# Microbial genetics

**1st Course**

**Lec.#6**

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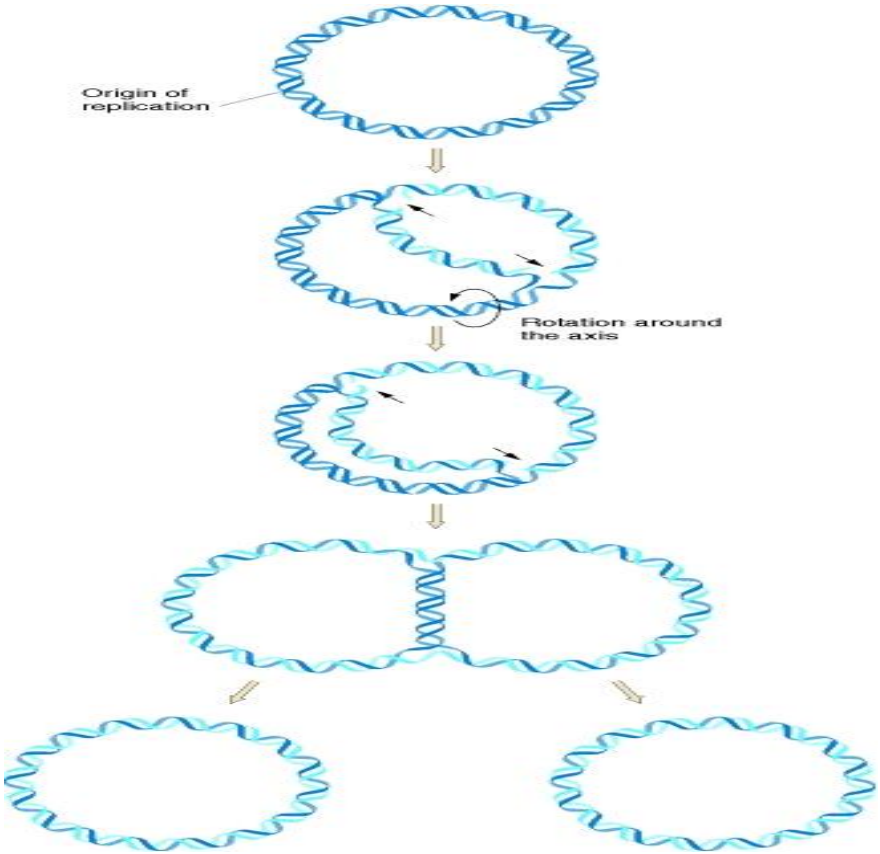


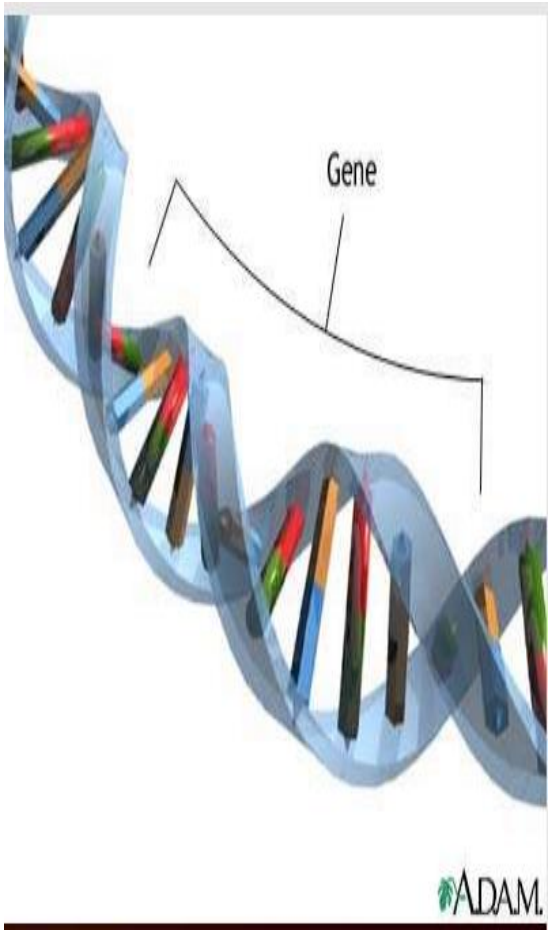
# Introduction

**Genetics**: is the science concerned with the cell characteristics, and how they are passed from one generation to the next.

**Gene**: it is the unit of heredity. It is a segment of DNA that carries, in its nucleotide sequence, information for specific biochemical or physiologic property.

