UNIT 06

Biomolecules

Descriptive Questions

Biomolecules

Q.1 How would you define biochemistry and molecular biology? 09406001

Ans. Biochemistry

Biochemistry is the study of the chemical processes that occur within living organisms (e.g., photosynthesis, cellular respiration).

Molecular Biology

Molecular biology is the study of the structure and function of the biomolecules (e.g., carbohydrates, proteins, nucleic acids.

Q.2 Define biological molecules. Explain in detail the major organic biomolecules, their location in the cell and main functions. 09406002

Ans. Definition

The molecules produced by organisms are called biomolecules or biological molecules. They include carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA). They are mostly large in size and are called macromolecules. The following table mentions important biomolecules, their location in the cell and main functions.

Table 6.1: Major Biomolecules and their Function.

Biomolecules	Location in the cell	Main functions
Carbohydrates	• Cytoplasm • Cell membrane	• Act as source of energy • Act as energy storage molecules
Proteins	• Cell membrane • Cytoplasm • Endoplasmic reticulum • Golgi apparatus	• Many proteins act as enzymes • Some hormones are proteins • Make membranes and many other structures in cell • Control cellular traffic
Lipids	• Cell membrane • Cytoplasm	• Act as energy storage molecules • Act as heat insulators • Make structure of cell membrane

DNA (Deoxyribonucleic Acid)	• Nucleus (eukaryotes) • Nucleoid region (Prokaryotes) • Mitochondria • Chloroplasts	• Carries genetic information for the development, functioning, and characteristics of organism
RNA (Ribonucleic Acid)	• Nucleus • Ribosomes • Cytoplasm	• Carries genetic information from DNA to ribosome for protein synthesis.

Percentage Composition of Biomolecules in Protoplasm

Biomolecules make the 93% of the dry mass of protoplasm. The remaining 7% of dry mass comprises vitamins and inorganic substances like carbon dioxide, acids, bases and salts.

Table 6.2: Percentage of Biomolecules in the Dry Mass of Protoplasm

Biomolecules	%Dry Mass
Proteins	50
Nucleic Acids	18
Carbohydrates	15
Lipids	10

Q .3 What is metabolism? Enlist its types. **09406003**

Ans. Metabolism

The sum of all the chemical reactions that occur in an organism are collectively called metabolism.

Types

i. Anabolism

Anabolism is the type of metabolism in which simpler substances are combined to form complex substances. Energy is used in these reactions. e.g. photosynthesis.

ii. Catabolism

It is the type of metabolism in which complex molecules are broken down into simpler ones. Energy is released in these reactions. e.g respiration.

Q .4 Write a comprehensive note on the structure and roles of the three classes of carbohydrates. **09406004**

Ans. Introduction

Carbohydrate means hydrated carbons. They are the organic compounds in which the ratio of H and O is 2:1 (same as in water). They are also known as "Saccharides" (**meaning sugar).**

General Formula

They have general formula $(CH_2O)_n$ where n is the number of carbon atoms, ranges from 3 to many thousands.

Classes of Carbohydrates

There are three classes of carbohydrates: Monosaccharides, disaccharides, or polysaccharides.

1. Monosaccharides

Introduction

Monosaccharides (simple sugars) are made of single sugar molecule. They are easily soluble in water and have sweet taste. They may have 3 to 7 carbon atoms. Pentoses (5 C) and hexoses (6 C) are most common.

Examples

- Ribose ($C_5H_{10}O_5$) and deoxyribose ($C_5H_{10}O_4$) are pentoses.
- Glucose, fructose, and galactose are hexoses ($C_6H_{12}O_6$).

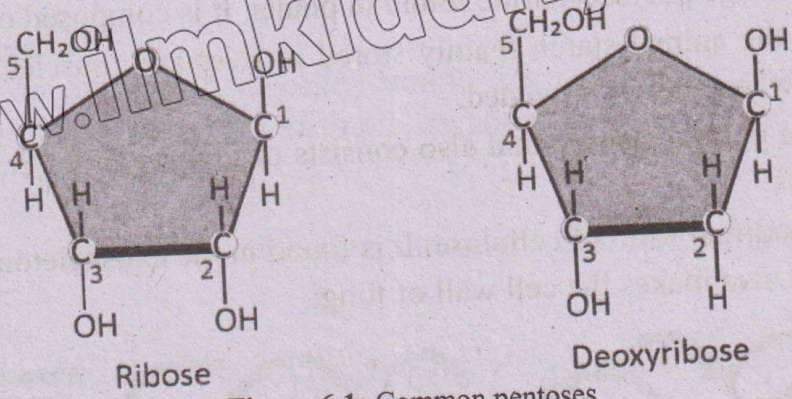


Figure 6.1: Common pentoses

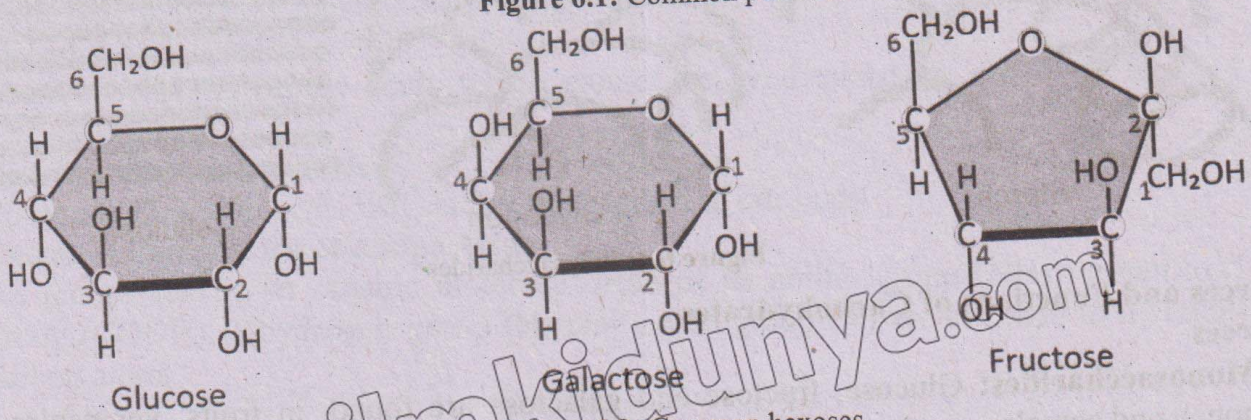


Figure 6.2: Common hexoses

2. Disaccharides

Introduction

They are made of two monosaccharides units. They are less soluble in water and are less sweet in taste.

