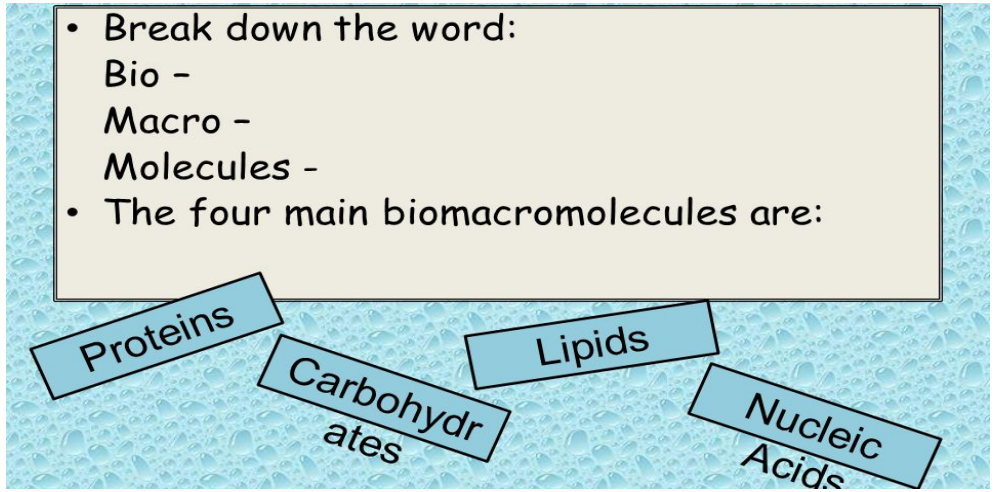
# BIOMACROMOLECULE

- Number of chemical reactions (**cell metabolism**) were require to sustain the living life.
- The **reactant** and **products** of cell metabolism are **Biomacromolecule**.
- Thus, these reactions involve large molecules called Biomacromolecules.

- **Biomacromolecules** are biomolecule (large carbon based molecules) that makeup our body system.

  Example:
  - Carbohydrates
  - Proteins
  - Lipids
  - Nucleic acid

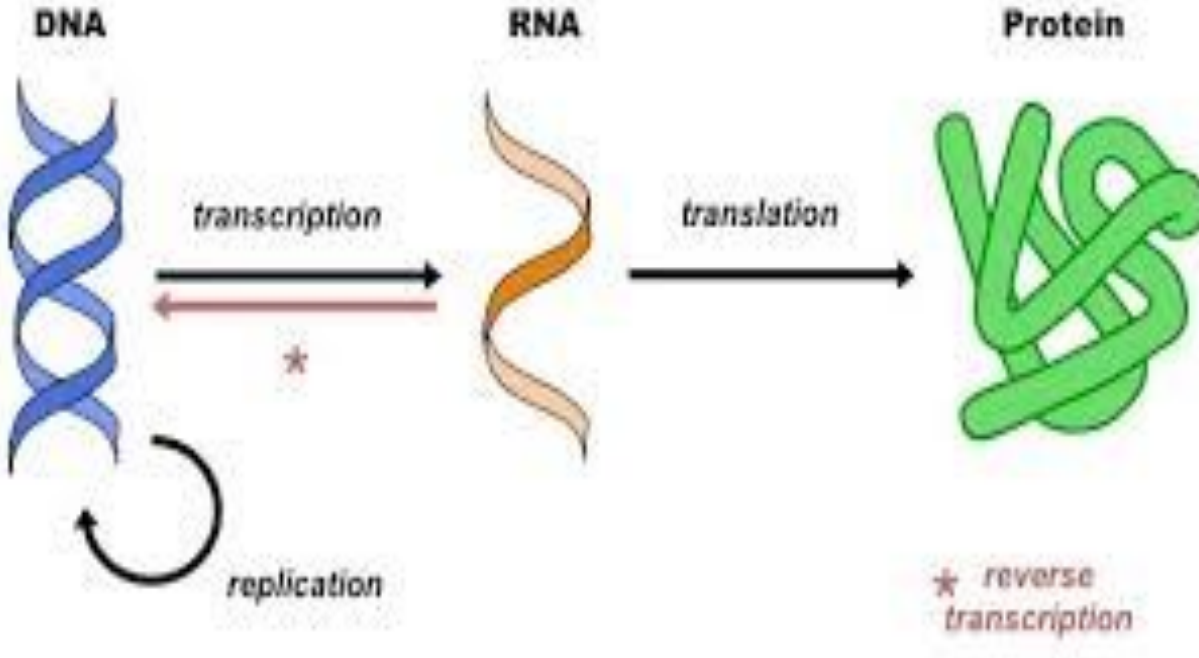


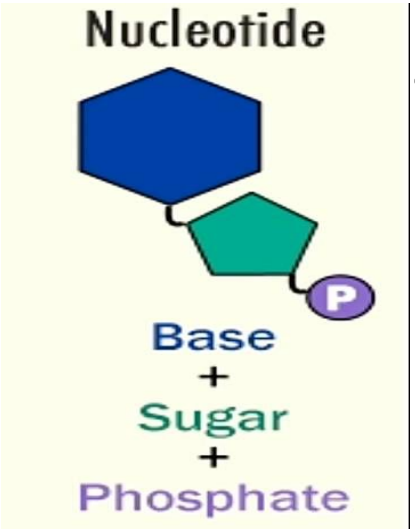

Although a cell is mostly with water, the rest of it contains carbon based large molecules called bio-macromolecules

