DNA

- DNA and RNA collectively called as nucleic acid.
- DNA genetic information in all species except some virus.
- DNA encode protein and RNA in a cell , RNA crucial role in transmission of genetic information in all species.

CHEMICAL COMOSITION.

- *DNA IS COMPLEX POLYMERS 0F MONOMERS* called ***Deoxyribonucleotides.***

DNA- a Polymer of Deoxyribonucleotides.

Four types of Deoxyribonucleotides are found in DNA as shown

2' dAMP- 2' deoxyadenosine monophosphate.

2' d GMP- 2 'deoxyguanosine monophosphate

2' d CMP - cytidine

2' d TMP- thymidine

- These deoxyribonucleotide differ in purine or pyrimidine base attached to deoxyribose by a N-glycosidic linkage.

BASES FOUND IN DNA.

- ***Purine-***

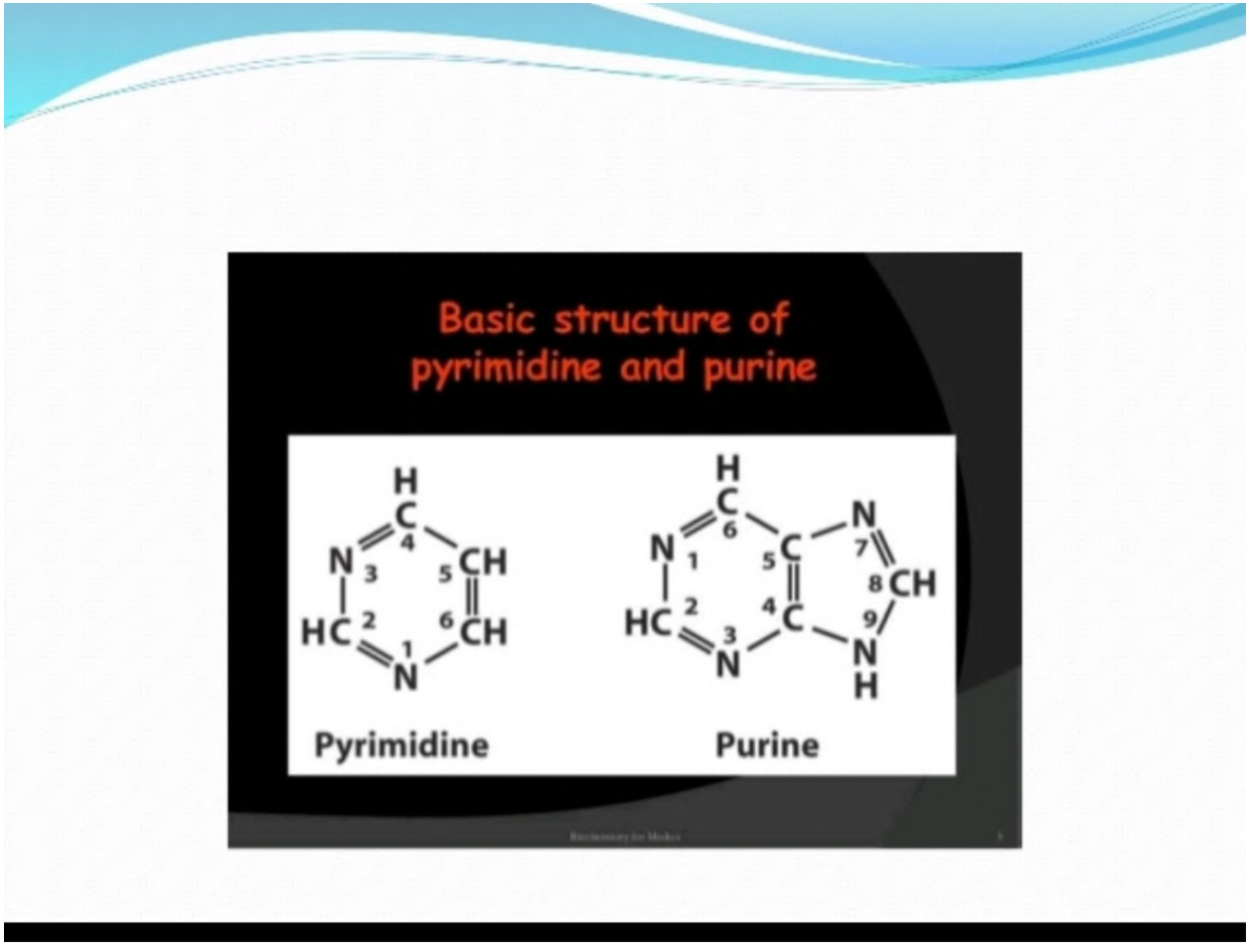
  Adenine and guanine---Fused ring of nitrogen and carbon atom.

- ***Pyrimidine-***

  cytosine and thymine– only a single ring.

- DNA contain thymine pyrimidine while RNA contain Uracil.

Structure of Pyrimidine and Purine.



