



**Class: 9th**

**Subject: Biology**

**Chapter 6: Biomolecules**

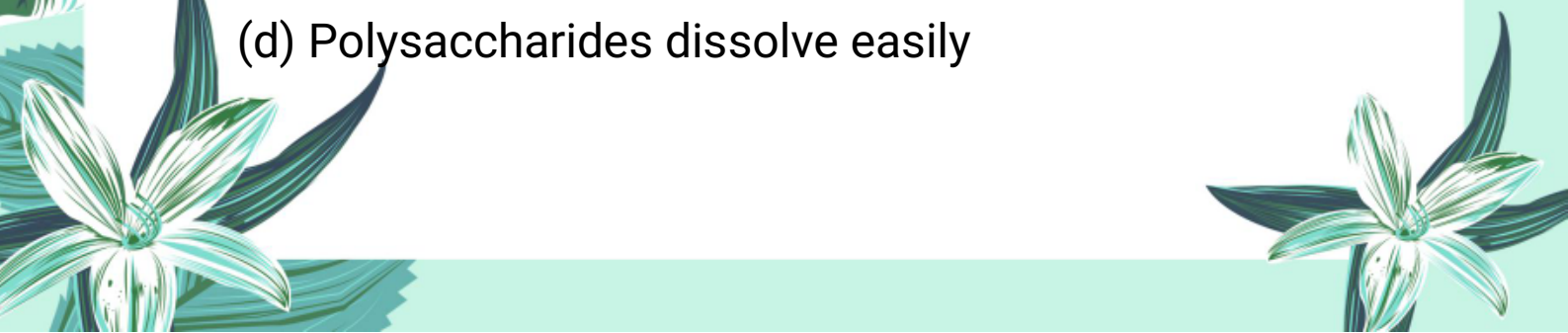


**Exercise MCQs:**

**1. What is the primary function of carbohydrates?**

- (a) Provide energy
- (b) Act as enzymes
- (c) Regulate processes
- (d) Make membranes


**2. How will you differentiate between monosaccharides and polysaccharides?**

- (a) Monosaccharides are single sugars
  - (b) Polysaccharides are sweet in taste
  - (c) Monosaccharides are present in plant cell wall
  - (d) Polysaccharides dissolve easily
- 



### 3. What is true about cellulose?

- (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?

- (a) Insulin
- (b) Haemoglobin
- (c) Collagen
- (d) Keratin

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

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


### 6. Which proteins are involved in defence against





**pathogens?**

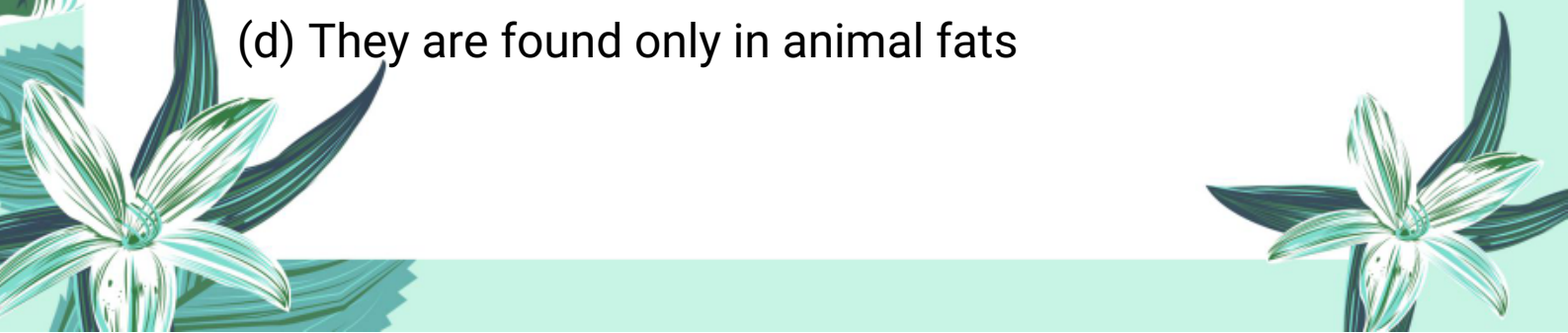
- (a) Antibodies
- (b) Collagen
- (c) Fibrinogen
- (d) Haemoglobin




**7. Which of the following are the units of most lipids?**

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

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

- (a) They have more hydrogen atoms
  - (b) They contain double bonds in their hydrocarbon chains
  - (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?**

- (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?**

- (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?**

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



## Important MCQs:

1. Which of the following is not a macromolecule?

- (a) Carbohydrate
- (b) Lipid
- (c) Water
- (d) Protein

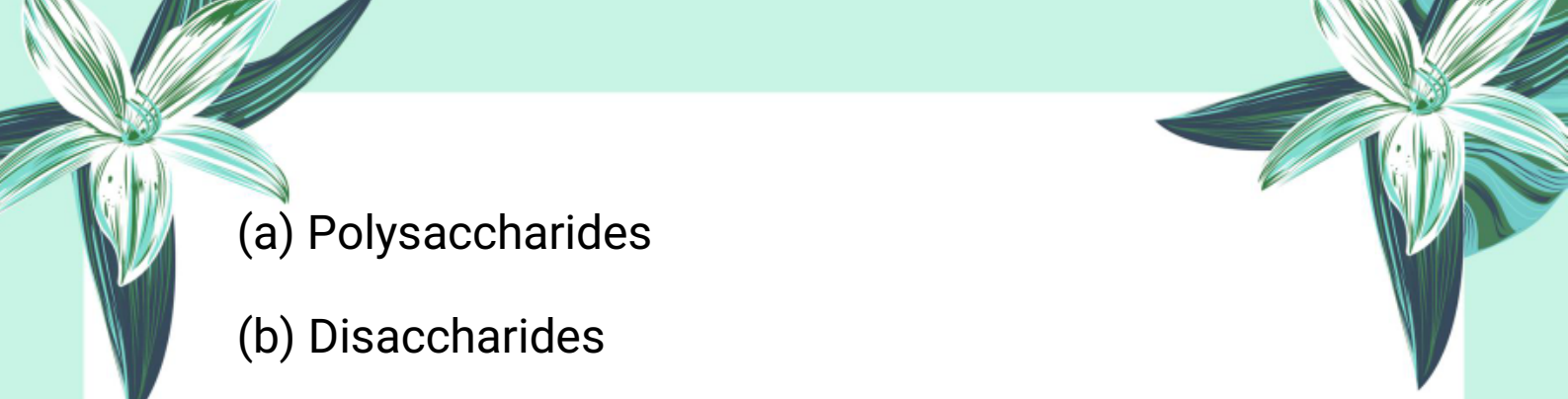
2. What is the general formula of carbohydrates?

- (a)  $C_nH_{2n}O_n$
- (b)  $C_n(H_2O)_n$
- (c)  $CH_2O$
- (d)  $C_nH_nO_n$

3. Ribose and deoxyribose are examples of:

- (a) Disaccharides
- (b) Polysaccharides
- (c) Hexoses
- (d) Pentoses

4. Glucose and fructose are classified as:


- 
- (a) Polysaccharides
  - (b) Disaccharides
  - (c) Monosaccharides
  - (d) Lipids



**5. Which disaccharide is made of glucose and fructose?**

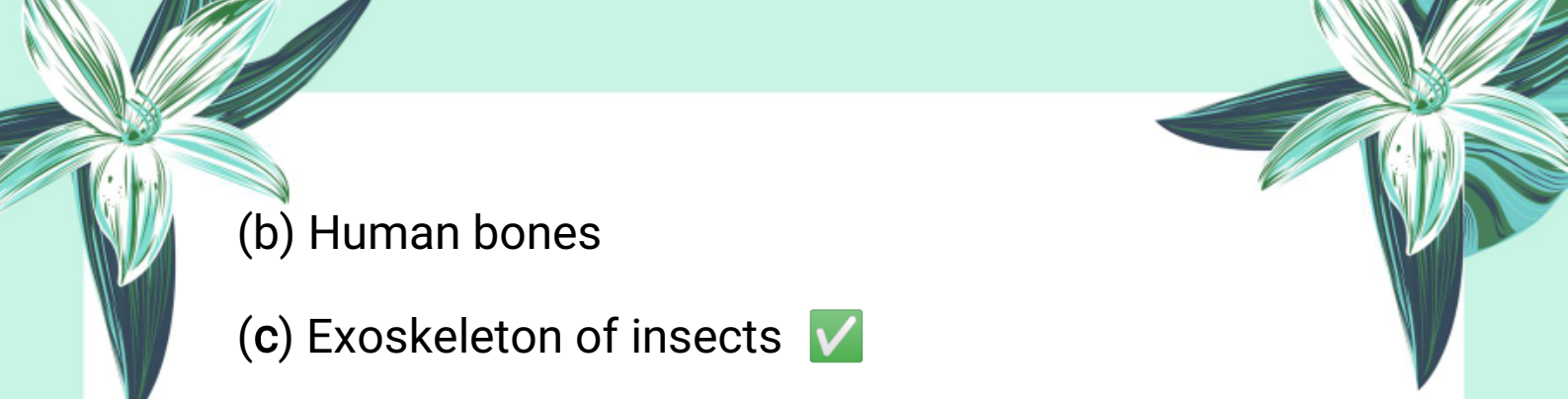
- (a) Maltose
- (b) Sucrose
- (c) Lactose
- (d) Ribose