**Phenotype**: All the heritable physical characters of the organism (Eye colour in humans, resistance to antibiotic in bacteria ….. etc.)

**Genotype**: It means the information in the DNA that control the phenotype.

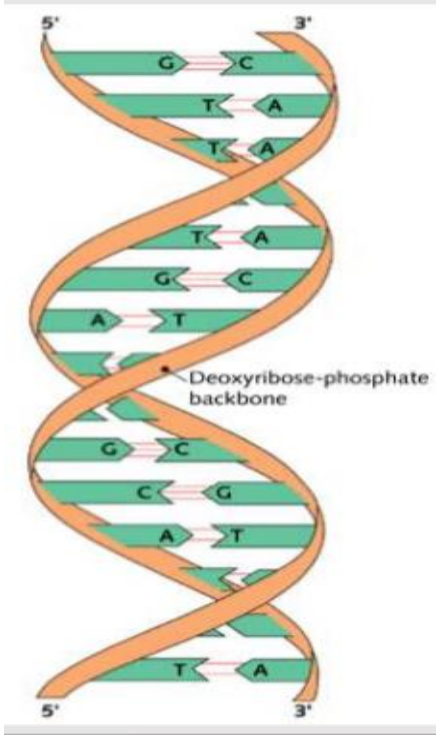


# Molecules of Genetics

• The main molecules of genetics are called **nucleic acids**.

• All the genetic information are stored as a sequence of bases through nucleic acids mainly in DNA and in RNA in some RNA viruses.

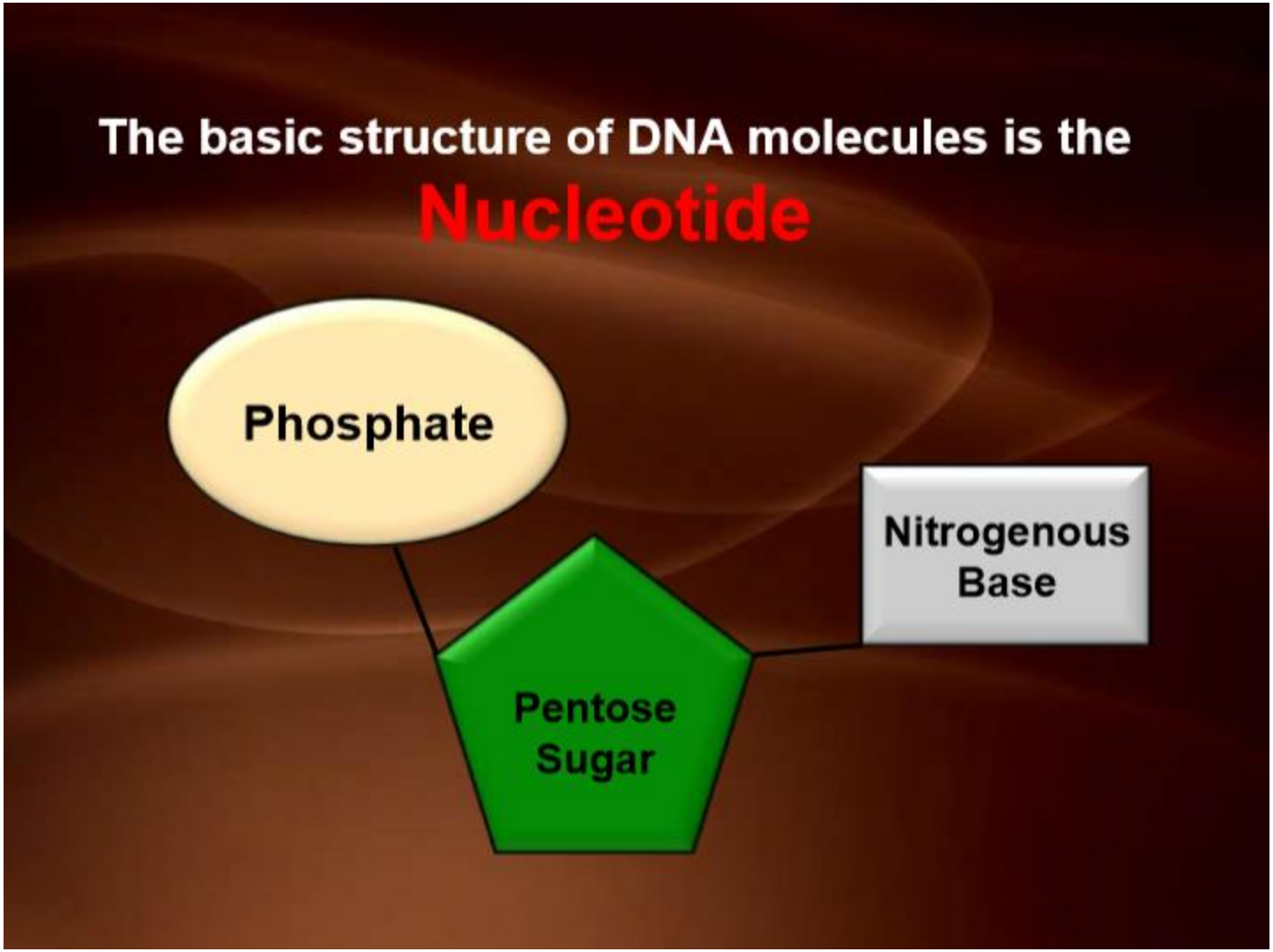
DNA (Deoxyribonucleic acid serves as organism's genetic material. It is divided into functional units (genes). Most of DNA is double stranded. The two strands held together by hydrogen bonds between A and T or G and C It consists of non- identical, complementary base sequences



