**Biological molecules** (Chapter 2) **Page 1**

Organic molecules

Molecules with a backbone of carbon atoms

Examples: Figs 2.9 - 2.11

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

**Biological molecules Page 2**

Carbohydrate (saccharide)

A monosaccharide (simple sugar), a disaccharide (two monosacchardides linkied together), or a polysaccharide (many simple sugars linked together)

• The body uses monosaccharides for energy for cells

Monosaccharide (simple sugar)

Any small molecule with the general formula CnH2nOn­

• Glucose is the most common monosaccharide in the body

√ Glucose is our “blood sugar”

√ Cells use glucose as their main fuel

• Glucose is usually shown as a hexagon:

• Most simple sugar names end in “-ose”

√ Examples: Glucose, fructose, galactose, ribose

Fig 2.14

**Biological molecules Page 3**

Disaccharide

A carbohydrate made from two monosaccharides joined together

Fig 2.16

## 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 2.15

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Lipids

Hydrophobic macromolecules

• Examples: Fat, oil, grease, wax moecules

• Lipid molecules have large regions of only carbon atoms and

hydrogen 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 2.18

**Biological molecules Page 5**

Triglyceride (fat and oil)

Three fatty acids joined to a glycerol molecule

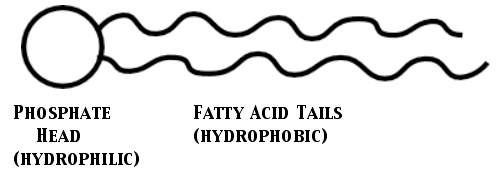
• Fats and oils are used for energy storage and insulation

Fig 2.20

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 hydrophobic fatty acid tails prevent most solutes from

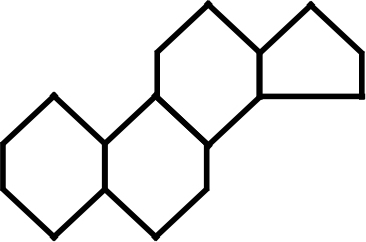
passing through the membrane

Fig 2.22

**Biological molecules Page 6**

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 2.24

Proteins

Polymers of amino acids

• There are 20 different types of amino acids

√ The average protein is 400 amino acids long

• 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,

fibrous proteins

Fig 2.26

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Enzymes

Proteins that perform chemical reactions in the body

• Each enzyme is highly specific to perform one and only one

chemical reaction

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

that it works on and where it performs 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

- Substrate = The molecule that enters the enzyme's

active site

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

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

then repeats its chemical reaction on the next substrate

molecule

• 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 4.2 and table 4.2

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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

• Sometimes exogenous molecules (molecules from outside the body, such as drugs, bacterial or plant toxins, or animal venoms) are similar in shape to the receptor’s natural molecule and therefore can also fit into the receptor’s binding site

√ Agonist = An exogenous molecule that fits into the receptor’s

binding site and triggers the cellular response

√ Antagonist = An exogenous molecule that fits into the receptor’s binding site but does not trigger the cellular

response

- Antagonists decrease the response because they block

the natural molecule from entering the receptor’s

binding site

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Channel proteins (carrier proteins, 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 the solute

molecules that it is supposed to transport

Fig 6.16

Fibrous (structural) proteins

Rope-like proteins that provide strength and framework to tissues

• Examples:

√ Collagen = A strong and leathery fibrous protein

- The more collagen a tissue has the stronger and tougher

the tissue will be

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

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

the skin

Fig 2.30

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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 nucleus, each made of a

long piece of DNA

- Each chromosome contains hundreds of genes

Figs 2.31, 2.33, and 3.26

Adenosine Triphosphate (ATP)

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

energy they need to perform their work

• An RNA nucleotide with 3 phosphate ions

• The energy is released from ATP 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 to reattach the removed phosphate ion

Fig 4.15