**6. Which carbohydrate is stored in liver and muscles?**


- 
- (a) Cellulose
  - (b) Chitin
  - (c) Glycogen
  - (d) Starch

**7. Chitin is found in the:**


- (a) Cell wall of plants
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- 
- (b) Human bones
  - (c) Exoskeleton of insects
  - (d) Muscles of animals

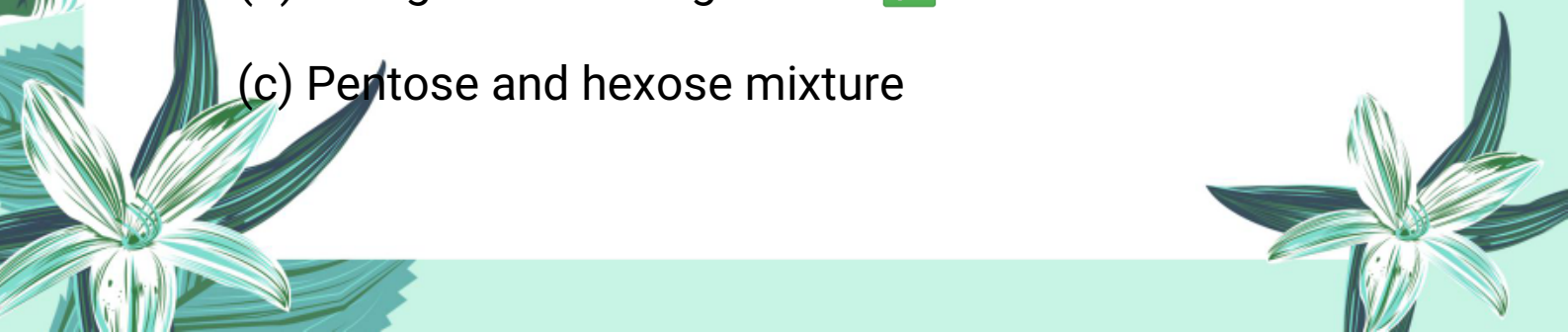
**8. Which of the following is not sweet in taste?**

- 
- (a) Glucose
  - (b) Fructose
  - (c) Maltose
  - (d) Cellulose

**9. The ratio of hydrogen and oxygen in carbohydrates is:**

- 
- (a) 3:2
  - (b) 2:1
  - (c) 1:2
  - (d) 1:1

**10. Cellulose is composed of:**

- 
- (a) Branched chains of fructose
  - (b) Straight chains of glucose
  - (c) Pentose and hexose mixture



(d) Amino acids

1. Which monosaccharide is commonly found in honey and fruits?

(a) Galactose

(b) Glucose

(c) Lactose

(d) Maltose

12. Sucrose is found in:

(a) Milk

(b) Cereals

(c) Sugarcane

(d) Pulses

13. Which polysaccharide is most abundant in nature?

(a) Starch

(b) Glycogen

(c) Chitin

(d) Cellulose





**14. The function of dietary fiber (cellulose) is to:**

- (a) Provide energy
- (b) Aid in bowel movements
- (c) Form blood
- (d) Make enzymes



**15. Ribose and deoxyribose are components of:**

- (a) Enzymes
- (b) Hormones
- (c) Nucleic acids
- (d) Muscles

**16. Which disaccharide is present in milk?**

- (a) Sucrose
- (b) Maltose
- (c) Lactose
- (d) Glucose

**17. What is the primary function of carbohydrates?**

- (a) Protection
  - (b) Structure
- 




(c) Energy production

(d) Enzyme activity

**18. Proteins are made up of:**

(a) Fatty acids



(b) Amino acids

(c) Sugars

(d) Nucleotides

**19. Which protein transports oxygen in blood?**

(a) Actin

(b) Keratin

(c) Haemoglobin

(d) Insulin

**20. Enzymes are:**

(a) Lipids

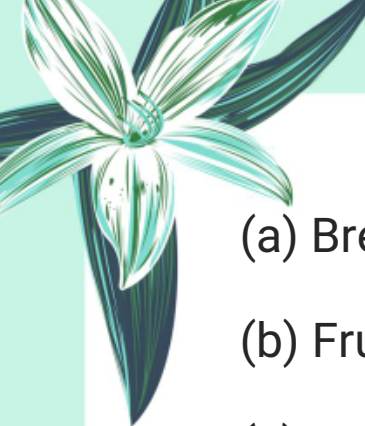

(b) Proteins

(c) Carbohydrates

(d) Vitamins

**21. Which food is rich in essential amino acids?**



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- 
- (a) Bread
  - (b) Fruits
  - (c) Meat
  - (d) Sugar



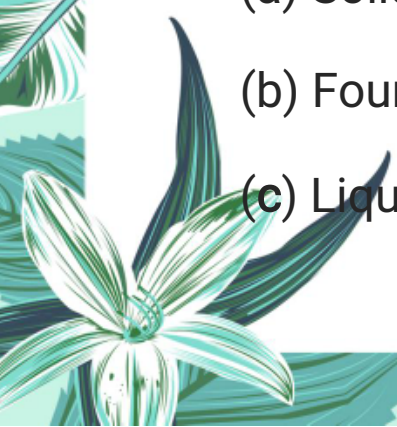

**22. Actin and myosin are proteins found in:**

- (a) Blood
- (b) Muscles
- (c) Skin
- (d) Hair

**23. Lipids are composed of:**

- (a) Sugar and phosphate
- (b) Glycerol and amino acids
- (c) Glycerol and fatty acids
- (d) Glucose and starch

**24. Unsaturated fatty acids are:**

- (a) Solid at room temperature
  - (b) Found in animal fat
  - (c) Liquid at room temperature
- 
- 



(d) Without double bonds

**25. Phospholipids are major components of:**

- (a) Hair
- (b) Membranes
- (c) Bones
- (d) Enzymes

**26. The building blocks of nucleic acids are called:**

- (a) Amino acids
- (b) Nucleotides
- (c) Fatty acids
- (d) Sugars

**27. Which sugar is found in RNA?**

- (a) Glucose
- (b) Deoxyribose
- (c) Ribose
- (d) Maltose

**28. Which nitrogenous base is present in RNA but not in DNA?**






(a) Thymine

(b) Adenine

(c) Uracil

(d) Cytosine



**29. The double helix model of DNA was proposed by:**

(a) Watson and Mendel

(b) Watson and Crick

(c) Franklin and Mendel

**30. The function of DNA is to:**

(a) Break down food

(b) Transport oxygen

(c) Store hereditary information

(d) Synthesize fats

**31. RNA is usually:**

(a) Double-stranded

(b) Single-stranded

(c) Triple-stranded





(d) Helical and circular

**32. Which type of RNA carries amino acids to ribosomes?**

(a) mRNA

(b) rRNA

(c) tRNA

(d) DNA



**33. The process of copying DNA into mRNA is called:**

(a) Translation

(b) Transcription

(c) Replication

(d) Mutation

**34. The segment of DNA that carries information for protein synthesis is called a:**

(a) Nucleotide

(b) Enzyme

(c) Gene



(d) Ribosome

### Exercise Short Questions:

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

**Answer:** Carbohydrates provide energy to the body. They are the main source of fuel for cellular activities and are broken down into glucose during digestion.

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

**Answer:**

- Monosaccharides and disaccharides are sweet in taste.
- Polysaccharides are generally tasteless because they are large and complex molecules.

3. Name two common monosaccharides and two disaccharides.

**Answer:**

- **Monosaccharides:** Glucose, Fructose
- **Disaccharides:** Sucrose (table sugar), Maltose

4. Which monosaccharides make a sucrose molecule?

**Answer:**

Sucrose is made up of one molecule of glucose and one molecule of fructose.

5. Give an example of a storage polysaccharide in plants.

**Answer:**

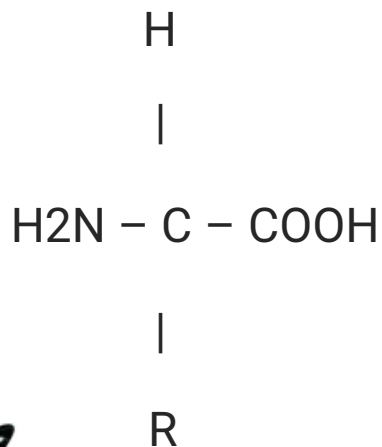
Starch is a storage polysaccharide found in plants. It stores energy for later use.