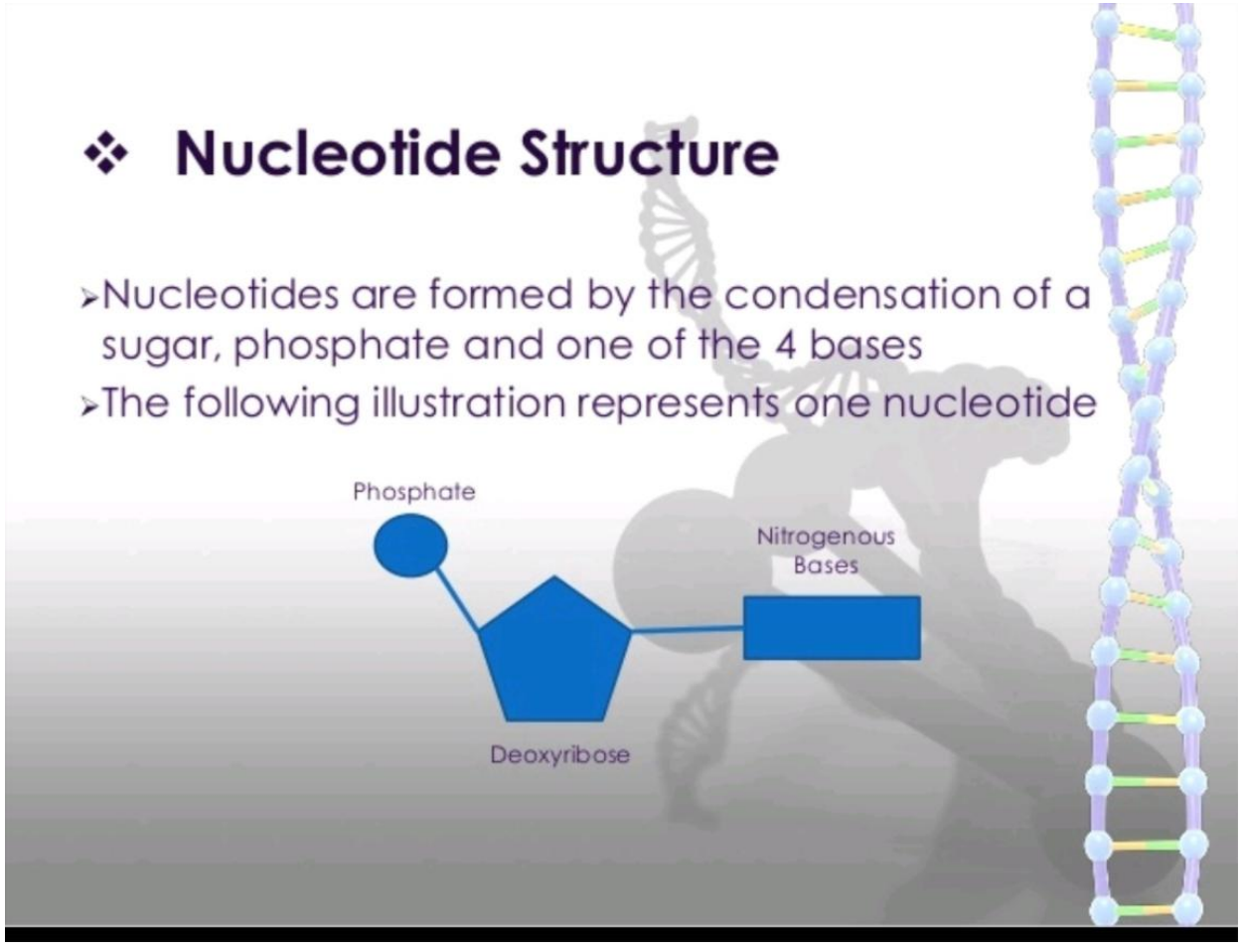
Components of nucleotides.

- Base.(Nitrogen base.)-A, G, C or T.
- Sugar.(Pentose sugar)
- Phosphate.

NUCLEOTIDE

- Basic unit of nucleic acid composed of three component, These are sugar, phosphate group, and a ring of carbon and nitrogen atom known as a Base.
- ***NUCLEOSIDE*** = Base + Sugar
- ***NUCLEOTIDE***= Nucleoside + phosphate.
- A cyclic five carbon sugar(D- ribose or D 2-deoxyribose)
- A heterocyclic nitrogenous base(Purine or Pyrimidine)
- Phosphoric acid or phosphate.
- NUCLEOTIDE--- is monomer of DNA.

NUCLEOTIDE STRUCTURE.



PHOSPHATE

- Phosphoric acid is-H_3PO_4.
- Contain 3 monovalent hydroxyl group and a divalent oxygen atom, all linked to the pentavalent phosphorous atom.

PENTOSE SUGAR

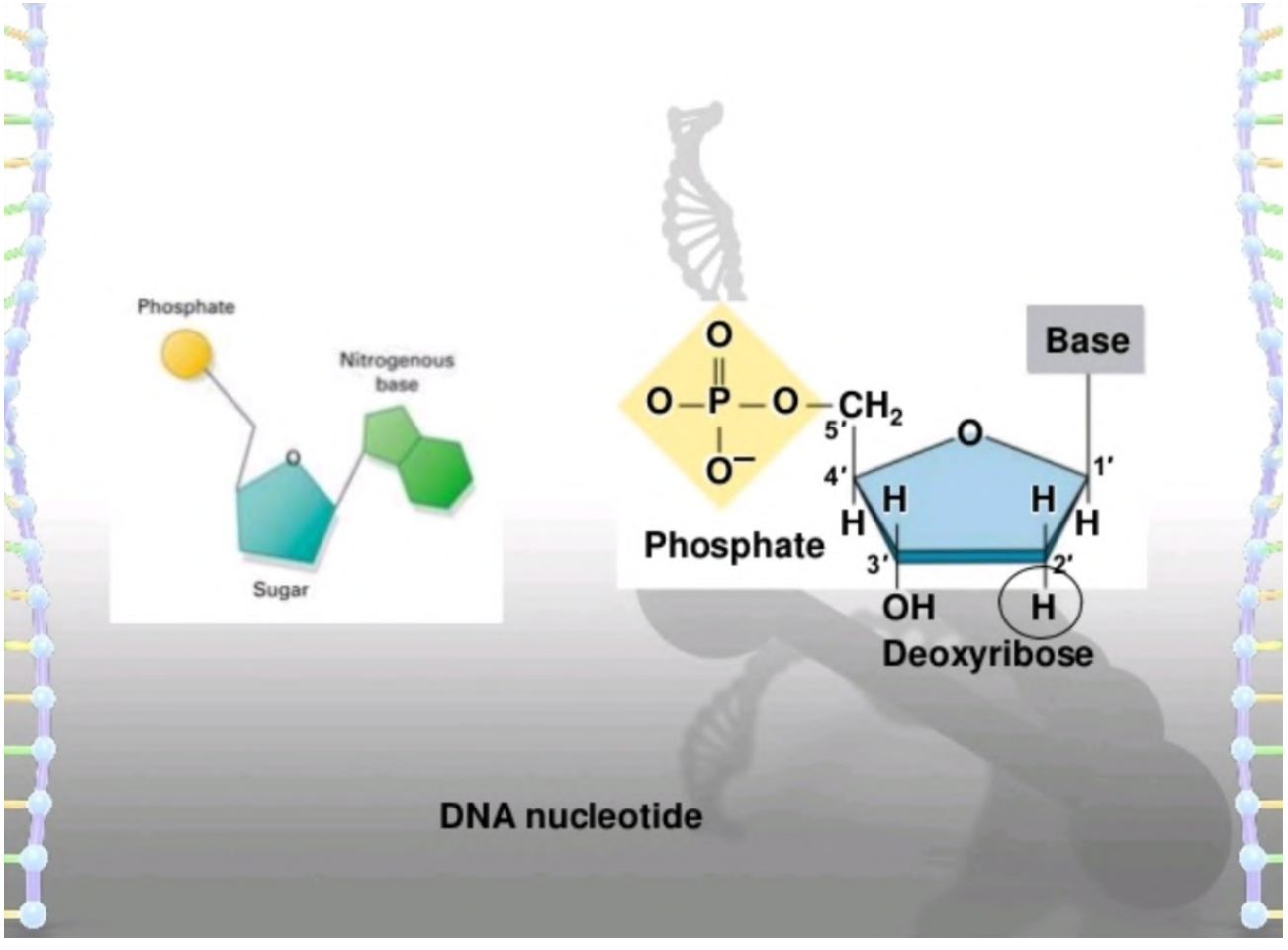
- DNA contain—2-deoxy-D - ribose
- Pentose sugar has capacity to form ester with phosphoric acid. OH- group of pentose , especially 3rd and 5th involved forming 3'-5 '– phosphodiester bond between adjacent pentose residue.

