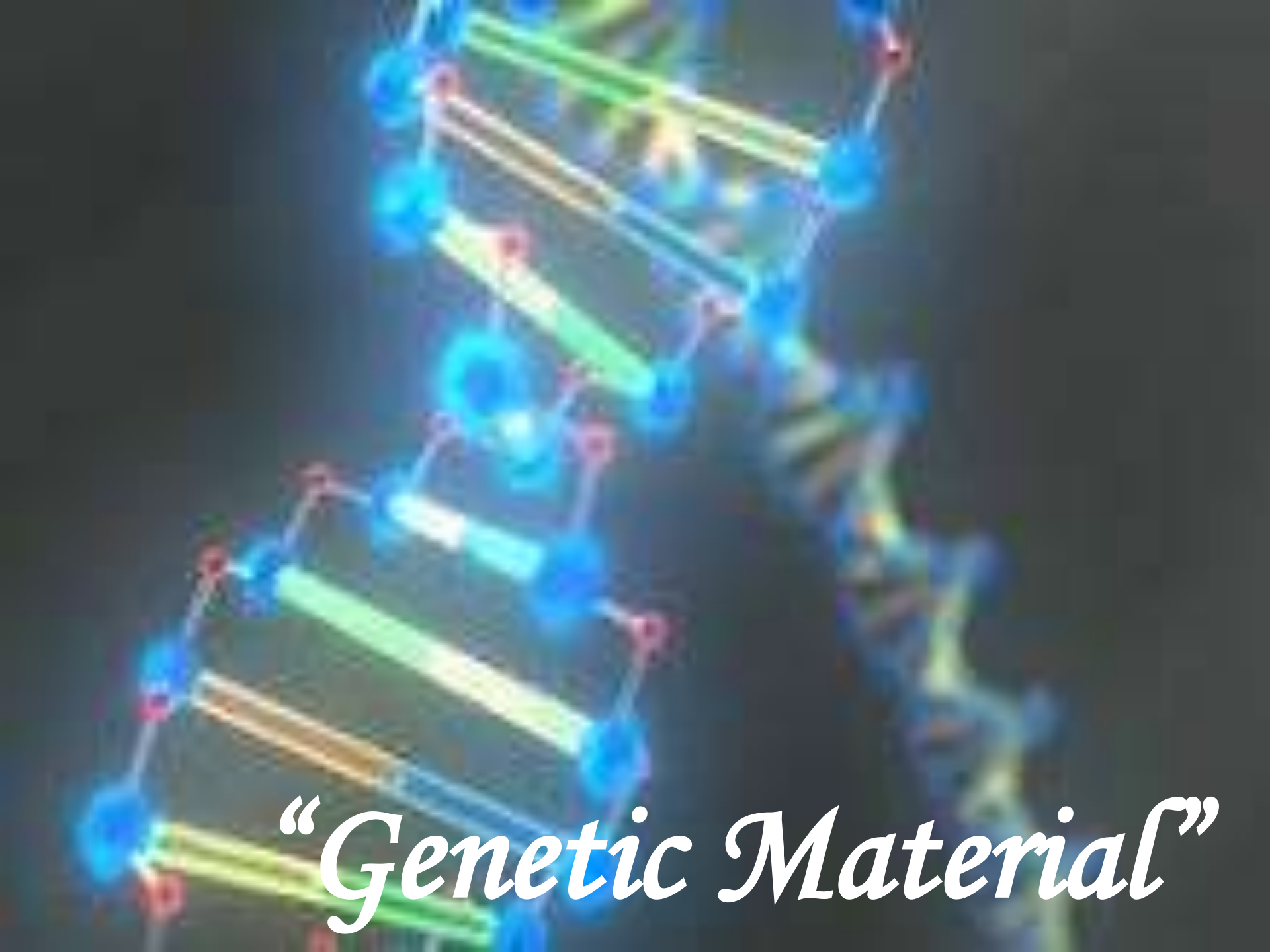

"Genetic Material"

“ Molecular Biology and Biotechnology”

B. Sc III Botany Sem VI

Section –II, Unit I

“Genetic Material”

by Dr. A. R. Alvikar

Historic Resume

Friedrich Miescher 1868

- Genetic material – small biomolecule found in all living organism, storee and transfer genetic information.
- Isolated what he called Nuclein from the nuclei of the pus cells.
- Nuclein was shown to have acidic properties, hence it became called nucleic acid.
- **Altman 1889**- Gave the name as Nucleic acid.