6. Define amino acid and draw its structure.

**Answer:**

**Definition:** Amino acids are the building blocks of proteins. Each amino acid contains an amino group ( $-\text{NH}_2$ ), a carboxyl group ( $-\text{COOH}$ ), a hydrogen atom, and an R group attached to a central carbon.

**Structure:**

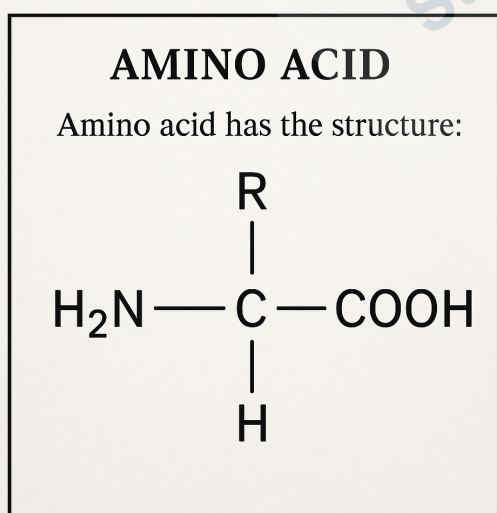


7. What are the basic components of lipids? Draw their curves.

**Answer:**

Lipids are made up of glycerol and fatty acids. One glycerol molecule combines with three fatty acids to form a triglyceride.

**Diagram:**





Glycerol + 3 Fatty Acid  $\rightarrow$  Lipid (Triglyceride)

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

**Answer:**



**There are three types of RNA:**

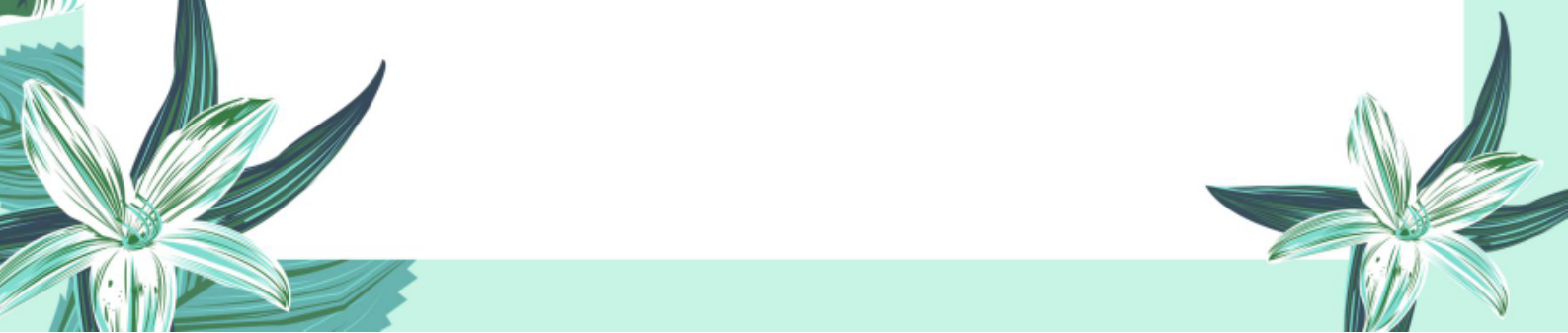
- mRNA (Messenger RNA): Carries genetic code from DNA to ribosomes.
- tRNA (Transfer RNA): Brings specific amino acids to ribosomes.
- rRNA (Ribosomal RNA): Forms the structure of ribosomes and helps in protein synthesis.

**9. Briefly describe the function of DNA.**



**Answer:**

DNA stores hereditary information. It contains genes made of nucleotide sequences, which determine the order of amino acids in proteins. DNA passes genetic traits from parents to offspring.



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## Important Short Questions:

**1. What are biomolecules? Name four major types.**

**Answer:** Molecules produced by organisms are called biomolecules. The four major types are carbohydrates, lipids, proteins, and nucleic acids.

**2. Why are biomolecules called macromolecules?**

**Answer:** Because they are large-sized molecules composed of many smaller units.

**3. What is the general formula of carbohydrates?**

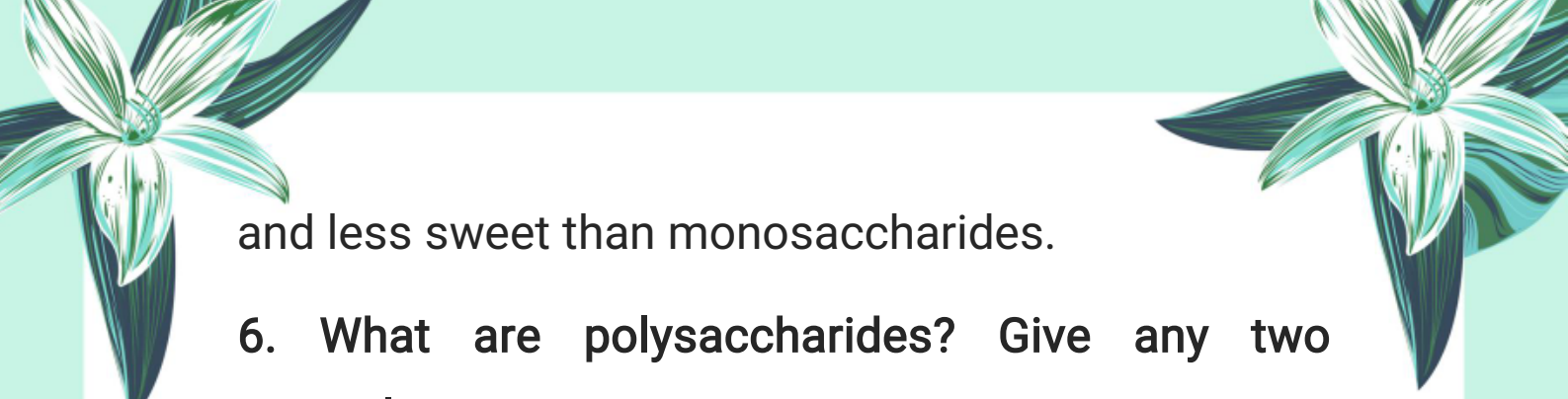
**Answer:** The general formula is  $C_n(H_2O)_n$ , where "n" is the number of carbon atoms.

**4. What are monosaccharides? Give two examples.**

**Answer:** Monosaccharides are single sugar molecules. **Examples:** Glucose and Fructose.

**5. How are disaccharides different from monosaccharides?**

**Answer:** Disaccharides are made of two monosaccharide units, are less soluble in water,



and less sweet than monosaccharides.

**6. What are polysaccharides? Give any two examples.**

Answer: Polysaccharides are complex carbohydrates made of many monosaccharides.

Examples: Starch and Cellulose.



**7. Where is glycogen stored in animals?**

Answer: Glycogen is stored in the liver and muscles.

**8. What is the function of cellulose in plants?**

Answer: Cellulose provides structural support to plant cells and the whole plant.

**9. Name the carbohydrate found in the exoskeleton of insects.**

Answer: Chitin is the carbohydrate found in exoskeletons of insects and in fungal cell walls.

**10. What are proteins made of?**

Answer: Proteins are made of amino acids, which are their monomers.

**11. Name the protein that carries oxygen in blood.**






**Answer:** Haemoglobin carries oxygen in the blood.

**12. What is the function of enzymes in the body?**

**Answer:** Enzymes catalyse biochemical reactions in the body.



**13. Which proteins are responsible for muscle contractions?**

**Answer:** Actin and myosin proteins control muscle contractions.

**14. Name two structural proteins found in hair and cartilage.**

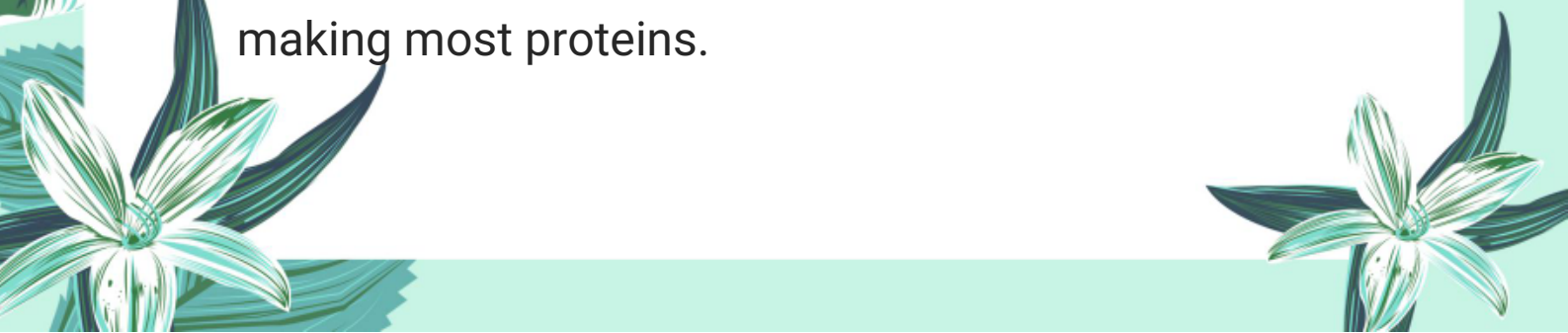
**Answer:** Keratin (in hair and nails) and collagen (in cartilage).

