

DNA

NUCLEIC ACID

Nucleic acids are the biopolymers, or small biomolecules, essential to all known forms of life.

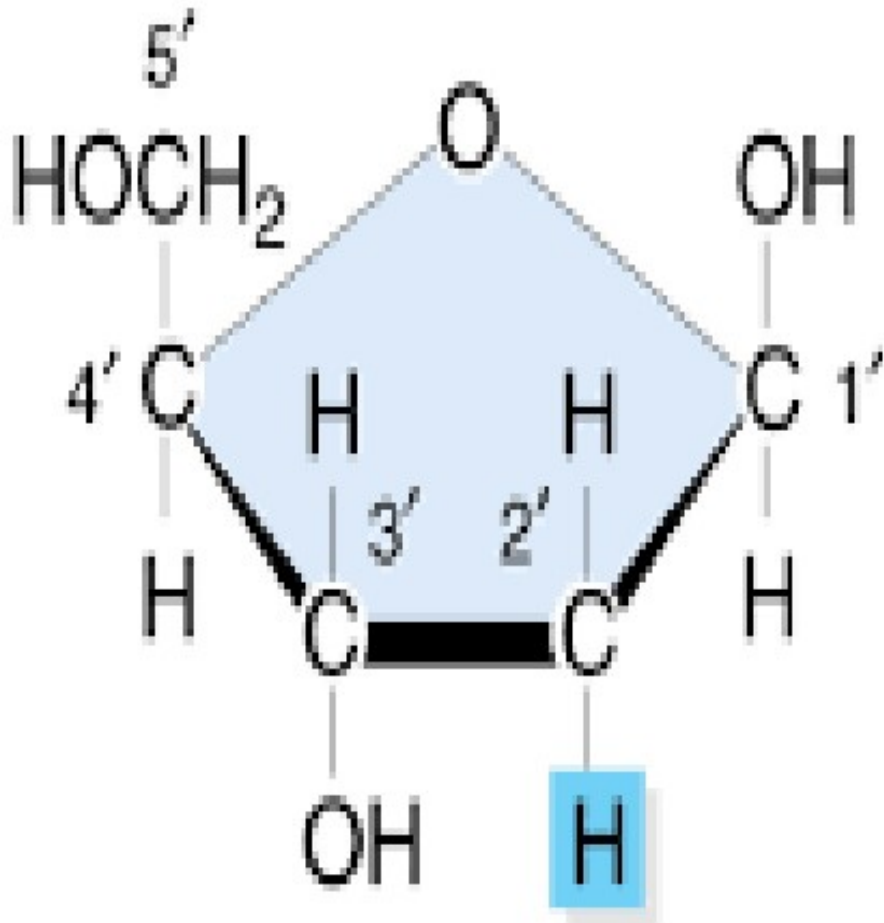
The nucleic acid is of two types:

1. **DNA** (deoxyribonucleic acid)
2. **RNA** (ribonucleic acid).