Examples

- Sucrose (table sugar) is made of two monosaccharides i.e. glucose and fructose.
- Maltose is made of two glucose molecules.

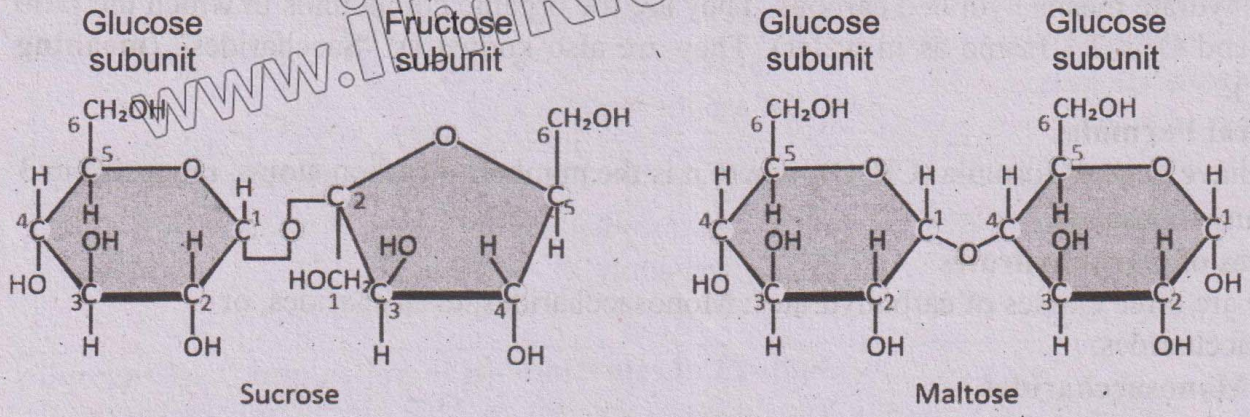


Figure 6.3: Common disaccharides

3. Polysaccharides

Introduction

Polysaccharides are large molecules composed of hundreds to thousands of monosaccharides units. They are insoluble in water and are tasteless. Polysaccharides are the most abundant carbohydrates in nature.

Examples

- **Starch** is a storage polysaccharide found in plants. It is composed of glucose units
- **Glycogen** is the animal starch mainly stored in liver and muscles. It is broken down into glucose when energy is needed.
- **Cellulose** is a polysaccharide that also consists of glucose units. It is found in the cell walls of plants.
- **Chitin** is a modified form of cellulose. It is found in the exoskeletons of crabs, lobsters and insects. It also makes the cell wall of fungi.

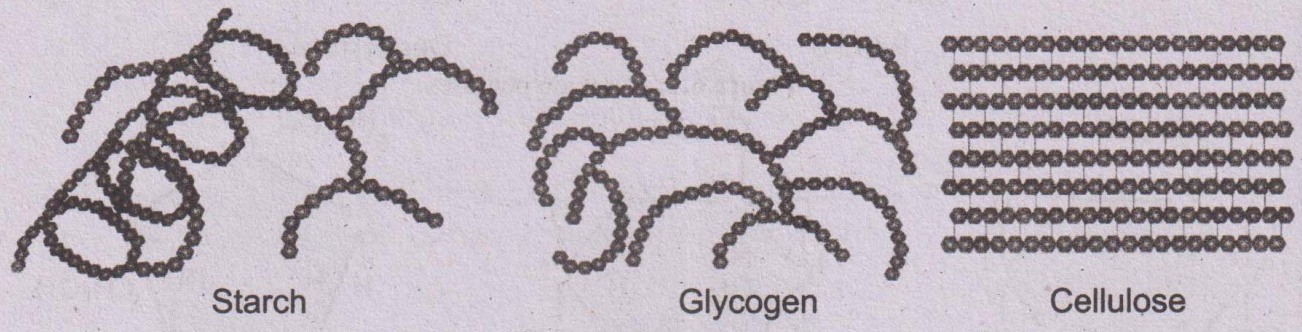


Figure 6.4: Polysaccharides

Sources and Functions of Carbohydrates

Sources

- **Monosaccharides:** Glucose, fructose and galactose are found, in fruits, vegetables, honey and cereals.
- **Disaccharides:** Sucrose is found in sugar beet, sugar cane and fruits. Lactose is found in milk and dairy products. Maltose is found in cereals.
- **Polysaccharides:** Starch is found in cereal crops, wheat, barley, maize, rice etc.

Functions

- Carbohydrates are the primary sources of energy. Glucose is used by cells to produce energy through cellular respiration.
- Dietary fibre contains undigestible carbohydrates e,g., cellulose. It helps to maintain the proper bowel movements.
- Pentoses (ribose and deoxyribose) are essential part of nucleic acids (RNA and DNA respectively).
- Plants convert their monosaccharides to disaccharides like sucrose to transport monosaccharides between body parts.
- Cellulose is the most abundant carbohydrate. It provides support to plant cells and ultimately to the whole plant.
- Chitin is a polysaccharide found in the exoskeleton of insects and in the cell walls of fungi. It provides strength and support to these organisms.

Proteins

Q.5 What are proteins? Describe their structure sources and functions. **09406005**

Ans. Introduction

Proteins are the most abundant biomolecules in cell. They are defined as the polymers of amino acids. Proteins are important for the structures of cells.

Structure of Proteins

a) **Monomers of Proteins**
Proteins are made up of monomers called amino acids. Different proteins contain different numbers of amino acids. For example, insulin protein has 51 amino acids and haemoglobin has 574 amino acids.

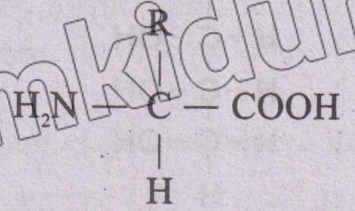
b) **Nature of Amino Acids**
Amino acids are the organic molecules that join in specific number and sequence to make proteins.

c) **Types of Amino Acids**
About 170 types of amino acids occur in organisms. However, 20 types of amino acids participate in making most of the proteins.

d) **Essential Amino Acids**
There are the 09 amino acids which cannot be synthesized by our body and are supplied by foods.