**15. What is the function of antibodies in the body?**

**Answer:** Antibodies defend the body against pathogens.

**16. How many types of amino acids are used to make most proteins?**

**Answer:** 20 types of amino acids are used in making most proteins.





**17. What are lipids made of?**

**Answer:** Lipids are made of glycerol and fatty acids.

**18. What is the difference between saturated and unsaturated fatty acids?**



**Answer:**

- **Saturated** fatty acids have no double bonds and are solid at room temperature.
- **Unsaturated** fatty acids have one or more double bonds and are liquid at room temperature.

**19. What are the sources of lipids?**

**Answer:**

- **Animal sources:** Meat and dairy products
- **Plant sources:** Nuts, seeds, olive oil

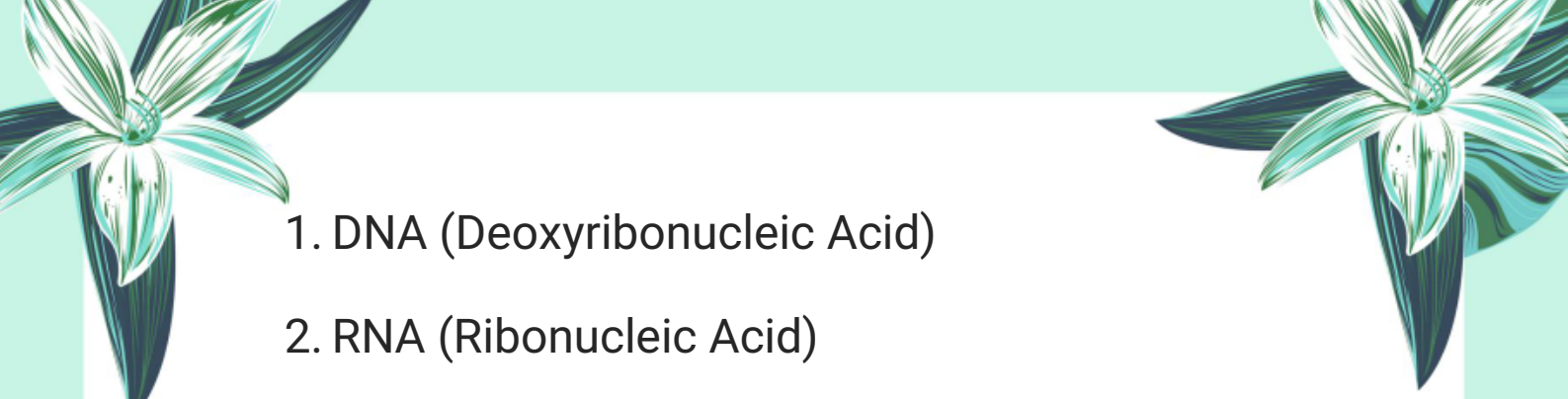
**20. What are nucleic acids? Name their types.**

**Answer:**

Nucleic acids are biological macromolecules that store and transfer genetic information in a cell.


There are two main types:



- 
1. DNA (Deoxyribonucleic Acid)
  2. RNA (Ribonucleic Acid)

## 21. What is DNA?

### Answer:



DNA stands for Deoxyribonucleic Acid. It is a double-stranded molecule that contains genetic information necessary for the development and functioning of all living organisms. It is composed of deoxyribonucleotides arranged in a double helix structure.

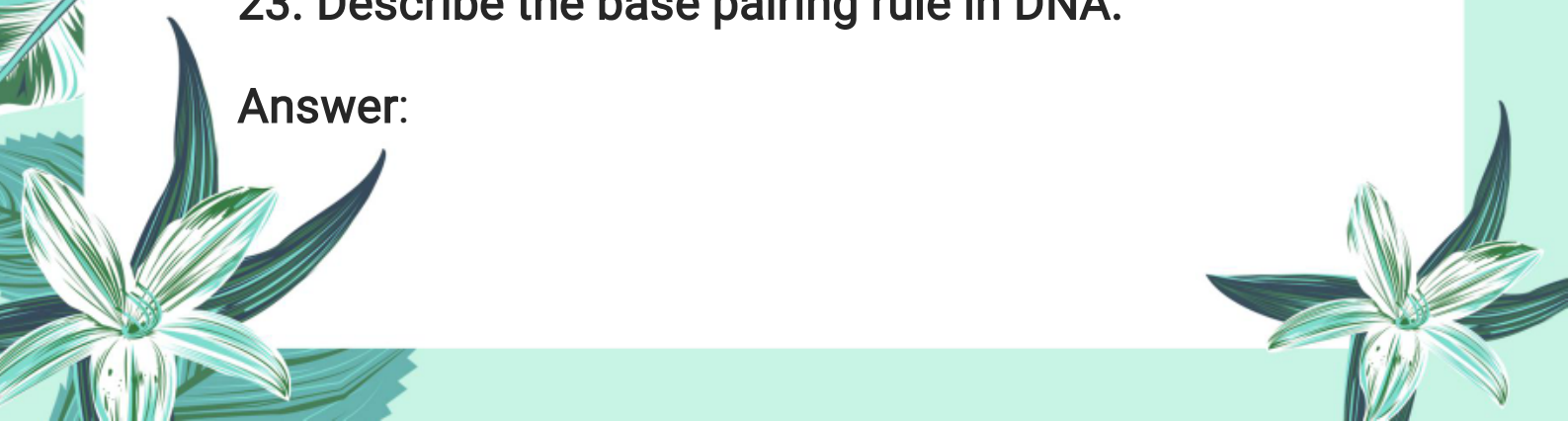
## 22. Who discovered the double helix structure of DNA and when?

### Answer:

The double helix structure of DNA was discovered by James Watson (USA) and Francis Crick (UK) in 1953. They received the Nobel Prize in 1962 for this discovery.

## 23. Describe the base pairing rule in DNA.

### Answer:



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**In DNA:**

- Adenine (A) always pairs with Thymine (T) with two hydrogen bonds.
- Cytosine (C) always pairs with Guanine (G) with three hydrogen bonds.
- This base pairing ensures the stability of the double helix structure.

**24. What is the function of DNA in living organisms?**

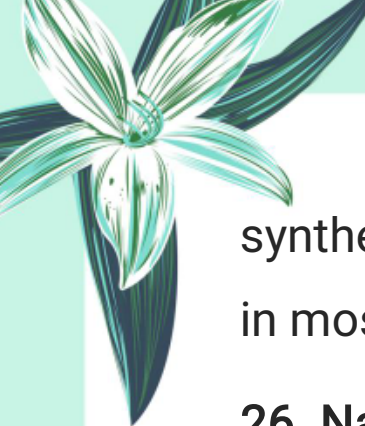
**Answer:**

DNA stores hereditary information and controls the synthesis of proteins by determining the sequence of amino acids. It is passed from parent to offspring during reproduction, ensuring continuity of genetic traits.

**25. What is RNA? How is it different from DNA?**

**Answer:**


RNA (Ribonucleic Acid) is a single-stranded molecule made of ribonucleotides. Its sugar is ribose, and it contains uracil (U) instead of thymine. Unlike DNA, RNA helps in the process of protein



synthesis and is not the permanent genetic material in most organisms.

**26. Name and give functions of three types of RNA.**

**Answer:**



1. **mRNA** (Messenger RNA): Carries genetic code from DNA to ribosomes.

2. **tRNA** (Transfer RNA): Brings amino acids to ribosomes during protein synthesis.

3. **rRNA** (Ribosomal RNA): Forms structure of ribosomes and assists in protein synthesis.