Friedrich Miescher 1868

Nucleic acid

- Nucleic acid are polymers that consist of nucleotide residues.
- Located in nuclei of cell
- Hereditary determinants of living organisms.
- **Elemental composition**- Carbon, Hydrogen, Oxygen, Nitrogen -14% and Phosphorus-2.5 %

Types of Nucleic Acid

1. Deoxyribonucleic acid (DNA)

2. Ribonucleic acid (RNA)

The distribution of Nucleic acids in the eukaryotic cell

- DNA is found in the **nucleus** with small amounts in **mitochondria and chloroplasts.**
- RNA is found throughout the cell.

Nucleic Acid Structure

- Nucleic acids are polynucleotides
- Their building blocks are nucleotides

Nucleotides

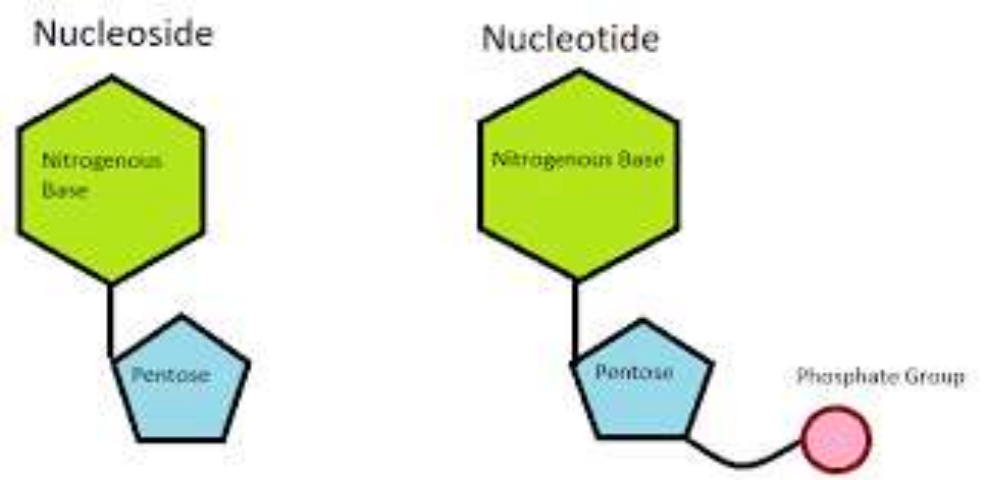
- **Energy rich compounds** that drive metabolic process in cell
- Serve as **chemical signals, key links in cellular systems** that respond to hormones and other extracellular stimuli.
- Structural component of no. of enzymes co-factor and metabolic intermediate.

Nucleotides

Each nucleotide is formed by 3 units

1. Phosphate group
2. Sugar
3. Nitrogenous base

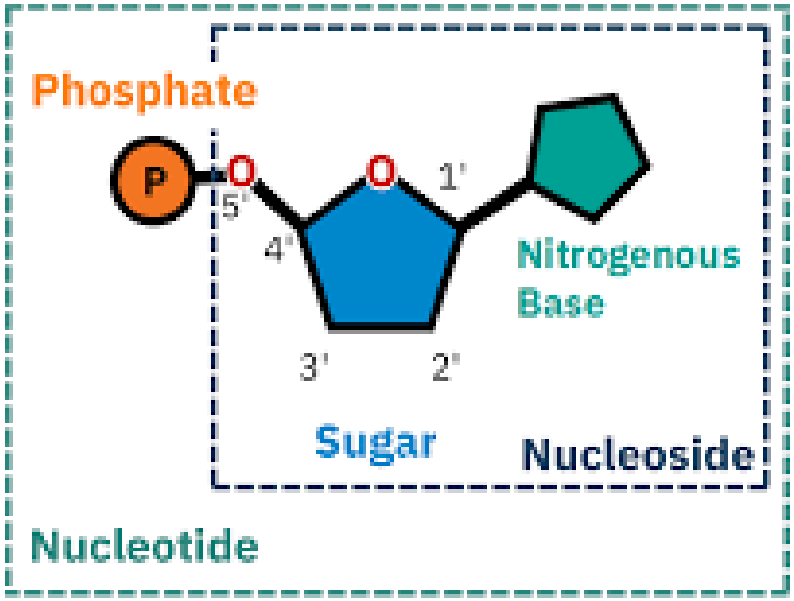
Nucleotide one unit



Nucleoside structure

1. Phosphoric acid

- Molecular formula **H_3PO_4**
- Contains **3 monovalent hydroxyl group** and a **divalent oxygen atom**.
- All linked to **penta-valent** phosphorous atom