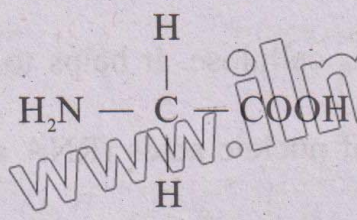
e) **Non- essential Amino Acids**
There are 11 amino acids that can be synthesized in our body.

f) **Chemical Composition of Amino Acids**
An amino acid is an organic molecule made of an amino group (NH_2), a carboxyl group (COOH), a hydrogen group (H) and a side group (R) are attached to a central carbon atom:

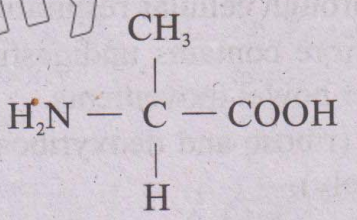


Amino acid - general structure

Different amino acids contain different R groups. For example, in amino acid glycine the R group in H and in amino acid alanine, the R group is CH_3.



Glycine



Alanine

Sources and Functions of Proteins

Sources

- Good sources of protein include meat (mutton, chicken), fish, eggs, milk, pulses, beans etc.

Functions

Proteins perform various functions in our bodies, including:

- Proteins are an important part of all cell membranes.
- Some proteins e.g. collagen and keratin make almost whole structures of cartilage, hair, and nails.
- Enzymes are proteins that catalyse all biochemical reactions occurring in organisms.
- Some proteins are hormones. They regulate body processes.
- Heamoglobin protein transports oxygen in the blood.
- Actin and myosin proteins are the main components of muscle cells. They are responsible for muscular contractions.
- Fibrin is a blood clotting protein that make blood clot to prevent the loss of blood after an injury.
- Some proteins called antibodies (part of our immune system) defend the body against harmful pathogens.

Lipids

Q .6. What are lipids? Describe their Chemical composition, structure, sources and their role. 09406006

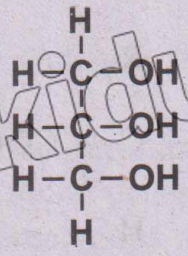
Ans. Introduction

Lipids are organic compounds that are insoluble in water but are soluble in organic solvents. (e.g., alcohol, ether and benzene).

Chemical Composition

They are composed of glycerol and fatty acids.

a) **Glycerol** is an alcohol having 3 carbon atoms. Each carbon has a hydroxyl group.



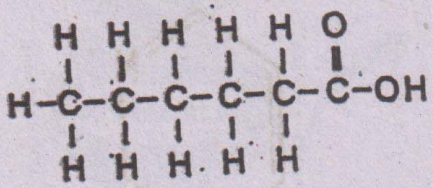
Glycerol

b) **Fatty acids** are long hydrocarbon chains with carboxyl group (COOH) at the end.

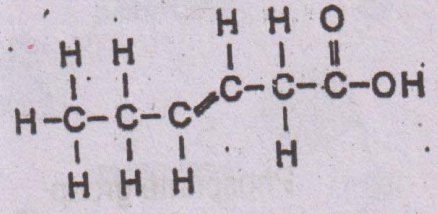
Types of Fatty Acids

There are two types of fatty acids.

1. **Saturated Fatty Acids** have internal carbon atoms bonded with maximum number of hydrogen atoms. They do not have double bonds between carbon atoms. Saturated fatty acids are solid at room temperature. e.g. fats.
2. **Unsaturated Fatty Acids** have one or more double bonds between carbon atoms. They are liquid at room temperature. e.g. oil.



Saturated fatty acid

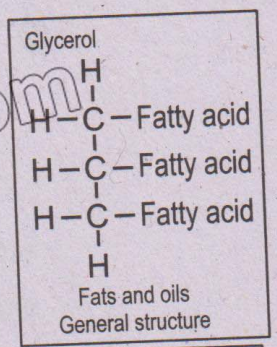


Unsaturated fatty acid

Main Groups of Lipids

1. Fats and Oils

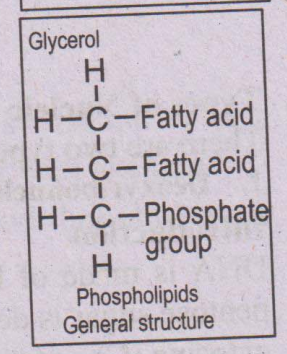
Fats and oils are the most familiar lipids. They contain one glycerol and three fatty acids. Fats contain saturated fatty acids and so are solid at room temperature e.g., animal fats. On the other hand, oils contain unsaturated fatty acids and so are liquid at room temperature e.g., plant oils such as olive oil, corn oil, and coconut oil.



Fats and oils
General structure

2. Phospholipids

These lipids make the core of all membranes. A phospholipid molecule consists of one glycerol, two fatty acids and a phosphate group.



Phospholipids
General structure

Sources and Functions of Lipids

Sources

Sources of lipids from animals are meat and dairy products, while the sources of lipids from plants are nuts, seeds, olive oil etc. Plants synthesize oils and store them in seeds, such as sunflower oil, coconut oil, and corn oil.

Functions

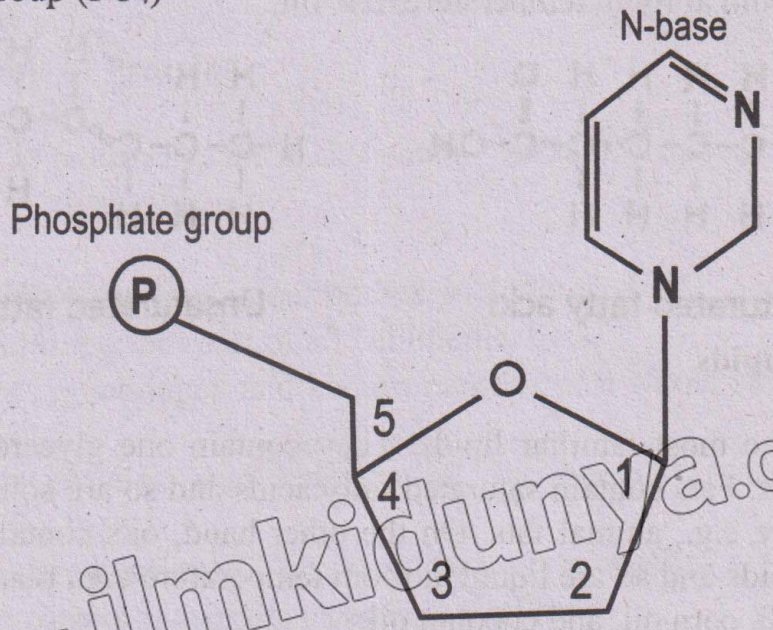
- Lipids are the most energy-rich biomolecules. They serve as a long-term energy reserve in the form of fats in adipose tissue. When the, body requires energy, these stored lipids are broken down to release fatty acids and glycerol, which can be used as fuel for energy.
- Lipids are essential components of cell membranes.
- Lipids act as insulator and protect vital organs. For example, adipose tissue surrounding organs, provides cushioning and heat insulation.
- Some lipids help in the synthesis of hormones. Steroid hormones are derived from a lipid i.e., cholesterol.
- Lipids help in the absorption of fat-soluble vitamins. (A,D,E and K) in the digestive system.

