## ***REPLICATION OF DNA***

Whenever a cell divides to produce daughter cells , it is necessary to have duplication of DNA giving rise to a new DNA molecule with the same base sequence as the original. This duplication process is called replication.

DNA replication is the process by which DNA makes a copy of itself during cell division.

During DNA duplication the two chains dissociate and each one serve as a template for the synthesis of a new complementary chain . In this way two DNA molecules are produced each having exactly the same molecular composition. Approximately 20 or more enzymes and proteins are needed during replication . Replication occurs at a rate of between 15 nucleotides per second in mammals and 500 per second in bacteria.

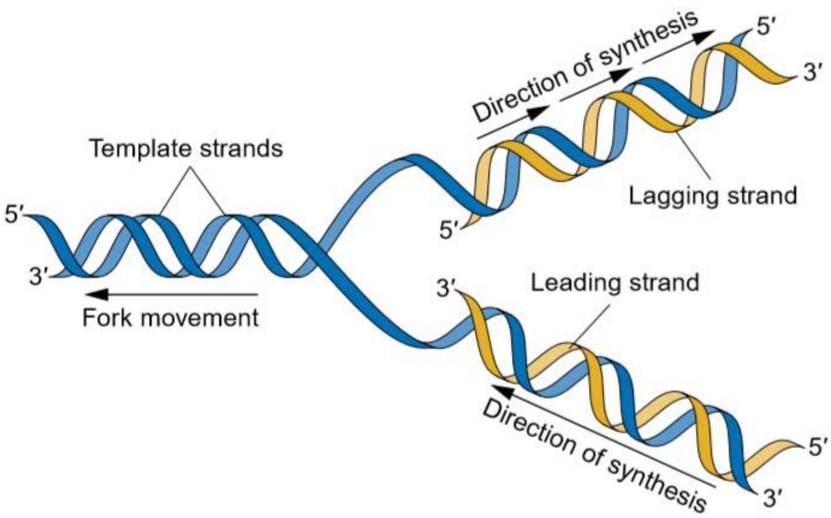
*Mechanism of DNA replication:*

The hydrogen Bonds between the complementary bases of the two strands of the parent DNA molecule break so that 2 polynucleotide strands of DNA separate . The strands thus separated are complementary to each other . Each separated strand act as a template for synthesis of a new complementary strand . Thus two identical daughter DNA molecules are formed. As the base pairing is very specific, each nucleotide of the separated chains attract its complementary nucleotide from the cell cytoplasm after the nucleotides are attached by hydrogen bonds, the sugar molecule joins through the phosphate component the formation of new polypeptide is completed .

Thus each strand of a double Helix DNA serves a template or model on which its complement strand is synthesized . This method of DNA replication is described as semiconservative ,because each new DNA molecule contains one strand from the original DNA and one newly synthesised strand.

Summary

1. The base pairing is specific during DNA replication i.e., adenine pairs with thymine and guanine pairs with cytosine .
2. Nucleotide monomers are added one by one to the 3 end of the growing strand by enzyme DNA polymerase.
3. The sequence of bases in each daughter strand is complementary to the base sequence in the template strand .
4. 3’ carbon of deoxyribose present on the 3’ end of the new polynucleotide chain of DNA has OH group and is free to bind to another nucleotide . 5’carbon of deoxyribose on the 5’ end of polynucleotide chain has a phosphate . Therefore the new polynucleotide chain is always synthesised in 5’to 3’direction