# Structure Of DNA

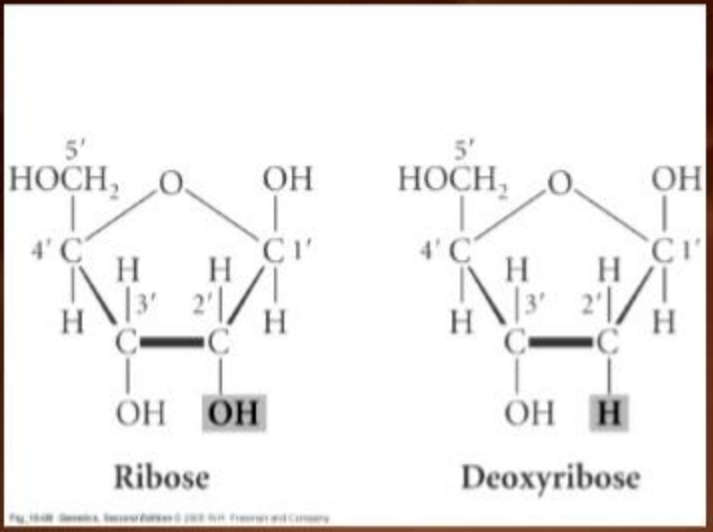
- Proposed by Watson & Crick.
- Double helix model.
- Composed of 2 chains of polypeptides, each chain has a backbone of deoxyribose sugar and phosphate residues arranged alternately.
- 4 nitrogenous bases:

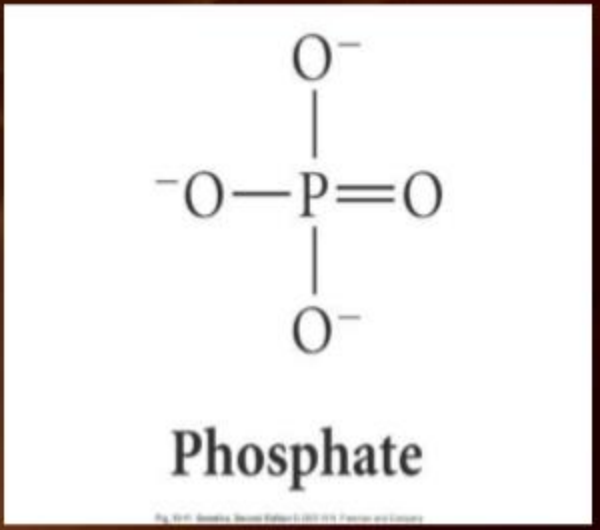
| | |
|---|---|
| Adenine (A) | Purine |
| Guanine (G) | |
| Thymine(T) | Pyrimidine |
| Cytosine (C) | |


The basic structure of DNA molecules is the
Nucleotide
Phosphate
Nitrogenous Base
Pentose Sugar

**Sugar:** It is a cyclic form of 2-deoxyribose sugar that forms the backbone of the DNA.

**Phosphate**



# 3. Nitrogenous Bases

-cyclic structure of purine and pyrimidine rings.