**27. What is transcription?**

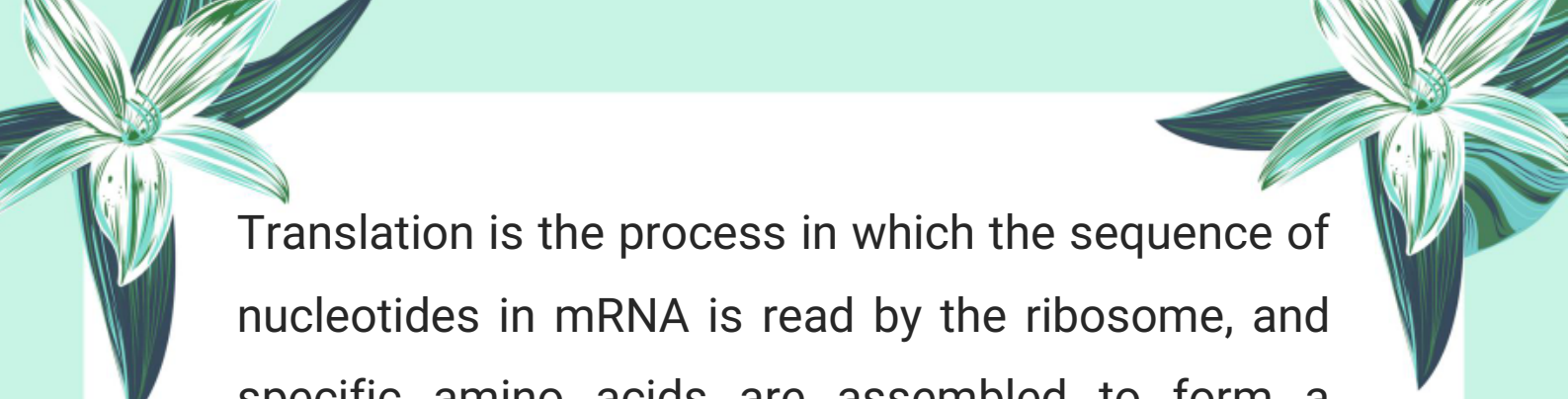
**Answer:**

Transcription is the process in which a messenger RNA (mRNA) strand is formed by copying the sequence of nucleotides from a gene on the DNA. This mRNA carries the code to the ribosome for protein synthesis.

**28. What is translation?**

**Answer:**






Translation is the process in which the sequence of nucleotides in mRNA is read by the ribosome, and specific amino acids are assembled to form a protein with the help of tRNA.

**29. What is a gene?**

**Answer:**



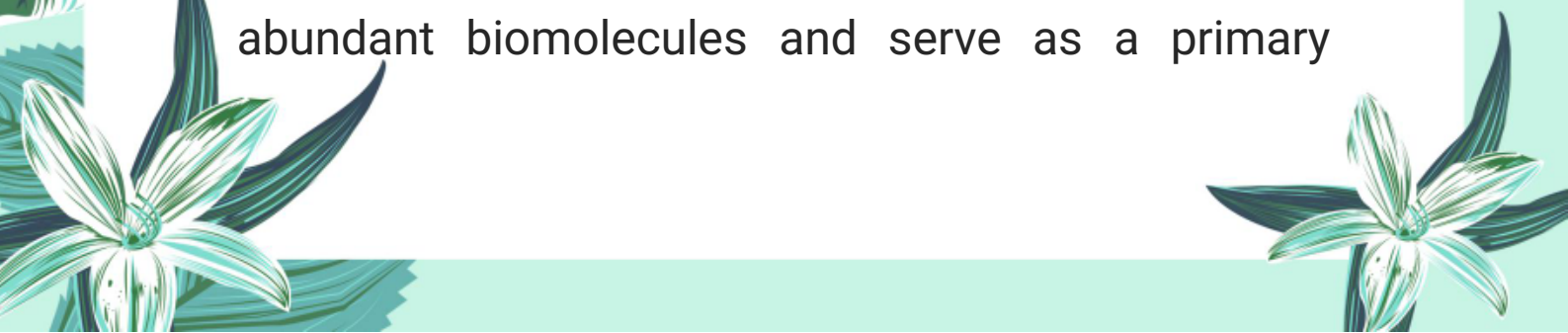
A gene is a specific segment of DNA that contains the instructions (sequence of nucleotides) for the synthesis of a particular protein. It is the basic unit of heredity.

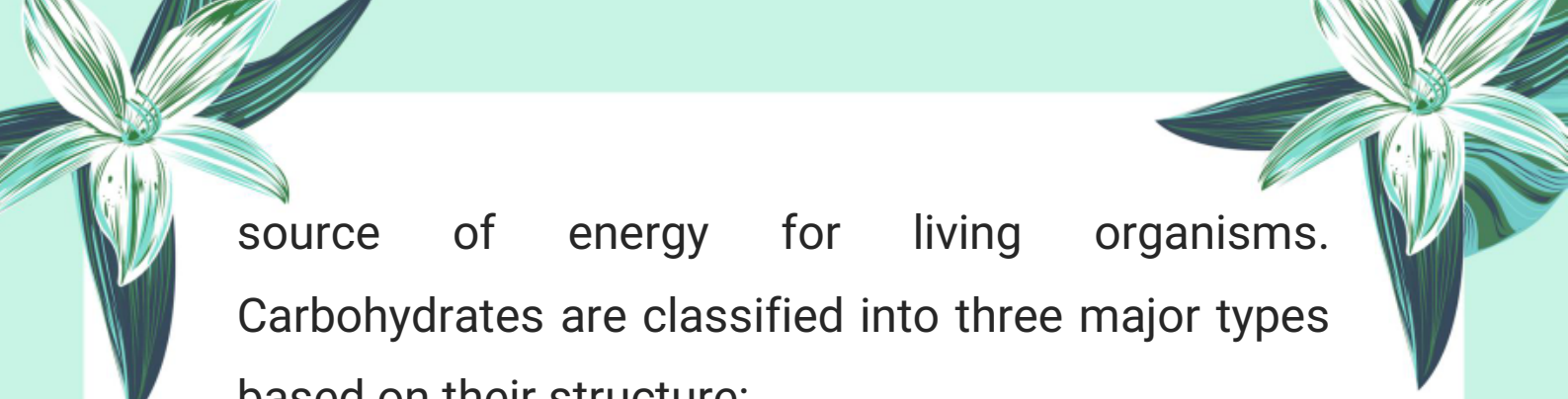
### **Important Long Questions:**

**Q1: Write a comprehensive note on the structures and roles of the three classes of carbohydrates.**

**Answer:**


Carbohydrates are organic compounds made up of carbon (C), hydrogen (H), and oxygen (O) atoms, usually in the ratio of 1:2:1. They are the most abundant biomolecules and serve as a primary





source of energy for living organisms. Carbohydrates are classified into three major types based on their structure:

### 1. Monosaccharides (Simple Sugars):



**Structure:** These are the simplest carbohydrates that cannot be broken down further by hydrolysis. Each monosaccharide molecule consists of a single sugar unit made of 3 to 7 carbon atoms.

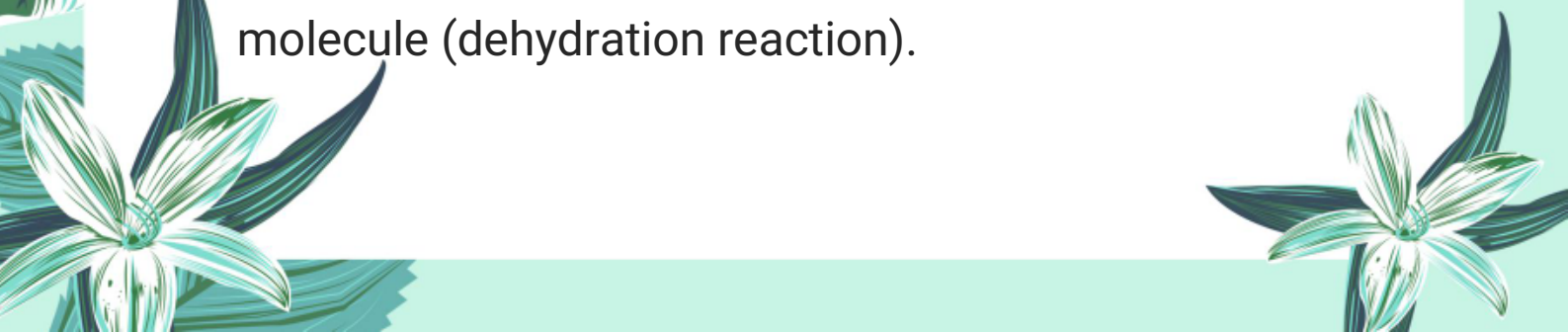
**Examples:** Glucose, fructose, and galactose.

**Role:**

- Glucose is the main source of energy for cells.
- Fructose (found in fruits) provides quick energy.
- Galactose is important in milk sugar (lactose).

### 2. Disaccharides:

**Structure:** These are formed by the combination of two monosaccharide molecules through a glycosidic bond with the elimination of a water molecule (dehydration reaction).





## Examples:

- Sucrose = Glucose + Fructose (table sugar)
- Lactose = Glucose + Galactose (milk sugar)
- Maltose = Glucose + Glucose (malt sugar)



## Role:

- Disaccharides are an energy source.
- They are broken down into monosaccharides during digestion for absorption.