# Nucleic acid

- Nucleic acid are are biological molecules essential for life.
- Ex. For heredity and protein synthesis

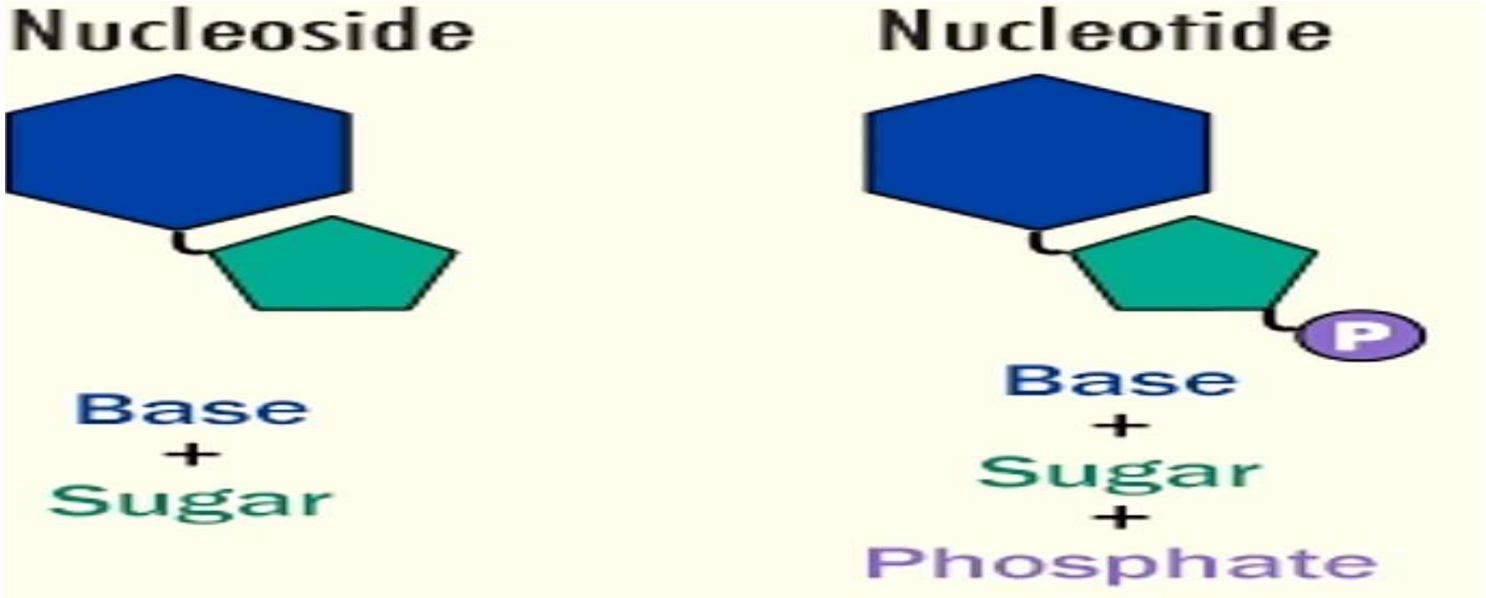
- There are two types of nucleic acid that are Deoxyribonucleic acid (**DNA**) and Ribonucleic acid (**RNA**)




- These are polymers consisting of long chains of **monomers** called **nucleotides**

# NUCLEOSIDE / NUCLEOTIDE




- **Nitrogenous Base** (ATCG/ AUCG).
- **Pentose Sugar**. (In DNA, the sugar is 2'-deoxyribose. ... In RNA Ribose sugar)
- **Phosphate Group**.

# Nitrogenous bases

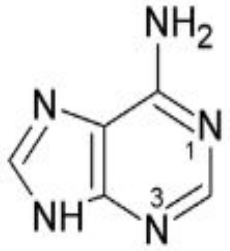
There are are the two categories of nitrogenous bases

- Purines : adenine & guanine
- Pyrimidines: cytosine & thymine

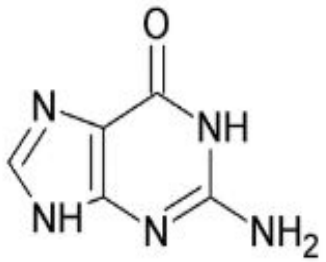
## Nitrogenous bases in DNA and RNA

- In DNA are adenine (A), guanine (G), cytosine (C) and thymine (T).
- In RNA, are adenine (A), guanine (G), cytosine (C) and uracil (U) the only differing nitrogenous base