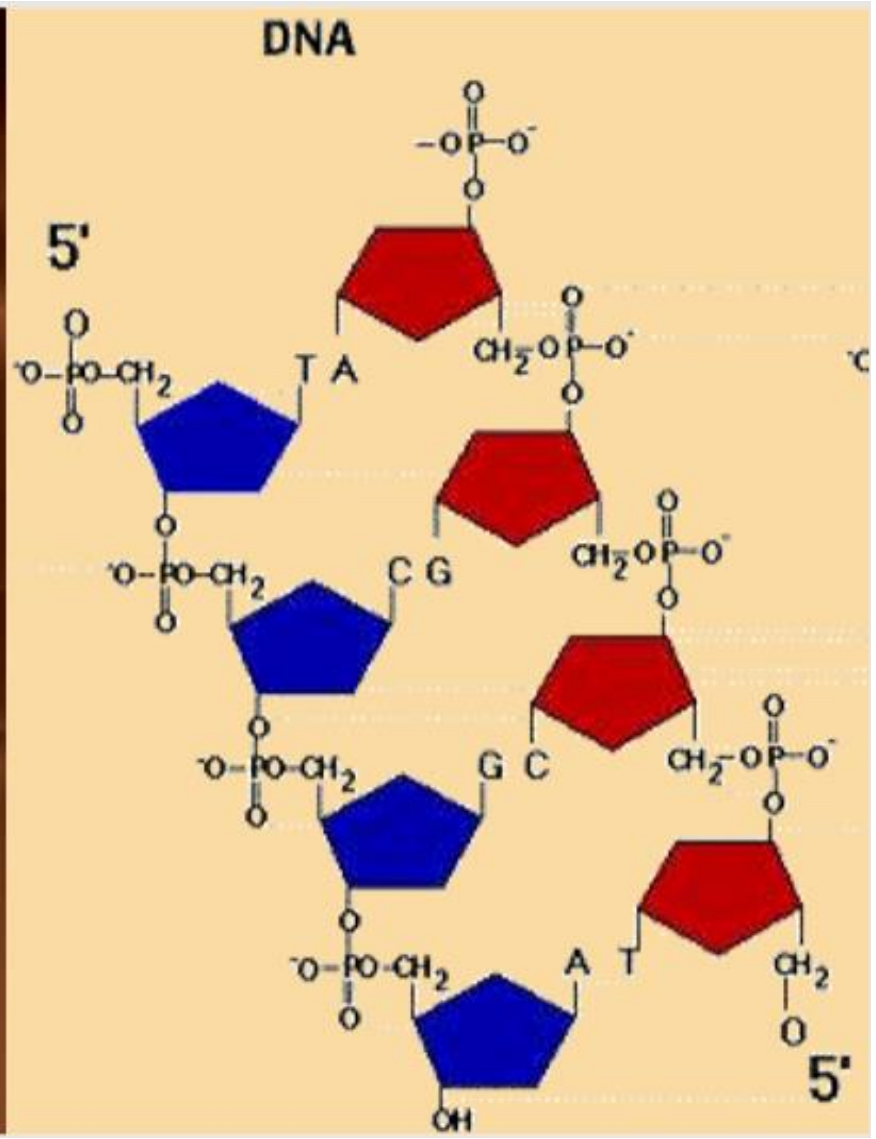
There are two major purines, adenine (A) and guanine (G),