## 3. Polysaccharides (Complex Carbohydrates):

**Structure:** Polysaccharides are long chains of hundreds or thousands of monosaccharide units.

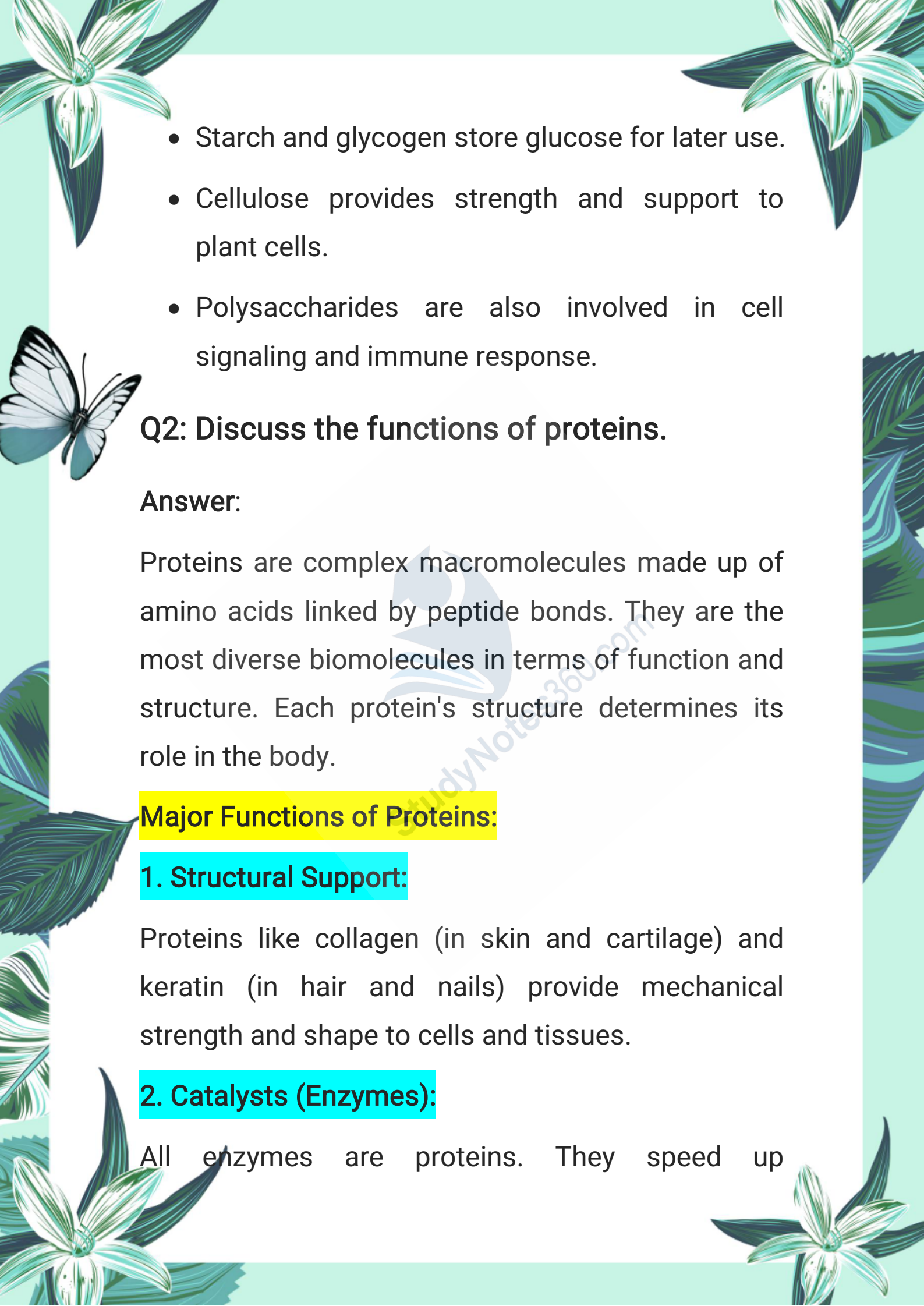
They can be branched or unbranched.

## Examples:

- **Starch:** Storage carbohydrate in plants.
- **Glycogen:** Storage carbohydrate in animals (especially liver and muscles).
- **Cellulose:** Structural component in the cell wall of plants.



## Role:

- 
- The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners, a white butterfly with black markings on its wings on the left side, and a large green leaf on the right side. The background is a light green color.
- Starch and glycogen store glucose for later use.
  - Cellulose provides strength and support to plant cells.
  - Polysaccharides are also involved in cell signaling and immune response.

## Q2: Discuss the functions of proteins.

### Answer:

Proteins are complex macromolecules made up of amino acids linked by peptide bonds. They are the most diverse biomolecules in terms of function and structure. Each protein's structure determines its role in the body.

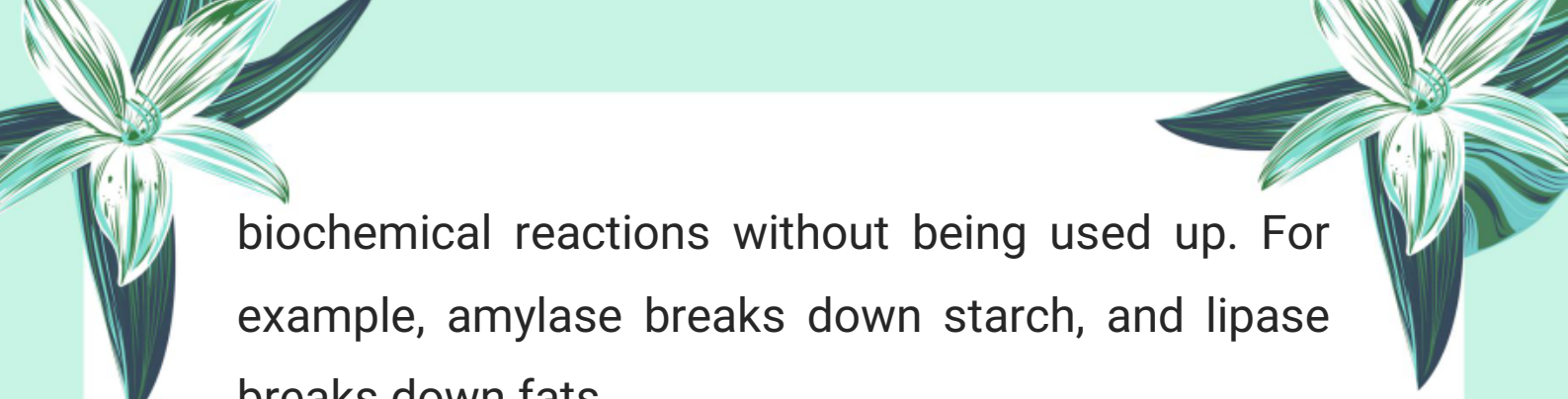
### Major Functions of Proteins:

#### 1. Structural Support:

Proteins like collagen (in skin and cartilage) and keratin (in hair and nails) provide mechanical strength and shape to cells and tissues.


#### 2. Catalysts (Enzymes):

All enzymes are proteins. They speed up



biochemical reactions without being used up. For example, amylase breaks down starch, and lipase breaks down fats.

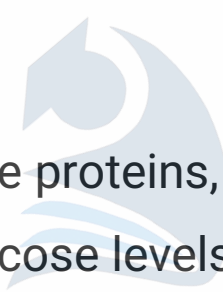
### **3. Transport:**



Hemoglobin, a protein in red blood cells, transports oxygen from lungs to body tissues.

Carrier proteins help in transporting molecules across cell membranes.

### **4. Hormones:**



Some hormones are proteins, such as insulin, which regulates blood glucose levels.

