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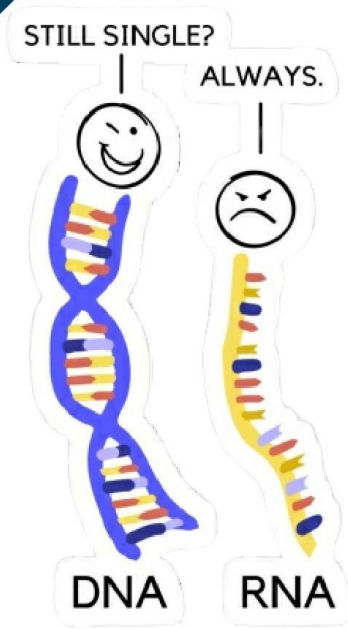

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UNIT 02

Chemical and Cellular Basis of Life

Proteins and Nucleic Acids

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Unit 02 Chemical and Cellular Basis o Life
Protein and DNA

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Biology

Unit - 02

Chemical and Cellular Basis of Life

- Protein and DNA

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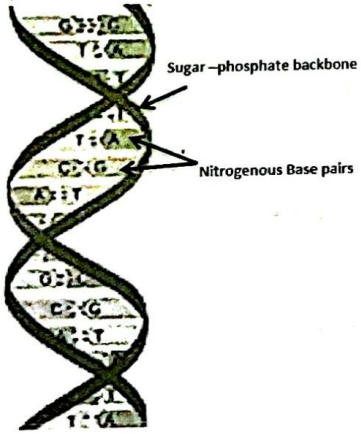
(b) Describe structure of DNA according to Watson and Crick model.

DNA molecule consists of two polynuclcotide chains
2. which are spirally arranged/spiral
3. around an imaginary axis and
4. forming a double helix.
5. Sugar-Phosphate backbones run in opposite directions
6. and is called antiparallel.
7. Sugar-Phosphate backbones are on outer side of the helix.
8. Nitrogenous bases are paired and
9. are interior (of the helix)
10. Two strands/chains are held (together) by hydrogen bonds
11. between two complementary nitrogenous bases.
12. Adenine/A pairs/binds with Thymine/T
13. Guanine/G pairs binds with Cytosine/C (If written as purines pair/bind with pyrimidines, consider as one point instead of 12 and 13)
14. Two hydrogen bonds between Adenine/A and Thymine/T.
15. Three hydrogen bonds between Guanine/G and Cytosine/C. **(Should be written in words, A=T x, G≡C x)**
16. Two chains/strands are complementary to each other.
17. DNA double helix one complete turn of 10 (nitrogenous) base pair.

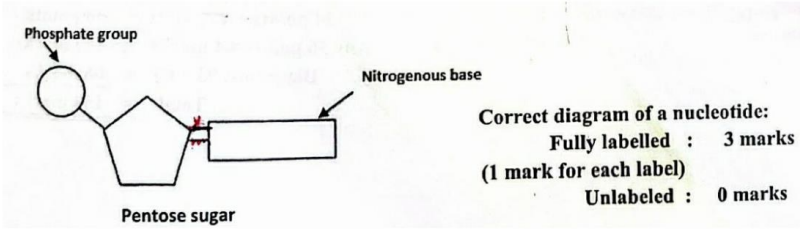


Correct diagram of DNA structure
Fully labelled correct diagram : 3 marks
(1 mark for each label)
Unlabeled diagram : 0 marks

24 points + ~~16~~ points = ~~30~~ points
Any 36 points × 4 marks = 144 marks
Diagrams: 03 + 03 = 06 marks
Total = 150 marks

17. (a) Describe the components of nucleotides and explain how nucleotides form backbone of DNA.

1. A nucleotide consist of pentose sugars
2. Nitrogenous bases and
3. Phosphate group
4. Two types of pentose sugars
5. Deoxyribose sugars
6. Ribose
7. In deoxy ribose, one oxygen atom is less than that in ribose/one oxygen atom is more than that of deoxyribose.
8. Two types of nitrogenous bases
9. Purines
10. Pyrimidines
11. Purines have two rings and
12. Pyrimidines have one ring
13. Pyrimidines ate smaller in size (than purines)/ Purines are larger in size (than pyrimidine)
14. Two types of purines
15. Adenine/A and
16. Guanine/G.
17. Three types of pyrimidines
18. Thymine/T
19. Uracil/U and
20. Cytosine/C.
21. Nucleotides in DNA/Deoxyribonucleotides join by phosphodiester bonds and
22. Form polynucleotide chain.
23. By condensation between OH group of phosphate of one nucleotide with OH group of 3rd carbon of deoxyribose sugars another /adjacent nucleotide (in DNA)
24. These bonds resulting with a backbone with a repeating pattern of sugar phosphate units.
25. Sugar molecules of DNA/Deoxyribonucleotides of DNA
26. Deoxyribose nucleotide contain Adenine/A, Thymine/T, Guanine/G, and Cytosine/C.
27. Sugar (molecule) of RNA is ribose.
28. RNA/Ribonucleotides contain Adenine/A, Guanine/G, and Cytosine/C and Uracil/U.



Correct diagram of a nucleotide:
Fully labelled : 3 marks
(1 mark for each label)
Unlabeled : 0 marks

ADVANCED LEVEL

Biology THEORY

in English Medium

New Syllabus

Unit 02 **Chemical and Cellular Basis of Life**

- Protein and DNA

Smart Note

SAMPATH LANKADHEERA

B.Sc. (Hons), M.Sc.

Exhilarating experience of delving in to Biology

PROTEINS

- Proteins are made up of …….. Twenty different amino acids are involved in the formation of proteins. Elemental composition is ……, ……., ……, ……. and ……... At the center of the amino acid is an …….... carbon atom except in glycine. Each amino acid is composed of an ……..., ……..., a …….... and a variable group symbolized by ……..., which is an ……. group. In the case of ……..…... R is replaced by H atom. The R group also called the '……' differs with each amino acid where as the other groups are in the ' ……' (including the H atom).

16. a) Describe the structure of DNA

1. DNA molecule consists of two polynucleotide chains
2. which form a double helix.
3. These chains run in opposite direction/chains are antiparallel.
4. Nucleotides are arranged linearly in polynucleotide chains.
5. Nucleotide consists of 3 parts:
6. nitrogenous base,
7. deoxyribose sugar and
8. phosphate group/PO_4^{3}-
9. Two types of nitrogenous bases
10. Purines and
11. Pyrimidines

Purines are

12. Adenine and
13. Guanine

Pyrimidines are

14. Cytosine and
15. Thymine.
16. Adjacent nucleotides are linked through phosphor-diester bonds
17. forming sugar phosphate back bone which are
18. linked through complementary bases
19. Adenine binds with Thymine
20. by two hydrogen bonds
21. Guanine binds with cytosine
21. by three hydrogen bonds