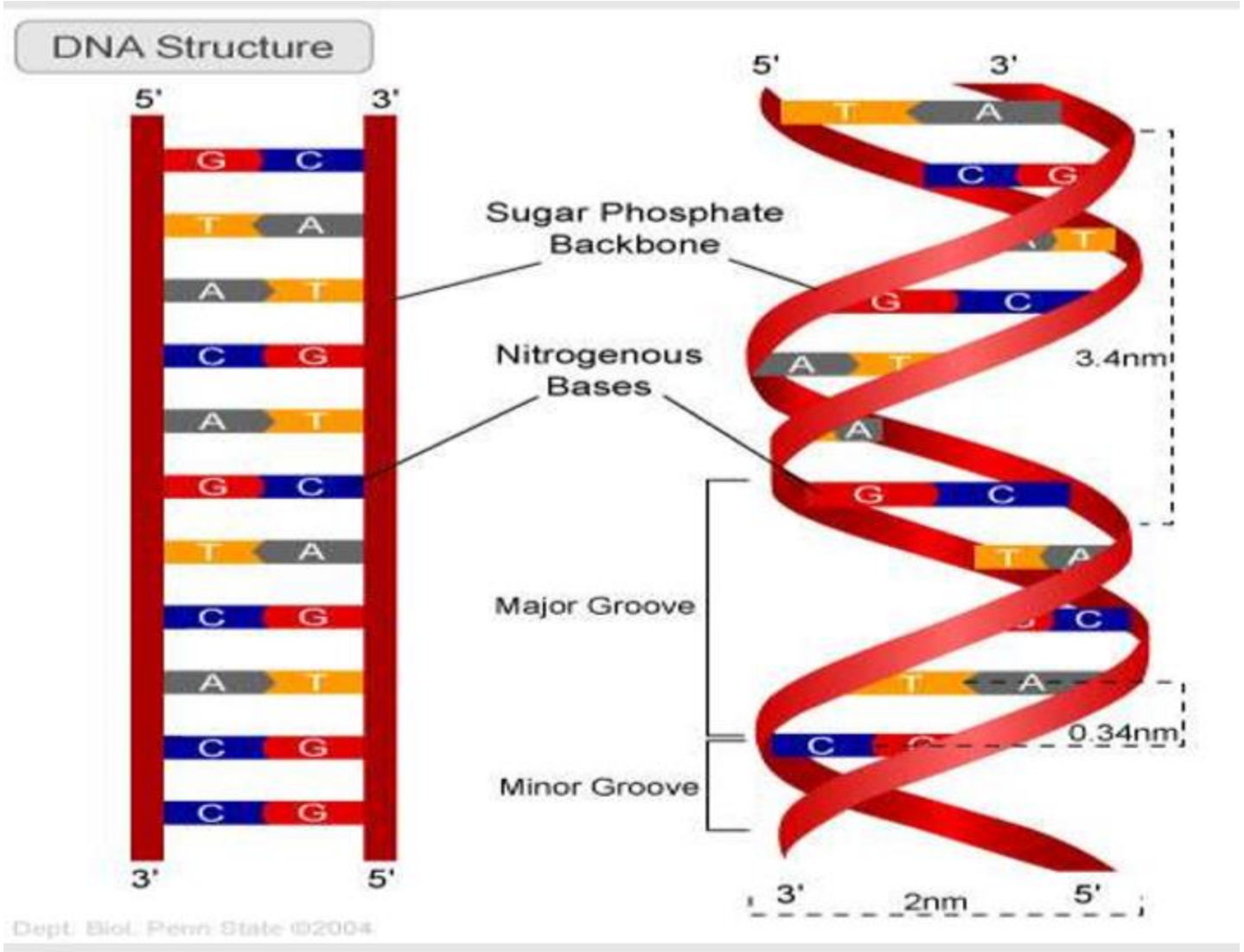
•Three major pyrimidines, cytosine (C), uracil (U), and thymine (T).

phosphate connects two sugars: bonding the 3' carbon of one sugar and the 5' carbon of the next sugar.

DNA is only polymerized 5' to 3' and as antiparallel

i.e. one strand in the direction 5' to 3' and the other strand polymerized in the opposite direction.




DNA Structure
5'
3'
Sugar Phosphate Backbone
Nitrogenous Bases
Major Groove
Minor Groove
3.4nm
0.34nm
2nm
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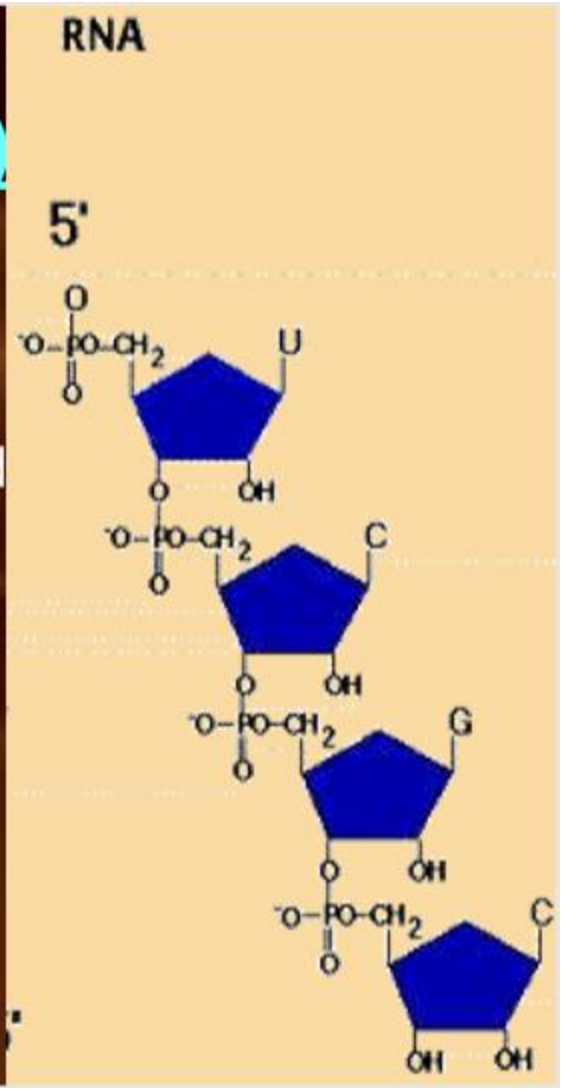
# RNA (Ribonucleic acid)