Q .7 Write a note on nucleic acids. **09406007**

Ans. Introduction

Nucleic acids are the biomolecules that are composed of units called nucleotides. A nucleotide is made up of three components.

1. Pentose sugar (ribose or deoxyribose)
2. Nitrogenous base
3. Phosphate group (PO_4)



General Structure of Nucleotide

Types of Nucleic Acids

There are two types of nucleic acids.

1. Deoxyribonucleic Acid (DNA)

Introduction

DNA is made of Deoxyribonucleotides (de-oxy-ribo-nucleotides). In this nucleotide, the pentose sugar is deoxyribose while the nitrogenous base may be adenine (A), thymine (T), cytosine (C) , or guanine (G)

Double Helix Model of DNA / Explain double Helix structure of DNA, and discuss the base pairing in this structure.

In 1953 US biologist James Watson and British biologist Francis Crick proposed the double helix model of DNA.

Main Points

According to this model:

- DNA is a double helix molecule. It is made of two strands of nucleotides.
- Both strands are coiled around each other.
- The nitrogenous base of one strand make hydrogen bonds with the nitrogenous bases of the opposite strand.

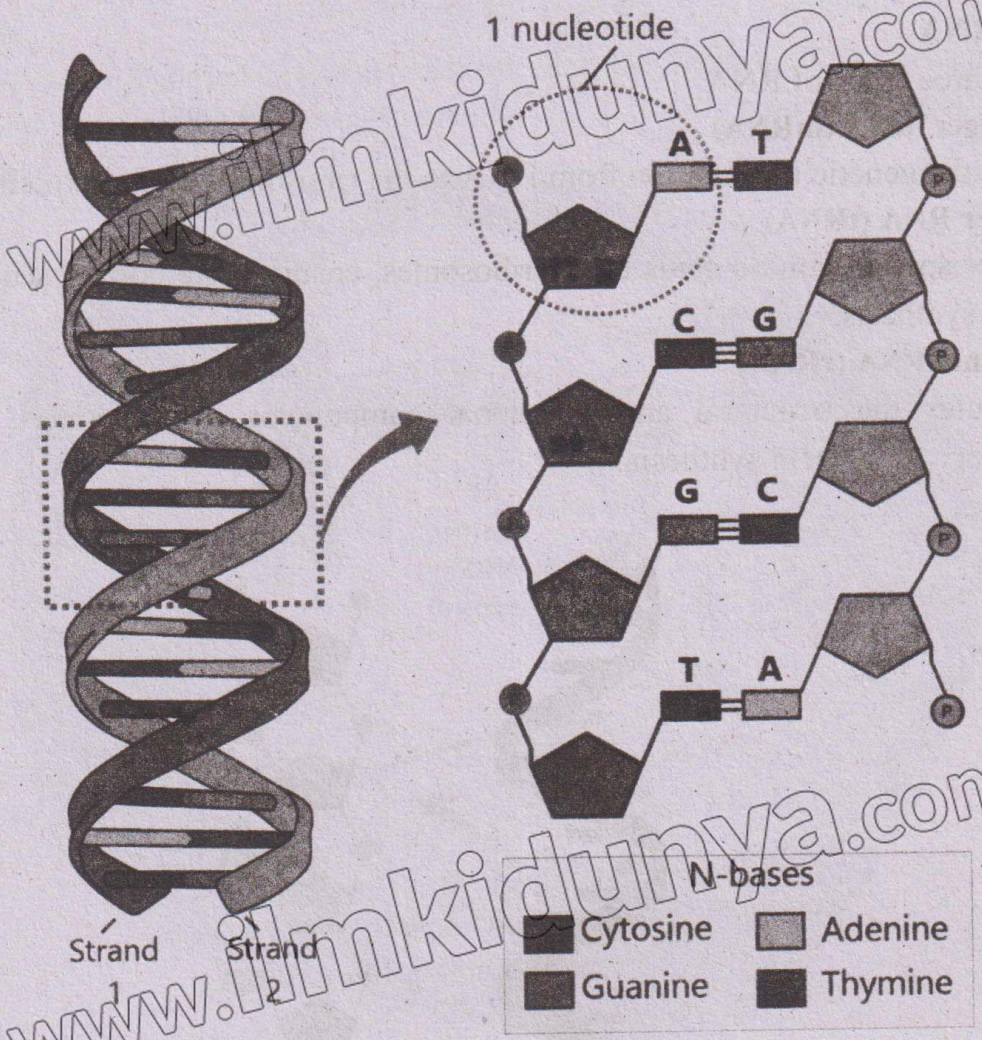


Figure 6.5: Double helix model of DNA

- The paring of nitrogenous bases is specific i.e., adenine of one strand form a pair with thymine of opposing strand. Similarly, cytosine forms a pair with guanine.
- There are two hydrogen bonds between adenine and thymine and three hydrogen bond between cytosine and guanine.

Function of DNA

i. Hereditary Information

DNA contains the hereditary information. This information is in the form of a sequence of nucleotides. This sequence determines the order of amino acids during protein synthesis.

ii. Gene

The segment of DNA in which the sequence of nucleotides determines the synthesis of a proteins is called a gene. During reproduction, DNA is passed from one generation to the next. In this way DNA carries the heredity information to the next generation.

2. Ribonucleic Acid (RNA)

Introduction

RNA is single stranded molecule. Its strand consists of ribonucleotides. A ribonucleotide contains ribose sugar instead of deoxyribose. In a ribonucleotide, the nitrogenous base may be adenine (A) uracil (U) cytosine (C) or guanine (G).

Types of RNA

There are three types of RNA

a) **Messenger RNA (mRNA)**
Carries the genetic information from DNA to the ribosomes during protein synthesis.

b) **Transfer RNA (tRNA)**
Transfer specific amino acids to the ribosomes, ensuring the correct sequence during protein synthesis.

c) **Ribosomal RNA (rRNA)**
Constitutes the structural and functional components of ribosomes, the cellular machinery for protein synthesis.