NITROGENOUS BASE

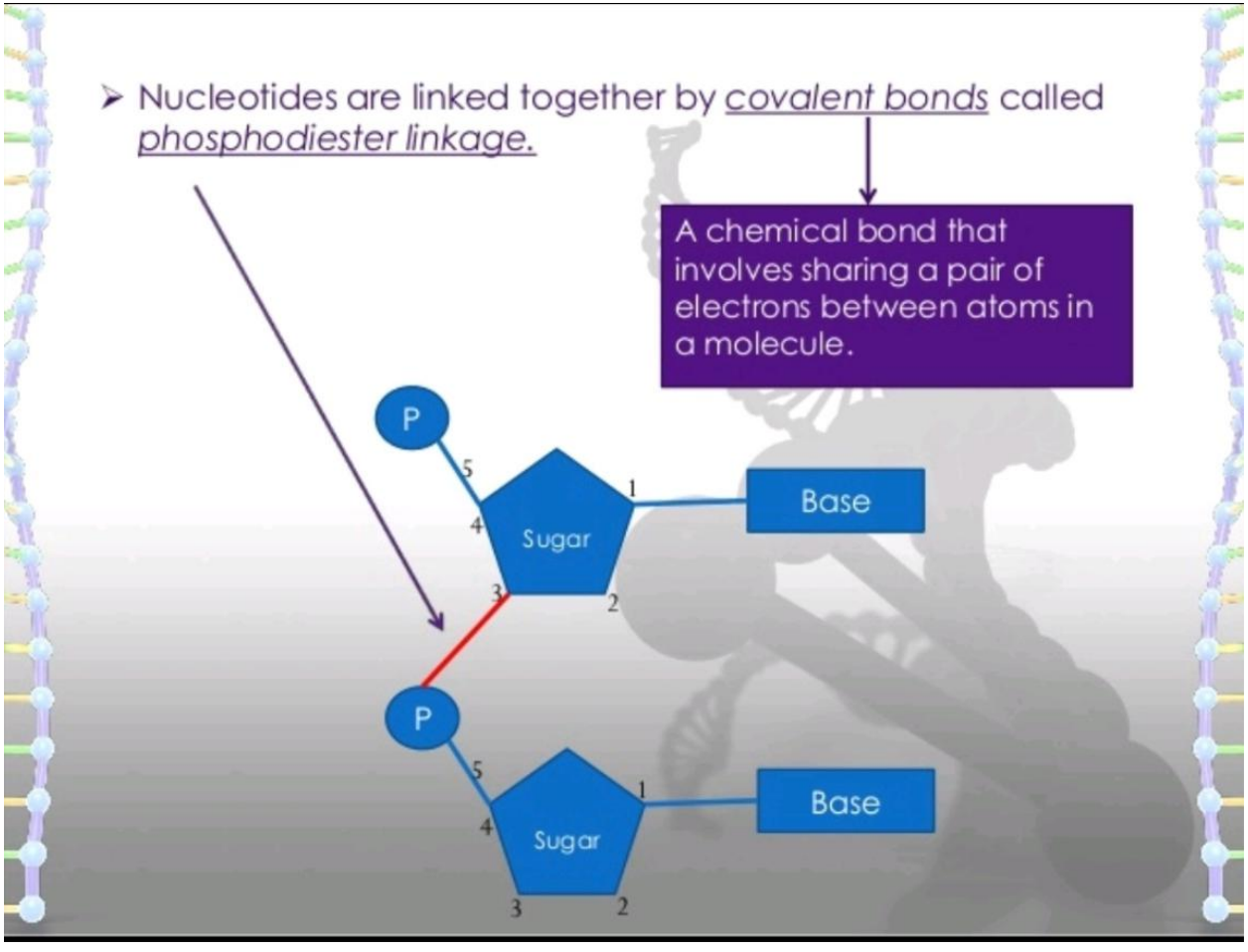
- PURINE and PYRIMIDINE.
- BASE is linked to the sugar moiety by the same carbon (c1) used in sugar sugar bond.
- *PURINE Bases—Adenine and Guanine.*

- *PYRIMIDINE--* Uracil, Thymine and cytosine.

DNA NUCLEOTIDE.



PHOSPHODIESTER LINKAGE.



Watson-Crick Model of DNA Structure.

> Helical structure-*Double stranded helix.*

- *Polarity*----5' to 3' direction strand or 3' to 5 'direction strand.
- Backbone of the strand up of alternative phosphate and deoxyribose molecule, and lies exterior while bases lies inside....
- Two strand of DNA are placed *antiparallel* to each other.

- ***Right Handed Double Helix*** -
- DNA consists of two polydeoxyribonucleotide chains twisted around one another in a right handed double helix similar to a spiral stair case.

BASE PAIRING RULES.

- Always two strand are complementary to each other.
- Adenine of one strand will pair with thymine of opposite strand, while guanine will pair with cytosine.
- The base pairing (A with T, G with C) is called *chargaff's rule.*
- Which states that number of the number of purines is equal to the number of pyrimidines.

HYDROGEN BONDING.

- The DNA strands are held together mainly by hydrogen bonds between the purine and pyrimidine bases.
- Two hydrogen bond between A and T while there are three hydrogen bonds between C and G .
- GC bond is stronger than AT bond.

ANTIPARALLEL.

- One strand in 5’ to 3’ direction, while the other is in the 3’ to 5’ direction.

OTHER FEATURES.

- ***Denaturation of DNA strands-----***
- ***MELTING***- Double stranded DNA may be denatured and separated by heat.
- At lower temperature the melted strand are re-associated, this is called annealing.