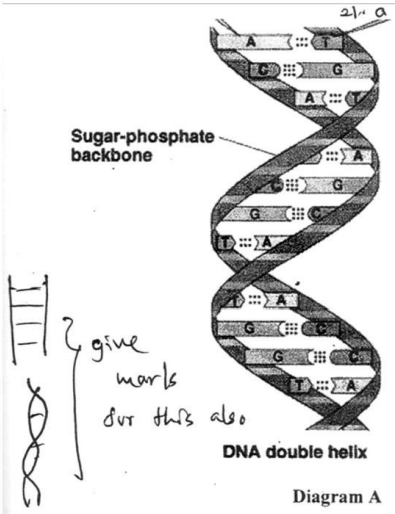


Diagram A

Fully labeled diagram	6 marks
Partially labeled diagram	3 marks
Unlabelled diagram	no marks

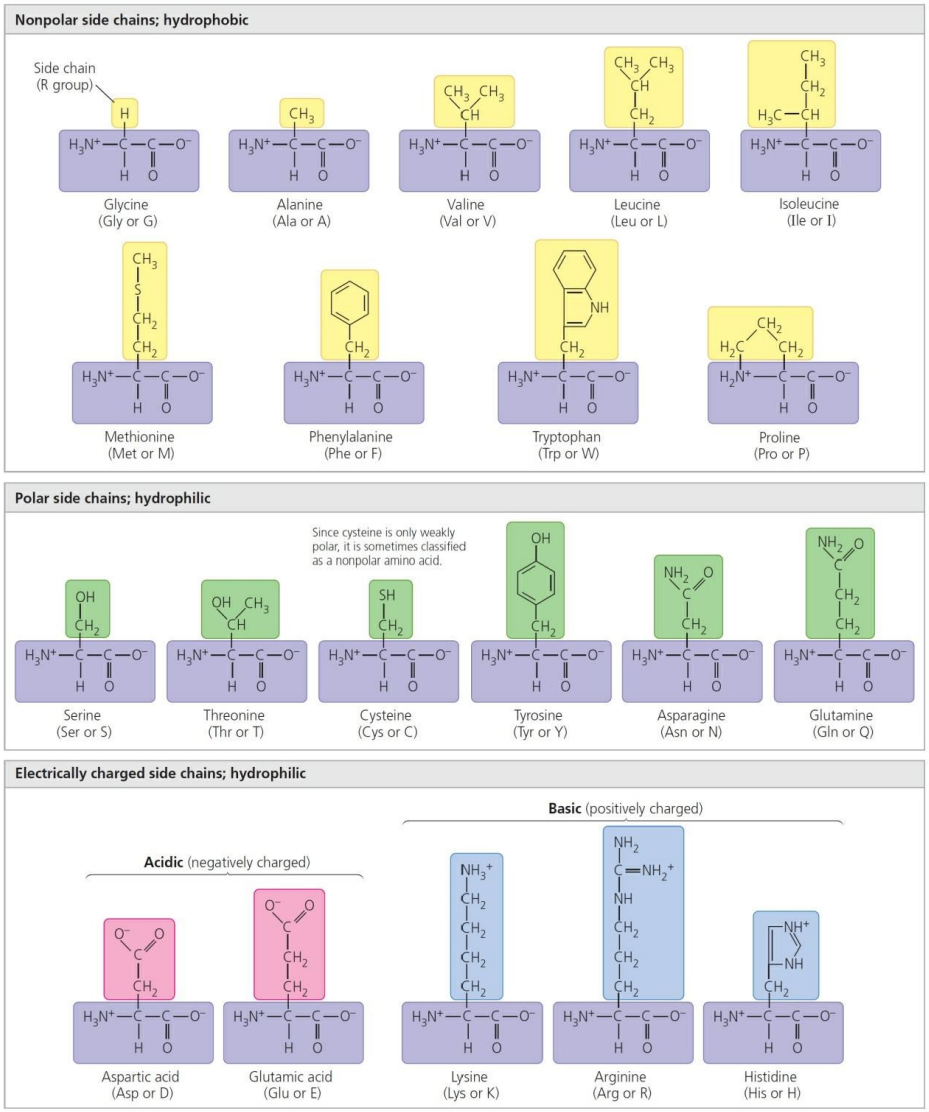
(1 & 2)

Essay 03

16. Describe the structure of the DNA molecule. (AL/2000 and 2014)

17. (a) Describe the components of nucleotides and explain how nucleotides form backbone of DNA.
(b) Describe structure of DNA according to Watson and Crick model.

- Amino acids may have one or more carboxyl groups and amino groups. Amino group has …… nature and carboxyl group has ……..……. nature. When both characteristics are found in one molecule they are known as amphoteric molecules. Therefore, amino acids are as …… Two Amino acids undergo condensation reaction by removing a water molecule from both and result a bond known as peptide bond; -OH group one amino acid –H group of other amino acid join to form water molecule.
- Protein is composed of one or more polypeptide chains which are composed of amino acids.



(vii) DNA molecule with 8000 nucleotides have 60% Guanine + Cytosine, Find number of Adenine, Cytosine and total hydrogen bonds.

(viii) DNA molecule has 24000 nucleotides. Out of that 20% is adenine. Count the purine number, guanine number and total H – bonds.

(ix) Particular DNA molecule has 3000 cytosine molecules and 15000 hydrogen bonds. Find the number of adenine bases present in these molecule.

(x) 23.7 % of a DNA molecule contains Adenine. Find the % of purine in the molecule.

(i) What is the distance between 2 base pairs.
(ii) What is the length of a DNA molecule with 200 base pairs.

(ii) How many base pairs in a DNA molecule with 40.8 nm.

(iii) A DNA molecule has 36000 nucleotides. 40% of that is Cytosine. How many Guanine present in the molecule. How many hydrogen bonds present.

(iv) DNA with 20000 nucleotide pairs have 20% adenine. Find number of Guanine nucleotides in the molecule and total number of hydrogen bonds.

(v) DNA with 40000 nucleotide have 15% adenine. Count number of purine and its %. How many H – bonds present.

(vi) DNA molecule has 12000 nucleotides. 30% of that is adenine. Find number of Guanine, Thymine and H –bonds.

Levels of Protein Structures

- There are four levels of structure which play important roles in their functions;
  1. Primary 2. Secondary 3. Tertiary 4. Quaternary

Primary structure

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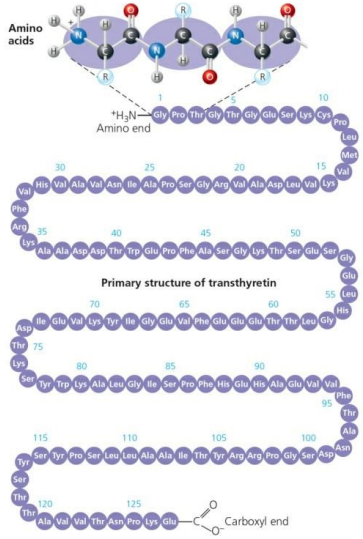
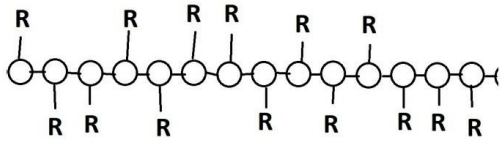
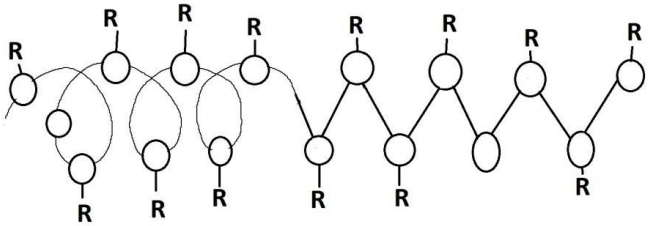
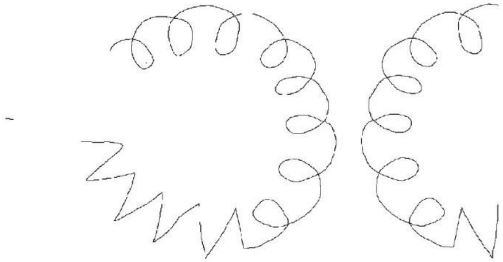
.....
.....
.....
.....