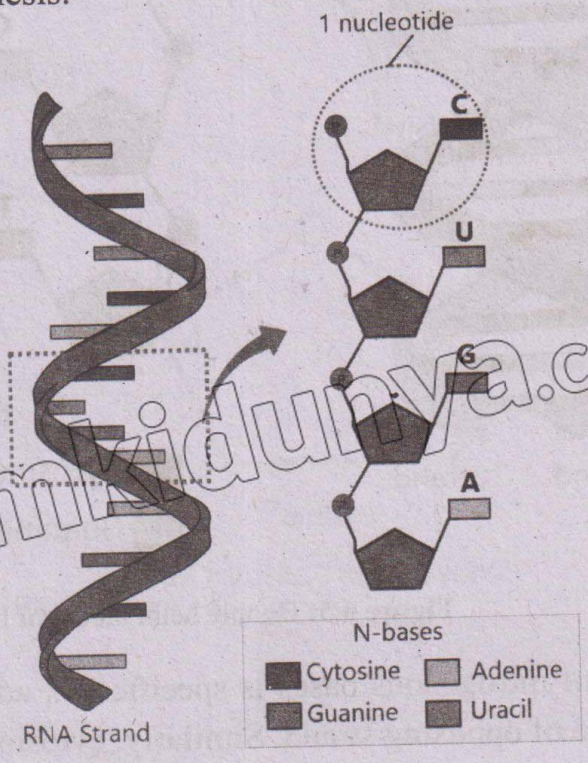


Figure 6.6: Structure of RNA

The Working of DNA and RNA

Q.8 Explain how the information in DNA is converted to information on RNA and then into proteins? **09406008**

Ans.

a) Introduction

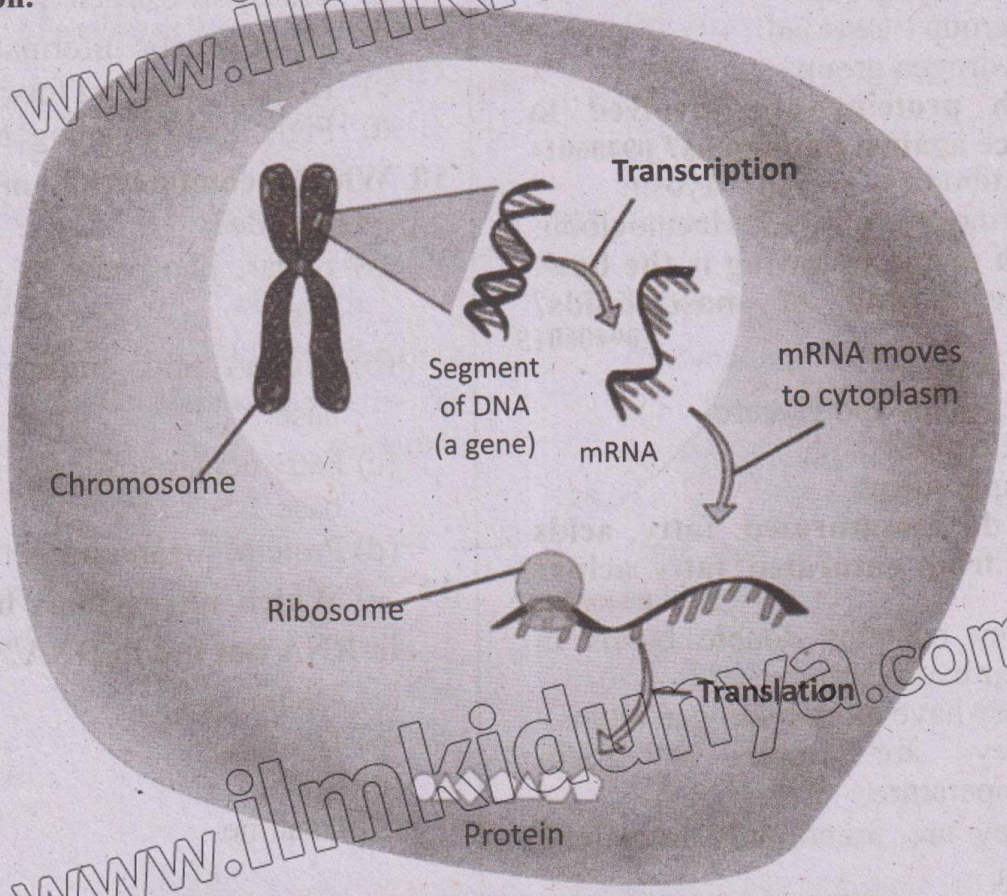
The DNA molecule in a chromosome consists of thousands of nucleotides. Along the length of DNA molecule, there are specific segments called genes. Each gene consists of specific sequence of nucleotides that carries information for the synthesis of a specific protein.

b) Gene Expression (Central Dogma)

i. **Transcription**
During the working of a gene, the specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA). This process is called **transcription.**

ii. **Translation**

The mRNA carries the sequence of its nucleotides to the ribosome. The ribosome reads this sequence and joins specific amino acids, according to it, to form protein. This step is known as **translation.**



(HQ picture is available on Pg # 211)

Figure 6.7: Working of DNA (also called the Central Dogma)

Multiple Choice Questions (Exercise)

1. **What is the primary function of carbohydrates?** 09406009
   a) Provide energy
   b) Act as enzymes
   c) Regulate processes
   d) Make membranes

2. **How will you differentiate between monosaccharides and polysaccharides?** 09406010
   a) Monosaccharides are single sugar
   b) Polysaccharides are sweet in taste.
   c) Monosaccharides are present in plant cell wall.
   d) Polysaccharides dissolve easily.

3. **What is true about cellulose?** 09406011
   a) It is sweet in taste
   b) It is digestible by human digestive system
   c) It provides structural support in plants
   d) It is soluble in water

4. **Which of the following proteins is involved in oxygen transport?** 09406012
   (a) Insulin
   (b) Haemoglobin
   (c) Collagen
   (d) Keratin

5. **Which component of an amino acid determines its unique properties?** 09406013

(a) Amino group
(b) Carboxyl group
(c) R group (side chain)
(d) Hydrogen group

6. **Which proteins are involved in defence against pathogens?** 09406014

(a) Antibodies (b) Myosin
c) Fibrinogen (d) Haemoglobin

7. **Which of the following is the basic structural unit of most lipids?** 09406015

a) Amino acid
b) Fatty acids and glycerol
c) Nucleotides
d) Simple sugars

8. **How do unsaturated fatty acids differ from saturated fatty acids?** 09406016

a) They contains double bonds in their hydrocarbon chains.
b) They have more hydrogen atoms.
c) They are solid at room temperature.
d) They are found only in animal fats.