Purines

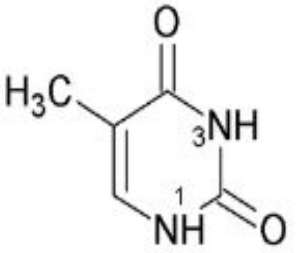



Adenine

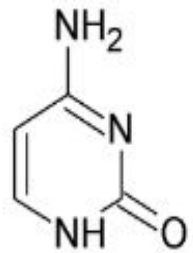



Guanine

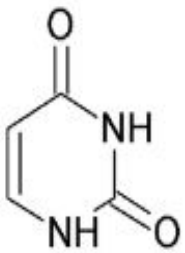
Pyrimidines




Thymine



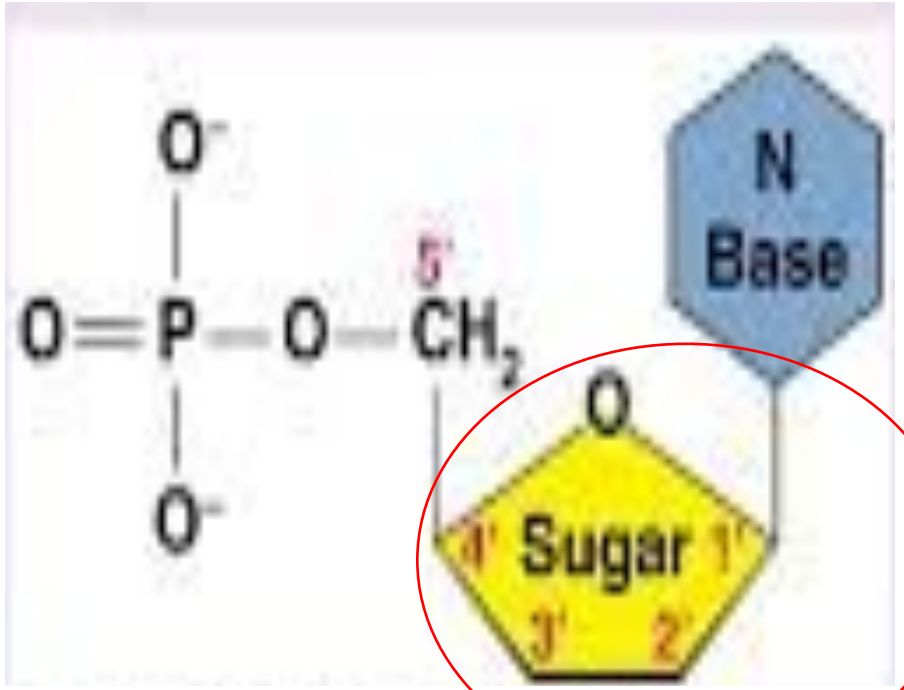

Cytosine

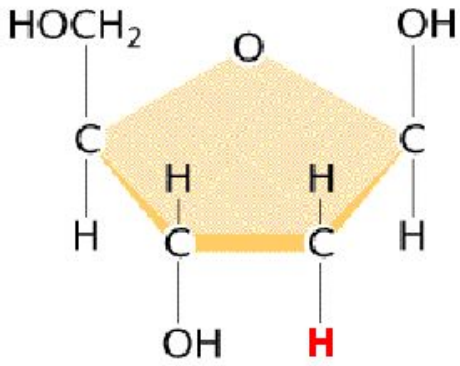



Uracil

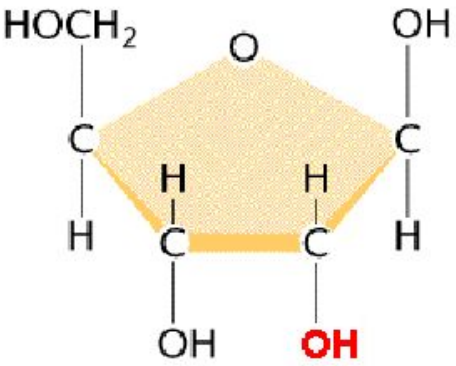
# Sugar

- The sugar present in a molecule of DNA is deoxyribose
- The sugar present in a RNA molecule is ribose,