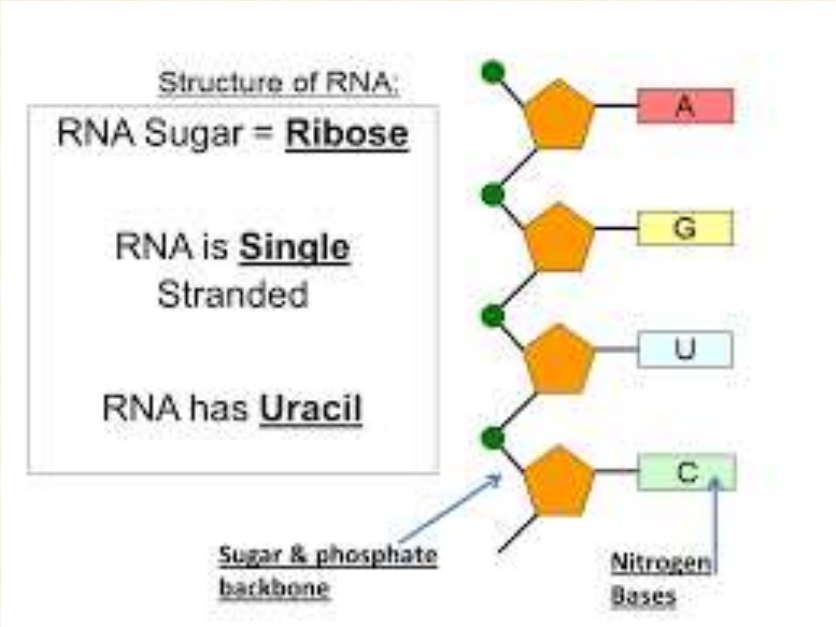
2. Sugar

- **5 carbon Keto-sugar or pentose**
- One possess d_2 **deoxyribose** and other contained **ribose.**

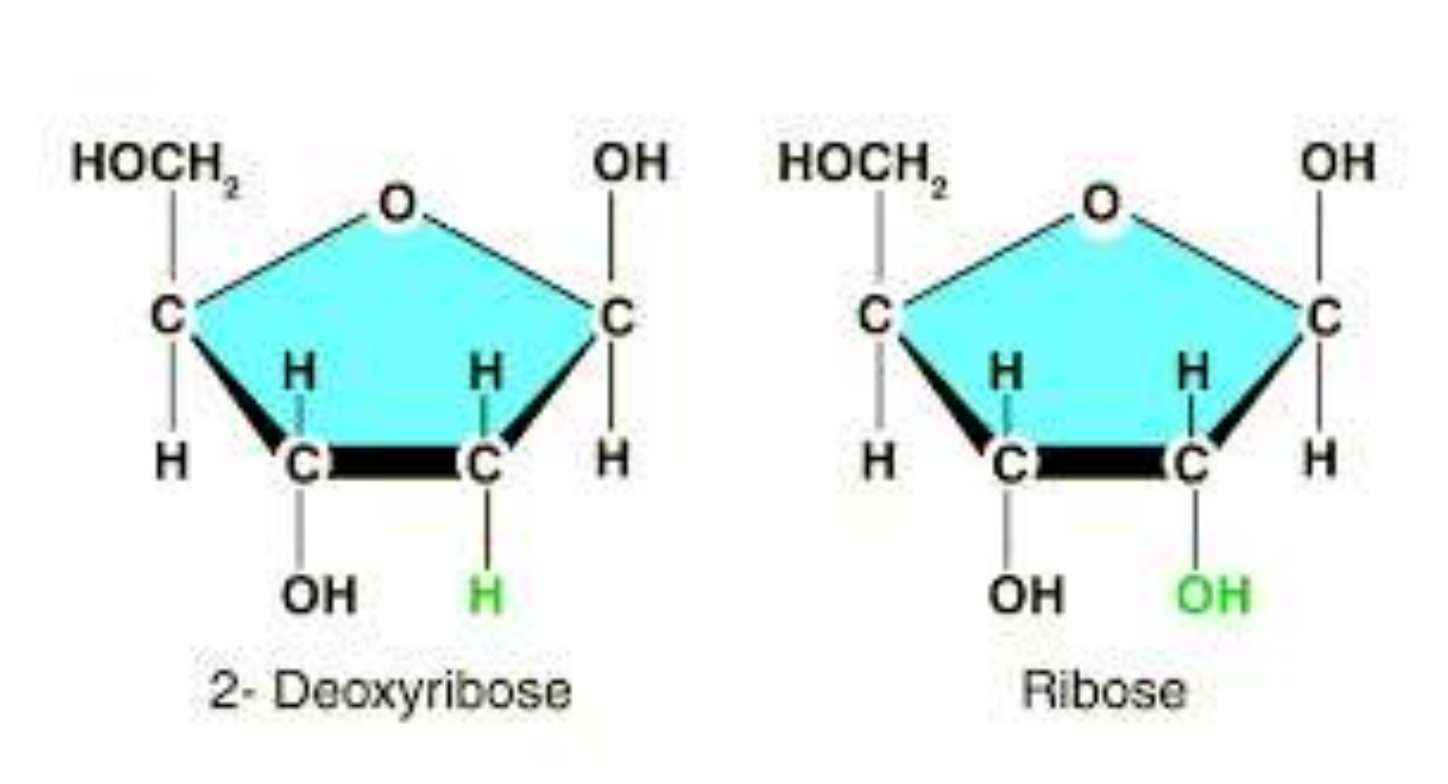
- Both sugar are present in furanose form and beta configuration.
- Pentose sugar form esters with phosphoric acid and is called as phosphodiester bond.