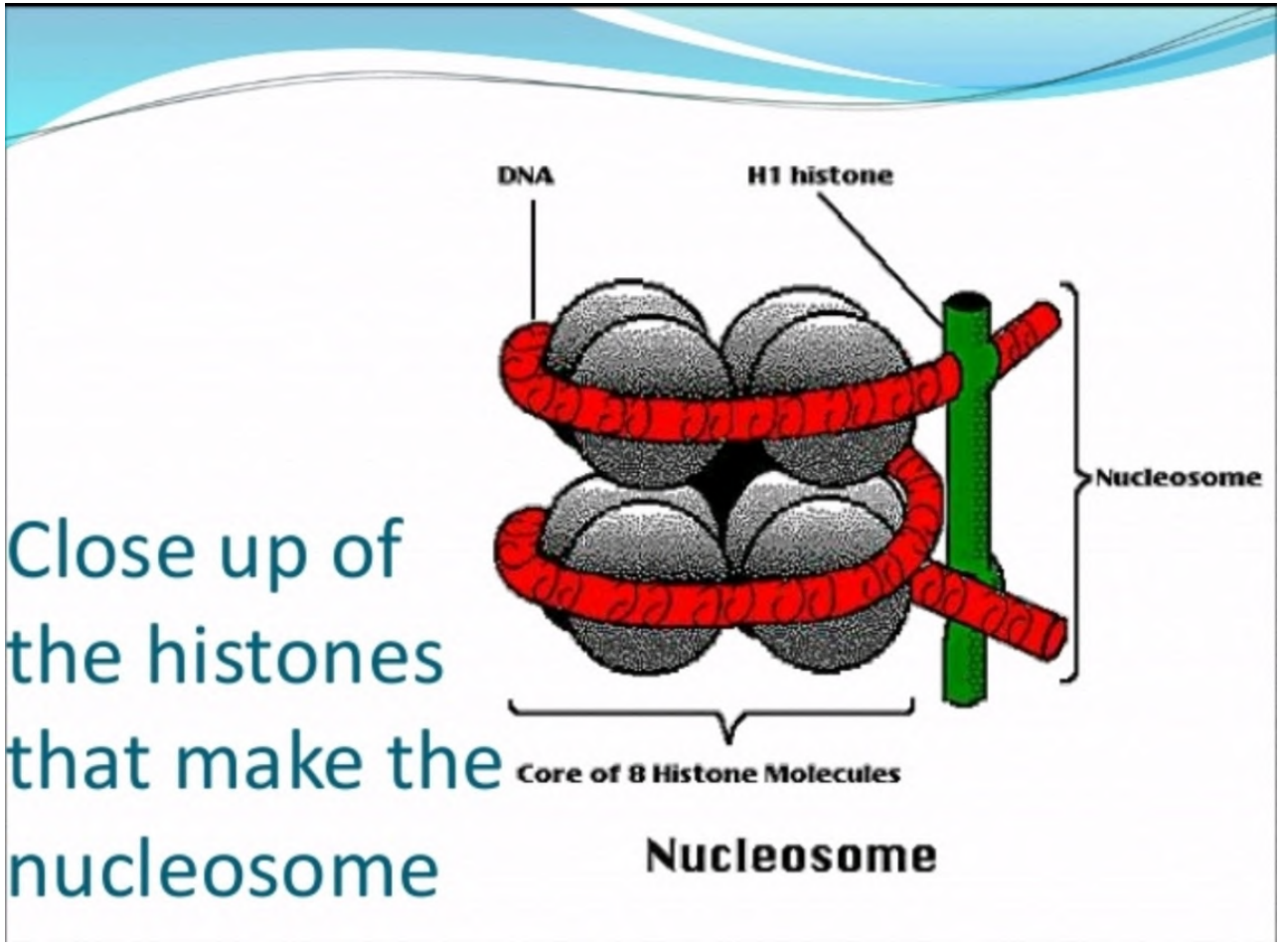
Higher organisation of DNA

- ***NUCLEOSOMES***--
- Double stranded DNA is wound round histones to form nucleosomes.
- *CHROMATIN*—Long stretch of DNA in association with histones.
- *CHROMOSOMES*—Chromatin further condensed to form chromosomes.
-

Histones.

- Protein with higher concentration of basic amino acids.
- Acetylation of histones leads to activation of transcription.
- Deacetylation of histones causes depression of transcription.

NUCLEOSOME.



DNA is very long molecules.

- Human diploid genome consists of about 7x 10’9 base pairs.

INTRONS, EXONS, CISTRONS.

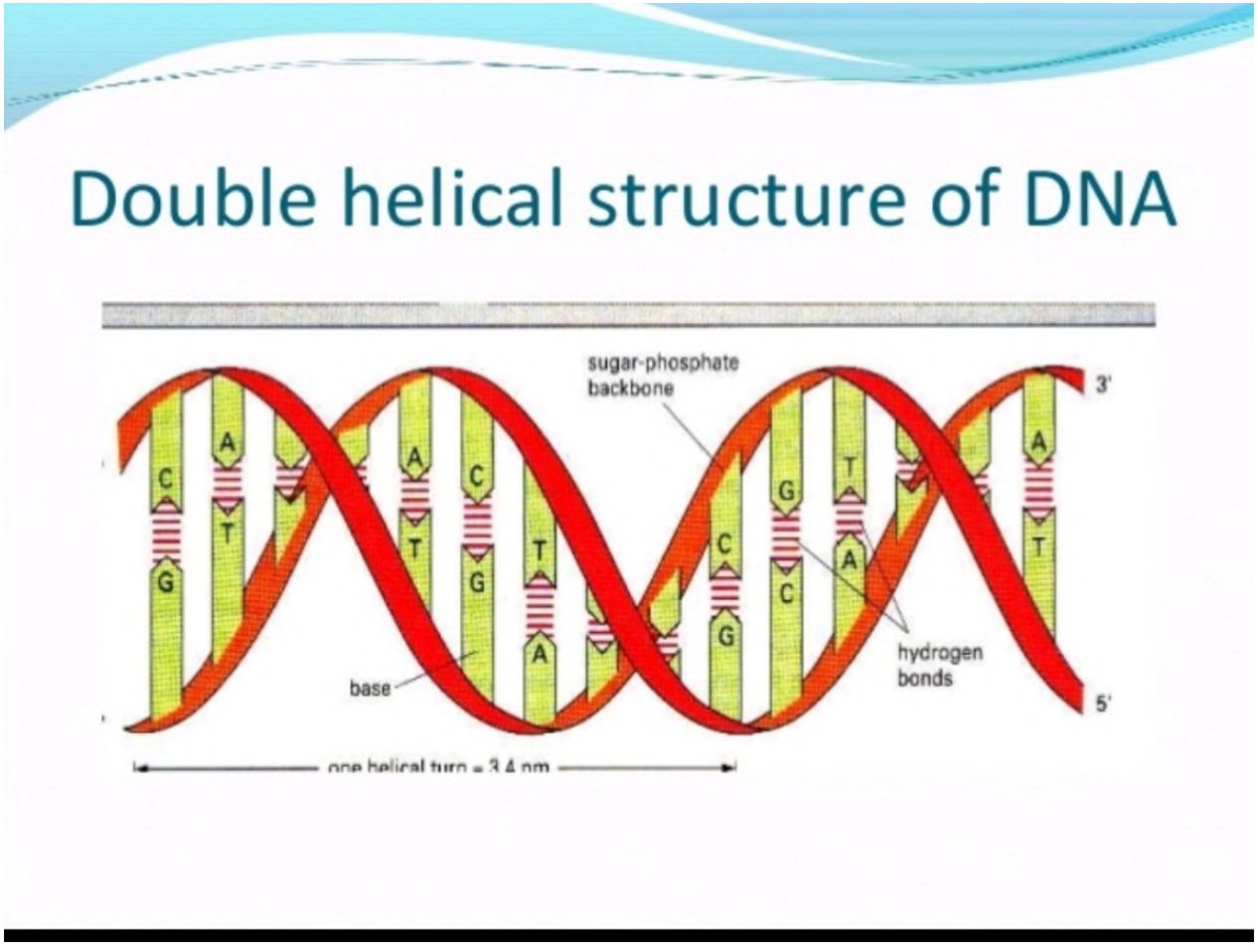
- ***EXONS***-The segment of the gene coding for proteins are called exons.(expressed regions).
- *INTRONS*-Interspaced silent areas in the DNA(intervening areas). Introns are not translated.
- *CISTRONS*- is the unit of genetic expression.

  one cistron will code for one polypeptide.