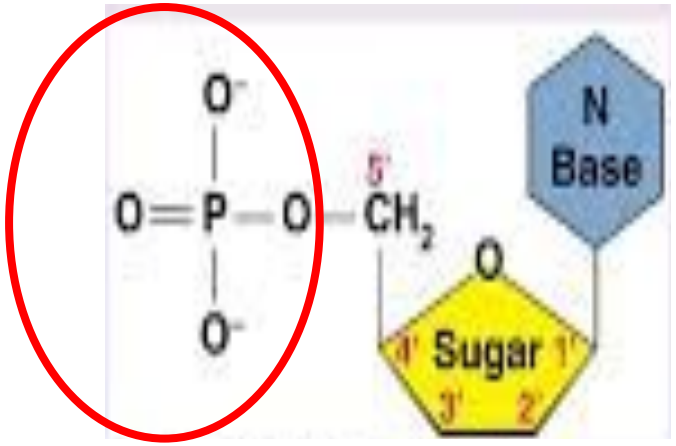

2-Deoxyribose




Ribose

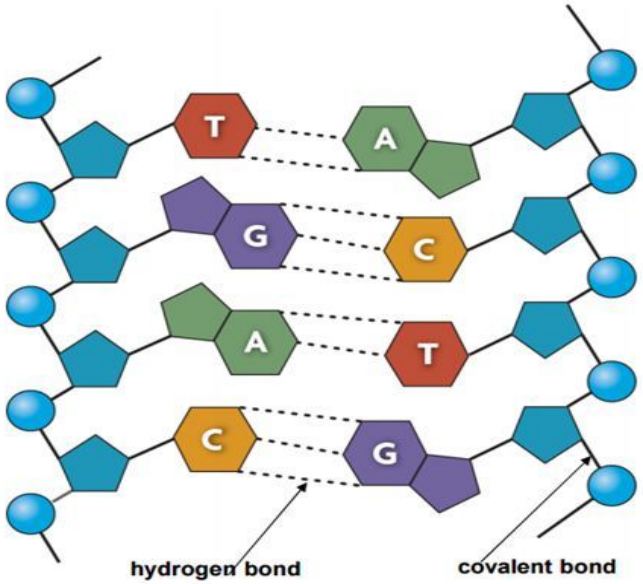
# Phosphate Group

**In DNA and RNA** the backbone is composed of alternating sugar and **phosphate** groups



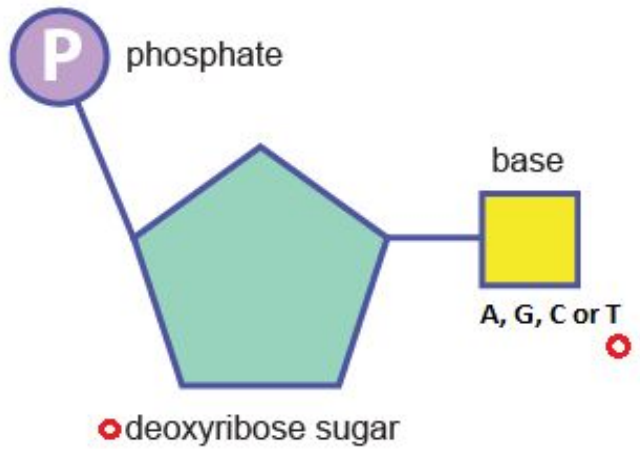

# Bonds in DNA

- The backbone is connected by covalent bonds
- The bases are connected by hydrogen bonds

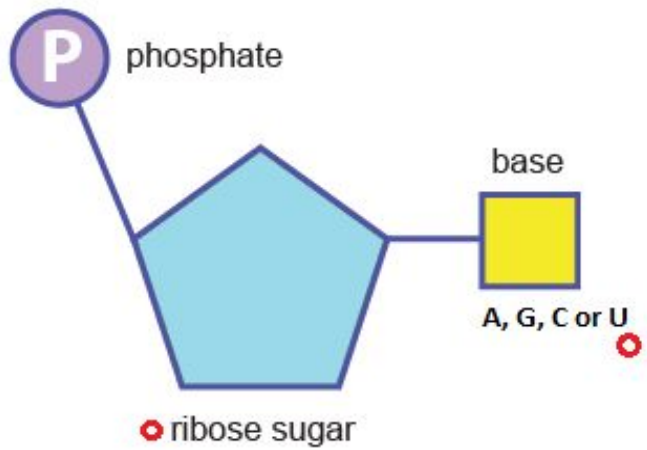


Difference between DNA and RNA are:

| DNA | RNA |
|---|---|
| It is double stranded nucleic acid. | It is single stranded nucleic acid. |
| It contains deoxyribise sugar. | It contains ribose sugar. |
| It contains Thymine (T) as a nitrogenous base. | It contains Uracil (U) instead of Thymine. |
| It is the genetic and hereditary material of the cells. | It is involved in synthesis of proteins. |
| It is present in the nucleus of the cells. | It is present in both nucleus and cytoplasm. |




**DNA**




**RNA**

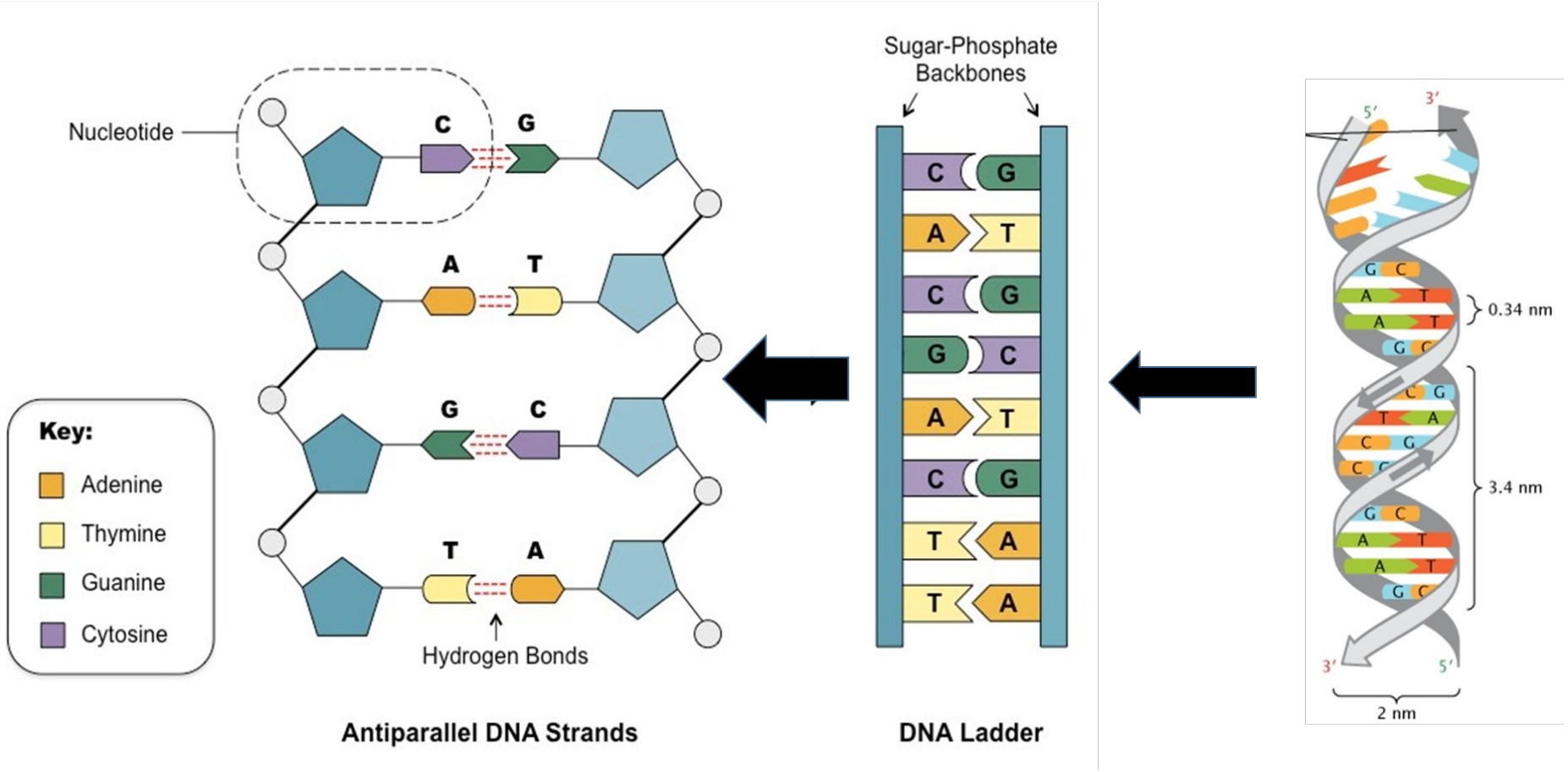
# DEOXYRIBONUCLEIC ACID (DNA)