9. **Which of the following is NOT a function of proteins?** 09406017

a) Transport oxygen in the blood
b) Carry genetic information
c) Help in digesting food
d) Fight against pathogens

10. **Which components make up a nucleotide?** 09406018

(a) Sugar, phosphate, nitrogenous base
(b) Amino acid, sugar, nitrogenous base
(c) Fatty acid, phosphate, nitrogenous base
(d) Protein, sugar, nitrogenous base

11. **Which nitrogenous base is found in RNA but not in DNA?** 09406019

(a) Adenine
(b) Thymine
(c) Uracil
(d) Guanine

Multiple Choice Questions (Additional)

Biomolecules

12. **Biomolecules make the dry mass of living organisms:** 09406020

(a) 73 (b) 53
(c) 93 (d) 43

Carbohydrates

13. **Which of the disaccharide is also called transport sugar?** 09406021

(a) Sucrose (b) Maltose
(c) Fructose (d) Lactose

14. **Which is not a function of carbohydrates?** 09406022

(a) Providing energy
(b) Serving as building blocks for complex carbohydrates
(c) Forming the primary structure of cell membranes
(d) Breaking down into glucose

16. **%age of carbohydrates in dry mass of protoplasm:** 09406023

(a) 93 (b) 7
(c) 15 (d) 50

15. **Most abundant carbohydrate is:** 09406024

(a) Glucose (b) Starch
(c) Cellulose (d) Chitin

Proteins

17. **Different amino acids differ from each other on the basis of their ——— group:** 09406025

(a) Alkyl
(b) carboxylic
(c) Amino
(d) phosphate

18. %age of protein in dry mass of protoplasm: 09406026
(a) 18 (b) 15
(c) 50 (d) 10

19. Types of amino acids make proteins: 09406027
(a) 170 (b) 20
(c) 40 (d) 57

20. Proteins present in muscle cells: 09406028
(a) Fibrin (b) Actin
(c) Myosin (d) b and c both

21. Most abundant biomolecule in the cell is: 09406029
(a) Carbohydrates
(b) Proteins
(c) Lipids
(d) Nucleic acids

22. Amino acids present in insulin: 09406030
(a) 574 (b) 95
(c) 51 (d) 47

Lipids

23. The amount of energy obtained from one gram of fat is: 09406031
(a) 5 Kcal/g (b) 9 Kcal/g
(c) 13 Kcal/g (d) 17 Kcal/g

24. %age of lipids in dry mass of protoplasm: 09406032
(a) 10 (b) 15
(c) 50 (d) 18

Nucleic Acids

25. During translation, sequence of amino acids in the protein decided on the basis of sequence of nucleotides in: 09406033
(a) tRNA (b) rRNA
(c) mRNA (d) DNA

26. Both strands of DNA are held together by hydrogen bonding, double hydrogen bonds are present between: 09406034
(a) Adenine and thymine
(b) Cytosine and guanine
(c) Cytosine and thymine
(d) Adenine and guanine

27. Transcription takes place in the: 09406035
(a) Cytoplasm
(b) Nucleus
(c) Ribosomes
(d) Rough endoplasmic reticulum

28. All the nucleotides of RNA differ from the nucleotides of DNA in having different: 09406036
(a) Nitrogen base
(b) Pentose sugar, nitrogen base
(c) Phosphate group
(d) Carboxylic group

29. The type of RNA that brings amino acids to the ribosome is: 09406037
(a) snRNA (b) tRNA
(c) rRNA (d) mRNA

30. Genes are short segments of: 09406038
(a) protein (b) carbohydrates
(c) DNA (d) lipids

31. Which of the following statements regarding genes is false? 09406039
(a) Genes are located on chromosomes
(b) Genes consist of a long sequence of DNA
(c) A gene contains information for the production of a protein
(d) Each cell contains a single copy of every gene

32. **Genes contain instructions for the synthesis of:** 09406040
(a) Fats
(b) Carbohydrates
(c) Vitamins
(d) Proteins

33. **Polynucleotide strands present in DNA molecule are:** 09406041
(a) 2 (b) 3
(c) 4 (d) 5

34. **This is a heredity material:** 09406042
(a) DNA (b) RNA
(c) tRNA (d) rRNA

35. **%age of nucleic acids in dry mass of protoplasm:** 09406043
(a) 7 (b) 90
(c) 10 (d) 18

36. **Essential part of nucleic acids are:** 09406044
(a) Pentoses (b) Heptoses
(c) Hexoses (d) Trioses

Answer Key

1	a	2	a	3	c	4	b	5	c
6	a	7	b	8	a	9	b	10	a
11	c	12	c	13	a	14	c	15	c
16	c	17	a	18	c	19	b	20	d
21	b	22	c	23	b	24	a	25	c
26	a	27	b	28	b	29	b	30	c
31	b	32	d	33	a	34	a	35	d
36	a								

Short Answer Questions (Exercise)

Q.1 What are the main functions of carbohydrates in the body? 09406045

Ans.

- Carbohydrates are the primary source of energy. Glucose is used by cells to produce energy through cellular respiration.
- Dietary fibre contains undigestible carbohydrates e.g., cellulose. It helps to maintain the proper bowel movements.
- Pentoses (ribose and deoxyribose) are essential parts of nucleic acids (RNA and DNA respectively).
- Plants convert their monosaccharides to disaccharides like sucrose to transport monosaccharides between body parts.
- Cellulose provides support to plant cells and ultimately to the whole plant.
- Chitin is a polysaccharide provides strength and support to insects.

Q.2 How do the three groups of carbohydrates differ in taste? 09406046

Ans. Monosaccharides have sweet taste, disaccharides are less sweet in taste while polysaccharides are tasteless. Therefore the sweetness decreases as the complexity of carbohydrates increases.

Q.3 Name two common monosaccharides and two disaccharides. 09406047

Ans.

1. Pentoses (5C) and hexoses (6 C) are common monosaccharides.

2. Sucrose and maltose are common disaccharides.

Q.4 Which monosaccharides make a sucrose molecules? 09406048

Ans. Sucrose (Table sugar) is made of two monosaccharides i.e, glucose and fructose.