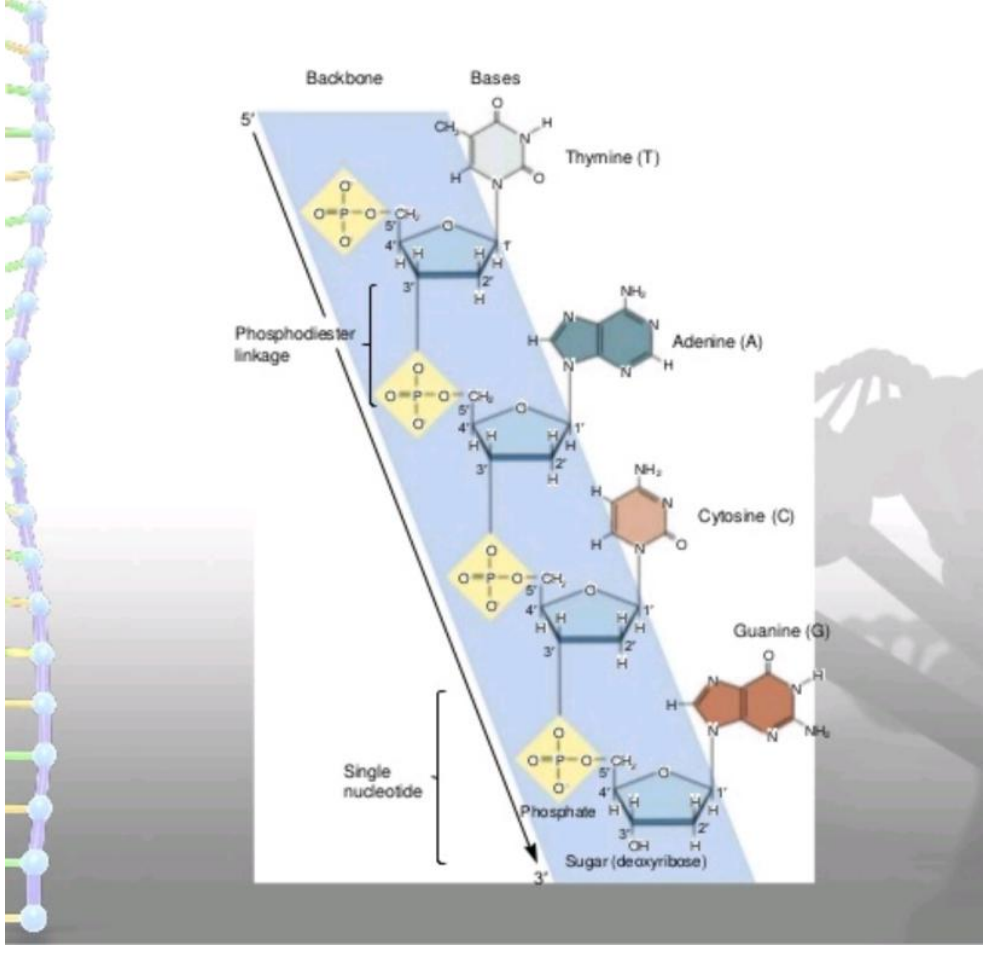
Repeat sequences of DNA.

- Only about 1-2 % of the human DNA contain genes, the rest are silent areas.
- About 90% of the DNA is made up of non coding intervening sequences, called as introns.
- About 30 % of the genome consists of repetitive sequences.

DNA STRUCTURE.