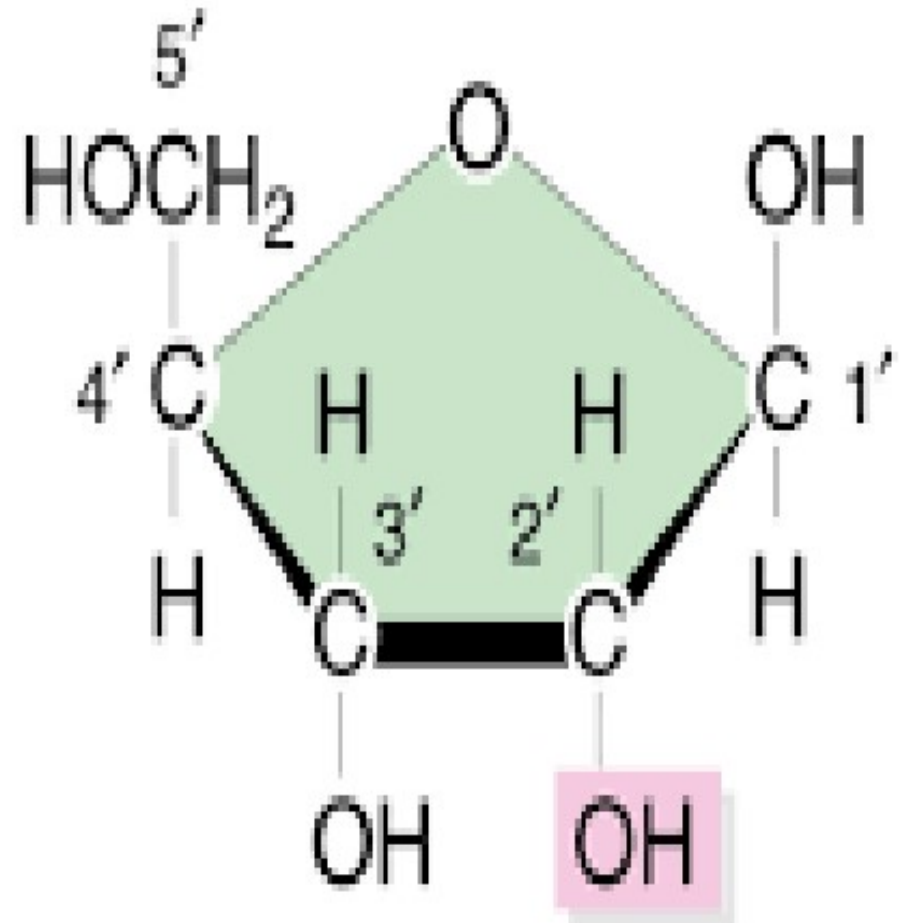
They are composed of three components:

- i. 5-carbon sugar (pentose sugar)
- ii. phosphate group
- iii. nitrogenous base.

The sugars found in nucleic acids are pentose sugars;
a pentose sugar has **five carbon atoms**.



Deoxyribose



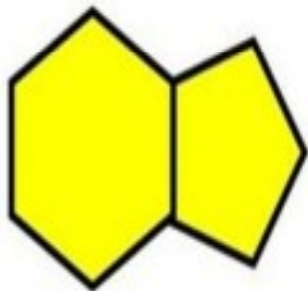
Ribose

There are five nitrogenous bases in total:

Found in:

DNA

RNA



Guanine

Found in:

DNA

RNA



Adenine

Found in:

DNA

RNA



Cytosine

Found in:

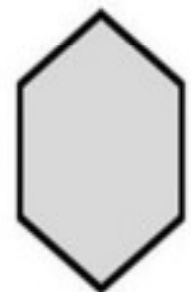
DNA



Thymine

Found in:

