



NUCLEIC ACIDS

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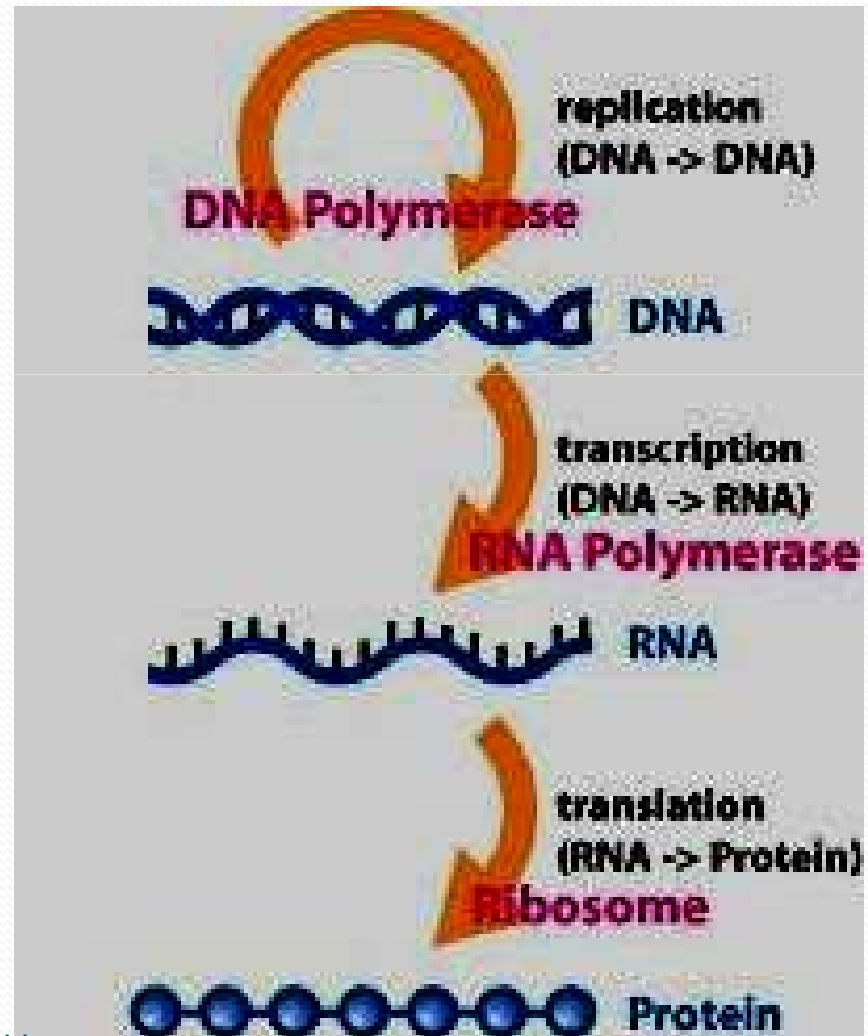
NUCLEIC ACIDS

- **A group of complex compounds found in all living cells and viruses, composed of purines, pyrimidines, carbohydrates, and phosphoric acid.**
- **Nucleic acids in the form of DNA and RNA control cellular function and heredity.**

- **First isolated by Freidrich Miescher in 1871.
called *Nuclein***
- **Nucleic acid – DNA – Deoxyribose Nucleic Acid &
RNA – Ribose Nucleic Acid**
- **All living cells/organisms – DNA & RNA**
- **Viruses – DNA/RNA**

CENTRAL DOGMA OF MOLECULAR BIOLOGY

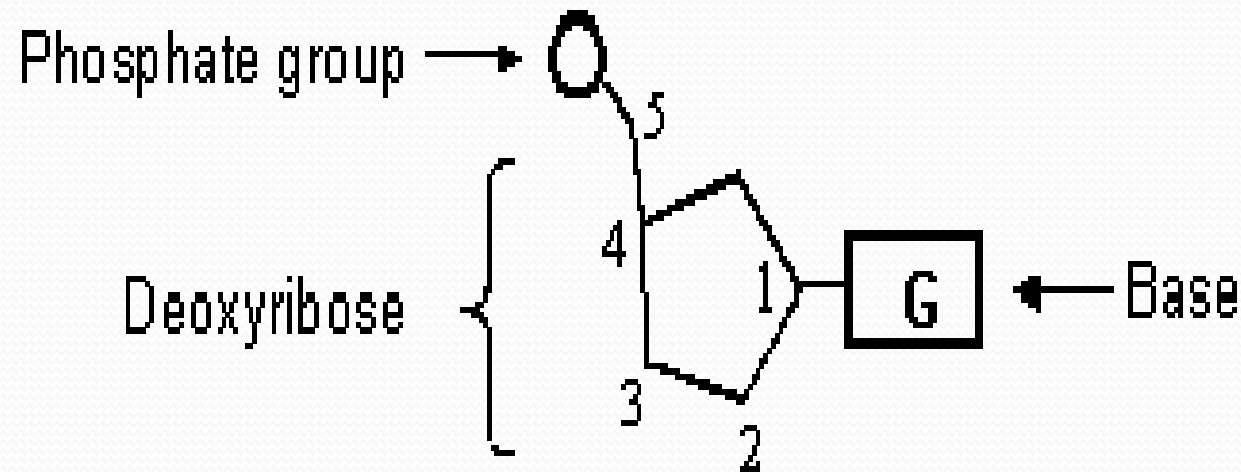
A CELL



I. Chemical Structure of DNA

A. Nucleotide:

1. Thousands of repeating units that make up the DNA (DNA is a polymer)



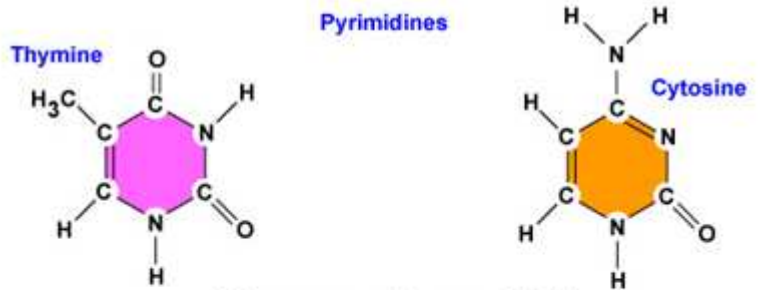


a) A phosphate group

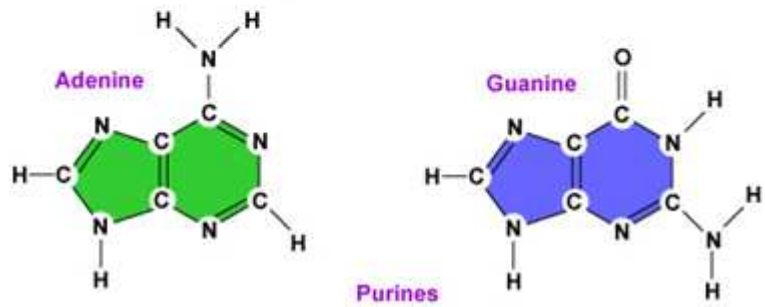
b) A deoxyribose molecule (5-carbon sugar)

