**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

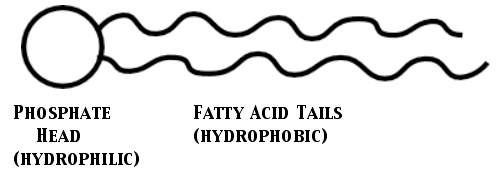
• Fats and oils are used for energy storage and insulation

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)

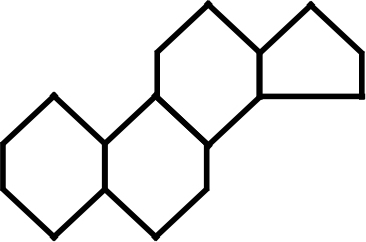
√ The phospholipid tails prevent most solutes from passing

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,

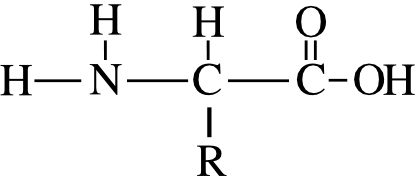
progesterone, corticosterone), vitamin D

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