RNA

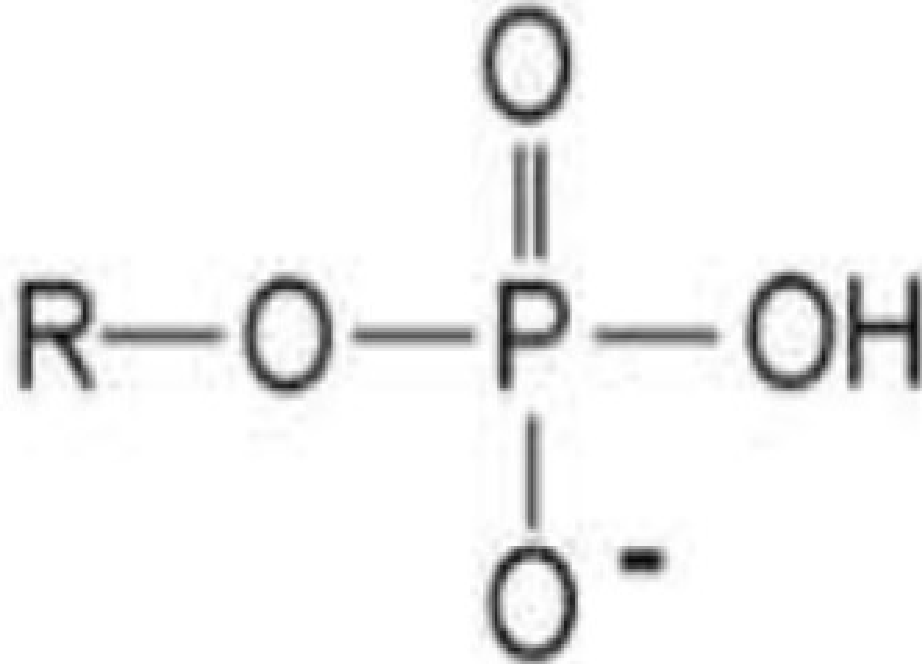


Uracil

Purines = double ring structures

Pyrimidines = single ring structures

A phosphate group is just a phosphorus atom bound to **four oxygen atoms**, but it has many important roles



HISTORY

- **Nuclein were discovered by Friedrich Miescher in 1869.**
- **Father of nucleic acid – Friedrich Miescher.**
- **In 1889 Richard Altmann creates the term nucleic acid**

DNA

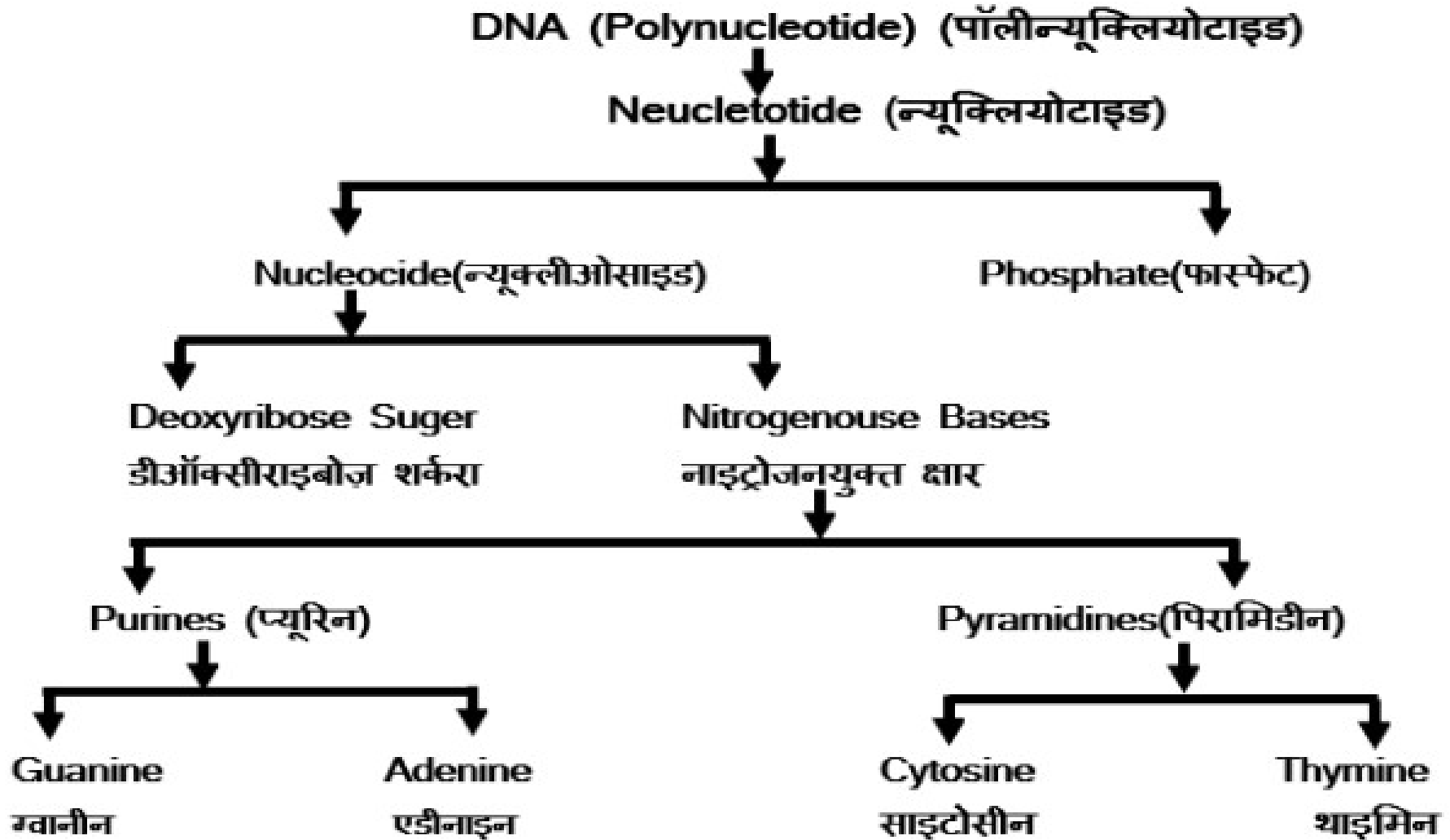
- **DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms.**
- **Nearly every cell in a person's body has the same DNA.**
- **Most DNA is located in the cell nucleus (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria and chloroplast**