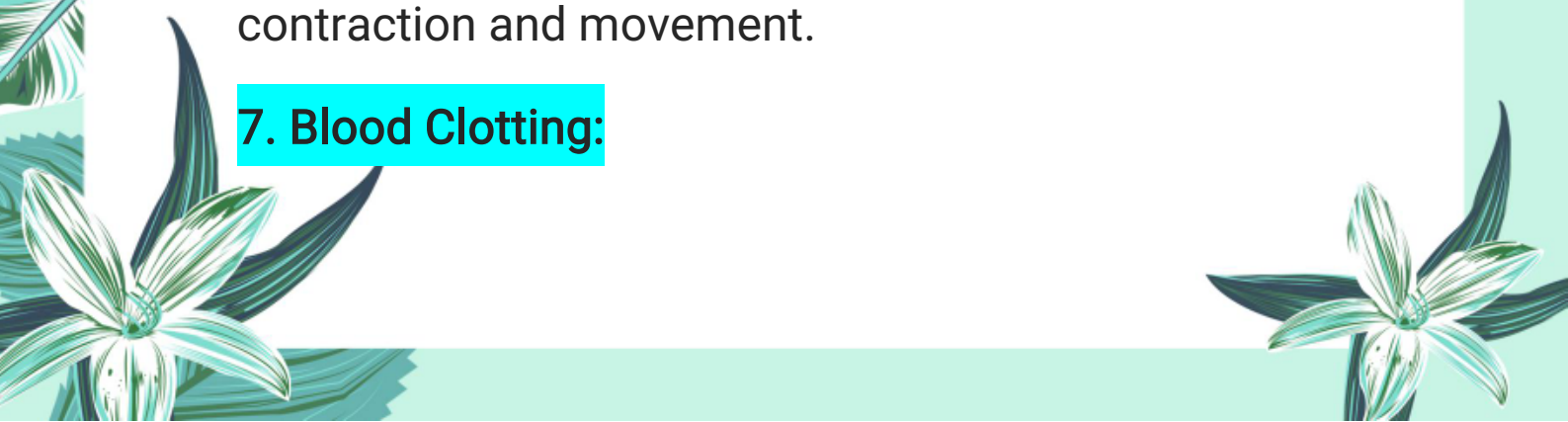
### **5. Immune Defense:**

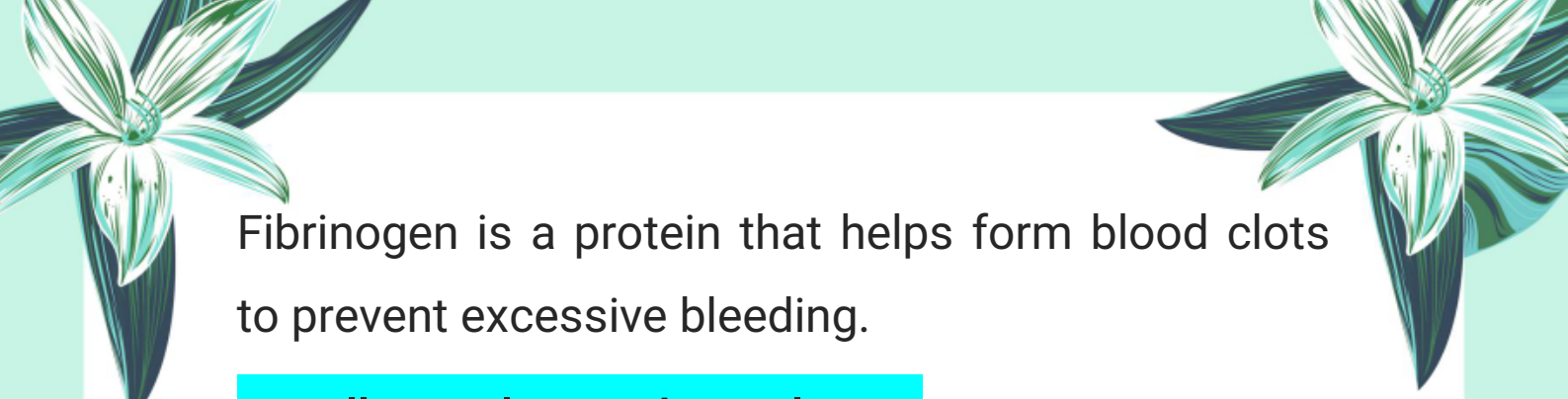
Antibodies are specialized proteins produced by white blood cells. They identify and neutralize harmful microorganisms.

### **6. Movement:**

Actin and myosin are proteins involved in muscle contraction and movement.

### **7. Blood Clotting:**





Fibrinogen is a protein that helps form blood clots to prevent excessive bleeding.

## 8. Cell Signaling and Regulation:

Proteins also act as receptors on cell membranes and help in communication between cells.

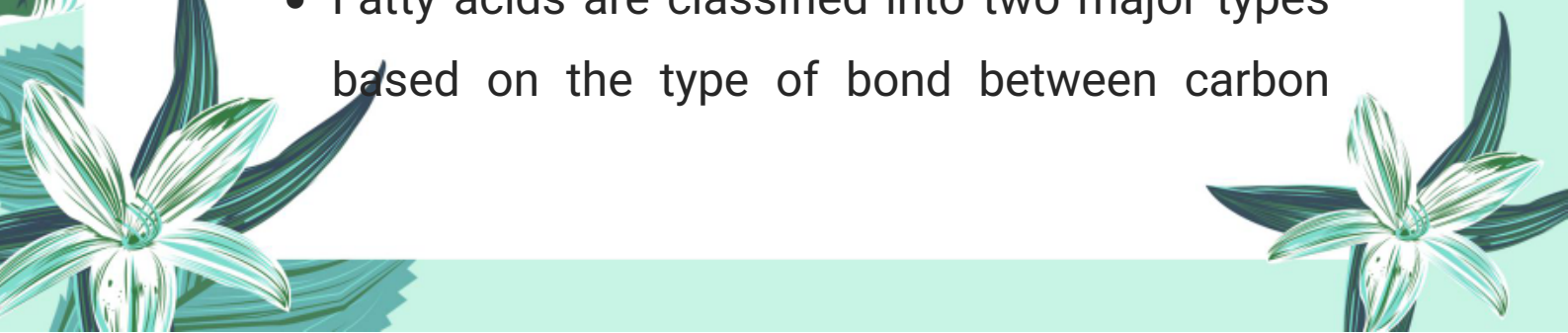


**Q3: What are fatty acids? Explain their types.**

**Answer:**

Fatty acids are long hydrocarbon chains with a carboxyl group (-COOH) at one end. They are the building blocks of many types of lipids, especially fats and oils.

### Structure of a Fatty Acid:

- A straight chain of carbon atoms (usually 14–22 carbons).
  - One end has a carboxyl group (-COOH).
  - The rest of the chain is made of hydrogen and carbon atoms.
  - Fatty acids are classified into two major types based on the type of bond between carbon
- 



atoms:

## 1. Saturated Fatty Acids:

**Structure:** All the carbon atoms are joined by single bonds. Each carbon is bonded to the maximum number of hydrogen atoms.

**Properties:**

- Solid at room temperature.
- Straight chains allow tight packing.
- **Examples:** Found in animal fats, butter, and cheese.
- **Health impact:** Excessive intake may lead to heart diseases.

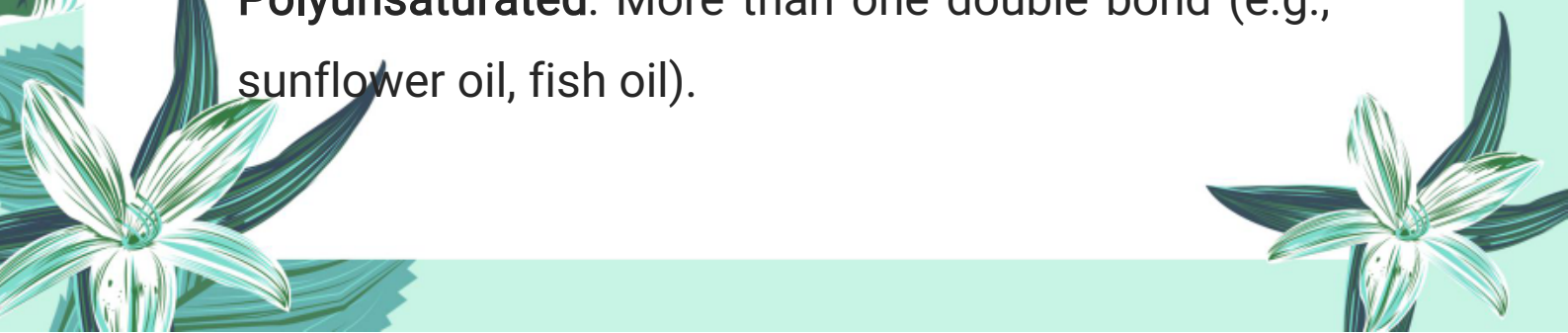
## 2. Unsaturated Fatty Acids:

**Structure:** Contain one or more double bonds between carbon atoms.

**Types:**

**Monounsaturated:** One double bond (e.g., olive oil).

**Polyunsaturated:** More than one double bond (e.g., sunflower oil, fish oil).



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## Properties:

- Liquid at room temperature.
- Double bonds introduce kinks, preventing tight packing.
- **Sources:** Plant oils, nuts, seeds, and fish.
- **Health impact:** Considered heart-healthy and help lower bad cholesterol.



**Q4: Describe the basic structure of fats and oils. Explain how lipids play a role in energy storage.**

### Answer:

Fats and oils are types of lipids, which are organic compounds insoluble in water but soluble in organic solvents like alcohol and ether. They serve as rich energy sources in living organisms.

### Structure of Fats and Oils:

- Both fats and oils are triglycerides.
- A triglyceride is formed when one molecule of glycerol (a 3-carbon alcohol) combines with three fatty acid molecules through a



condensation reaction, releasing three molecules of water.

- This bond between glycerol and fatty acids is called an ester bond.



### Fats:



- Composed mostly of saturated fatty acids.
- Solid at room temperature.
- Found in animal products (e.g., butter, meat fat).

### Oils:

- Contain mostly unsaturated fatty acids.
- Liquid at room temperature.
- Found in plants (e.g., olive oil, sunflower oil).