Nitrogen bases

- 2 types of nitrogen base
- **Purine** and **Pyrimidine** derivatives.
- This base is linked to sugar moiety by same carbon used in sugar-sugar bond.
- Purines are - **Adenine and Guanine**
- Pyrimidine derivatives are – **Uracil, Thymine And Cytosine**



Ribose and Deoxyribose Structure

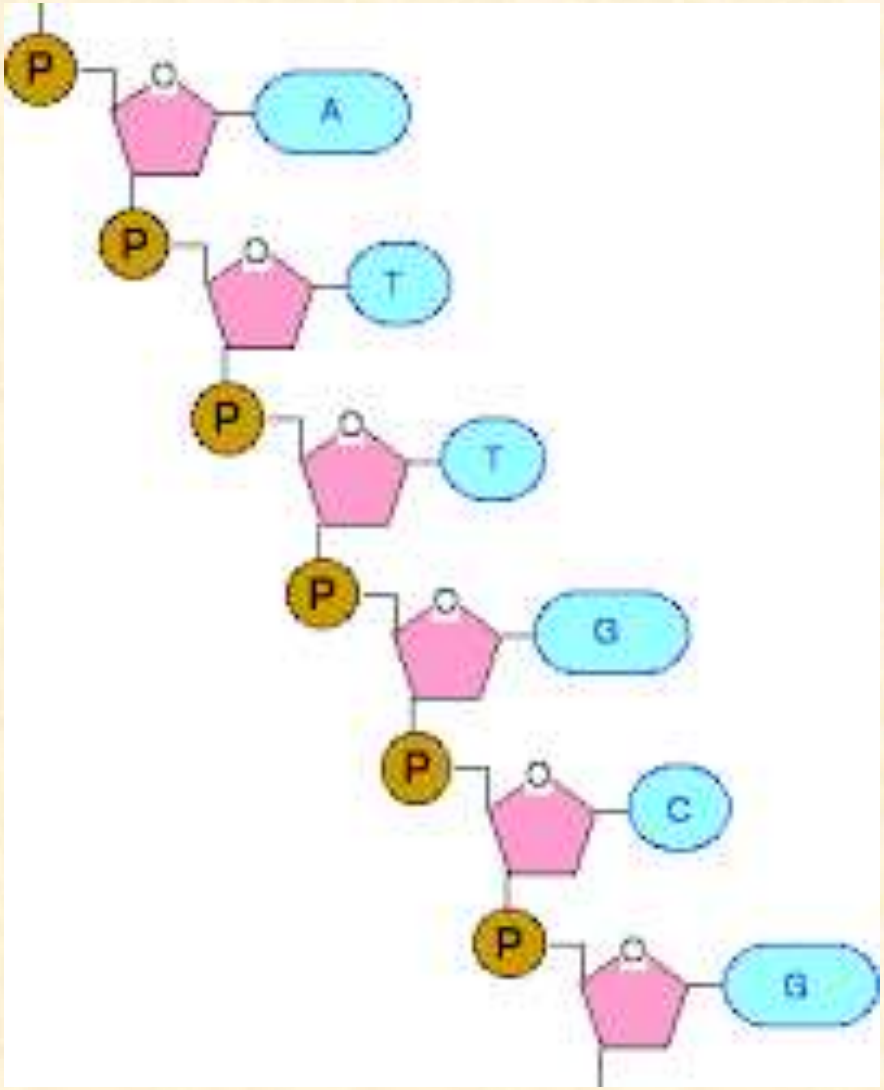


- Ribose – Pentose sugar with 5 C atom, it has hydroxyl group (–OH) attached to each carbon.