**Frederick Griffith**: In 1928 confirmed DNA is the genetic materials

**Rosalind Franklin**: In 1952 took various x ray photos of DNA

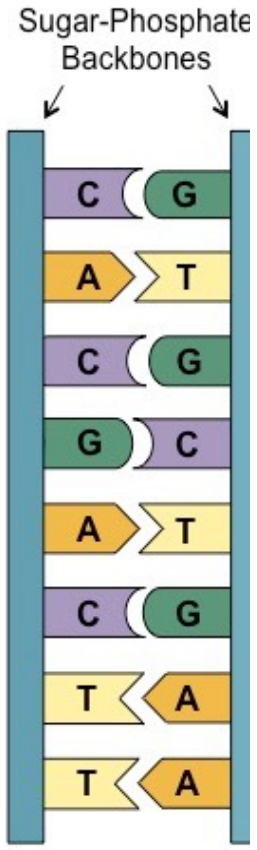
**Watson and crick** : In 1953 build the first model of DNA from Franklins X rays.

# DOUBLE HEICAL STRUCTURE OF DNA



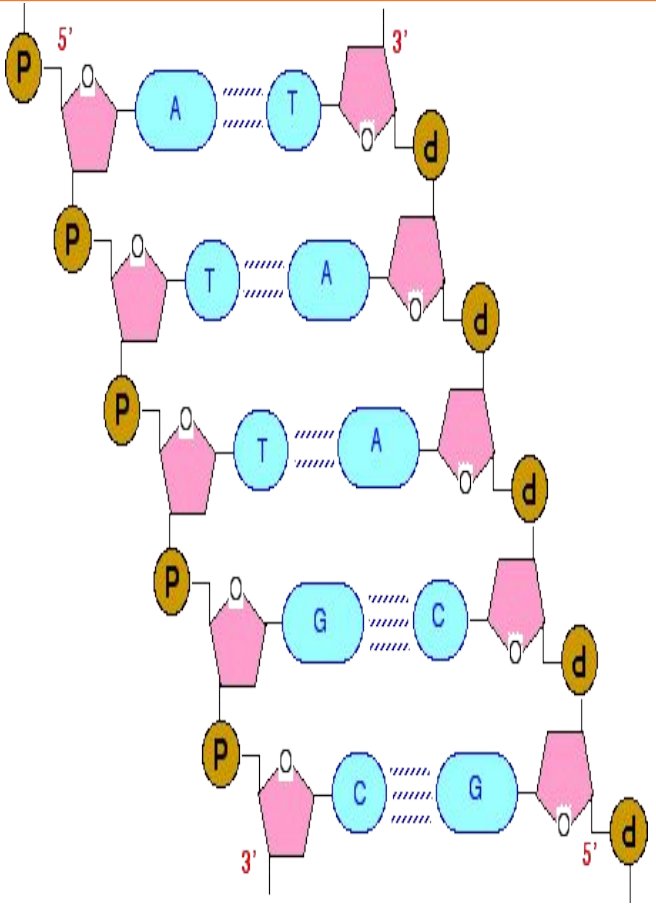

- The width(or diameter) of a double helix is 20 A °(2nm).
- Each turn (pitch)of the helix is 34A°(3.4nm) with 10 pairs of nucleotides, each pair placed at a distance of about 3.4 A °(0.34nm).