**c) A nitrogenous base
adenine/thymine/guanine/cytosine**

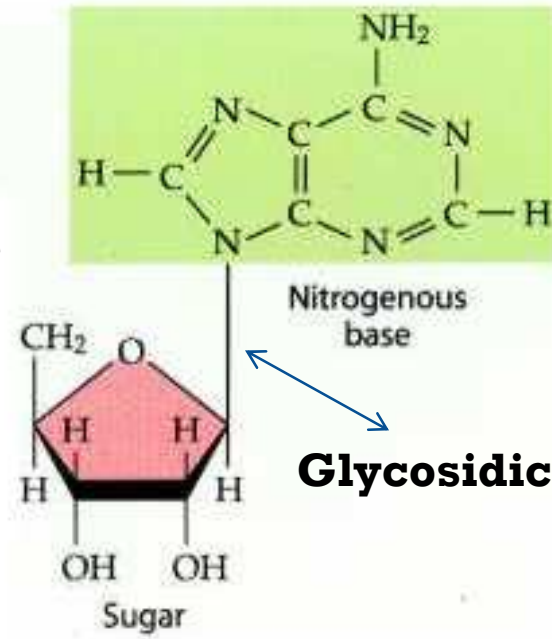
**(There are four different types of nucleotides,
depending on which of the four bases is
present- A, T, C, or G)**