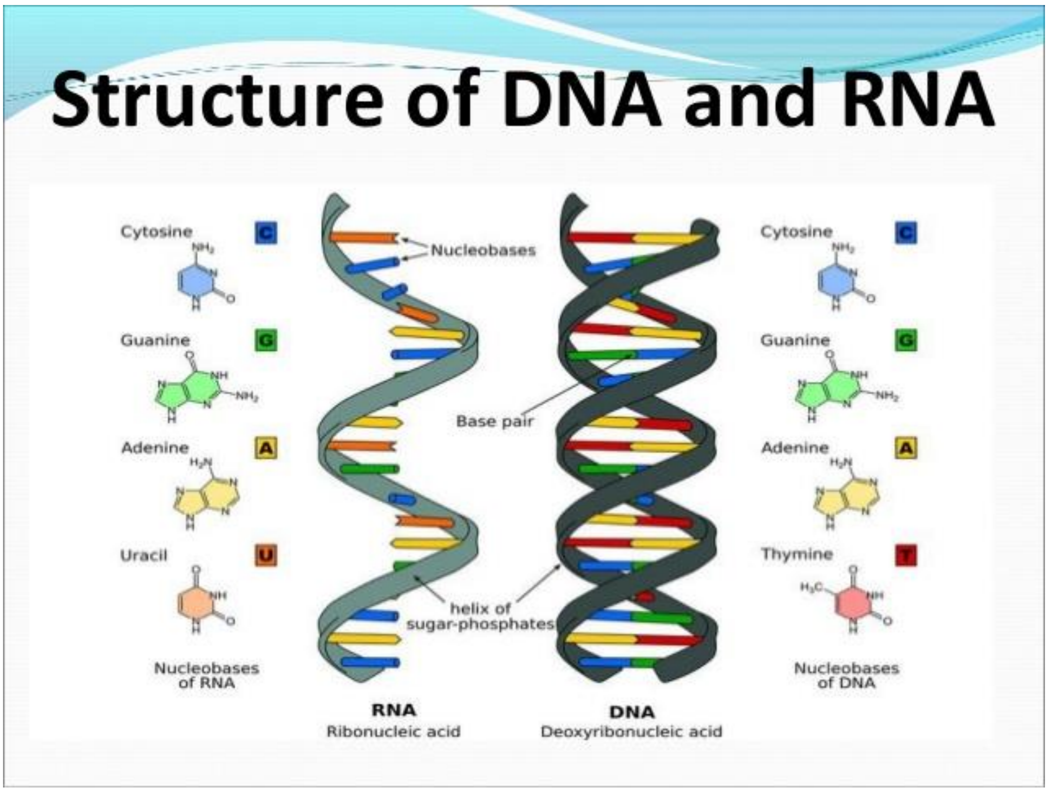
***RNA***

Ribonucleic acid is a single stranded nucleic acid which is found in all living cells. RNA is chiefly found in the cytoplasm but also in nucleolus. ***The nucleolus is a region found within the cell nucleus that is concerned with producing and assembling the cell's ribosomes. Following assembly, ribosomes are transported to the cell cytoplasm where they serve as the sites for protein synthesis.***

Inside the cytoplasm it occurs freely as well as in ribosomes . The different forms of RNA are associated with the transmission of information from nucleus into cytoplasm and with the synthesis of proteins for the regulation of cell activities . RNA is also only macromolecule which also functions for the storage of information and also as a catalyst . RNA is a single stranded molecule consisting of unbranched polynucleotide chain, but it is often folded back on itself forming helices. However DNA double stranded structure and its two polynucleotide chains are bounded spirally around the main axis. Like DNA in RNA also we have 3’to5’phosphodiester bond . As the sugar found in RNA is ribose, nucleotides of RNA are called ribonucleotide, there are 4 bases in RNA in addition to these bases some unusual nitrogenous bases are also found in RNA ,however the base composition of RNA does not agree to the ratio ,

A::U≈G::C=1

In DNA, nucleotides of two polynucleotide strands pair to hydrogen bonds. In RNA intramolecular pairing between nucleotides of single strand of RNA provide stability to the molecule.



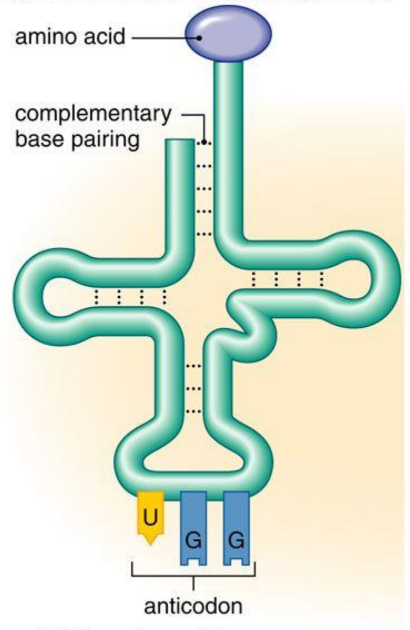
***Types of RNAs:***

There are six kinds of RNA- transfer RNA, Ribosomal RNA, messenger RNA, small nuclear RNA, microRNA and small interfering RNA. All these play an important in the life processes of cells. DNA is the hereditary material, whereas RNAs perform different functions during protein synthesis. The various kind of RNA participate in the synthesis of proteins in a series of reactions ultimately directed by the base sequence of the cell's DNA. The base sequences of all types of RNA are determined by that of DNA. The process by which the order of bases is passed from DNA to RNA is called transcription. Transfer RNA, ribosomal RNA and messenger RNA are the three functional types of RNAs.