(vii) What is the field of science developed with the discovery of structure of DNA.

……

(viii) This is the sequence of a piece of a DNA molecule. AGATCGATTCAG. Write the sequence of the complimentary strand.

……

(ix) How many H-Bonds are broken during replication of above DNA piece.

……

(x) State why A+G/C+T ratio is one for DNA.

……

(xi) Particular DNA molecule has 3000 cytosine molecules and 15000 hydrogen bonds. Find the number of adenine bases present in these molecule.

……

……

……

(x) Give differences present in RNA compared to DNA

……

……

……

……

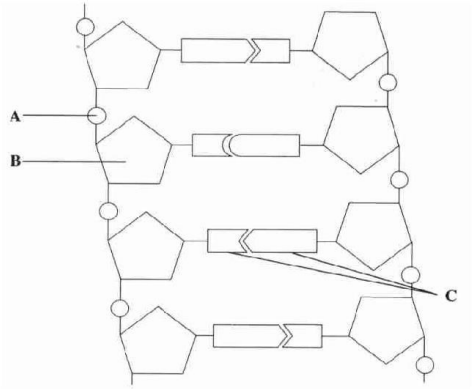
45. The drawing shows a DNA molecule.

(i) Name the part labeled

A - ……..

B - ……..

C - ……..



(i) (a) Label 1,2,3 and 4.

……

……

(b) Identify the nucleotide of above diagram and circle it. (Should include nitrogenous base, deoxyribose sugar, phosphate to the circle)

(ii) How RNA differ chemically from DNA

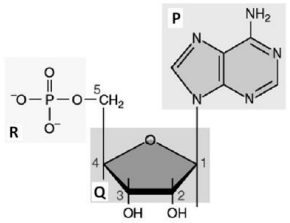
……

……

(iii) State RNA types present in an eukaryotic cell and state function of each of them.

RNA type	Function

44. Following diagram shows a nucleotide. Answer questions based on it.



(i) The group shown in P, is it a purine or a pyrimidine. State how did you decide that.

……

(ii) Except DNA and RNA what are other molecules contain nucleotides.

……

(iii) What are other molecules contain $PO4^{-3}$ except nucleotides.

……

(iv) How ATP are different to other Nucleotides.

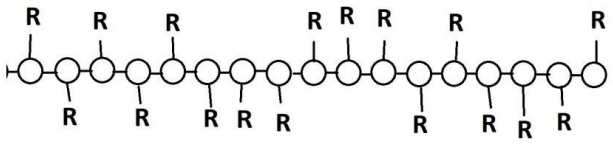
……

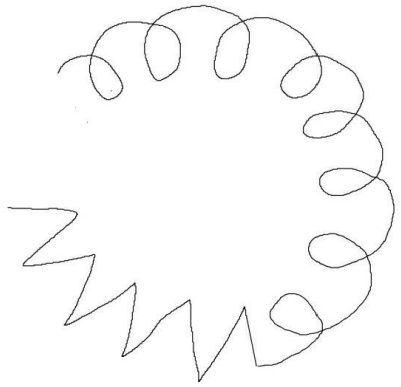
(v) What are advantages of having H-bonds in DNA.

……

(vi) What are bonds formed between nucleotides to form a polynucleotide strand.

……





Secondary Structure

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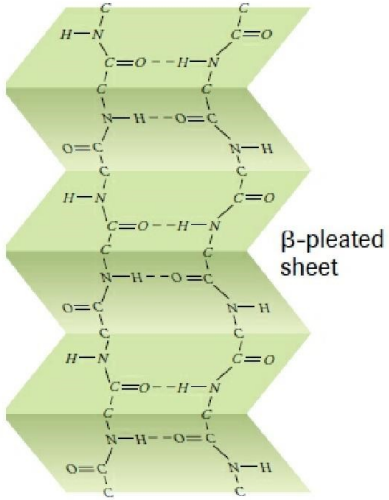
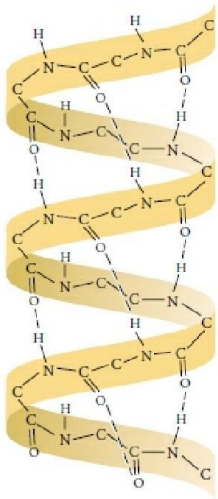
1. Alpha helix Eg: Keratin.
2. β pleated sheet Eg: Spider silk fiber



β-pleated sheet



α helix

(b) Name (i) a structural protein and (ii) a transport protein found in organisms and indicate the specific function of each of them.

Protein	Specific function
(i)	
(ii)	

(iii) (a) What are the four nitrogenous bases in a DNA molecule?

.....

(b) Indicate the correct combination of pairing of these bases in a DNA molecule .

.....

.....

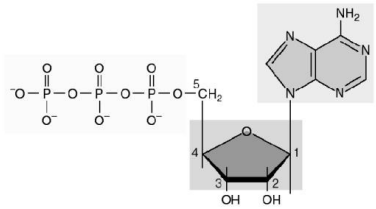
B Briefly explain how the presence of the following bio-chemicals in a sample is tested using simple laboratory methods.

Albumin

.....

.....

42. A. (i) Given below is a diagram of molecular structure of an important biological molecule.



(a) What is the chemical name of this molecule?

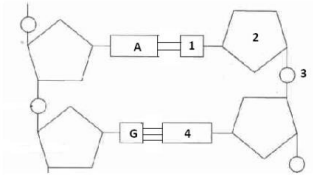
.....

(b) Name the three constituents of this molecule .

.....

43. **GCE/AL 2011 New Syllabus**

(A) The diagram given above shows a part of the DNA molecule.



(ii) Write three features of DNA, which are necessary for its function as hereditary material of organisms.

……

……

……

B. (i) Name two sites outside the nucleus of an eukaryotic cell where RNA is found.

…… ……

(ii) Name the site of an eukaryotic cell where RNA is synthesized.

……

(iii) State three structural differences between DNA and RNA .

DNA RNA

……

……

……

(iv) State **three** functions of RNA

……

……

……

C. (i) Name the **three** essential components of a nucleotide.

……

……

……

(ii) Name **three** nucleotides other than those found in DNA and RNA and state one function of each of them.