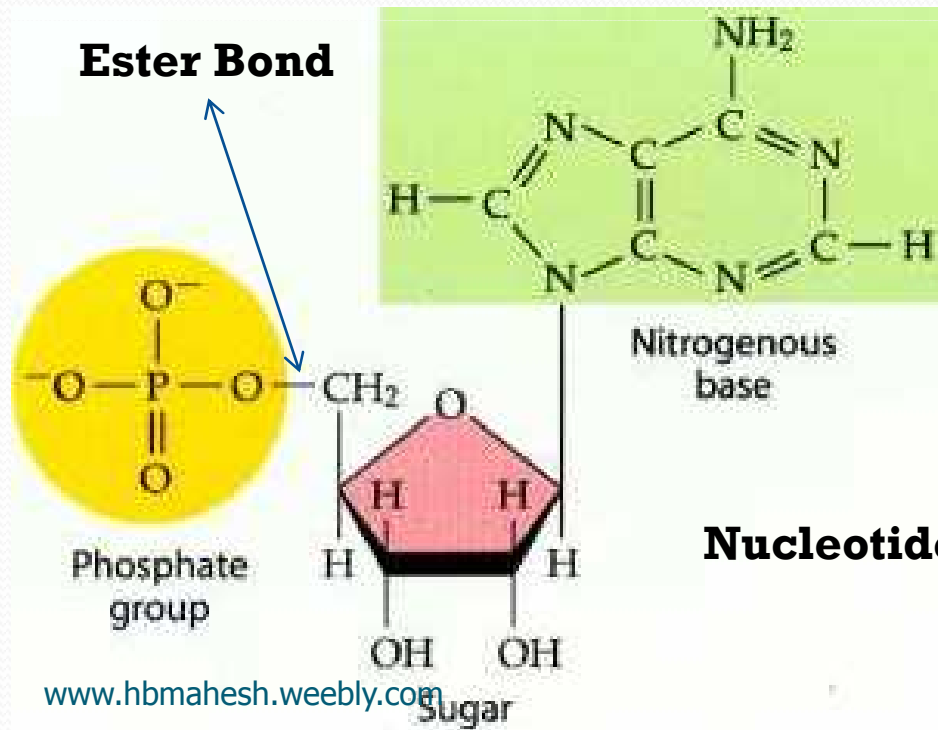
Nitrogenous Bases of DNA



Nucleoside



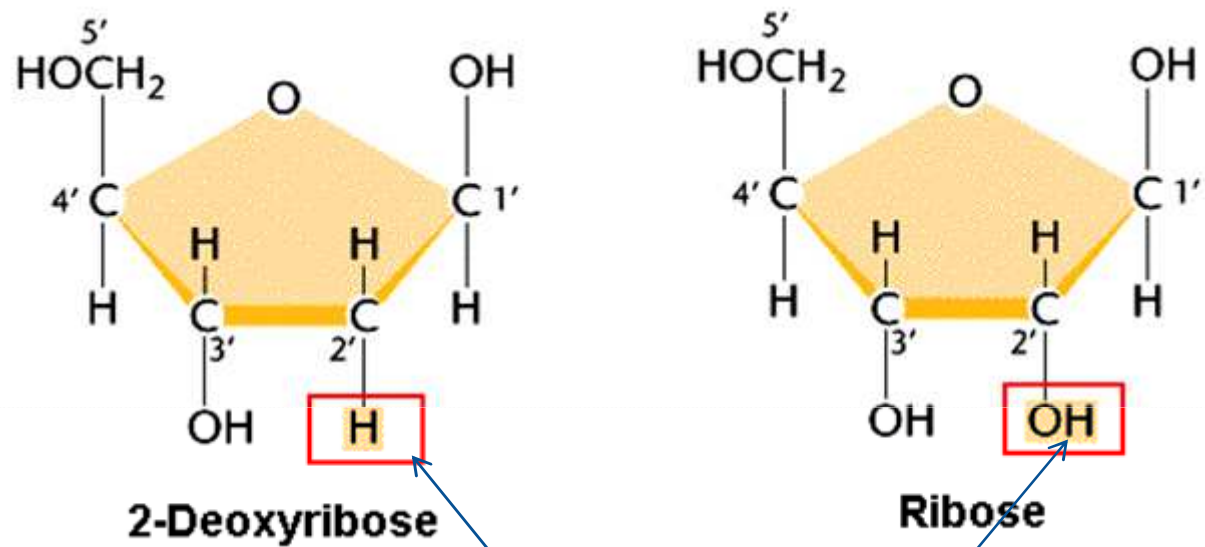
Ester Bond



Nitrogenous Bases, Nucleosides, Nucleotides and Abbreviation

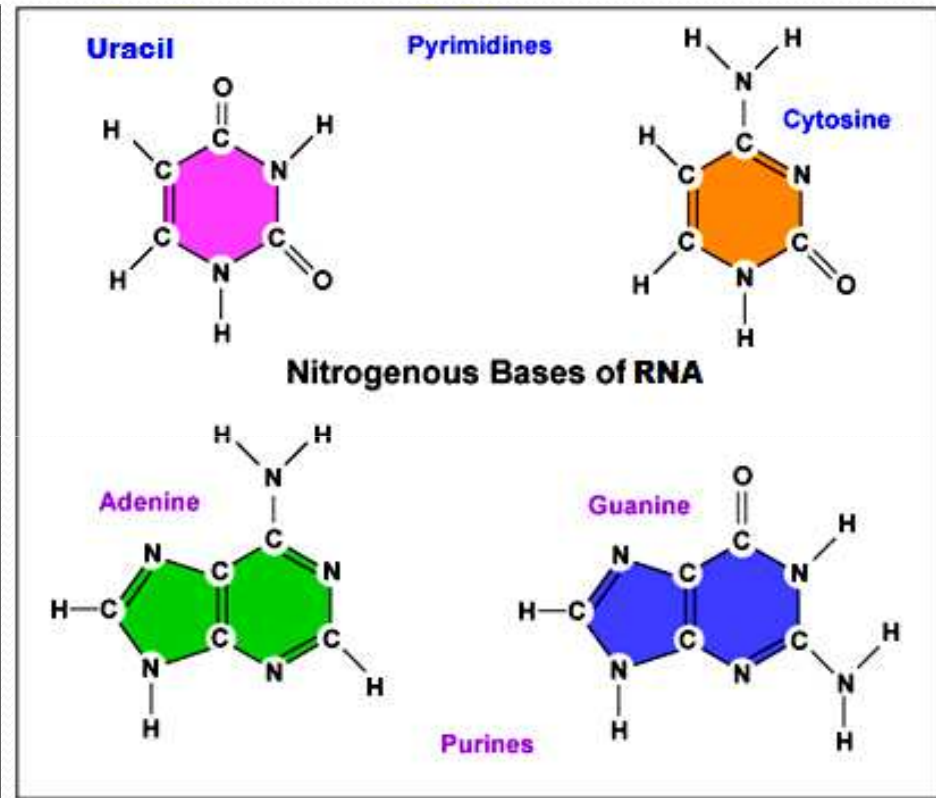
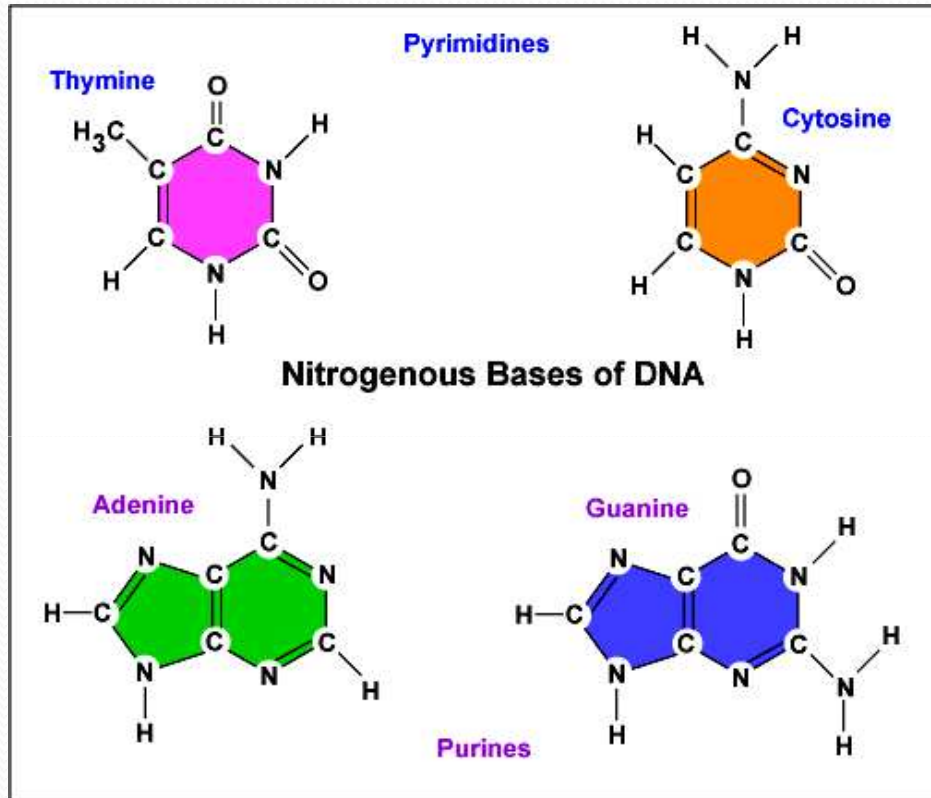
Nitrogenous Base	Nucleoside	Nucleotide	Abbreviation
Adenine	Deoxyadenosine	Deoxyadenosine-3'monophosphate	3'-dAMP
Guanine	Deoxyguanosine	Deoxyguanosine-5'monophosphate	5'-dGMP
Cytosine	Deoxycytidine	Deoxycytidine-5'monophosphate	5'-dCMP
Thymine	Deoxythymidine	Deoxythymidine-5'monophosphate	5'-dTMP

Difference between DNA and RNA



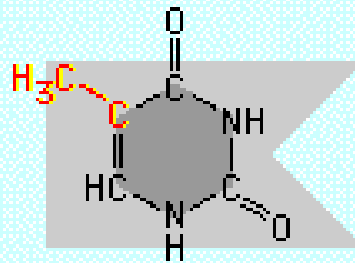
Difference

Nitrogenous Bases of DNA and RNA



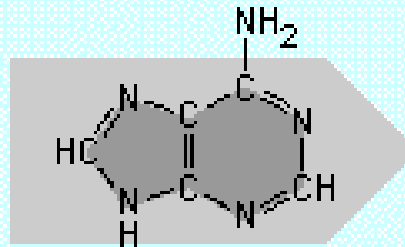
DNA

Pyrimidines

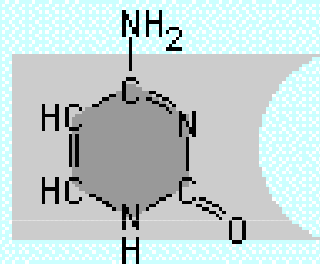


Thymine (T)

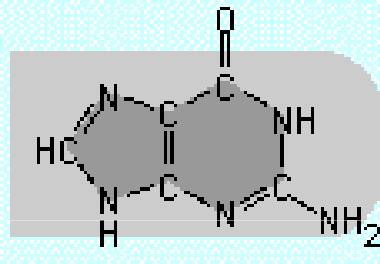
Purines



Adenine (A)



Cytosine (C)

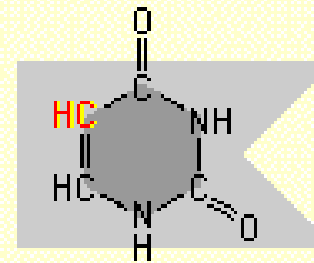


Guanine (G)

DNA bases

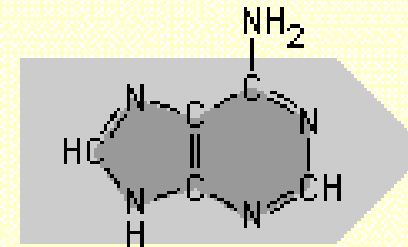
RNA

Pyrimidines

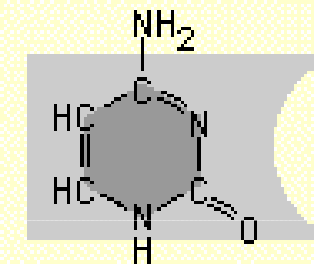


Uracil (U)

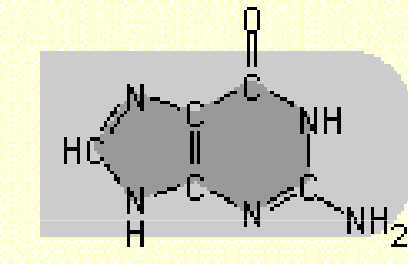
Purines



Adenine (A)

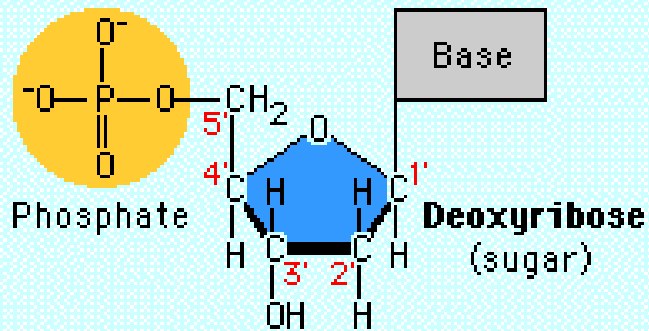


Cytosine (C)