- Deoxyribose- Similar to ribose but lacks the –OH group on the 2’ carbon hence prefix “deoxy”

Sugar Phosphate backbone - Nucleotide

- The nucleotides are all orientated in the same direction.
- **The phosphate group joins the 3rd carbon of one sugar to the 5th carbon of the next in line.**
- The **bases** are attached to the **first carbon**.
- Their order is important it determines the genetic information of the molecules.



Deoxy-Ribonucleic acid

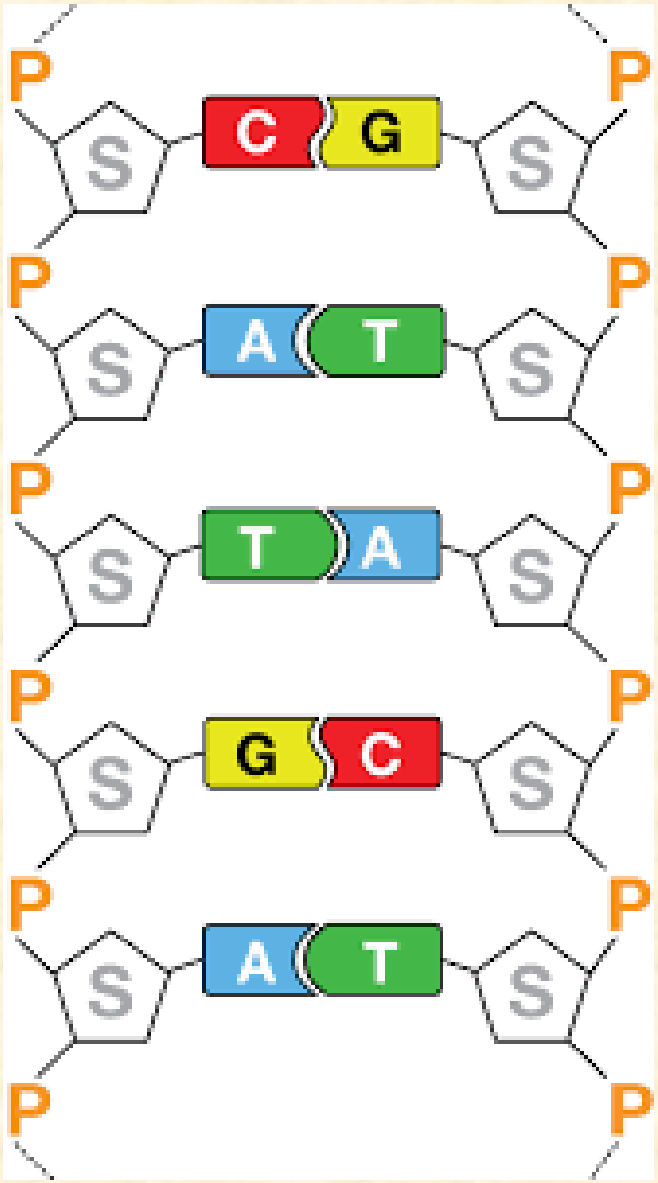
- Every living organism contain DNA
- Material of inheritence discovered in **1960 by Frankilin, Watson and Crick.**
- Though series of experiments done and concluded that DNA is the genetic material present in nucleus of cell.
- Human DNA contains **3 million deoxyribonucleotide** residues and contain 25000 genes.
- Genes are stretch of DNA that carries codes of protein production.

DNA is made up of two strands of polynucleotide

- The sister strands of the DNA molecule run in opposite directions (antiparallel).
- They are joined by the bases
- Each base is paired with a specific partner

  A is always paired with T

  G is always paired with C
- **Each purine is pared with pyrimidine**
- Sister strands are complementary but not identical
- The bases are joined by hydrogen bonds.



Purine and Pyrimidine