- **DNA was discovered in 1869 by Swiss researcher Friedrich Miescher on white blood cells.**
- **He isolated a new molecule he called nuclein from a cell nucleus.**
- **In 1953 James Watson and Francis Crick, aided by the work of biophysicists Rosalind Franklin and Maurice Wilkins, determined that the structure of DNA is a double-helix polymer, a spiral consisting of two DNA strands wound around each other**

WATSON-CRICK MODEL OF DNA:

- **In 1953, J.D. Watson (an American biologist) and F.H.C. Crick (a British Physicist) proposed the three dimensional model of physiological DNA (i. e B-DNA) on the basis of X-ray diffraction data of DNA obtained by Franklin and Wilkins.**
- **For this epoch-making discovery, Watson, Crick and Wilkins got Nobel Prize in medicine in 1962.**
- **Term DNA was given by Zaccharis.**

DNA is polynucleotide



Nucleoside: -

- A nucleoside is formed by the addition of a nitrogenous base and a sugar.
- The base and the sugar are linked together by an N glycosidic linkage bond.

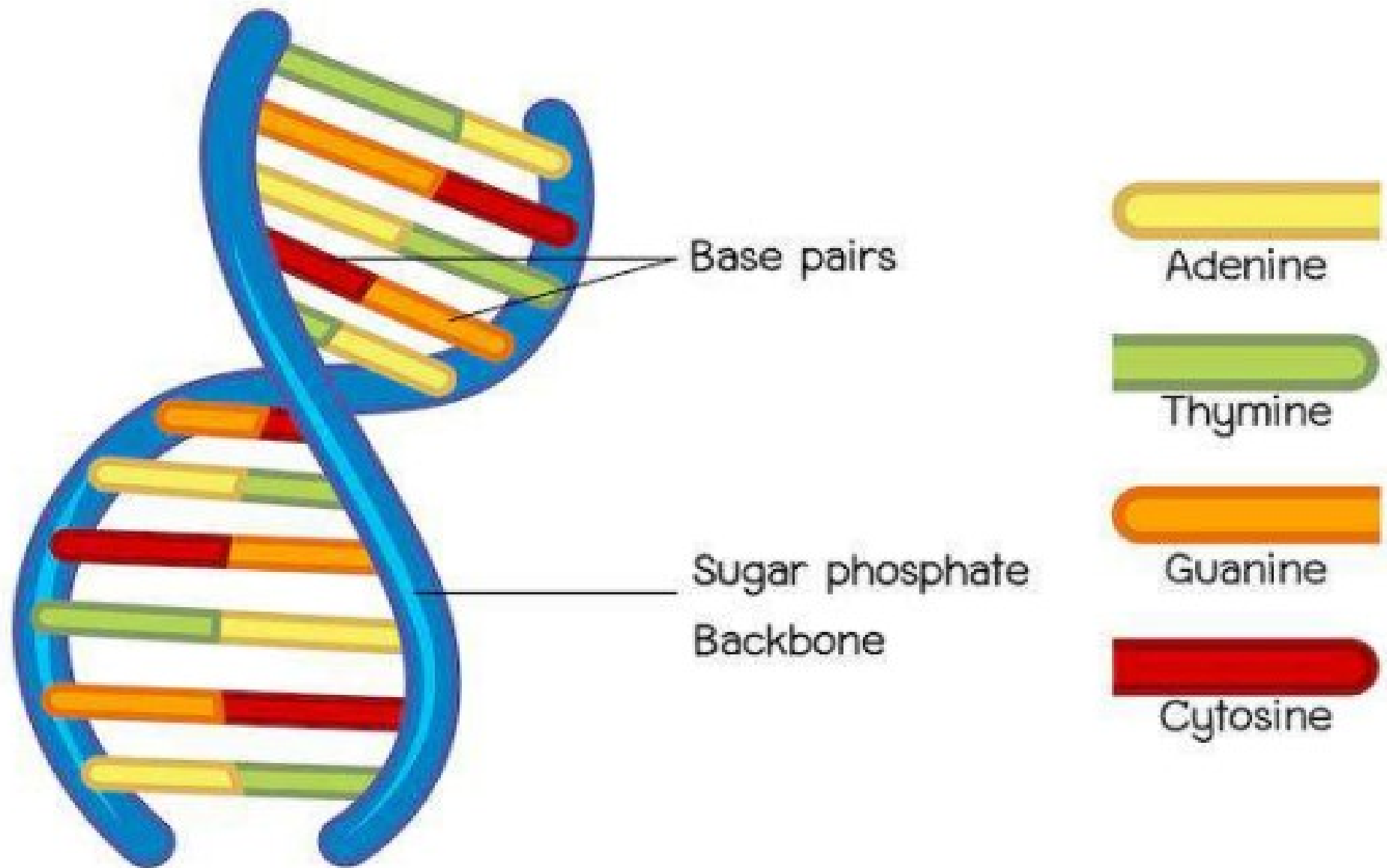
nucleotide:-

- A nucleotide is formed when a phosphate group is attached to a nucleoside by a “phosphoester linkage” bond.

polynucleotide:-

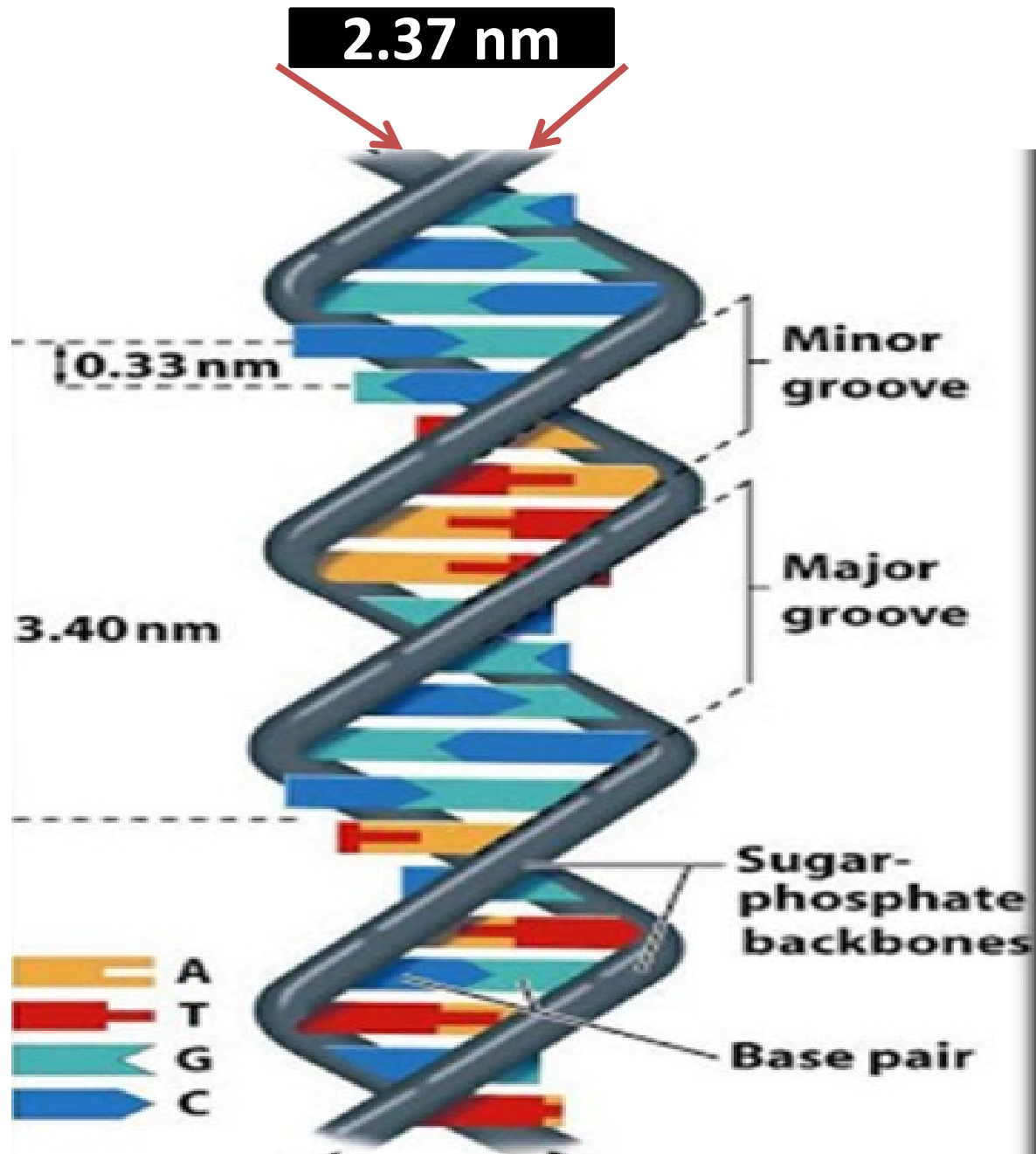
- When two nucleotides are joined together by a phosphodiester bond, a polynucleotide is formed