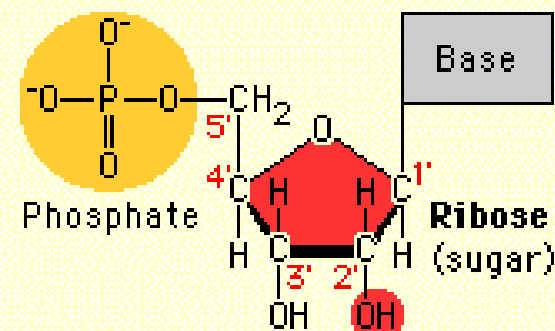


Guanine (G)

RNA bases

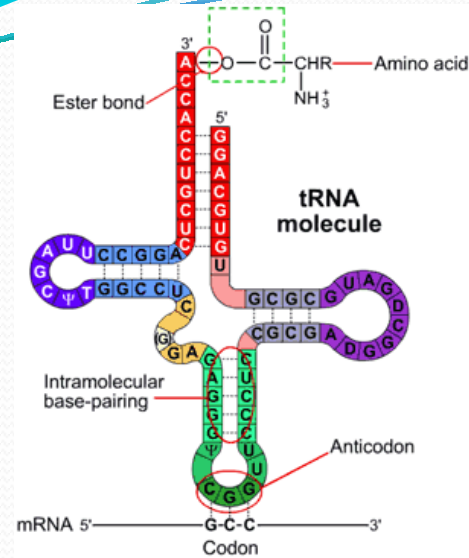


DNA nucleotide



RNA nucleotide

tRNA

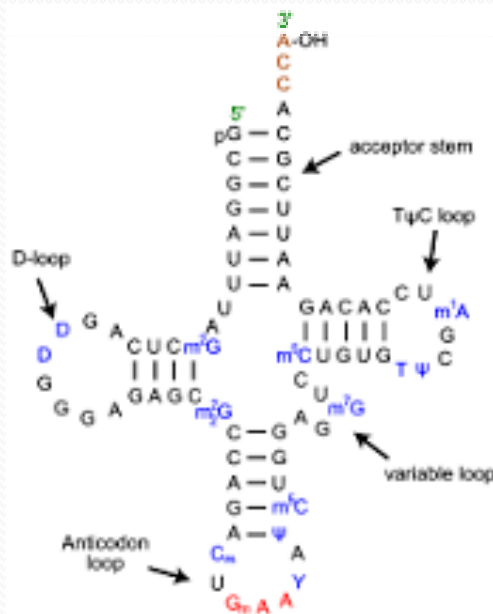


Transfer RNA (tRNA) is an adaptor mol, typically 73 to 93 nucleotides in length.

Constitutes 10-12 % of total RNA of the cell with a MW of 25- 30 kd and 0.025 % DNA codes for tRNA.

Structure:

1. The 5' –terminal phosphate group.
2. The acceptor stem is a 7-base pair (bp).
3. The CCA tail is at the 3' end of the tRNA .
4. The D arm is a 4 bp stem ending in a loop that often contains dihydrouridine.
5. The anticodon arm is a 5-bp stem whose loop contains the anticodon.
6. The T arm is a 5 bp stem containing the sequence TΨC where Ψ is a pseudouridine.



m RNA

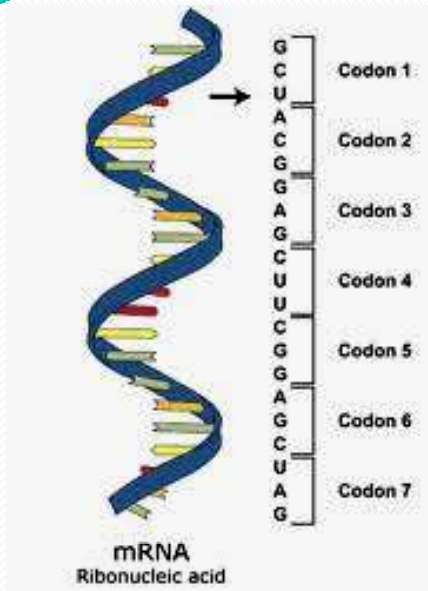
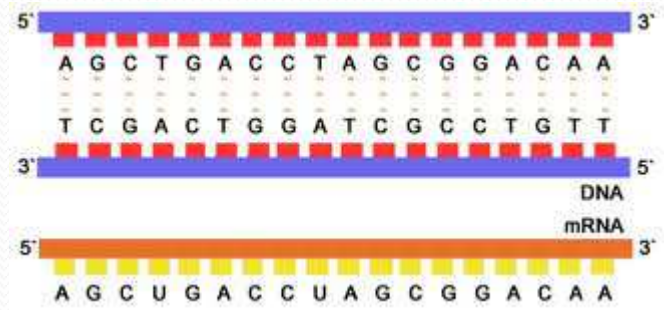
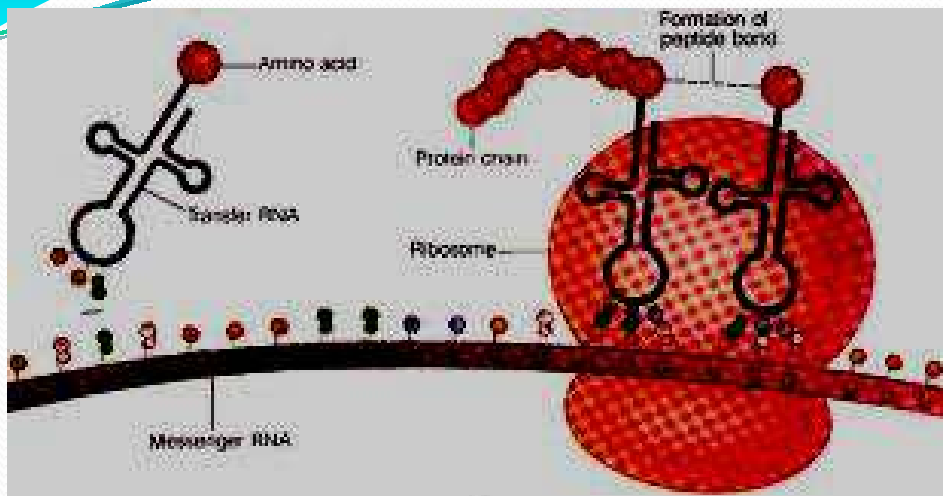


Image adapted from: National Human Genome Research Institute. Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion/DIR/VIP/Glossary/illustration/codon.shtml.

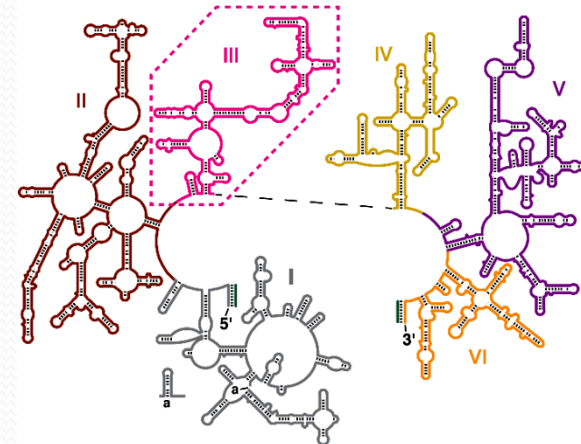
Messenger RNA (mRNA) carries the genetic information copied from DNA. mRNA constitutes 3-5 % of total RNA of the cell. The average MW is about 500 kd.



rRNA



A) Secondary structure of *T. thermophilis* 23S rRNA



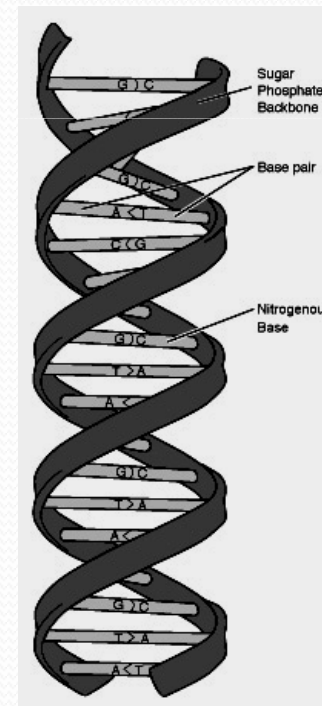
Ribosomal RNA (rRNA) associates with a set of proteins to form ribosome. These complex structures, which physically move along an mRNA molecule, catalyze the assembly of amino acids into protein chains. They also bind tRNAs and various accessory molecules necessary for protein synthesis. This constitutes 80 % of total RNA of the cell 3.2 % DNA codes for rRNA.