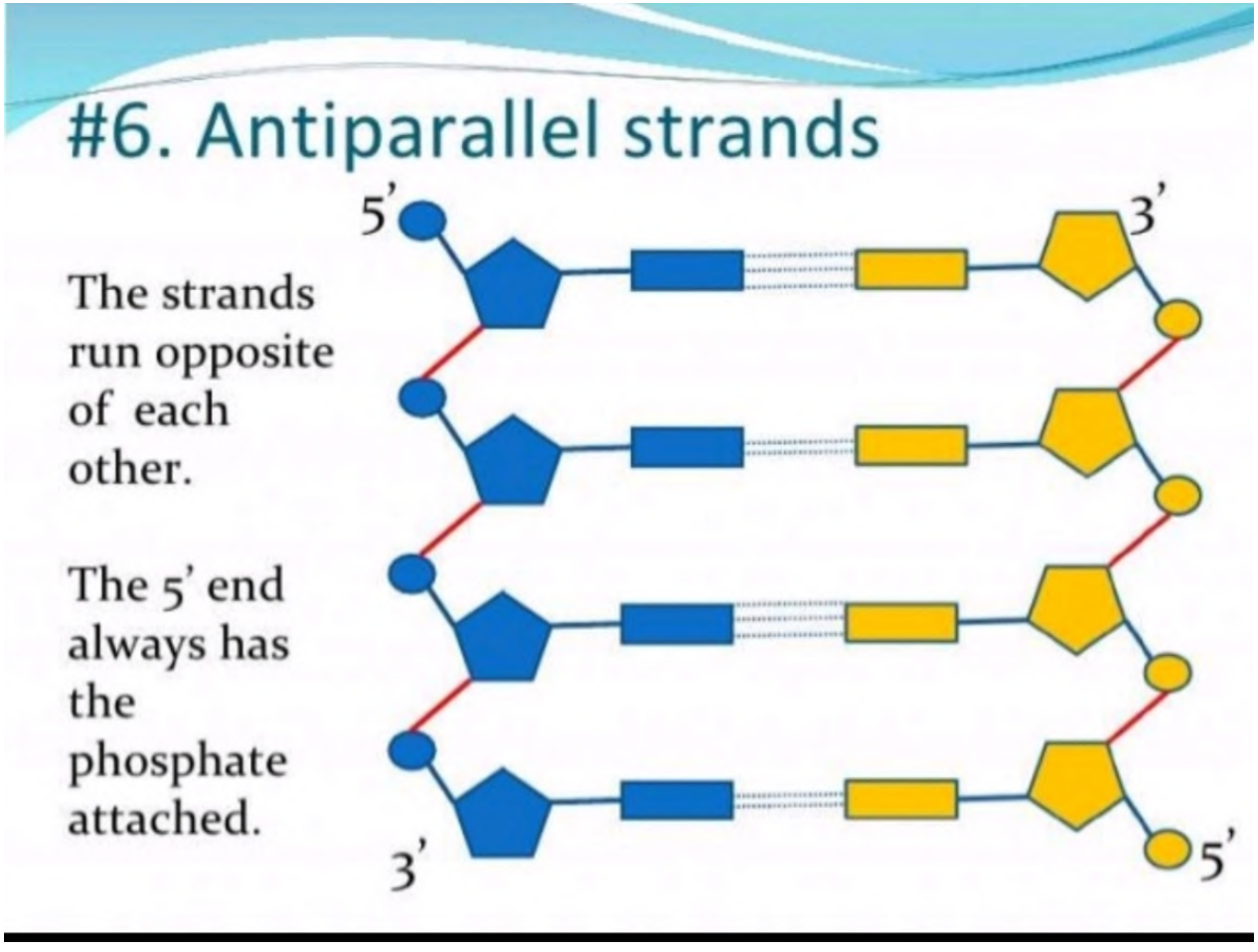
STRUCTURE DNA



DNA STRUCTURE.

- Two strand are held together by hydrogen bond, hydrophobic interaction and vander wall forces.
- Adenine bonds with thymine by two hydrogen bond.
- Guanine bonds with cytosine by 3 hydrogen bond.
- Double stranded molecule is coiled into a Right handed helix.

DNA STRANDS VIEW.



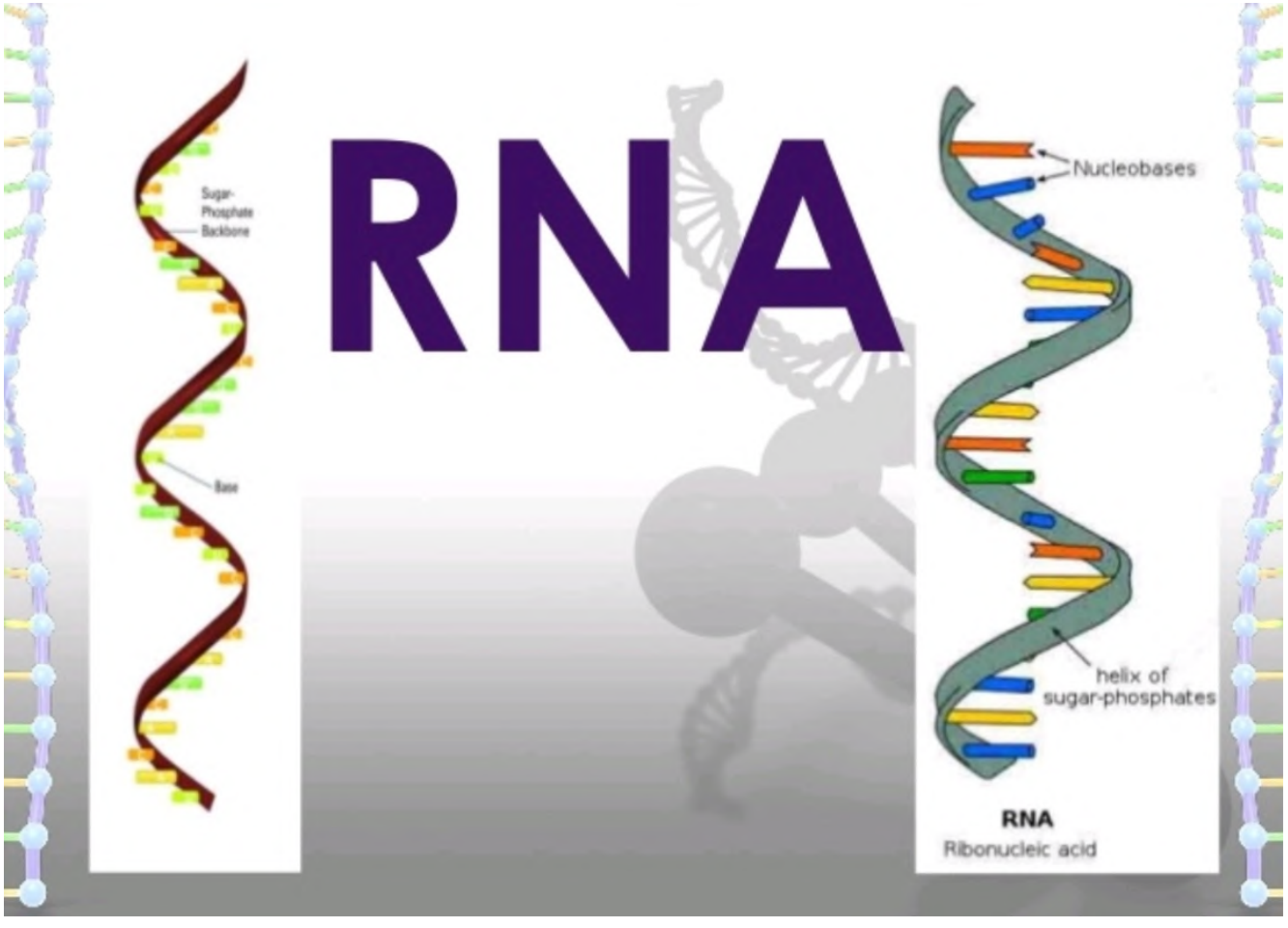
TYPES OF DNA.

DNA FORM	PITCH-nm	Bases per turn	Major grouve	Minor grouve
A	2.46	11	Deep narrow	Broad and shallow
B	3.32	10	Wide and deep	Narrow and deep
Z	4.56	12	Flat	Deep narrow

B- FORM OF DNA

- Most common form...
- Right handed double helix.
- Pitch of length of each turn is approx 3.4 nm.
- Pitch has approx 10 base pairs.
- Wide major groove and narrow minor groove.
- Z DNA----
- zig- zag not true helical.
- left handed helix and has 12 base pairs per turn.
- No true major groove.