Nucleotide **Function**

…… ……

…… ……

…… ……

41. **AL/2012 (Old)**

A. (ii) (a) Draw a figure to show the basic chemical structure of a simple amino acid.

Tertiary structure

……

……

……

……

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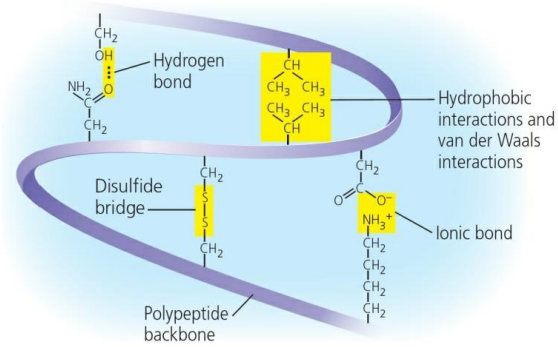
1. H bonds
2. Disulphide bonds
3. Ionic bonds
4. Hydrophobic interactions and Van der Waals interactions

Eg: Most Enzymes, Myoglobin, Albumin



Quaternary structure

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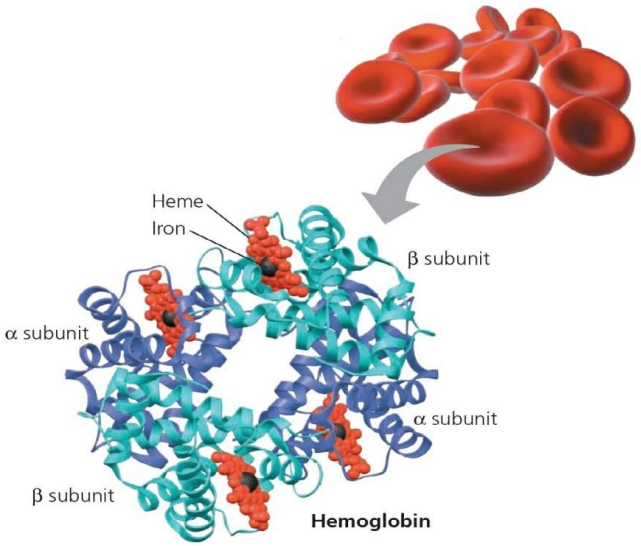
Eg. Haemoglobin, Collagen



Hemoglobin

Denaturation of proteins

- Denaturation of protein is the loss of specific three dimensional shape due to alteration of weak of weak chemical bonds and interactions.

Agents affecting the denaturation

1. High temperature and high energy radiation
2. Strong acids, alkaline and high concentrations of salts
3. Heavy metals
4. Organic solvents and detergents

33. Which of the following symbolic representations of base pairing of DNA is/are correct?
(A) A = T (B) C ≡ G (C) A ≡ T (D) C = T (E) A = U (AL/2009)

34. Which one of the following contains Sulphur?
(1) DNA (2) Lipids (3) Proteins (4) Chitin (5) Inuline (2012 new)

35. Phosphorous is a structural element in which of the following?
(A) Proteins (B) Carbohydrates (C) Lipids (D) Nucleic acids (E) Chlorophylls (2013 new)

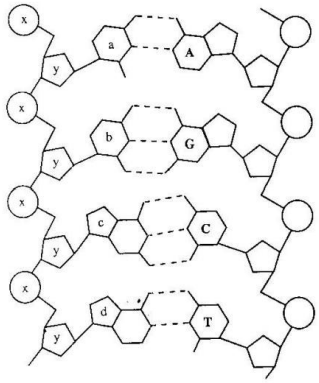
36. Which of the following features is/are common to both DNA and RNA?
(A) Both are polymers of nucleotides. (B) Both have identical sugar molecules.
(C) Both are genetic material. (D) Both have pyrimidine and purine bases.
(E) Both are double stranded. (2013 new)

37. Which of the following statements is incorrect?
(1) Ratio of the number of hydrogen atoms to the number of oxygen atoms in a carbohydrate molecule is 2:1
(2) Protein always contain C, H, O and N.
(3) Ratio of number of Hydrogen atoms to Oxygen in a lipid molecule is 1:2.
(4) Amino acids of proteins do not contain P.
(5) The sugar component of nucleotides of DNA is always a five carbon molecule. (1997/Bot)

38. The base Adenine (A) of DNA of an organism forms 23.3% of its composition. Which of the following is the most likely base composition of its DNA?
(1) A = T 23.3% and G = C 23.3% (2) A = T 26.7% and G = C 26.7%
(3) A = T 23.3% and G = C 26.7% (4) A = T 26.7% and G = C 23.3%
(5) A = T 23.3% and G = C 76.7% .

Nucleic Acid *Exam Questions*

40. A/L 2006



A The above diagram is a representation of part of a DNA molecule.

(i) Name the components labelled a, b. C. d, x and y.

a..... b .....

c..... d .....

x ..... y .....

19. Which of the following statement is incorrect regarding DNA'?
(1) DNA determine the structure of proteins (2) One gene is different from other by DNA sequence
(3) RNA can synthesize by DNA (4) RNA can produce DNA
(5) Slight changes of DNA may change gene entirely

20. Which of the following is incorrect regarding DNA structure?
(1) DNA has 4 different types of nucleotides (2) Purines are always paired with pyrimidines
(3) 2 hydrogen bonds present between A and T (4) 3 hydrogen bonds present between G and C
(5) Nucleotide has sugar and base group

21. A+T/C+G ration of DNA
(1) Constant for a species and varies between species (2) Constant for all, regardless of the species
(3) Have a constant value for plants and animals (4) Different from one animal tissue to another
(5) Highly variable value

22. Which of the following is incorrect regarding RNA?
(1) They are mostly present as single stranded structures
(2) Purines of DNA is similar to that of RNA (3) RNA bears the protein coding signal
(4) Pyrimidine of DNA is similar to that of RNA (5) RNA under go high level of mutation

23. Deoxyribonucleic acids are a polymer of
(1) Deoxyribose (2) Deoxyribose nucleotide (3) Purine bases (4) Pyrimidine bases (5) Ribose

24. If the 20% out of 10000 nucleotides are adenine, then the number of cytosine bases
(1) 2000 (2) 3000 (3) 4000 (4) 6000 (5) 8000

25. If the base sequence of a DNA template is AGCGCAT. Then what is the sequence of the complementary DNA strand.
(1) UCGCGCA (2) TCGCCGA (3) TCGCCTTA (4) ATGCGCT (5) TCGUATT

26. Select the incorrect sentence
(1) DNA is coded by RNA (2) DNA is required for protein synthesis (3) RNA is coded by DNA
(4) RNA is required for proteins synthesis (5) DNA, RNA and proteins are polymers

27. What is the number of different nucleotides present in living organisms?
(1) 2 (2) 4 (3) 5 (4) 8 (5) 10

28. Which of the following statements is incorrect for both DNA and RNA?
(1) replicate to produce identical strands. (2) Store genetic information.
(3) are polymers of nucleotides. (4) are found as essential constituents in higher plant cells.
(5) are linear un-branched polymer molecules. (92/Bot)

29. Which of the following does not contain phosphorous as a constituent?
(1) DNA (2) ATP (3) RNA (4) Lipid (5) Protein. (94/bot)

30. Which of the following compounds does not contain nitrogen as a constituent?
(1) RNA (2) Ribose (3) ATP (4) Chitin (5) Chlorophyll

31. Which one of the following biological molecules is not a polymer?
(1) RNA (2) Starch (3) ATP (4) Glycogen (5) Cellulose (AL/2004)