DNA Structure

The Watson-Crick Model of DNA Structure

DNA consists of two chains of nucleotides in a ladder-like structure which is twisted (Double Helix)

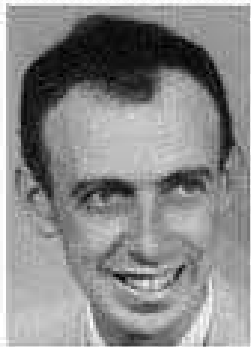


James Watson & Francis Crick

- Used data of *M.H.F. Wilkins and Rosalind Franklin, early 50's*
- **Wilkins and Franklin** studied the structure of DNA crystals using X-rays.
- The X pattern suggested the structure of DNA was a helix (spiral/coil).



Francis Crick



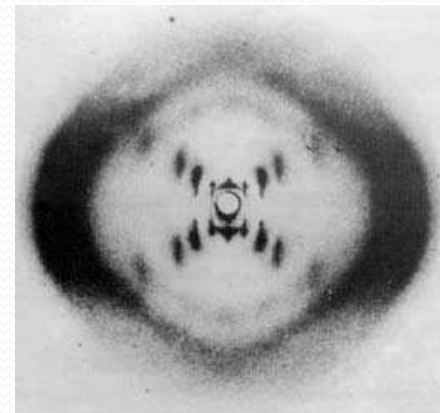
James Watson

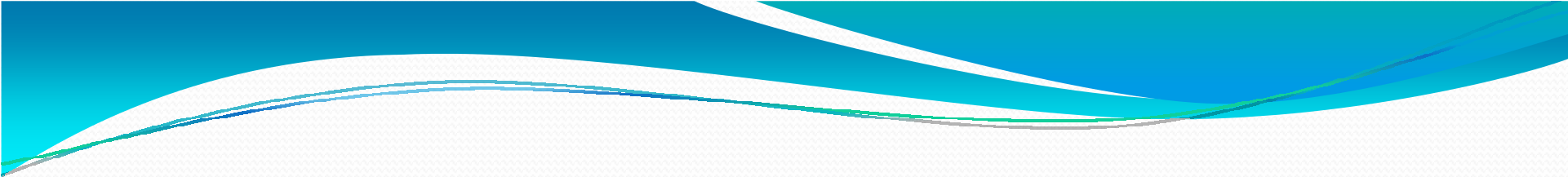


Maurice Wilkins



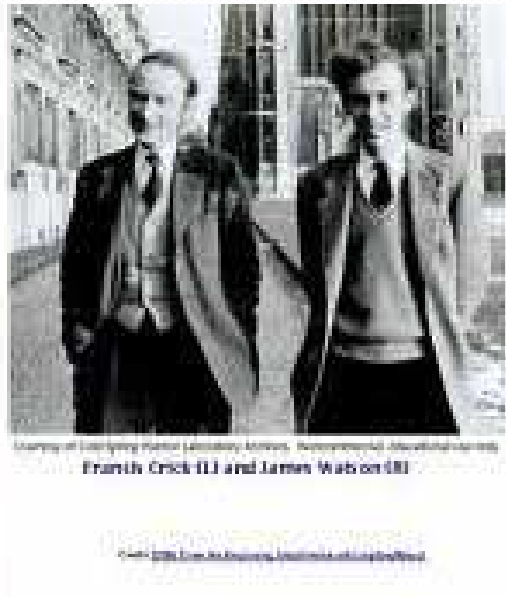
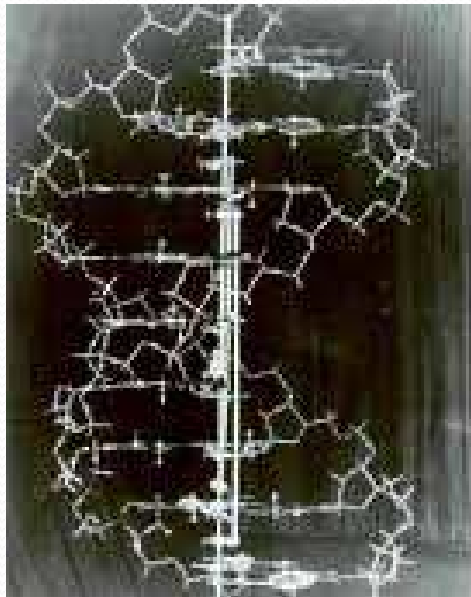
Rosalind Franklin





Chargaff's Rule: His data showed that in each species, the percent of **A** equals the percent of **T**, and the percent of **G** equals the percent of **C**.

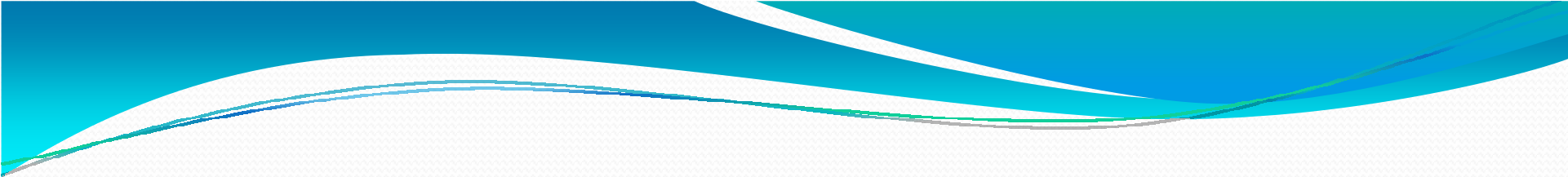
Watson and Crick (1953)