RNA



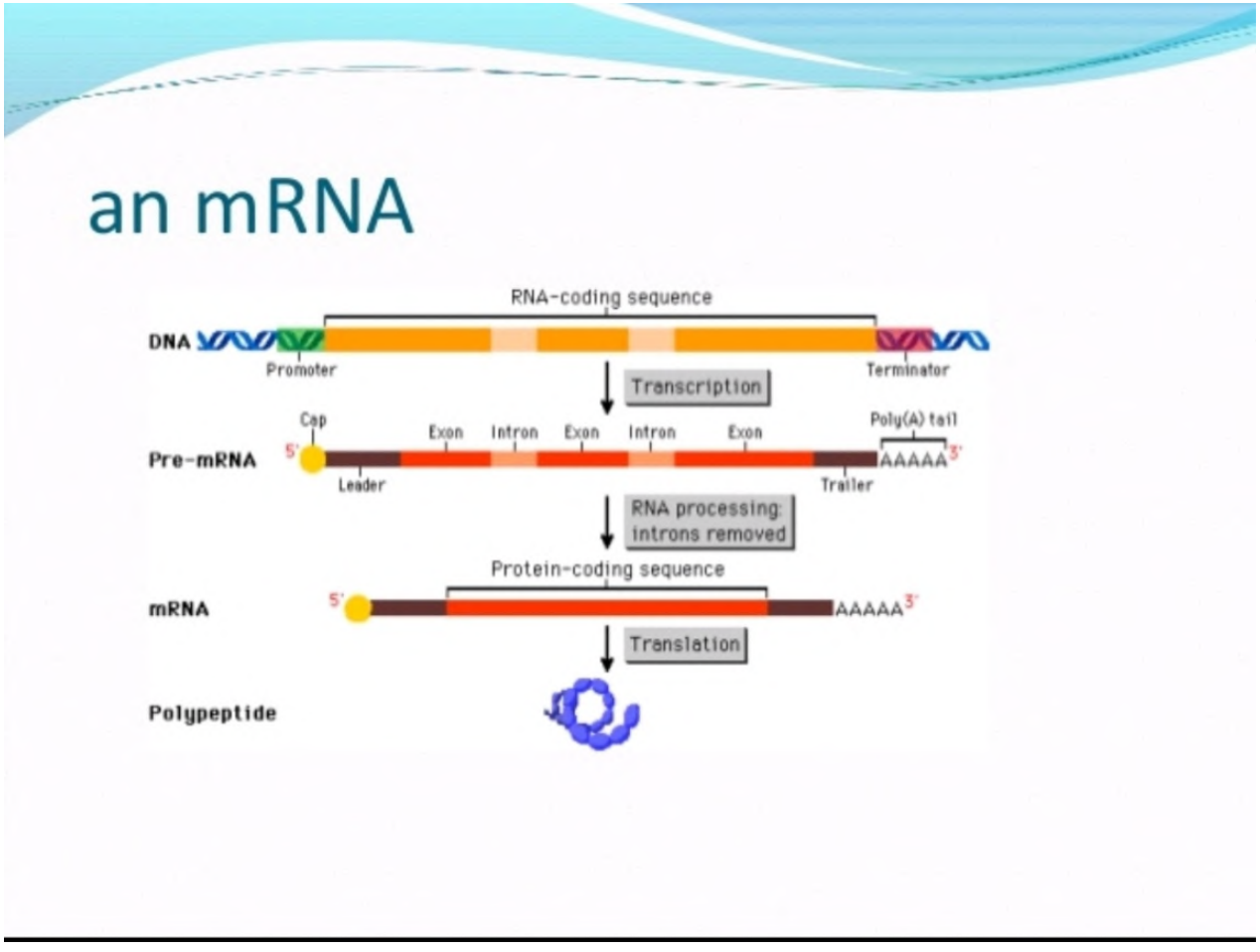
GENES, GENETIC INFORMATION, and CENTRAL DOGMA.

CENT
- DNA---
- REPLICATION.

RAL
- mRNA
- TRANSCRIPTION

DOGMA
- PROTEIN
- TRANSLATION.

POLYPEPTIDE SYNTHESIS.



m RNA.

- RNA is polymer of ribonucleotides.

m-RNA : it has cap, coding region, and poly A tail.

Cap at the 5' end is a 7- methyl- guanosine triphosphate molecule.

Ribosome recognise mRNA by its cap structure.

Leader region-leader sequence is immediately after the cap region.

Coding region—codes for protein synthesis, contains start(AUG) and stop (UAG) codon

Termination sequence-lies after coding sequence.

Poly A tail- present at 3' end, helps in stability of mRNA.

TYPES OF RNA

- messenger RNA.
- Transfer RNA.
- Ribosomal RNA.
- The others are =

small nuclear RNA

micro RNA.

small interferring RNA

heterogenous RNA.

Messenger RNA.

- 5% of RNA in cell.
- Function as messengers carrying the information in a gene to the protein synthesizing machinery.
- 5- terminal end is capped by 7- methyl guanosine Triphosphate cap.
- The cap is involved in the recognition of mRNA by the translating machinery.
- It stablise mRNA by protecting it from 5 exonuclease.
- 3- end of most m- RNA have a polymer of Adenylate residues.

Structure of m-RNA.

- m-RNA molecules are formed with the help of DNA template during process of transcription.
- The sequence of nucleotides in m – RNA is complementary to the sequence of nucleotide on template DNA.
- Sequence carried on m-RNA is read in the form of codons.
- Codon is made up of 3 nucleotides.

m-RNA is formed after processing of hn RNA.

hn RNA.

- Is immediate product of gene transcription.
- 75 % hn RNA is degradeded in the nucleus , only 25% is processed to mature RNA.
- Mature RNA is formed from primary transcript by caping, tailing ,splicing, and base modification.

Transfer RNA.

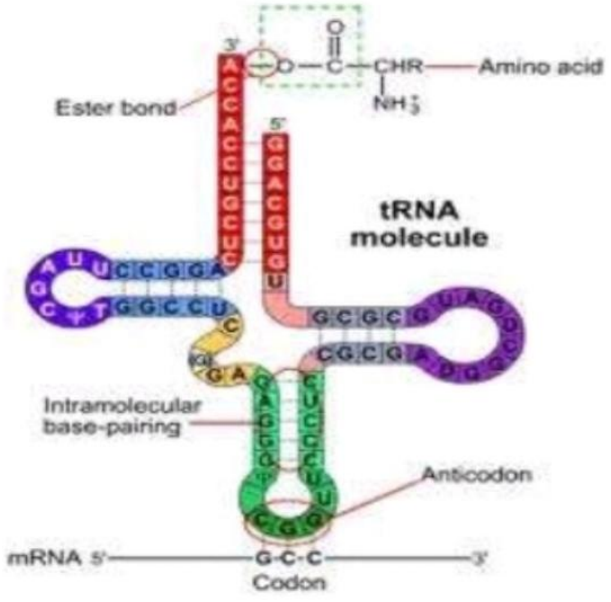
- Most t -RNA display a clover leaf like structure with several arms and loops.
- *ACCEPTOR ARM-*

  Near the 3' end and terminate in CCA sequence.

This arm carries specific amino acid.

Structure of t- RNA.