# Salent features of double helical structure of DNA




DNA Ladder

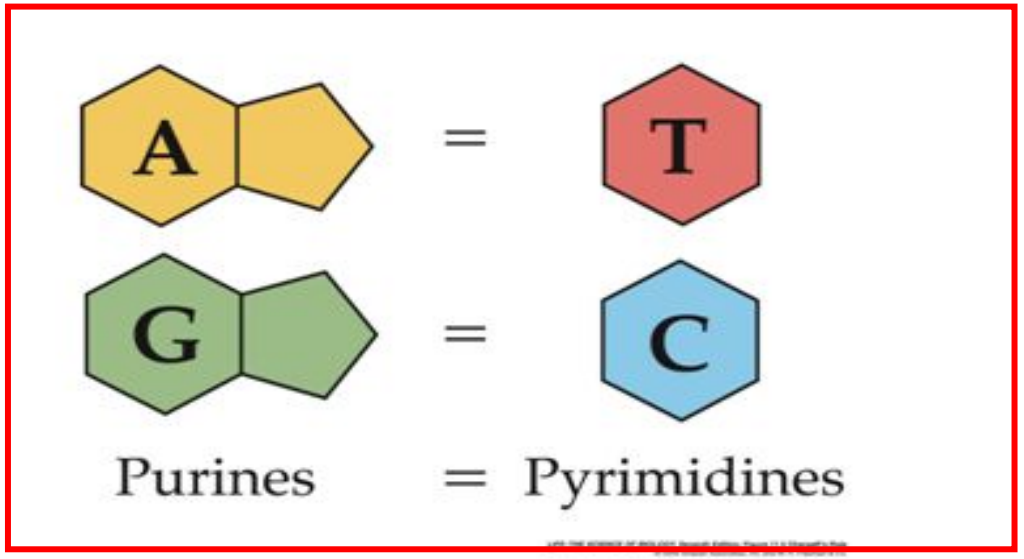
- The two strands are antiparallel i.e., one strand runs in the 5’ to 3’direction while the other in 3’ to 5’ direction.
- The two polynucleotide chains are not identical but complementary to each other due to base pairing.
- Each strand of DNA has a hydrophillic deoxyribose phosphate backbone on the outside(periphery) The two strands are held together by hydrogen bonds formed by complementary base pairs. The A-T pair has 2 hydrogen bonds while the C-G pair has 3 hydrogen bonds. The G-C is stronger by about 50% than A-T.
- The hydrogen bonds are formed between a purine and pyrimidine only. The only base arrangement possible in DNA structure is A-T, T-A , G-C, C-G.
- The genetic information resides on one of the two strands known as template strand or sense strand. The opposite strand is antisense strand.

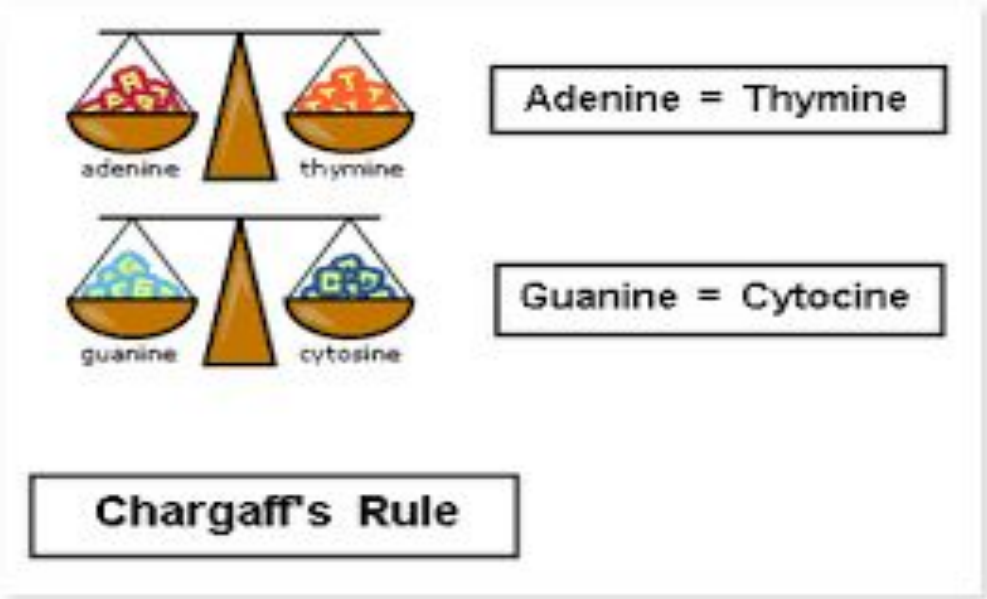


# CHARGAFF'S RULE

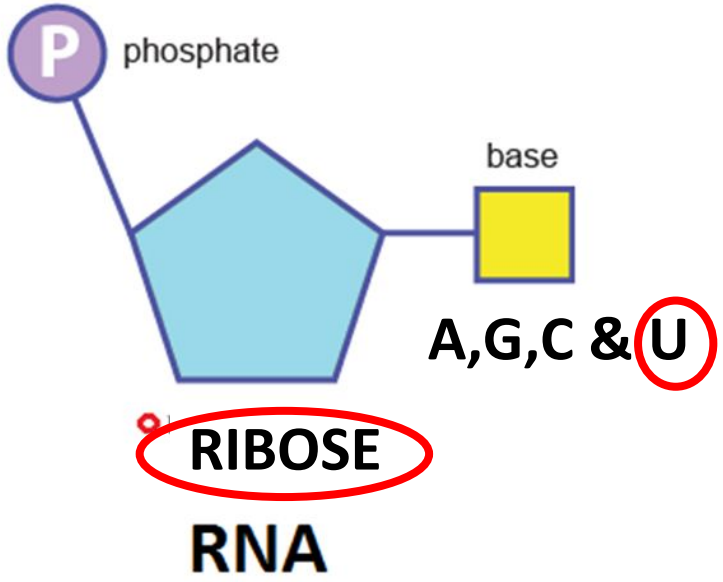
- Chargaff studied percentages of nitrogenous bases (1950)
- Percentage of guanine and cytosine are almost equal
- Percentages of adenine and thymine are almost equal
- Chargaff's Rule supports idea that Adenine (A) bonds to Thymine (T) and Cytosine (C) bonds to Guanine (G)