Watson and Crick Model

A. The **sides** of the ladder are made up of alternating molecules of **phosphate** and **deoxyribose**

B. The **bases** make up the rungs (A rod or bar forming a step of a ladder) **of the ladder**

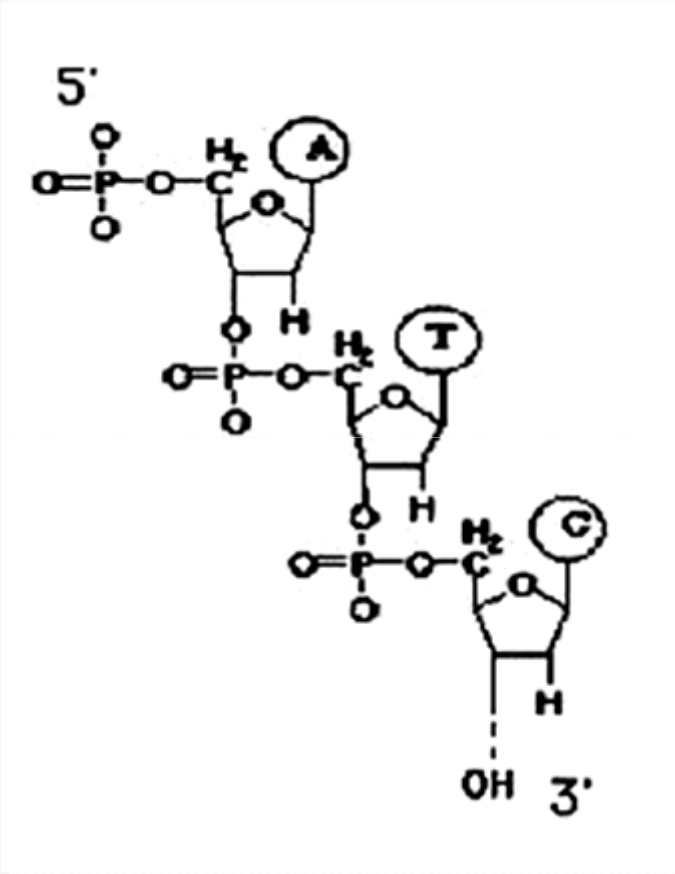
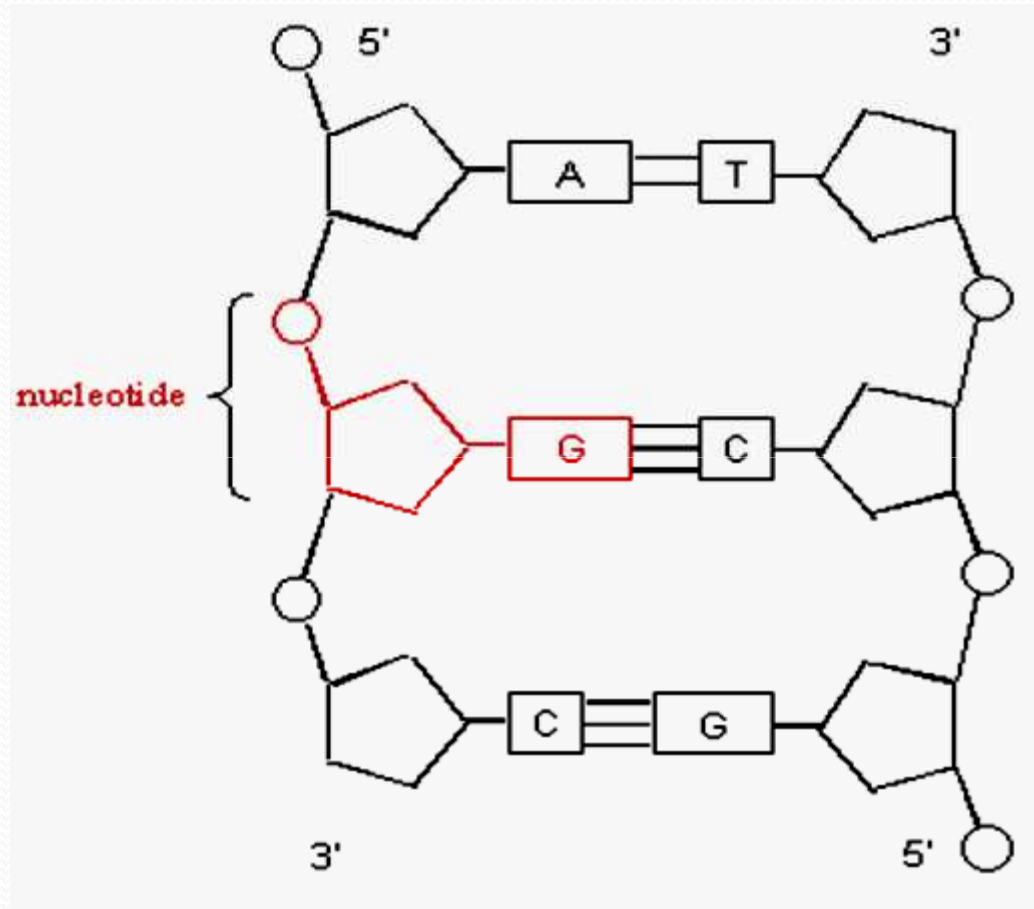


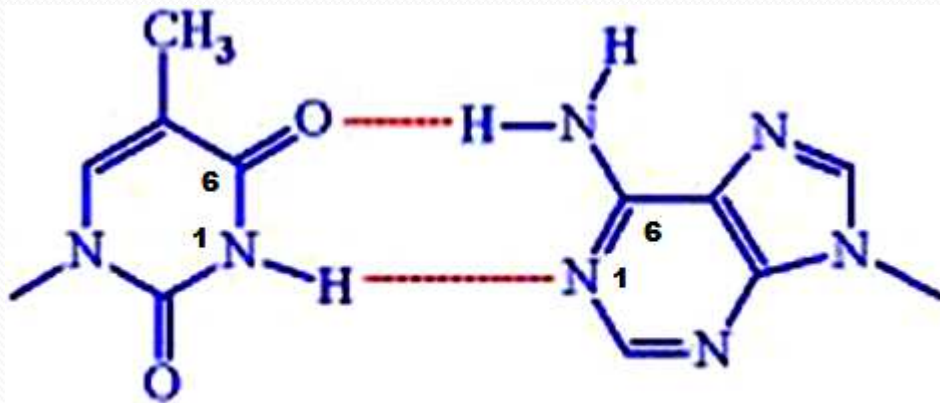
C. The bases that make up the rungs of the ladder are attracted by a weak chemical bonds called hydrogen bonds

Base Pairing Rule

Adenine (A) pairs with Thymine (T)

Guanine (G) pairs with Cytosine (C)