32. Which of the following three nitrogenous bases are common to both RNA and DNA?
(1) Cytosine, uracil and adenine (2) Cytosine uracil and thymine (3) Guanine adenine and thymine
(4) Cytosine adenine and thymine (5) Cytosine, guanine and adenine (AL/2008)

Functions of the proteins

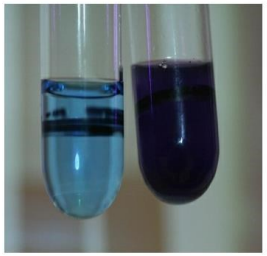
Type of protein	Example	Functions
Catalytic protein	Pepsin, Amylase	Catalyze biochemical reaction
Structural protein	Keratin	Prevent desiccation
	Collagen	Provide strength and support
Storage	Ovalbumin	Storage protein in egg
	Casein	Storage protein in milk
Transport	Haemoglobin	Transport O_2 and CO_2
	Serum albumin	Transport fatty acids
Hormones	Insulin	Regulate blood glucose level
	Glucagon	
Contractile/ Motor	Actin/Myosin	Contraction of muscle fibres
Defensive	Immunoglobins	Eliminate foreign bodies

Tests for Proteins

- Dissolve egg white and water in 1: 5 ratio to prepare protein solution.

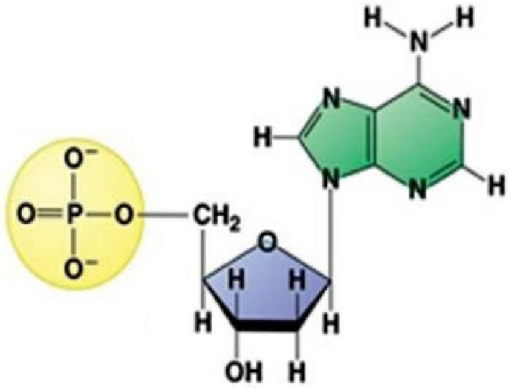
Biuret Test

- Add 2ml of proteins solution to a test tube. Add equal volume of 5% Potassium hydroxide (KOH) solution or sodium hydroxide solution (NaOH).
- Then add few drops of 1% $CuSO_4$ solution. Mix the content well and leave for several minutes. (10-20 min).
- If a purple coloured solution results, it will conforms the presence of proteins.
- This is a test for peptide bonds of a protein.



Nucleic acids

- Nucleic acids are Polymers exist as polynucleotides made up of monomers called nucleotides.
- They contain ....., ..., ..., ... and ..... Nucleic acids are macromolecules, biopolymers.
- There are two types of Nucleic acids:
  1. DNA (Deoxyribonucleic acids) and
  2. RNA (Ribonucleic acids).



- Form as a result of intra molecular hydrogen bonds, of the same poly peptide chain backbone.
- Secondary structure, which is either β pleated or alpha helical.
- Alpha helix- eg. Keratin.
- β pleated sheet eg. spider's silk fiber
- Tertiary structure:
- Usually the secondary polypeptide chain bends and folds extensively forming a precise compact unique, functional and three-dimensional shape resulting from following interactions between the side chain/R-group of amino acids;
- H bonds
- Di-sulphide bonds
- Ionic bonds
- Van der Waals interactions/Hydrophobic interactions
- eg. most of the enzymes, myoglobin, albumin
- Quaternary structure:
- Aggregation of two or more polypeptide chains involve in the formation of one functional protein.
- Separate chains are called protein subunits which were held together by inter and intra-molecular interactions.
- eg. Haemoglobin, Collagen
- Since peptide bond present proteins answers for biuret test to form a purple solution.

Functions of the proteins

•	Catalytic protein	Pepsin, Amylase	Catalyze biochemical reaction
•	Structural protein	Keratin),	Prevent desiccation
		Collagen	Provide strength and support
•	Storage	Ovalbumin	Storage protein in egg
		Casein	Storage protein in milk
•	Transport	(Haemoglobin)	Transport O_2 and CO_2
		Serum albumin	Transport fatty acids
•	Hormones	Insulin	Regulate blood glucose Glucagon level
•	Contractile/Motor	Actin/Myosin	Contraction of muscle fibres
•	Defensive	Immunoglobins	Eliminate foreign bodies

Nucleic Acids/MCQ

14. Which of the following statement is correct regarding DNA?
    (1) Uracil is one of the base of it (2) They are absent in virus (3) It has 2 identical strands
    (4) DNA is a structural component of ribosomes
    (5) DNA determines the structure of proteins

15. The back bone of the DNA molecule is made of,
    (1) Purines (2) Pyramidine (3) Sugar phosphate groups (4) Deoxyribose (5) Nucleotides

16. The double helix structure of DNA molecules were proposed by,
    (1) Pasture (2) Mendel (3) Watson (4) Darwin (5) Leeuwenhook

17. DNA molecule can be described as,
    (1) As a double helix (2) Self replicate structure (3) Polymer of nucleotides
    (4) Special form of stored memory (5) As a molecule posses all above properties

18. Which of the following base pairing is not present in DNA?
    (1) A = T (2) C Ξ G (3) G Ξ C (4) C Ξ A (5) T = A

Giving suitable examples, write an account of the basic chemical features and biological functions of proteins. (Model Question)

Answer

- Proteins are made up of amino acids.
- Twenty different amino acids are involved in the formation of proteins.
- Elemental composition is C, H,O,N and S.
- At the centre of the amino acid is an asymmetric carbon atom.
- Each amino acid is composed of an amino group, a carboxyl group, a hydrogen atom and a variable group symbolized by R.
- The R group also called the 'side chain' differs with each amino acid where as the other groups are in the ' back bone' (including the H atom).
- Amino acids may have one or more carboxyl groups and amino groups.
- Amino group has alkaline nature and carboxyl group has acidic nature.
- Therefore, amino acids are amphoteric.
- Two Amino acids undergo condensation reaction by removing a water molecule from both and result a bond known as peptide bond;
- There are four levels of structure which play important roles in their functions;
- Primary structure:
- is the unique sequence of linearly arranged amino acids linked by peptide bonds.
- Secondary structure:

Pentose sugar

- Pentose sugars are two types: namely deoxy ribose and ribose (in deoxy ribose one oxygen atom is less than ribose)

Phosphate group

- It gives the nucleic acids the acidic nature.

Nitrogenous bases

- There are two major groups of nitrogenous base;
  1. Purines - .....
  2. Pyrimidines - .....
- In purines there are two types; namely Adenine (A), Guanine (G).
- In pyrimidines there are three types, thymine (T), uracil (U) and cytosine (C).
- Bases are commonly represented by letters A, G, T, U and C respectively.

10. Which of the following best represents the elemental composition of proteins?
    (1) C,H,O (2) C, H, O, P (3) C, H, O, N, P (4) C, H, O, N, S (5) C, H, O, N, P, S (Bot/96)

11. Which one of the following elements is a constituent of all proteins?
    (1) calcium (2) nitrogen (3) phosphorous (4) sulphur (5) iron (1999/Zoo)

12. Which of the following statement is correct?
    (1) Sucrose gives a brick red precipitate when heated with Feshling's solution
    (2) Albumin gives violet colour when heated with alkaline copper sulphate
    (3) Lignin stained yellow with Safranin. (4) Coconut oil is stain yellow with Sudan III
    (5) Glycogen gives a blue black colour with iodine solution.