**1.Tansfer RNA(t-RNA)**

It is the smallest molecule of the three important kinds of RNA. Different types of t-RNA molecule can be found in every living cell because at least one t-RNA bonds specifically to each of the amino acid that commonly occur in proteins. A t-RNA is a single-stranded polynucleotide chain containing 75 to 93 nucleotides. Each t-RNA molecule has a 3'OH terminus and a 5'mono-phosphate terminus. Its polynucleotide chain undergoes secondary and tertiary folding's because of internal complimentary base pairing. There t-RNA molecule acquires a precise L-shaped three-dimensional configuration. The t-RNA plays a key role in protein synthesis. It picks up a specific amino acid from the cytoplasm, carries it to the site of protein synthesis and attaches itself to ribosomes in accordance with sequence specified by m-RNA. Finally, it transmits its amino acid to the polypeptide chain which is being synthesized.






a. tRNA–amino acid

***At the loop of still another arm is specific sequence of bases, called the anticodon. The anticodon is highly important because it allows the tRNA to bind with specific site-called the codon-of mRNA. The order in which amino acids are brought by their tRNA units to the mRNA strand is determined by the sequence of codons. This sequence therefore constitutes a genetic message. individual units of that message are triplets of nucleotides (the individual words, each corresponding to an amino acid)***

**2.Ribosomal RNA (r-RNA)**

Ribosomal RNA constitutes bulk of cellular RNA up to 85% of the total RNA. In contrast with t-RNA , r-RNA molecules tend to be quite large and only a few types of r-RNA exist in a cell. Cells contain millions of ribosome and each ribosome contains several molecules of r-RNA. (Ribosomes are nucleoproteins, comprised of approximately two-thirds RNA and one-third protein). The RNA portion of a ribosome account for 60% -65% of the total weight and the protein portion constitutes remaining 35% -40% of the weight. Ribosomes are the structures where proteins are synthesized. All ribosomes are constituted from 2 subunits, the larger unit is twice the size of smaller one . Both subunits contain RNA and protein . Ribosomal RNA cannot be removed from ribosomes without destroying them . All RNAs are single stranded however many of these are hydrogen bonded. r-RNA differs in base content from t-RNA and m-RNA. It is relatively rich in guanine and cytosine .The base components in E.coli have molar ratio of adenine 21 :uracil 19:guanine 37:cytosine 23.

***rRNA is a ribozyme which carries out protein synthesis in ribosomes. Ribosomal RNA is transcribed from ribosomal DNA (rDNA) and then bound to ribosomal proteins to form small and large ribosome subunits.***

***Ribosomes, as reaction catalyst, are most appropriately classified as ribozymes rather than enzymes, because it is RNA that catalyses the peptide bond formation during protein synthesis and not protein subunit of ribosomes.***

***Ex- The mechanism for peptide bond formation catalysed by 50s ribosome subunit, proposed by Moore and co-workers based on X-ray crystal structures.***

**3.Messenger RNA (m-RNA)**

It is the least abundant of main types of RNA. it constitutes 5% -10%of the total cellular RNA. Messenger RNA carries genetic information from chromosomal DNA to the cytoplasm, where it acts as a template for protein synthesis. it is complementary to DNA and carries the copy of the same base sequence as found in the part of DNA from which it is copied. The only difference is that thymine is substituted by uracil. the sequence of bases in m-RNA specify the order of amino acid in proteins. in rapidly growing cells, many different proteins are needed within a short time interval . Therefore, fast turnover in protein synthesis becomes essential . It is logical that m-RNA is formed when it is needed, directs the synthesis of proteins and then it is degraded so that nucleotides can be recycled. Of the main types of RNA , m-RNA is the one that usually turns over most rapidly in the cell. both t-RNA and r-RNA can be recycled intact for many rounds of protein synthesis.

Characteristics features of m-RNA:

1.It is formed as a complementary strand to one of the two strands of DNA.
2.As it carries the same sequence of base arrangement as found in the part of DNA from which it is copied m-RNA, therefore, contains the same information as coded in the part of DNA .
3.The molecules of m-RNA are linear and longest of all types of RNAs.
4.There is one m-RNA for each polypeptide chain . m-RNA acts as a template for protein synthesis .
5.It has a high turnover . However it has a short life span and Withers away after few translations .
6.Messenger RNA molecules are heterogeneous in size as are proteins whose sequence they specify .