Q.5 Give an example of storage polysaccharide in plants. 09406049

Ans. Starch is a storage polysaccharide found in plants. It is composed of glucose units.

Q.6 Define amino acid and draw its structure. 09406050

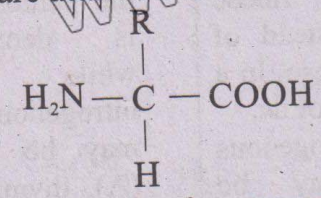
Ans. Proteins are made up of monomers called amino acids. Different proteins contain different numbers of amino acids.

Example

Insulin protein has 51 amino acids and haemoglobin has 574 amino acids.

Structure

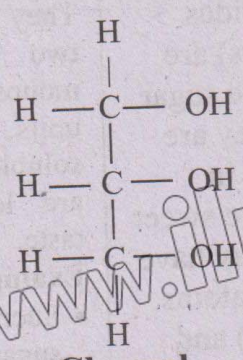
An amino acid is an organic molecule made of an amino group (NH_2), a carboxyl group (COOH), a hydrogen group (H) and a side group (R) are attached to a central atoms.



Q.7 What are basic components of lipids, draw their structure.09406051

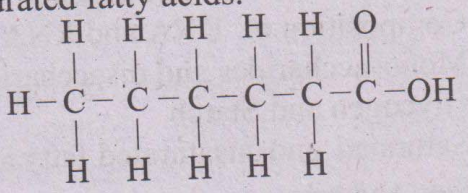
Ans. Lipids are composed of glycerol and fatty acids.

1. Glycerol is an alcohol having three carbons and each carbon has hydroxyl group.

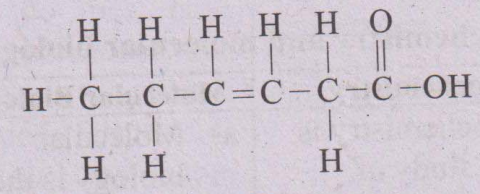


Glycerol

2. Fatty acids are long hydrocarbon chains with carboxyl group (COOH) at the end. Fatty acids may be saturated and unsaturated fatty acids.



Saturated Fatty Acid



Unsaturated Fatty Acid

Q.8 What are the types of RNA? Write their functions. 09406052

Ans. There are three types of RNA.

a. **Messenger RNA (mRNA):** Carries the genetic information from DNA to the ribosomes during protein synthesis.

b. **Transfer RNA (tRNA):** Transfers specific amino acids to the ribosomes, ensuring the correct sequence during protein synthesis.

c. **Ribosomal RNA (rRNA):** Constitutes the structural and functional components of ribosomes, the cellular machinery for protein synthesis.

Q.9 Briefly describe the function of DNA. 09406053

Ans. DNA contains the hereditary information. This information is in the form of a sequence determines the order of amino acids during protein synthesis. The segment of DNA in which the sequence of nucleotides determines the synthesis of a proteins is called a gene. During reproduction, DNA is passed from one generation to the next. In this way, DNA carries the heredity information to the next generation.

Q.10 Differentiate between: 09406054

i. Biochemistry and molecular biology
ii. Structure of DNA and RNA
iii. Composition of DNA and RNA
iv. Monosaccharides and disaccharides
v. Glycogen and Starch
vi. Saturated and unsaturated fatty acids
vii. Fats and oils

Ans.

i. Biochemistry and molecular biology

Biochemistry	Molecular Biology
a) Biochemistry is the study of chemical processes that occur within living organisms (e.g. photosynthesis).	a) Molecular biology is the specialized branch of biochemistry that is mainly concerned about the structure and functions of the biomolecules, e.g. carbohydrates, proteins and lipids.
b) Biochemistry is related to both biology and chemistry, that is why biochemistry solves the problems of living organisms by using the knowledge and techniques of chemistry.	b) In molecular biology, the interaction of bio molecules within the cells and biochemical processes like DNA replication, transcription and translation is studied.

ii. Structure of DNA and RNA

Structure of DNA	Structure of RNA
• DNA is made of deoxyribo nucleotides (de-oxy-ribo-nucleotides). • In this nucleotide, the pentose sugar is deoxyribose while nitrogenous base may be adenine (A), thymine (T), cytosine (C) or guanine (G).	• RNA is single–stranded. Its strand consists of ribonucleotides. • A ribonucleotide contains ribose sugar instead of deoxyribose. In a ribonucleotide, the nitrogenous base may be adenine (A) uracil (U) cytosine (C) or guanine (G).

iii. Composition and of RNA and DNA

RNA	DNA
• RNA is single stranded. Its strand consists of ribonucleotides. • A ribonucleotide contains ribose sugar instead of deoxyribose. In a ribonucleotide, the nitrogenous base may be adenine (A) uracil (U) cytosine (C) or guanine (G).	• DNA is made of deoxyribonucleotides (de-oxy-ribo-nucleotides). • In this nucleotide, the pentose sugar is deoxyribose while the nitrogenous base may be adenine (A), thymine (T), cytosine (C), or guanine (G).

iv. Monosaccharides and Disaccharides

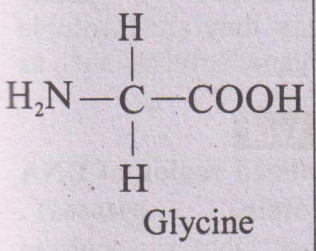
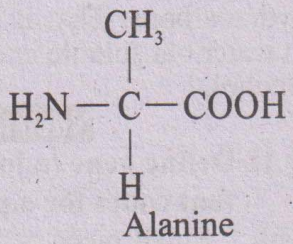
Monosaccharides	Disaccharides
Monosaccharides (simple sugars) are made of single sugar molecule. They are easily soluble in water and have sweet taste. They may have 3 to 7 carbon atoms. Pentoses (5 C) and	They are made of two monosaccharides units. They are less soluble in water and are less sweet in taste. **Examples** • Sucrose (table sugar) is made of

hexoses (6 C) **Examples** • Ribose ($C_5H_{10}C_4$) and deoxyribose ($C_5H_{10}O_4$) are pentoses. • Glucose, fructose, and galactose are hexoses ($C_6H_{12}O_6$).	two monosaccharides i.e., glucose and fructose. • Maltose is made of two glucose molecules.