## Role of Lipids in Energy Storage:

### 1. High Energy Yield:

- Lipids store more than twice the energy compared to carbohydrates.
  - 1 gram of fat gives approximately 9 kcal, while carbohydrates give 4 kcal per gram.
- 
- 




## 2. Long-term Energy Storage:

Lipids are stored in adipose tissues (fat cells) and used when energy demand increases or during starvation.



## 3. Insulation and Protection:

- 
- Fat stored under the skin helps in thermal insulation.
  - Fats also cushion internal organs and protect them from mechanical shocks.



## 4. Water Source:

The breakdown of fats also produces metabolic water, important for animals like camels.

**Q4:.** Explain the double helix of DNA and discuss the base pairing in this structure.

**Answer:**

DNA (Deoxyribonucleic Acid) is the genetic material found in the nucleus of cells. It carries the instructions for protein synthesis and inheritance.



The page is decorated with various green and blue illustrations. In the top corners, there are stylized flowers with long, narrow petals. On the left side, there is a butterfly with white wings and blue markings. The bottom corners also feature floral designs. A large, faint watermark of a bird is visible in the center of the page.

## Double Helix Structure:

- Proposed by James Watson and Francis Crick in 1953.
- DNA is made of two long strands of nucleotides twisted into a double helix (spiral staircase).

### Each nucleotide has:

- A deoxyribose sugar
- A phosphate group
- A nitrogenous base

### Nitrogenous Bases:

1. **Purines:** Adenine (A), Guanine (G) – double-ringed.
2. **Pyrimidines:** Thymine (T), Cytosine (C) – single-ringed.

### Base Pairing Rule:

The nitrogenous bases form hydrogen bonds between the two strands:

- Adenine (A) always pairs with Thymine (T)

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through 2 hydrogen bonds.

- Cytosine (C) always pairs with Guanine (G) through 3 hydrogen bonds.
- This specific base pairing maintains the uniform width of the DNA and ensures accurate replication and transcription.

**Q5: Explain how the information in DNA is converted to RNA and then to proteins.**

**Answer:**

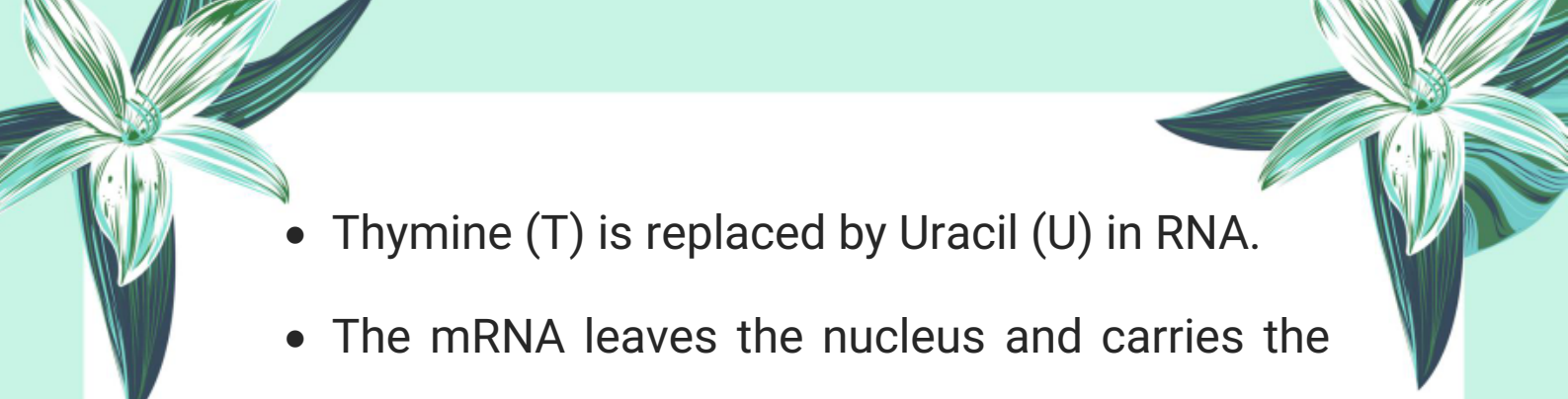
The conversion of genetic information from DNA to RNA and then to proteins occurs in two main steps: Transcription and Translation.

### **Step 1: Transcription (DNA to RNA)**


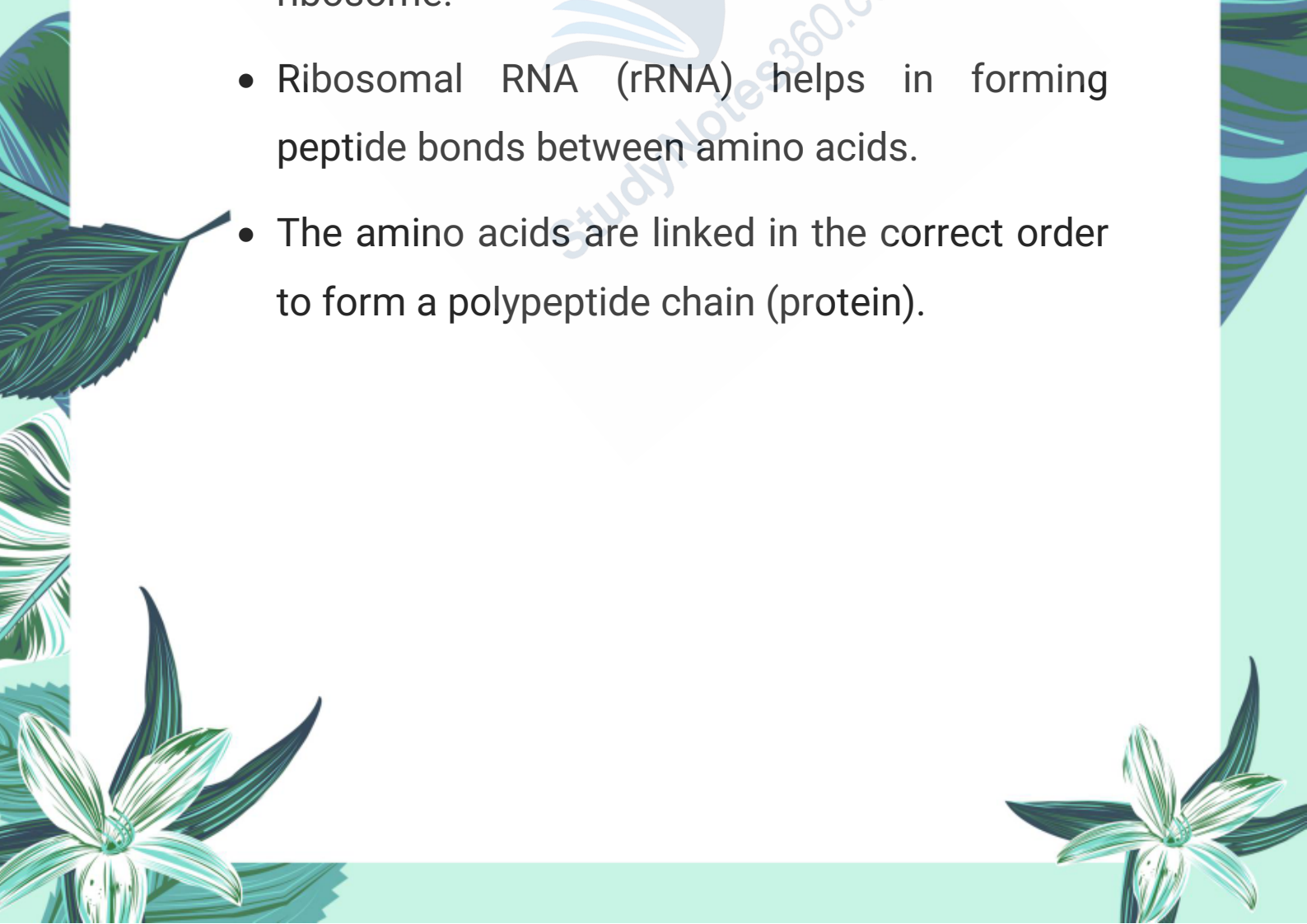
- Occurs in the nucleus.
- A specific segment of DNA (a gene) is copied into messenger RNA (mRNA) by the enzyme RNA polymerase.

**During this process:**

- Adenine (A) in DNA pairs with Uracil (U) in RNA.

- 
- Thymine (T) is replaced by Uracil (U) in RNA.
  - The mRNA leaves the nucleus and carries the genetic code to the ribosome.

## Step 2: Translation (RNA to Protein)

- 
- Occurs at the ribosome in the cytoplasm.
  - The mRNA is read in codons (three-letter nucleotide sequences).
  - Each codon codes for a specific amino acid.
  - Transfer RNA (tRNA) brings amino acids to the ribosome.
  - Ribosomal RNA (rRNA) helps in forming peptide bonds between amino acids.
  - The amino acids are linked in the correct order to form a polypeptide chain (protein).
- 



## Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

**Author: Muhammad Asghar**

**Purpose:** To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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