**Structurally similar to DNA**

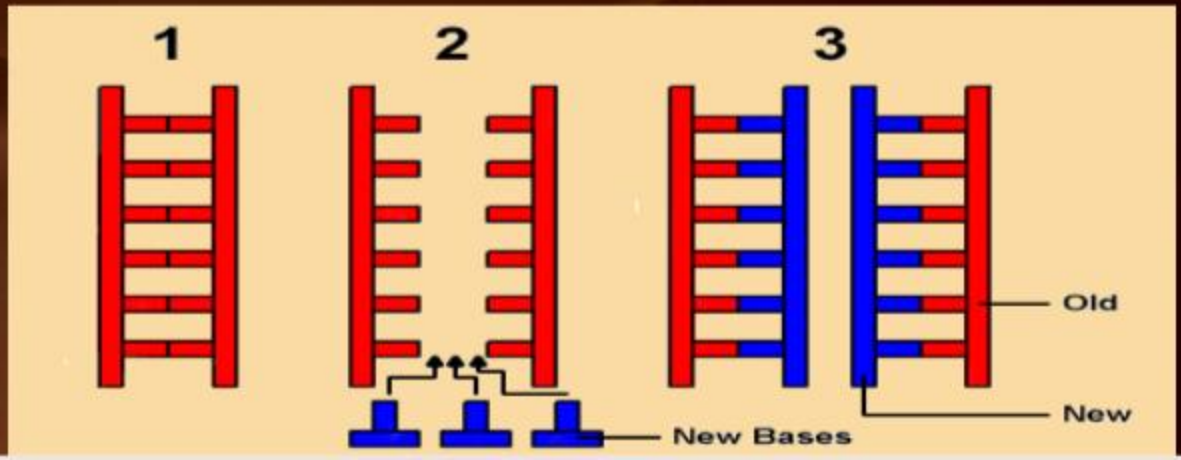
**except.**

- Most of RNAs are single stranded
- Sugar is ribose instead of deoxyribose
- Uracil base instead of thymine base



## DNA Replication

Semi conservative which means that one DNA molecule gives two DNA molecules each one consists of one strand from the original DNA and the other strand is newly formed one.



# Functionally different from DNA

- Some of RNAs are used as messenger molecules (mRNA) to transfer information from DNA to protein.
- Some of RNA as a part of ribosomes (rRNA ).
- Some are adaptor molecules(tRNA) .
- Few RNA only acts as a genetic material like DNA (the viruses)

# DNA Functions in microbiology

I- Replication

II- Gene expression (protein synthesis)

A. Transcription

B. Translation

C. post-translational processes

# Kinds of genetic elements

| Organism | Element | Description |
|---|---|---|
| **Prokaryote** | Chromosome | Extremely long, usually circular, double-stranded DNA molecule |
| | Plasmid | Typically a relatively short, usually circular, double-stranded DNA molecule, which is extrachromosomal |
| **Eukaryote** | Chromosome | Extremely long, linear, double-stranded DNA molecule |
| | Plasmid[a] | Typically a relatively short circular or linear double-stranded DNA molecule, which is extrachromosomal |
| **All Organisms** | Transposable elements | Double-stranded DNA molecule always found within another DNA molecule |
| **Mitochondrion or chloroplast** | Chromosome | Intermediate-length DNA molecules, usually circular |
| **Virus** | Genome | Single- or double-stranded DNA or RNA molecule |

# Mechanisms Of Genetic Variations

**Mutation**: any change of base sequence of DNA - single base mutation - insertion, deletion, transition, trans version

Mutation : Random, undirected heritable variation

Caused by a change in the nucleotide base sequence of the DNA

**Types of mutation:**

1.Point mutation

2. Frame shift mutation

3. Lethal mutation

4. Suppressor mutation

Mutagens - Agents which can induce mutation e.g. UV rays, 5 bromouracil, alkylating agents, etc.

## Point Mutation

Cause - due to addition, deletion or substitution of one or more bases. •

Types :

**Transition** : a purine base is replaced by a purine base or a pyrimidine base is replaced by another pyrimidine base. Most common type.