Essay 02

13. Giving suitable examples, write an account of the basic chemical features and biological functions of proteins. (Model Question)

Structured Essay

1. (a) In the space given below, show using suitable diagrams, how a peptide bond is formed between two amino acid molecules. (2015 AL)

   (b) What is the test used to detect the presence of peptide bonds in proteins?

   .....

2. What are agents of denaturation

   .....
   .....

3. How protein denaturation differ from protein digestion.

   .....
   .....
   .....
   .....

Proteins

4. One of the following is not a Protein.
   (1) Glycogen (2) Keratin (3) Amylase (4) Collagen (5) Lipase

5. Which of the following is not a protein?
   (1) Albumin (2) Hemoglobin (3) Histone (4) Chitin (5) Trypsinogen

6. The enormous diversity of protein molecules is related to
   (1) Amino groups on amino acids. (2) R groups on amino acids.
   (3) Presence of peptide bonds.(4) Amino acid sequences.
   (5) The tertiary structure of protein molecules. (92/zoo)

7. Sulphur is essential for plant growth. This element is a component in,
   (1) Polysaccharides (2) Chlorophyll (3) Proteins (4) Cellulose (5) RNA

8. Which of the following is not a carbohydrate?
   (1) Keratin (2) Chitin (3) Glycogen (4) Sucrose (5) Cellulose

9. Which of the following compound has sulphur as an element?
   (1) RNA (2) Starch (3) Chlorophyll (4) Proteins (5) Cellulose

Structure of nucleotides

- Nucleotides have 3 components; namely
  1. Pentose sugar
  2. Nitrogenous base
  3. Phosphate group

Nucleotides

Ribonucleotide	Deoxyribonucleotide

PRACTICAL NO: 1

Identification of starch, non-reducing sugars, reducing sugars, proteins and lipids using simple laboratory tests

Objectives

- Students should be able to

1. conduct tests to identify the biomolecules of given food materials,
2. follow laboratory procedures accordingly,
3. conduct experiments with due care,
4. record procedures and observations,
5. present the obtained results analytically.

Materials and equipment

- 1% lactose solution
- 1% fructose solution
- 1% glucose solution
- 1% sucrose solution (Analar sucrose)
- 1% starch solution (corn flour is recommended)
- Coconut oil or Sesame oil
- Egg albumin
- Iodine in Potassium Iodide solution
- Diluted HCl/H_2SO_4
- Sodium Hydrogen Carbonate ($NaHCO_3$)
- Benedict's reagent
- Sudan III
- 5% Potassium hydroxide solution
- 1% Copper sulphate solution
- pH papers
- Test tubes
- Test tube rack
- Bunsen burner
- Spatula
- $1cm^3$ syringe

Instructions

- Demonstrate simple laboratory tests to identify starch, non-reducing sugars, reducing sugars, proteins and lipids (appendix I).
- Provide (relevant pure forms of) food materials and equipment for the students.
- Guide students wherever necessary.
- Instruct the students to record the observations and present them analytically.

Test for Carbohydrates

1) Test for reducing sugars
Benedict's test
Add 2 cm^3 of a solution of a reducing sugar. Add equal volume of Benedict's solution. Shake and bring to boil.

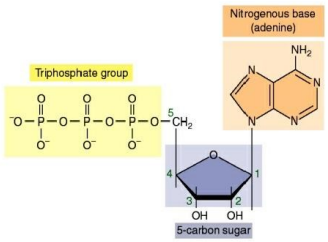
2) Test for non reducing sugars
Add 2 cm3 of sucrose solution to 1 cm^3 dil. HCL .Boil for one minute. Neutralize with $NaHCO^3$ and check with pH paper. Carry out Benedict's test.

3) Test for starch
Add 2 cm^3, 1% starch solution in a test tube and add a few drops of I_2/KI solution.

Test for Lipids
Add $2cm^3$ oil to $2cm^3$ of water in a test tube. Add a few drops of Sudan III and shake.

Test for Proteins
Biuret test
Add 2cm3 protein solution to equal volume of 5% KOH solution and mix. Add two drops of
1% $CuSO_4$ solution and mix.

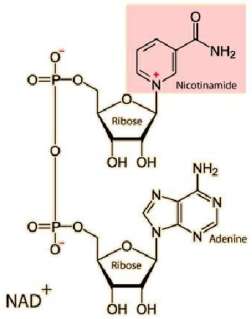
Preparation of Iodine solution
Dissolve 71.0 g of Iodine crystals and 2.0 g of Potassium Iodide in 300 cm^3 distilled water.



Functions of ATP

- Universal energy carrier.

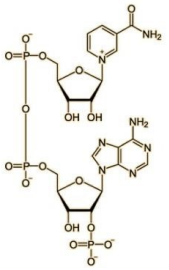
NAD^+



Functions of NAD^+

- A coenzyme
- Function as an electron acceptor
- Function as an oxidizing agent during respiration

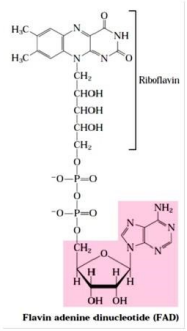
$NADP^+$



Functions of NADP

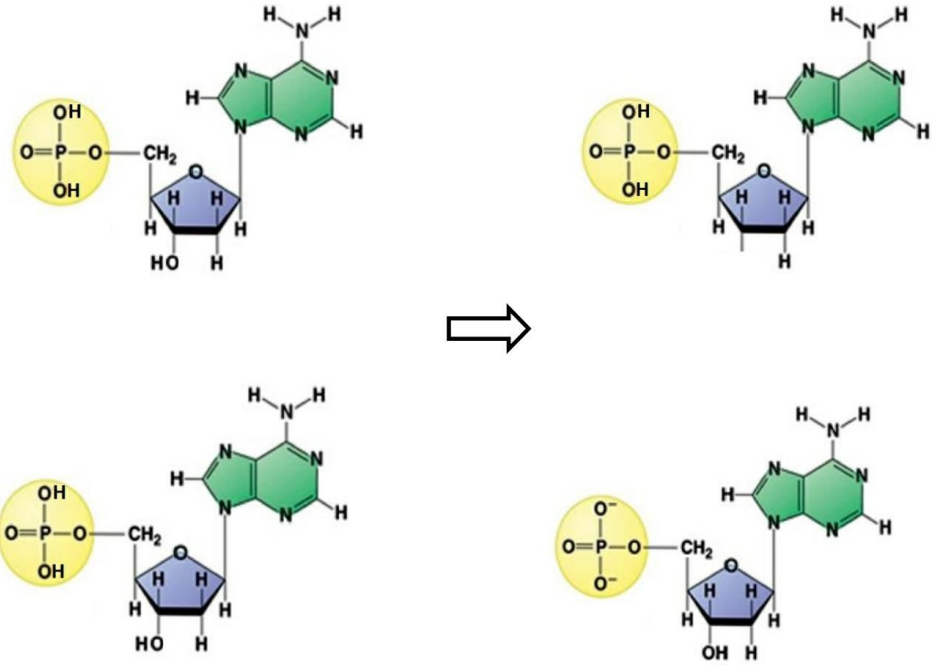
- Act as a coenzyme
- Act as a an electron carrier
- Act as an oxidizing agent in photosynthesis