$$(\%A + \%T) + (\%G + \%C) = 100\%$$



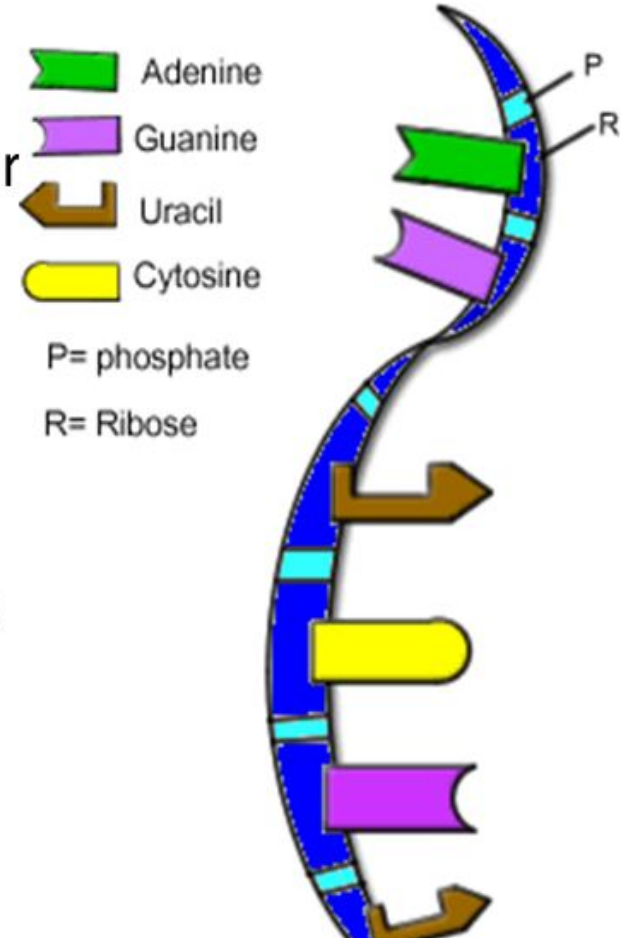



# RIBONUCLEIC ACID (RNA)




(Similar to DNA with several key differences)

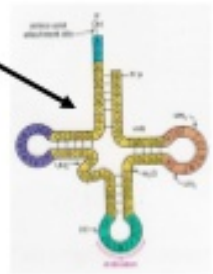
- Made up of a repeating strand of nucleotides, contains all 3 parts similar to DNA (sugar, phosphate, nitrogen base)
- The sugar in RNA is called Ribose
- Contains the nitrogen base Uracil instead of Thymine. Uracil will bind to Adenine (like thymine did)
- RNA is single strand



# Types of RNA

| mRNA | tRNA | rRNA |
| --- | --- | --- |
| "messenger" | "transfer" | "ribosomal" |
| made using DNA | <u>transfers</u> an amino acid to the growing protein | makes up the bulk of ribosomes |
| carries genetic info from the nucleus to the ribosome | cloverleaf shape | |
| every 3 bases (codon) specifies an amino acid | 3 complimentary bases (anticodon) binds to the mRNA codon | |

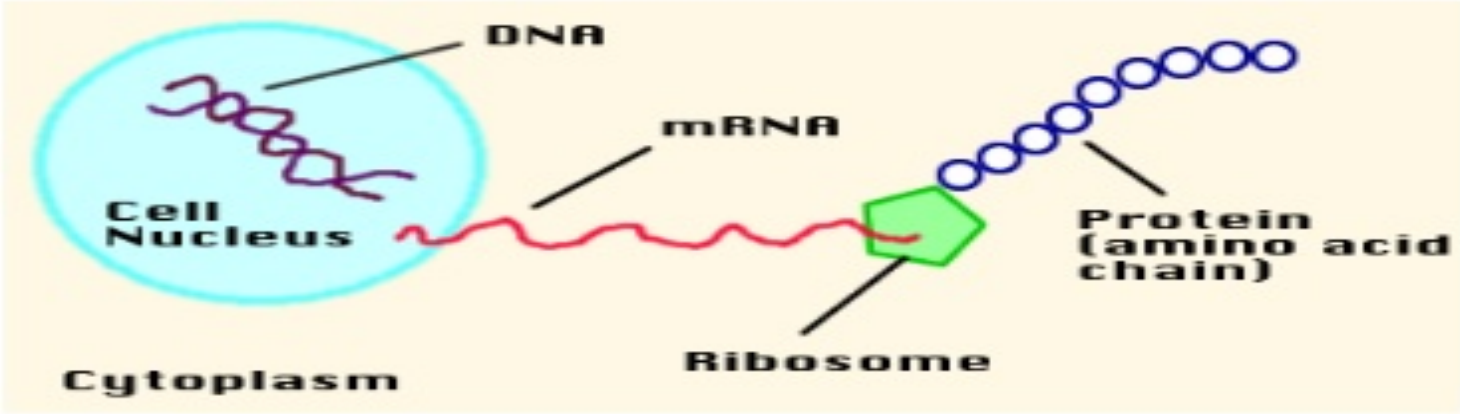
Messenger RNA
Carries instructions for polypeptide synthesis from nucleus to ribosomes in the cytoplasm.



Ribosome

Ribosomal RNA
Forms an important part of both subunits of the ribosome.