**Transversion** : substitution of a purine base by a pyrimidine base & vice versa

# Gene exchange (between bacterial cells):

1**. transformation** - acquisition by incorporation of exogenous or foreign DNA

2. **transduction** - transfer from one bacterium to another by bacteriophage

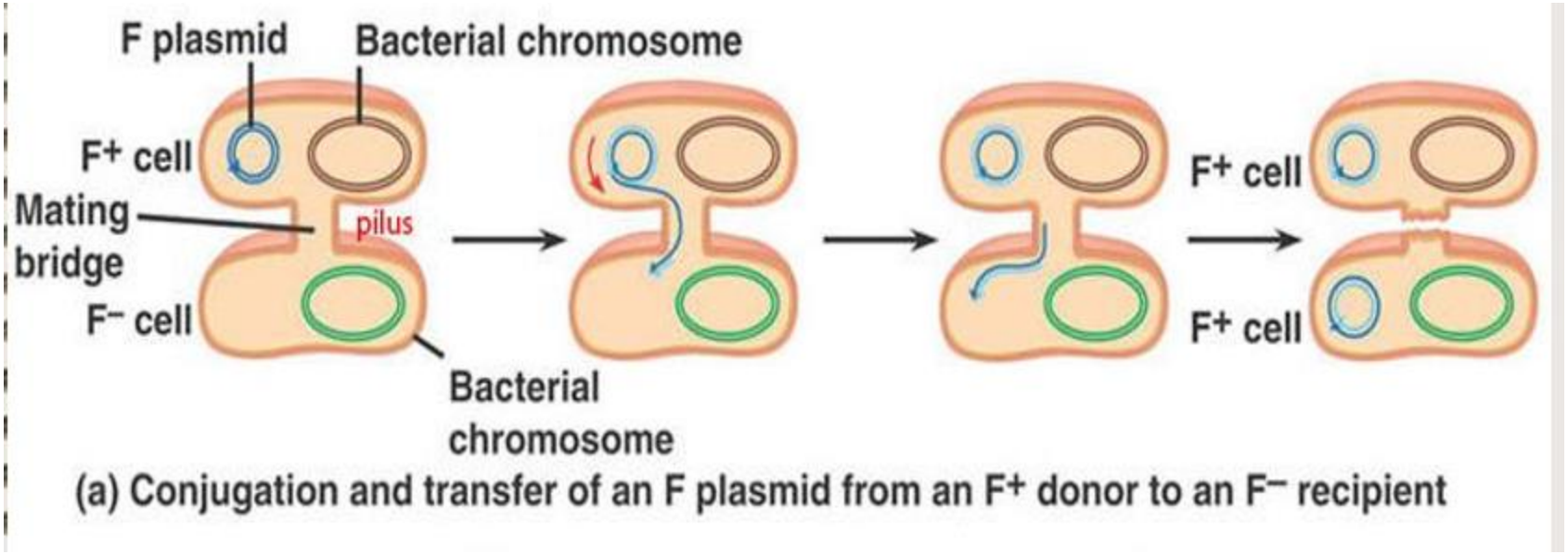
3. **conjugation** - sexual exchange , Bacteria frequently exchange DNA that is then integrated into chromosome or in plasmids and passed on to daughter cell

**Conjugation** • First described by Lederburg & Tatum in 1946 in a strain of E.coli called K12.

- A donor or male bacterium passes DNA directly to a recipient or female bacterium by a conjugation tube (sex pili).

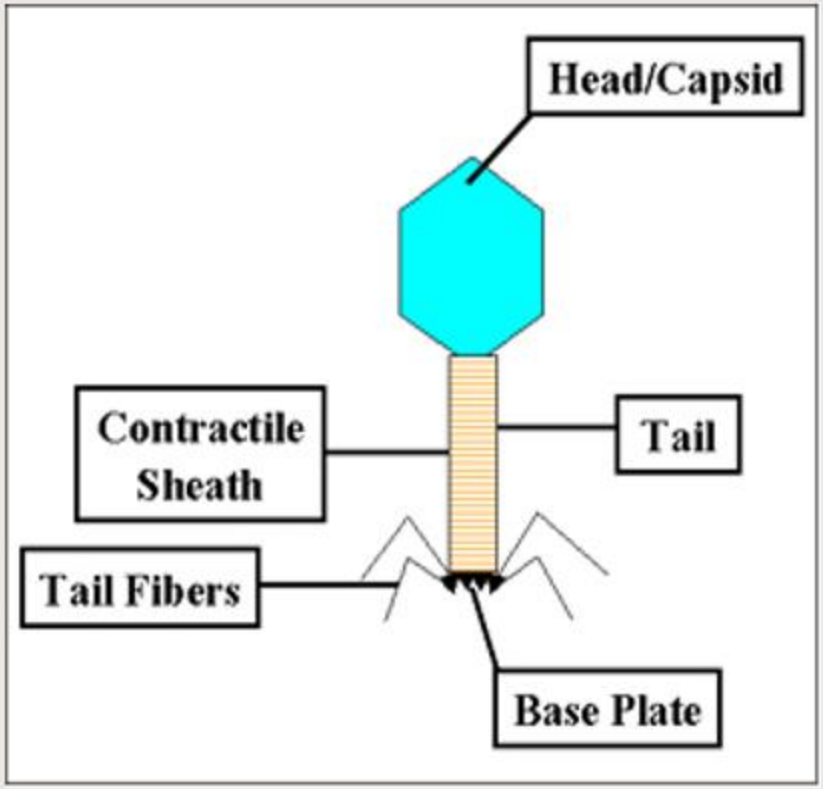
- The female bacterium attains donor status & in turn can conjugate with other female cells.