Secondary structure of t- RNA



The carboxyl group of amino acid is attached to 3'OH group of Adenine nucleotide of the acceptor arm. The anticodon arm base pairs with the codon present on the m- RNA

t- RNA.

- *ANTI CODON ARM* --

  Anticodon arm reads the nucleotide on mRNA ---CODON.

The comlimentary triplet anticodon is present in this arm.

- *D-ARM*--

  Because it contain at least two dihydrouracil bases.

Helps in recognition of t-RNA by the enzyme amino acyl t - RNA synthase.

Catalyse the attachment of aminoacid to the acceptor arm with CCA sequence.

t-RNA.

- *T psi C Arm*--

  Two unusual nucleotides –ribothymidine and pseudouridine...

Thymine normally present in DNA.

variable arm- not always present.

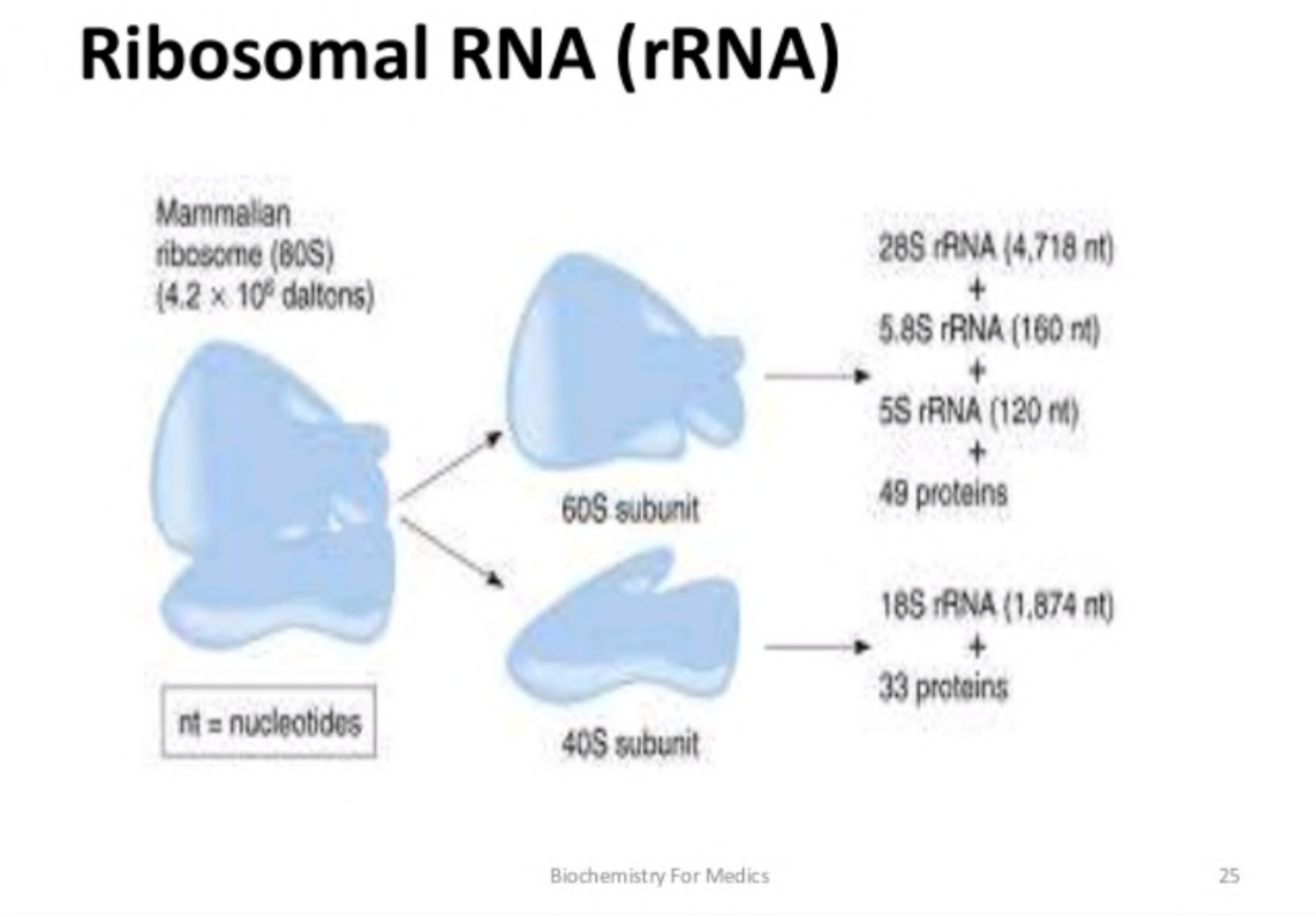
FUNCTION OF t- RNA.

- 15% of cellular RNA.
- Read information on mRNA and then provide specific amino acid to Ribosome.

RIBOSOMAL RNA.

- Ribosomes contain RNA 65% and protein 35%.
- Ribosomal RNA protein combine to form a nucleoprotein called ribosome.
- Ribosome serve as the site and carries the enzyme necessory for protein synthesis.

r RNA



r RNA.

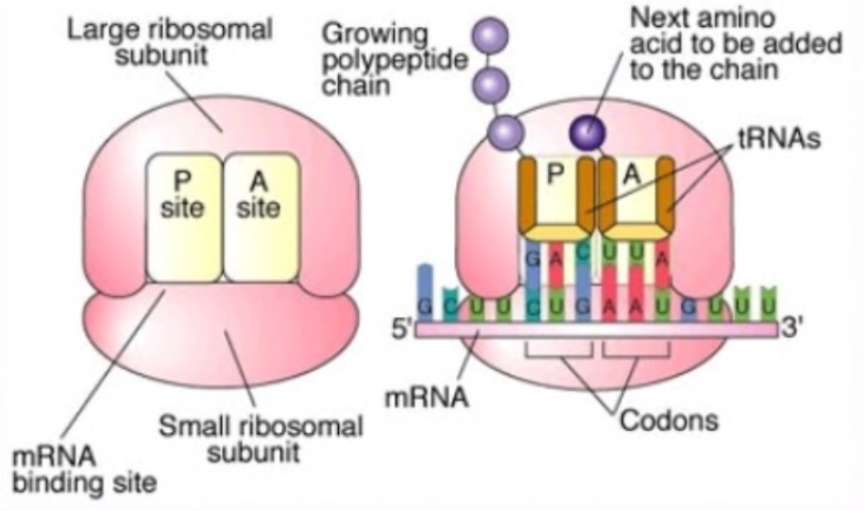


Fig- General representation of rRNA

FUNCTION OF RNA.

- *PROTEIN SYNTHESIS.*
- *GENETIC MATERIAL- eg---Retrovirus.....RNA virus.*
- *RIBOZYME-----RNA acting as enzyme—ribizyme.*