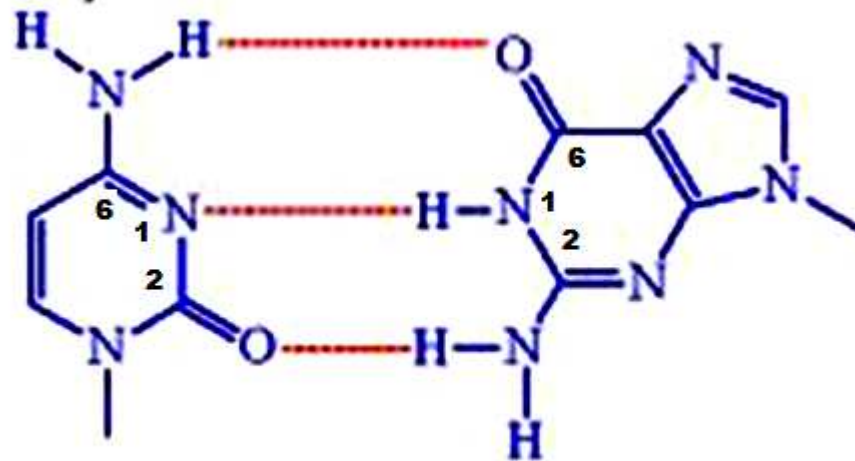




**Joined by two hydrogen bonds
at 6 & 1 positions**

Thymine

Adenine

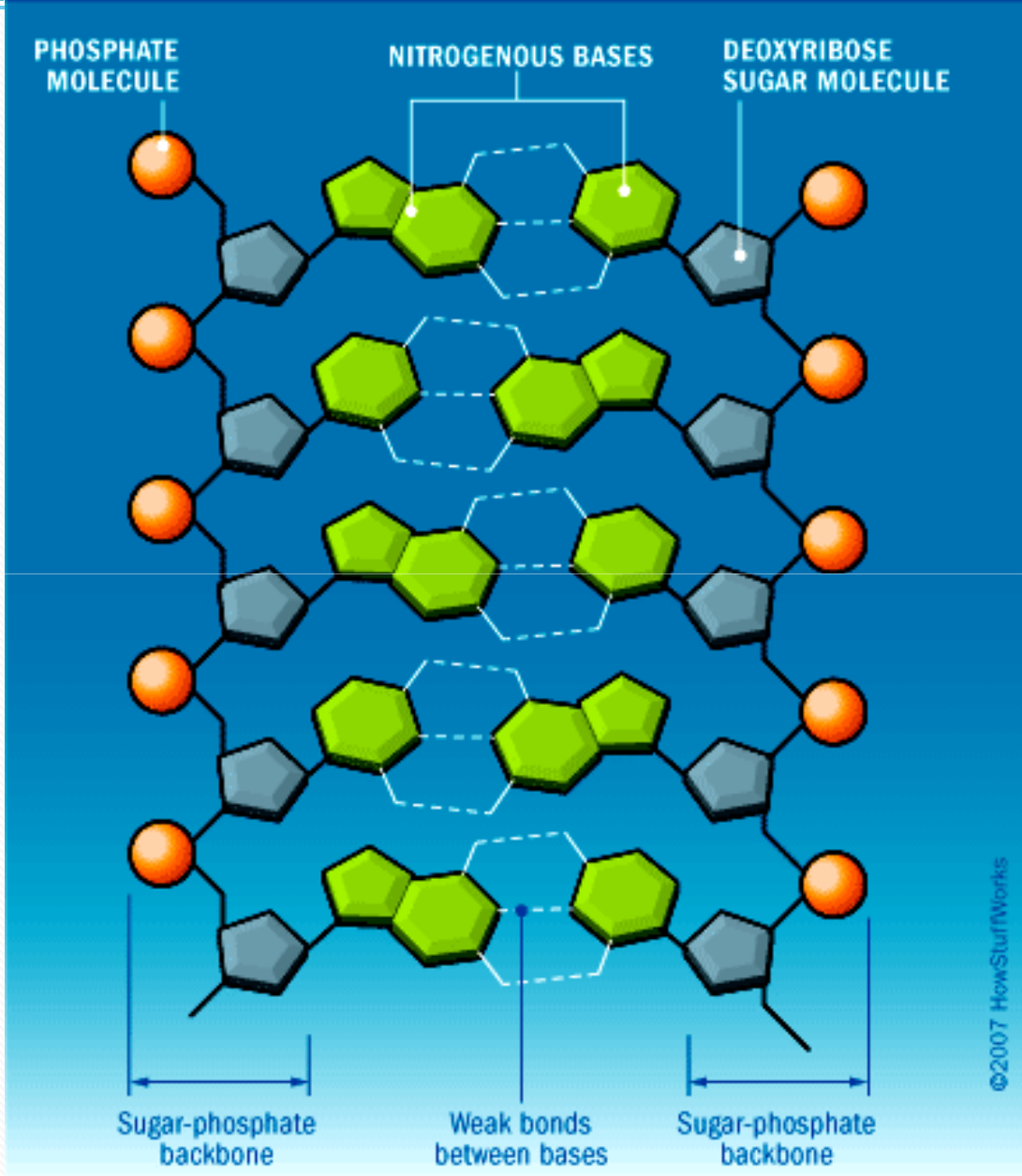


**Joined by three hydrogen bonds
at 6, 1, & 2 positions**

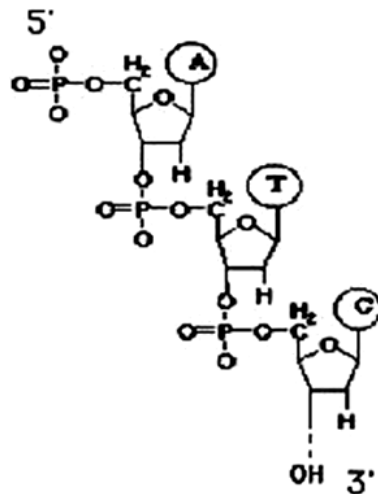
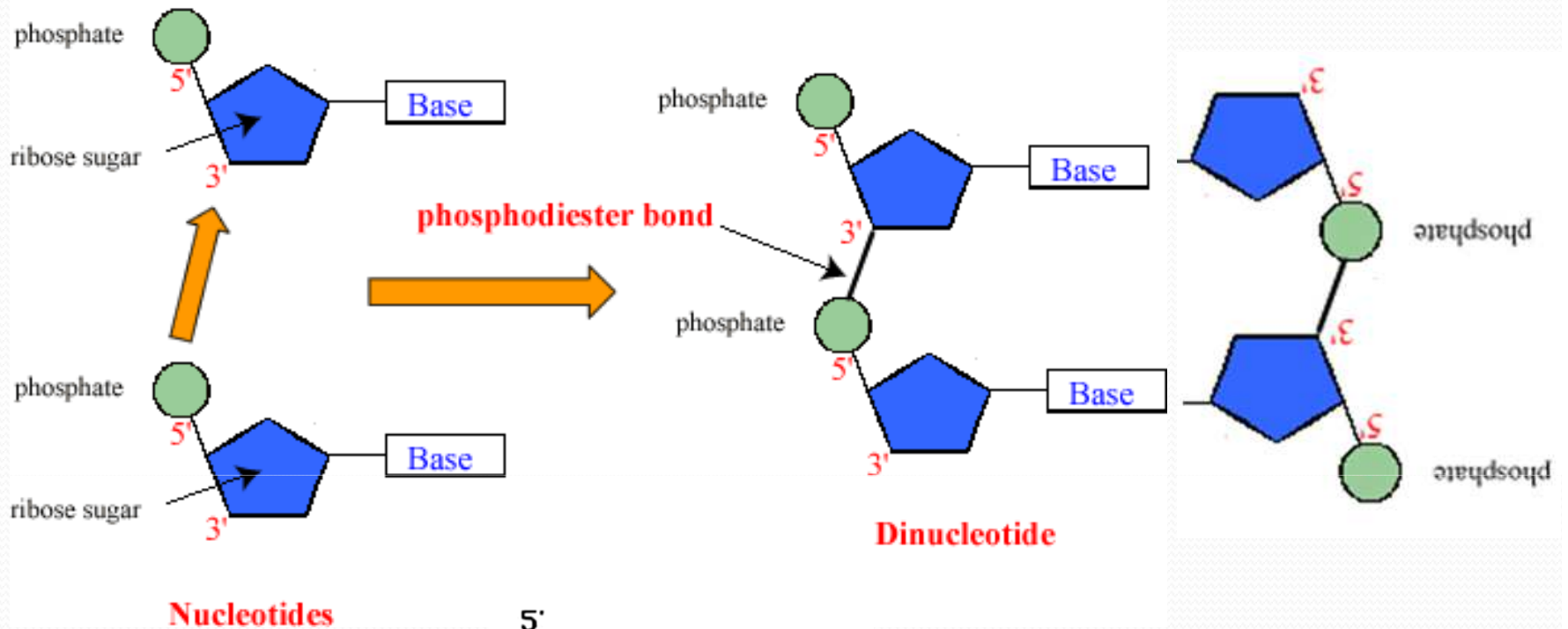
Cytosine