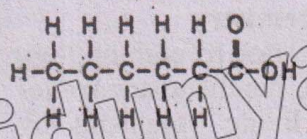
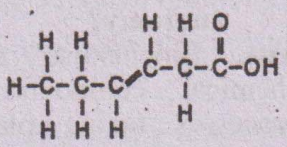
v. Glycogen and starch

Glycogen	Starch
i. Glycogen is the animal starch mainly stored in liver and muscles. ii. It is broken down into glucose when energy is needed.	i. Starch is a storage polysaccharide stored in plants. ii. It is composed of glucose units.

vi. Glycine and alanine

Glycine	Alanine
i. It is an amino acid in which R group is H ii.  Glycine	i. It is an amino acid in which the R group is CH_3. ii.  Alanine

vii. Saturated and unsaturated fatty acids

Saturated Fatty Acids	Unsaturated Fatty Acids
Saturated fatty acids have internal carbon atoms bonded with maximum number of hydrogen atoms. They do not have double bonds between carbon atoms. Saturated fatty acids are solid at room temperature. **Example** Palmitic acid.  Saturated fatty acid	Unsaturated fatty acids have one or more double bonds between carbon atoms. They are liquid at room temperature. **Example** Oleic acid.  Unsaturated fatty acid

viii. Fats and oils.

Fats	Oils
Fats contain saturated fatty acids and so are solid at room temperature e.g., animal fats.	Oils contain unsaturated fatty acids and so are liquid at room temperature e.g., plant oils such as olive oil, corn oil, and coconut oil.

Short Answer Questions (Additional)

Biomolecules

Q.11 Compare the energy level of carbohydrates, Proteins and lipids. 09406055

Ans.

Proteins	Lipids	Carbohydrates
(1) One gram of protein has 4 Kcal of energy	One gram of lipids provides 9.1 Kcal energy which is double than carbohydrates or proteins.	4 Kcal per gram of energy is released when glucose is broken down in the cell.
(2) Proteins can also be used for gaining energy	Lipids act as energy storage in fat cells, liver and in blood.	Carbohydrates are major source of useable and stored energy in the cells of living organisms.

Q.12 How biochemistry is important for study of physiology, cell biology and anatomy? 09406056

Ans. Biochemistry is the study of different chemical compounds and the chemical processes taking place within the living organisms.

Important Role of Biochemistry

Biochemistry is related to both biology and chemistry. Therefore, biochemistry solves the problems faced by living organisms by using the knowledge and techniques of chemistry. Similarly, knowledge of biochemistry is essential to study the physiology, cell biology and anatomy of organisms because life processes such as photosynthesis, respiration, digestion, inheritance are explained in biochemic terms.

Proteins

Q.13 What are different plant sources of proteins? 09406057

Ans. Plant seeds are most common source of proteins like beans, lentils, peas, nuts.

Q.14 How primary structure of protein is important? 09406058

Ans. The primary structure of a protein is important because it determines the protein's three dimensional shape, which in turn determines its function.

Q.15 Name two types of proteins that provide structure in the human body. 09406059

Ans. Keratin in hair and nails and collagen in tissues provide structure to various parts of the body.

Lipids

Q.16 How does the structure of fatty acids determine whether a fat is saturated or unsaturated? 09406060

Ans. Fatty acids in triglycerides can be either saturated or unsaturated. A fatty acid is considered saturated if there are no double bonds between carbon atoms of its chain.

On the other hand, an unsaturated fatty acid has one or more double bonds, formed by the removal of hydrogen atoms from the carbon skeleton.

Q.17 Why are lipids insoluble in water? 09406061

Ans. Lipids are organic compounds made up of carbon, hydrogen and oxygen. They have little or no affinity for water (hydrophobic in nature) due to the presence of mostly hydrocarbons. That is why they are insoluble in water but soluble in organic solvents such as alcohol.

Nucleic Acids

Q.18 Define gene (a localized region of DNA that codes for a protein). 09406062

Ans. Small piece of huge DNA molecule in the chromosome is called gene.

Genes actually store and control the hereditary information. Each chromosome is made up of large number of genes.

Q.19 How does molecular biology relate to the understanding of DNA and genetic information? 09406063

Ans. Molecular biology looks at the molecule related to genetic information, particularly DNA. It seeks to understand how DNA is made, copied and used providing insight into heredity, genetic variations and the basics of life.

Q.20 Differentiate between transcription and translation. 09406064

Ans.

Transcription	Translation
It is a process in which specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA). It takes place in the nucleus.	The mRNA carries the sequence of its nucleotides to ribosomes. Ribosomes read this sequence and joins specific amino acids, according to it proteins are synthesized. It takes place in the cytoplasm.

Inquisitive Questions

Q1. Evaluate the importance of water in the functioning of biomolecules. 09406065

Ans: Water is essential for the functioning of biomolecules because it acts as a solvent, allowing substances to dissolve causes biochemical reactions. It transports nutrients and to maintain the structure and stability of proteins, DNA, and other biomolecules. Due to its high heat capacity, it acts as environment stabilizer. Water plays key role in hydrolysis and condensation reactions. It plays structural role in plant and animal cells. Without water, the complex processes that support life would not occur.

Q2. Find the amount/ percentage of carbohydrates, protein, fats and water in the following food product and compare them with each other: 09406066

Roti (40 gm), burger, cucumber, egg, rice (100gm), potato fries (100 gm), carrot

Ans: The amount of carbohydrates, protein, fats, and water in the listed food items may vary slightly depending on method of preparation and product variation.

Amount in grams (approximately)

Food items	Weight (gm)	Amount in grams			
		Carbohydrates	Proteins	Fats	Water
Roti	40	20-25	3-4	1-2	10-15
Burger	100	30-40	15-25	15-25	20-30
Cucumber	100	3-4	0.5-1	0.1-0.2	93-95
Egg	100	0.5-1	6-7	5-6	35-38
Rice	100	28-30	2-3	0.5-1	68-70
Potato fries	100	35-40	3-4	15-20	40-50
Carrot	100	9-10	0.9-1	0.2-2.3	85-88

Amount in percentage (approximately)

Food items	Weight (gm)	Amount in percentage			
		Carbohydrates	Proteins	Fats	Water
Roti	40	50-62%	7-10%	2-5%	25-37%
Burger	100	30-40%	15-20%	15-25%	20-30%
Cucumber	100	3-4%	0.5-1%	0.1-0.2%	95%
Egg	100	1%	12-14%	10-12%	70%
Rice	100	28-30%	2-3%	0.5-1%	70%
Potato fries	100	35-40%	3-4%	15-20%	40-50%
Carrot	100	9-10%	0.9-1%	0.2-0.3%	88%