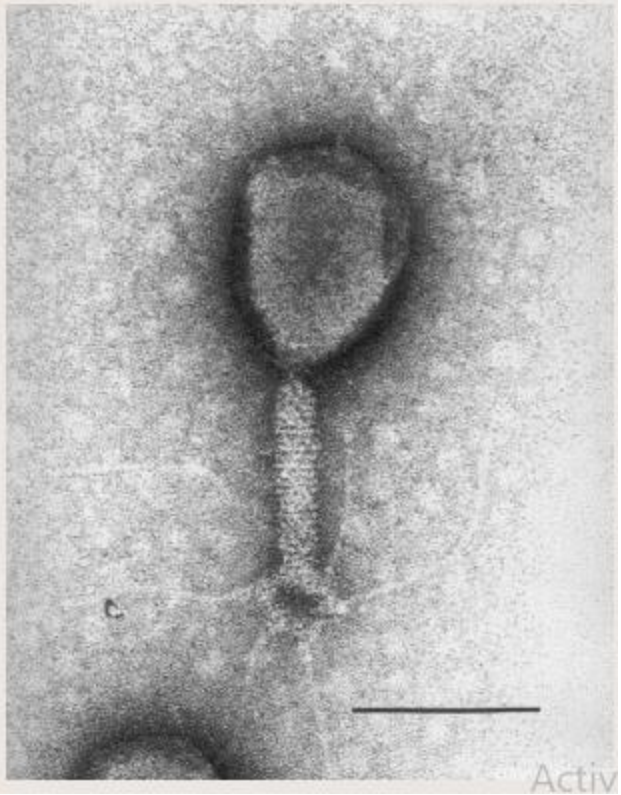
# Process of Conjugation



# Transduction-bacteriophage

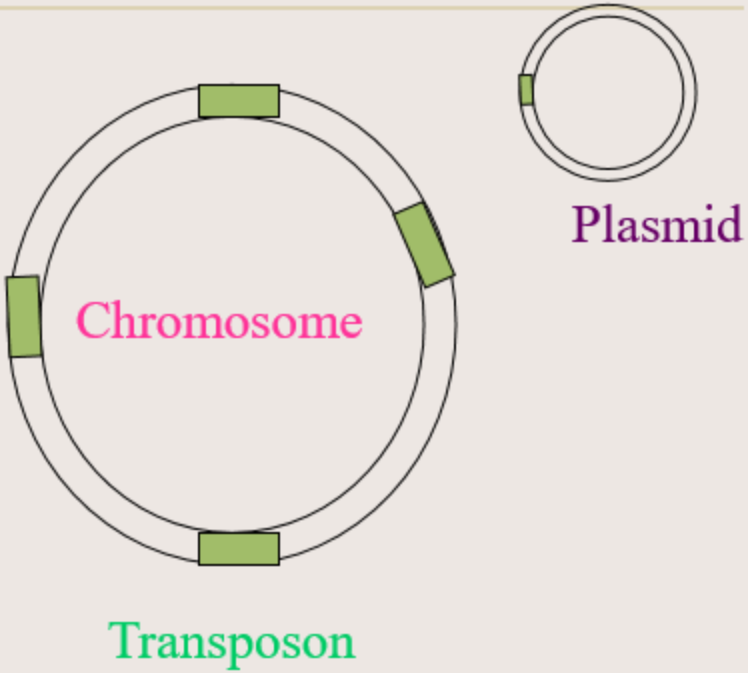
•Bacteriophage - parasitic virus of bacterial cell using their energy systém and protein synthesizing factors. DNA or RNA. Infection of bacterium - only nucleic acid



# **Transposon** (Jumping Genes)

DNA segment that can move between chromosome & plasmids




Transposons are not self replicative, they depend on chromosomal or plasmid DNA for replication


THANK
YOU