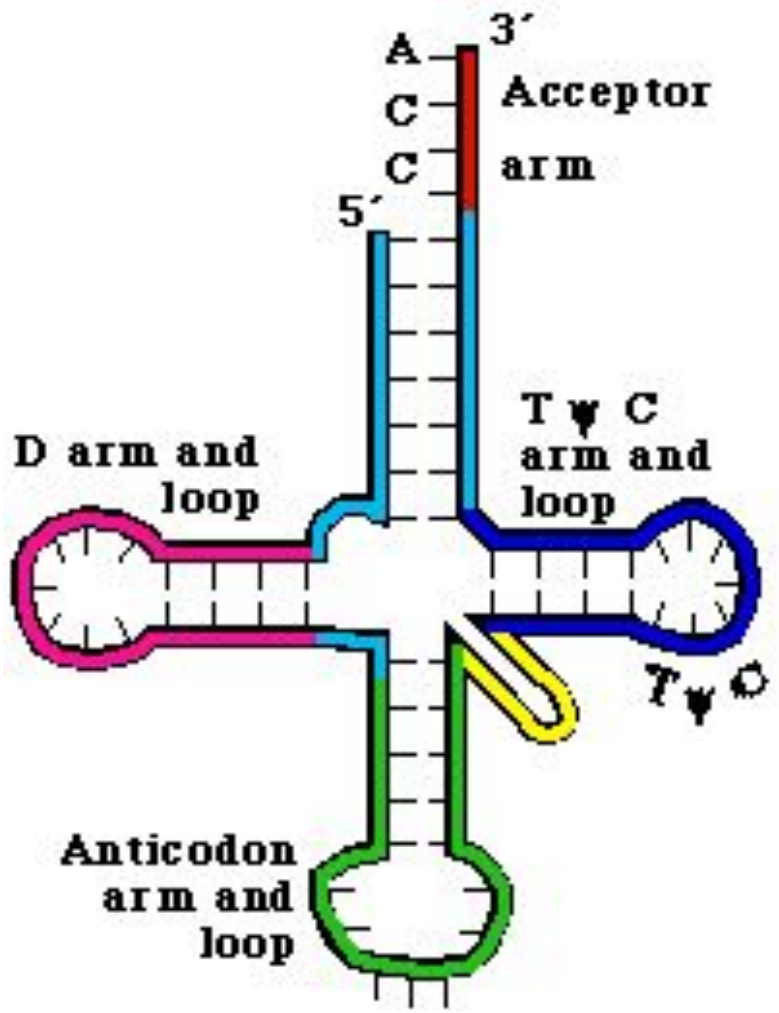
# MESSENGER RNA (mRNA)




- Comprises only 5% of the RNA in the cell
- Most heterogeneous in size and base sequence
- All members of the class function as messengers carrying the information in a gene to the protein synthesizing machinery

**Remember: Small enough to leave the nucleus. DNA is too big!**

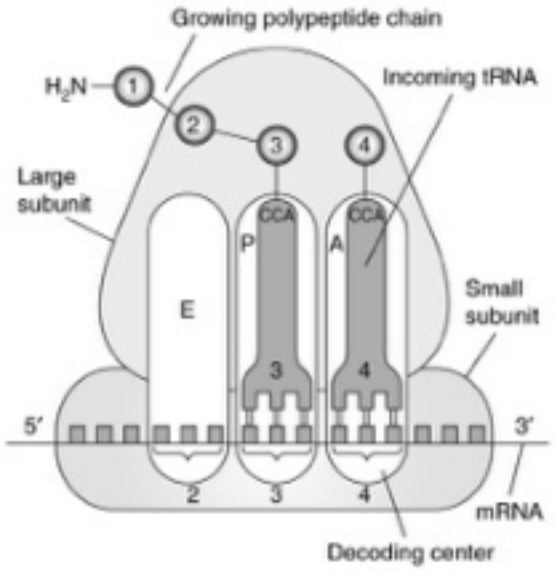
# TRANSFER RNA (tRNA)

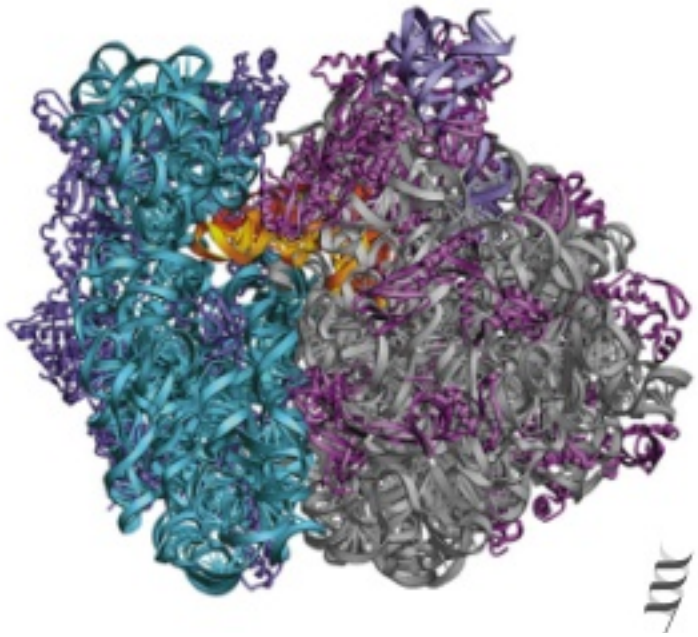


# RIBOSOMAL RNA (rRNA)

## rRNA

Ribosome= 60 % rRNA and 40 % proteins



# Questions

1. Define nucleotides and nucleosides? What are the composition of different nucleic acids?
2. What are the different bonds present in DNA and how are they formed?
3. What are the differences between DNA and RNA?
4. What are the salient features of the double helical structure of DNA proposed by Watson and Crick?
5. Explain Chargaff's rule with and example?
6. What are the functions of different types of RNA?