• Lipid molecules are composed of many more carbon atoms than

 oxygen atoms

 √ This is what makes lipids hydrophobic

• Major functions: Energy storage, insulation, cell membranes

• Fatty acid and glycerol are the building block molecules of most

 lipids

 • Fatty acid = A molecule containing a long “tail” of only carbon and

 hydrogen atoms

• Glycerol = A three-carbon molecule

 √ Each carbon is a docking site for one fatty acid

Figs 2.14, 2.15, 2.16

Triglyceride (fat and oil)

 Three fatty acids joined to a glycerol molecule

 • Fats and oils are used for energy storage and insulation

Fig 2.14

Phospholipid

Two fatty acids and a phosphate joined to a glycerol molecule

 • Phospholipids are usually diagramed as a circle with two tails



 • The main function of phospholipids is to form cell membranes

√ Cell membranes are phospholipid bilayers (two layers of

 phospholipids)

 √ The phospholipid tails prevent most solutes from passing

 through the membrane

Fig 2.15

Steroids

##  Lipids with a backbone of 4 fused rings of carbon in this shape:



• Examples: cholesterol, steroid hormones (estrogen, testosterone,

 progesterone, corticosterone), vitamin D

Fig 2.16

Proteins

 Polymers of amino acids

• There are 20 different types of amino acids, but all have this general

 structure:

√ The R part of the structure is different for each of the 20

 amino acids

• Proteins are the most abundant macromolecules in the body

 • Proteins have many diverse functions in the body

√ Major types of proteins: enzymes, receptors, channel proteins,

 and fibrous proteins

Figs 2.17, 2.18

Enzymes

Proteins that perform chemical reactions in the body

 • Each enzyme is highly specific to carry out one and only one

 chemical reaction

• Active site = The crevice in an enzyme where it binds the molecules

 it changes and carries out its chemical reaction on them

 √ Each enzyme is specific for only one reaction because

 only one molecule is the right shape to fit into its

 active site

√ After the enzyme finishes its chemical reaction, it releases the

Product molecules (the molecules it has made). The enzyme

 repeats its chemical reaction over and over again.

• Most enzymes are named after the molecule they react with followed

 by the ending “ase”

 √ Examples: Lipase = An enzyme that reacts with lipids

 Sucrase = An enzyme that reacts with sucrose

Fig 4.5

Receptors

 Proteins in the cell membrane that detect molecules outside the cell

 • Each receptor is highly specific to detect one and only one

 molecule because only one molecule fits into its binding site

 • When a molecule is detected, the cell is “preprogrammed” to

 perform some action in response

 - The intracellular region of the receptor triggers the cellular

 response

Channel proteins (also called carrier proteins and pores)

Proteins in the cell membrane that form a tunnel to allow solutes to pass through the membrane

• Each channel protein is highly specific to transport only one solute

 molecule type

Figs 3.14 and 3.18

Fibrous (structural) proteins

Rope-like proteins that provide strength and framework to tissues

• Examples:

√ Collagen = An extremely strong fibrous protein, abundant in

 tendons and ligaments

 √ Elastin = An elastic (rubber band-like) fibrous protein

 √ Keratin = A hard fibrous protein abundant in nails, hair, and

the skin

Fig 5A and 5.14

Nucleic acids

 Polymers of nucleotide monomers

• DNA and RNA are the two types of nucleic acids

 • The genes (the “blueprints” of life inside each cell) are made of

 DNA

 √ Each gene is a recipe for one of the cell’s proteins

√ Double helix = two intertwined DNA strands

 √ Chromosomes = Structures in the cell made of a long

 piece DNA

 - Each chromosome contains hundreds of genes

Figs 2.20, 2.20, and 4.12

Adenosine Triphosphate (ATP)

A high energy molecule inside the cell that supplies proteins with the

the energy needed to carry out their work

 • An RNA nucleotide with 3 phosphate ions

• The energy is released when one of the three phosphates is removed.

- This changes ATP into ADP and an unattached phosphate

 • The ADP is “recharged” into ATP using the energy of glucose and

 other nutrients

Fig 2.22, 4.7, 4.8