Basic DNA structure



THE IMPORTANT FEATURES:-

- 1. The DNA molecule consists of two polynucleotide chains or strands that spirally twisted around each other and coiled around a common axis to form a right-handed double-helix.**
- 2. The two strands are antiparallel i.e. they ran in opposite directions so that the 3' end of one chain facing the 5' end of the other**



3. The base sequence along a polynucleotide chain is variable and a specific sequence of bases carries the genetic information.
4. The base compositions of DNA obey **Chargaff's rules**.
5. The diameter of DNA is 2.0nm or 20 Å. Adjacent bases are separated 0.34 nm or by 3.4 Å along the axis. The length of a complete turn of helix is 3.4 nm or 34 Å i.e. there are **10bp per turn**. (B- DNA-Watson rick DNA)
9. The DNA helix has a shallow groove called minor groove (- 1,2nm) and a deep groove called major groove (- **2.2nm**) across.

Chargraff's Rule:

- **Discovered by Erwin Chargaff (in 1950).**
- **It specifies that the amounts of guanine and cytosine be the same.**
- **While the ratios of adenine and thiamine are the same.**

THREE MAJOR FORMS OF DNA:-

1. A-form DNA
2. B-form DNA
3. Z-form DNA

Characteristics	A form of DNA	B form of DNA	Z form of DNA
Helical sense	Right handed	Right handed	Left handed
Diameter	26Å	20Å	18Å
Rise per turn of helix	28Å	36Å	44Å
Base pairs per helical turn	11 base pairs	10 base pairs	12 base pairs
Helix rise per base pair	2.6Å	3.6Å	3.7Å
Base tilt normal to the helix axis	20°	6°	7°
Glycosyl bond conformation	Anti	Anti	Anti for pyrimidine and syn for purines

Table: Differences between various forms of DNA (A-DNA, B-DNA and Z-DNA)

Extra Points:-

- DNA is the carrier of genetics. DNA The part of DNA that provides information for proteins is called “Gene”. GENE
- Gene is unit of genetics
- Anotation : The process of marking genes in a DNA sequence.