FAD



Functions of FAD

- Act as a coenzyme.
- Act as an electron carrier.
- Act as oxidizing agent



Formation of Nucleic acids

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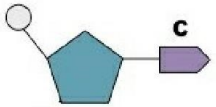
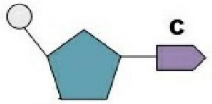
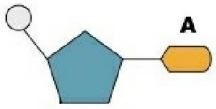
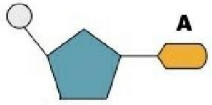
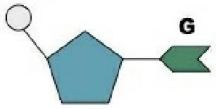
- **Nucleic acids are linear polymers of nucleotides.**
- **There are two kinds of nucleic acids depending on the type of the sugar molecules involved.**

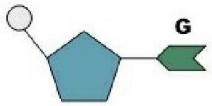


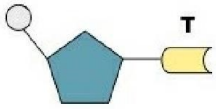


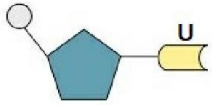


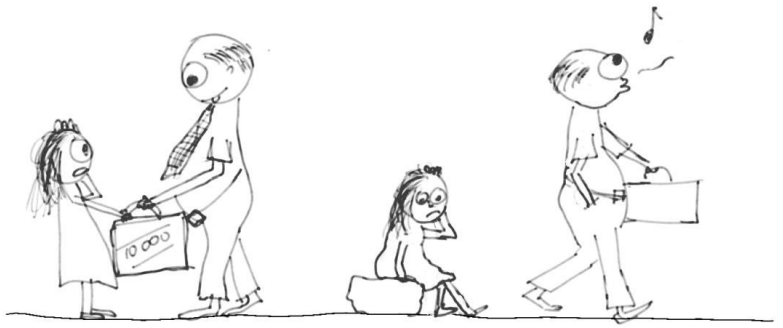






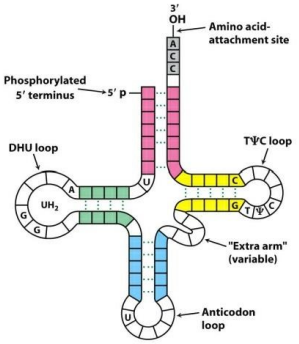






Transfer RNA (tRNA)

- ..... RNA molecule. Linear but forms into three looped structure as shown in the diagram.
- Its function is transportation of amino acids to the site of protein synthesis.



Ribosomal RNA (r RNA)

- It is the ..... type of RNA. r-RNA has a complex irregular structure. It provides the site where polypeptide chains are assembled.

Differences of DNA and RNA

.....

.....

.....

.....

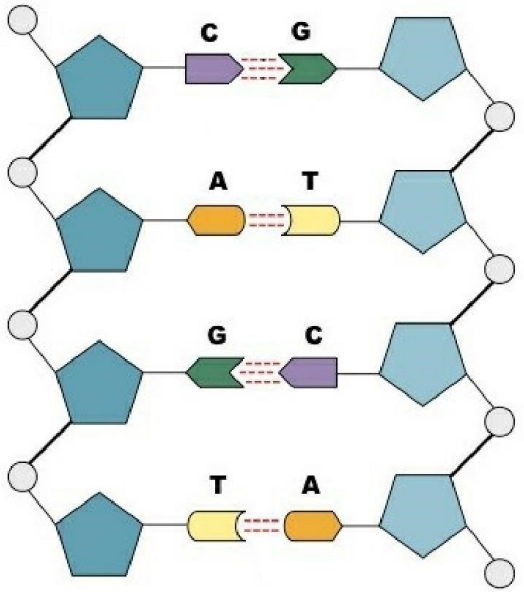
.....

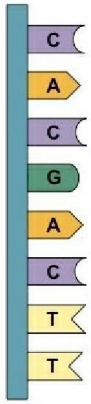
<u>Nucleotides other than those found in nucleic acids</u>

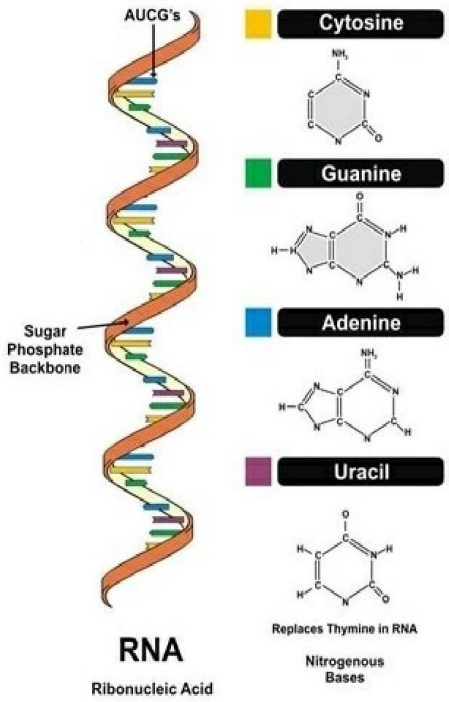
- ATP, NAD+, NADP+, FAD and their functions

Structure of DNA molecule (Watson and Crick model)

- DNA molecules have two anti-parallel polynucleotide chains that spiral around an imaginary axis, forming a .....
- The two sugar-phosphate backbones run in opposite directions from each other, and the arrangement is referred to as anti-parallel.
- The sugar phosphate backbones are on the outside of the helix, and the nitrogenous bases are paired in the interior of the helix.
- The two strands are held together by ..... bonds between the paired nitrogen bases.





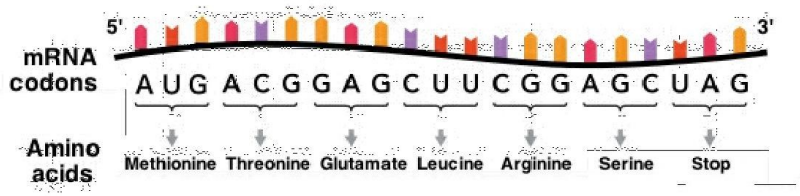


Protein Synthesis

Messenger RNA (m RNA)

- Messenger RNA is a .....molecule and is the least abundant type of RNA in a cells comparatively.
- There are two functions;

1. ..... the genetic information stored in DNA molecule as a sequence of nitrogenous bases
2. Transports genetic information from ..... to the site of protein synthesis (ribosome) through nucleopores



Functions of DNA

- Store and transmit genetic information from one generation to the next generation
- Store the genetic code for protein synthesis