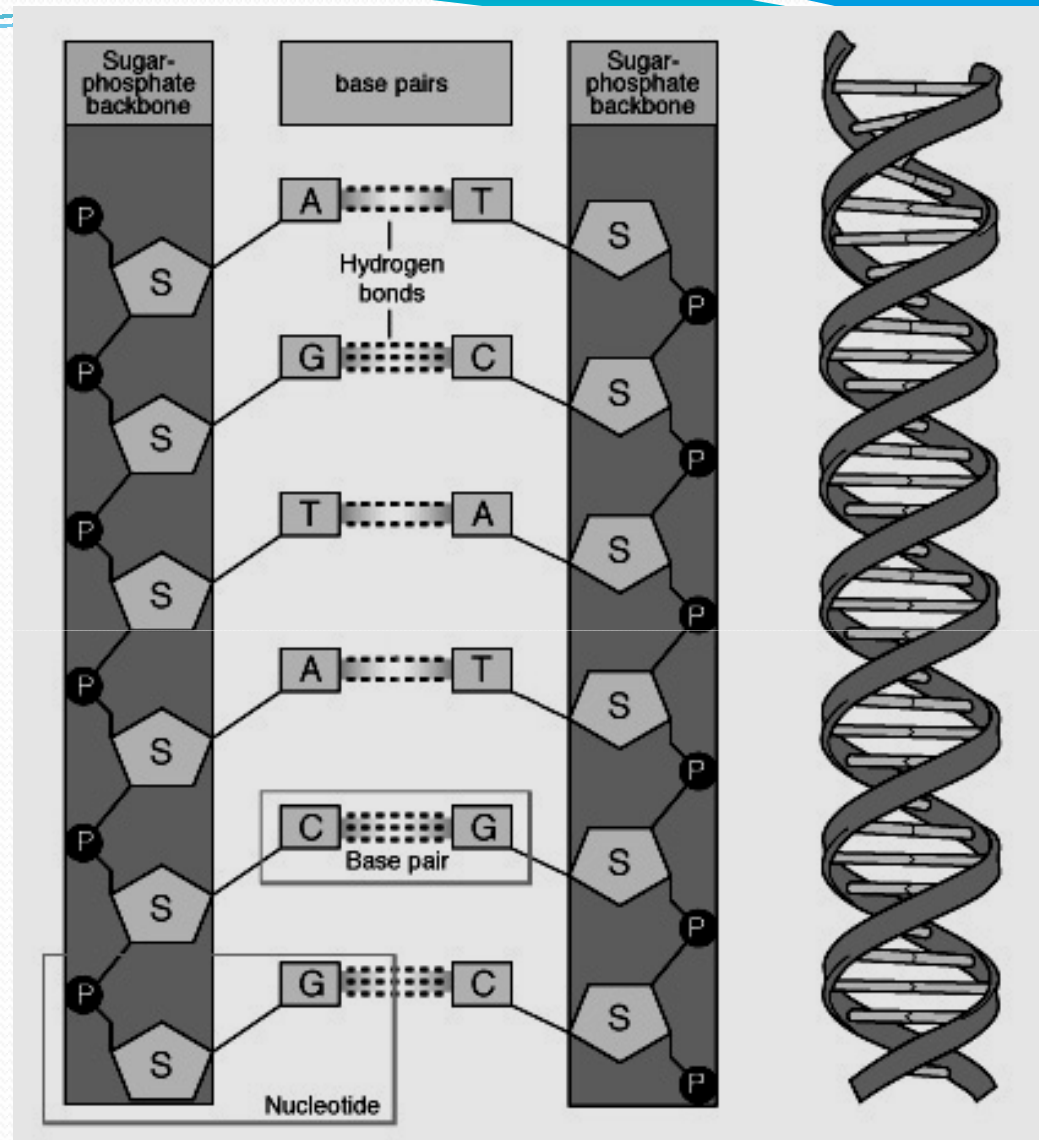
Guanine

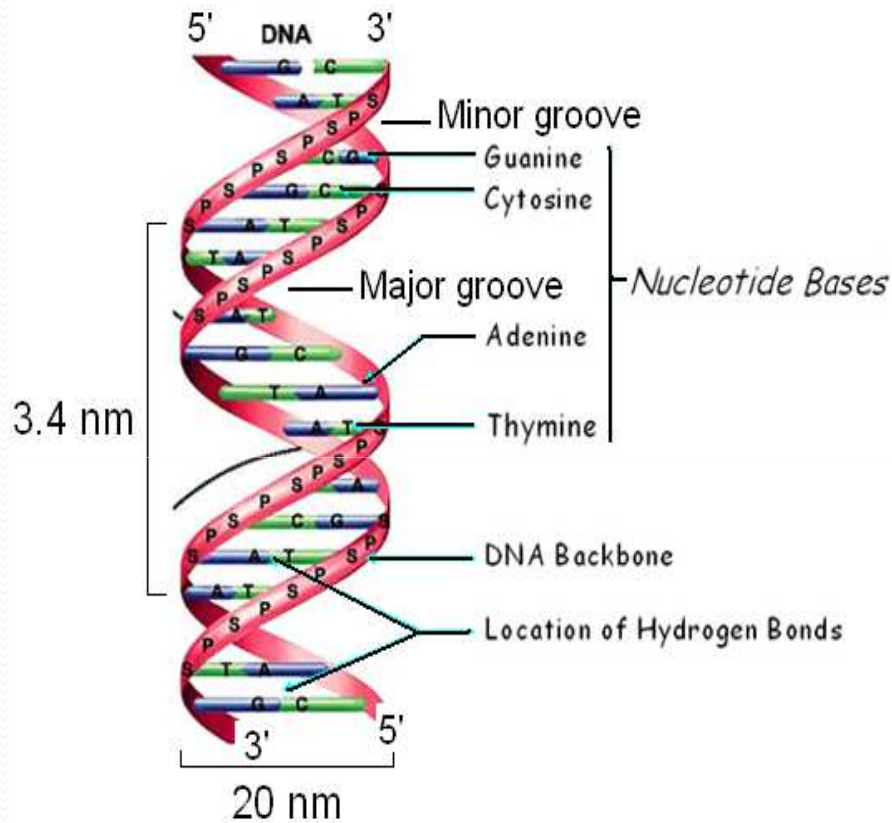
How DNA Works Base Nucleotide Pairings



Polynucleotide formation







Watson-Crick Model

36° turn/ base pair

Paired bases in same plane

Adjacent base pairs parallel

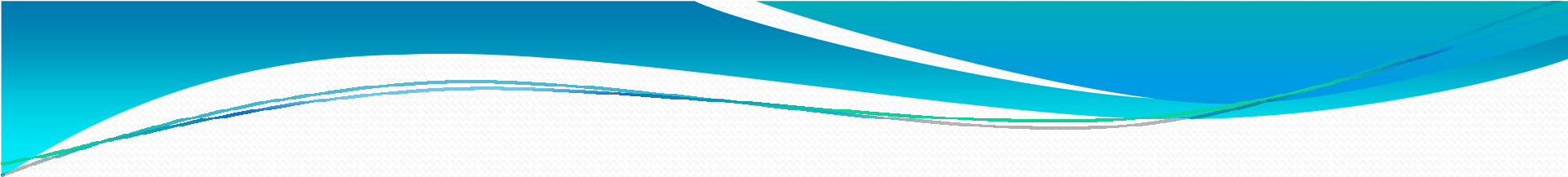
Structure is regular and not dependent on base sequence



Animations

<http://www.youtube.com/watch?v=gbSIBhFwQ4s&feature=related>

<http://www.youtube.com/watch?v=TPAL235Lwpo>



Acknowledgements
to
INTERNET
FOR
PICTURES AND PHOTOGRAPHS