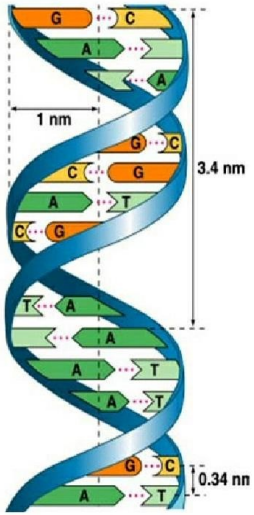
Structure of RNA

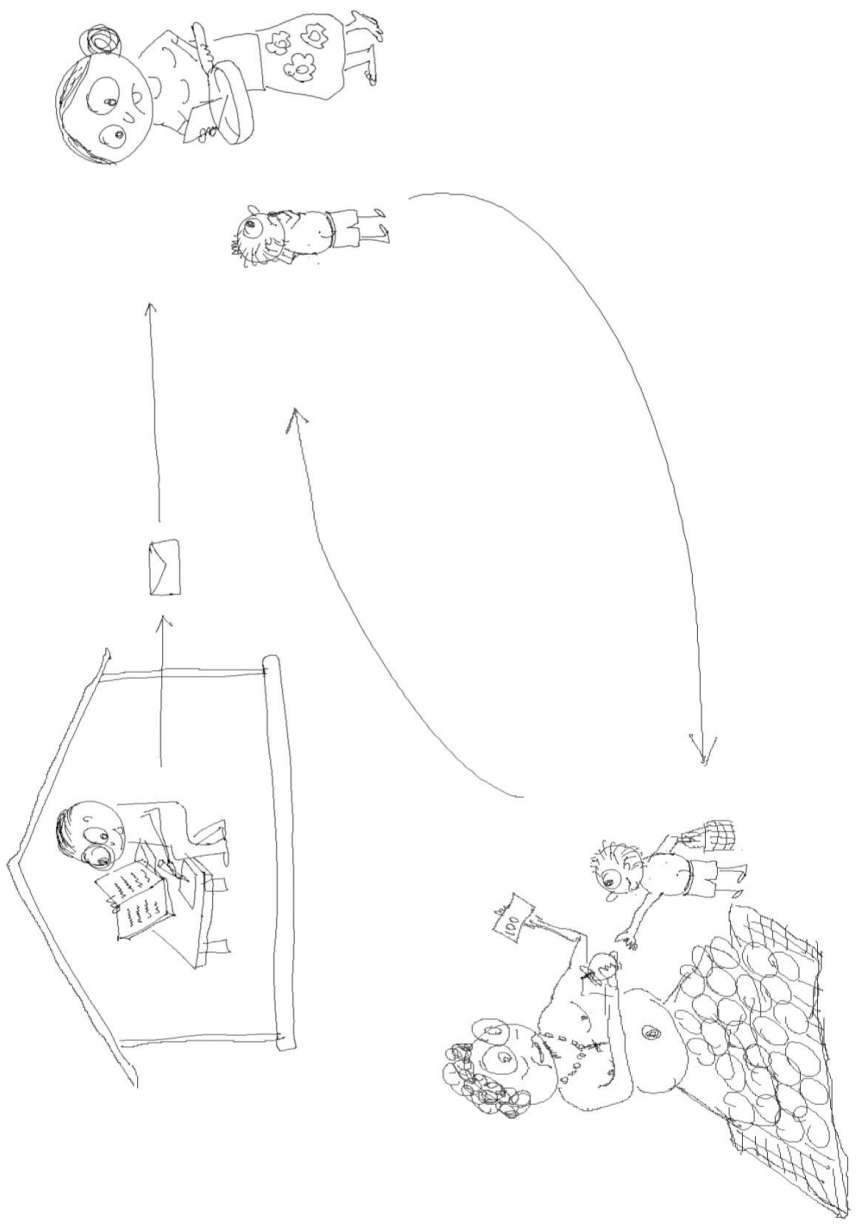
- This is normally a single stranded nucleic acid composed of ..... containing bases, Uracil (U), Cytosine (C), Guanine (G), Adenine (A).
- Complementary base pairing between .....RNA molecules or within the same molecule may occur in some.
- Complementary base pairing facilitates ..... shapes essential for their functioning.
- Adenine binds with Uracil with two ..... and Guanine binds with Cytosine with three hydrogen bonds. There are three types of RNA present in cells,

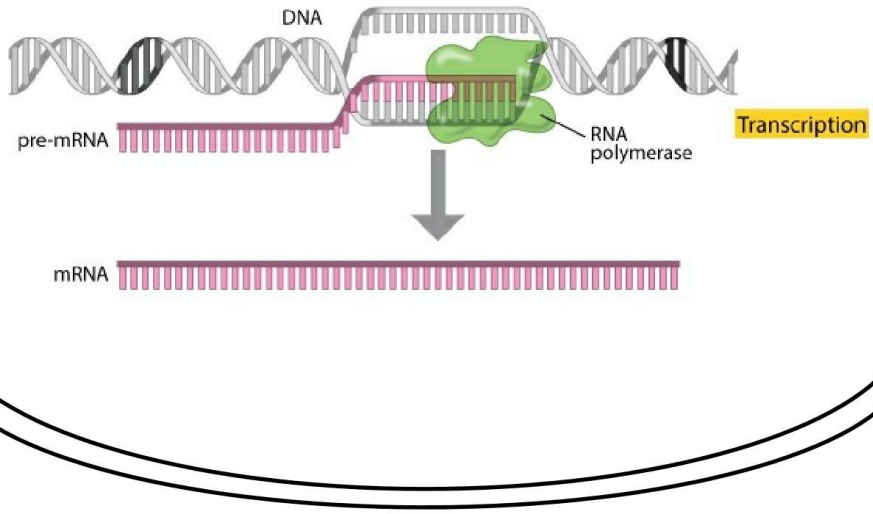
1. Messenger RNA (m-RNA)
2. Transfer RNA (t-RNA)
3. Ribosomal RNA (r-RNA)

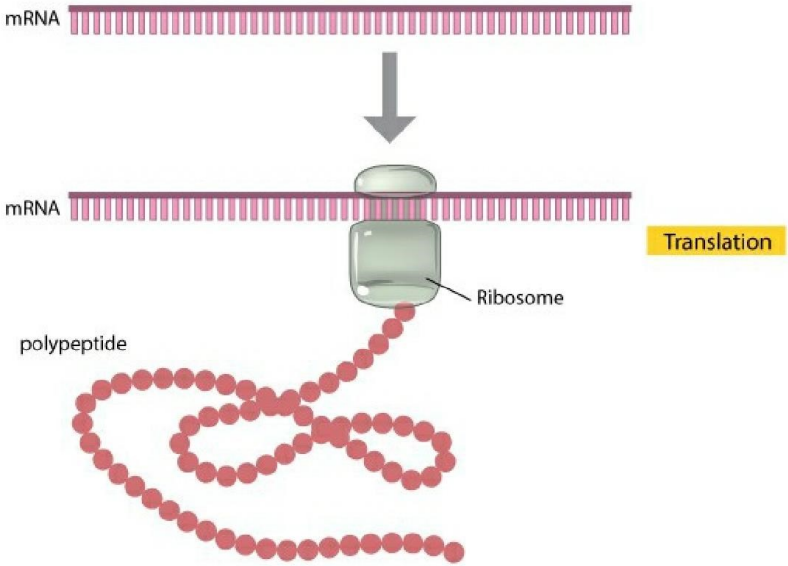
Base pair rule

- Always a purine base pairs with a specific ..... base which means,
- A = T (2 hydrogen bonds form)
- G ≡ C (3 hydrogen bonds form)
- Hence two strands of the DNA are said to be .....
- These pairs are known as complementary base pairs.
- In this original ..... structure, one complete turn consist of ten base pairs as shown in the diagram.






DNA
pre-mRNA
RNA polymerase
Transcription
mRNA


mRNA
mRNA
Translation
Ribosome
polypeptide