

## Bacterial Genetics

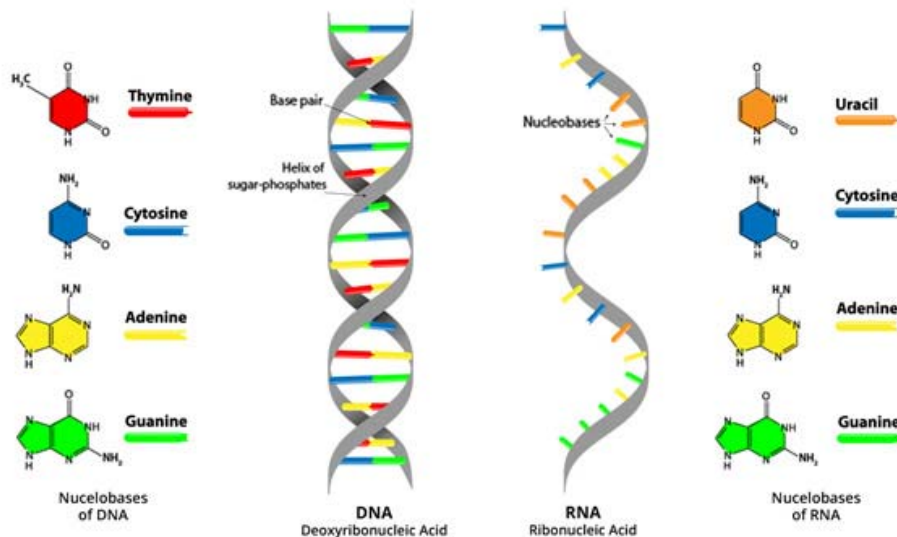
Dr. Shurooq Rayyis Kadhim

**Bacterial genetics** is the study of how genetic information is transferred, from a particular bacterium to its offspring. Bacterial inherited characteristics are encoded in DNA.

Types of DNA that contain their genes:  
Chromosome, Plasmid and Transposons.



**Nucleic acid:** Is a macromolecule composed of units called nucleotides. There are two types: Deoxyribonucleic acid DNA and Ribonucleic acid RNA.



**DNA :** Two strand of nucleotides twisted together in pairs to form a double helix. The two strands hold together by hydrogen bonds.

### **Nucleotide DNA :**

1. Nitrogen bases (adenine ,thiamine ,Guanine ,cytosine)
  2. Deoxyribose (pentose)
  3. Phosphate.
- (complementary) .

**RNA:** is single-strand that makes of alternating sugar (ribose) and phosphate groups. Attached to each sugar is one of four bases--adenine (A), uracil (U), cytosine (C), or guanine (G). Different types of RNA exist in the cell: messenger RNA (mRNA), ribosomal RNA (rRNA), and transfer RNA (tRNA).

**Bacterial chromosome:** is single, circular and double stranded DNA , occurs in cytoplasm .

**DNA Replication:** The two strands separate at replication fork, each strand acts as template ,synthesize by DNA polymerase and produce two new strands (semiconservative replication).The replication is in one direction or two direction .

## Features of DNA Replication

Both strands serve as a template:

- synthesis is always 5'-3'
- leading* strand synthesis is continuous,  
*Lagging* strand synthesis is discontinuous

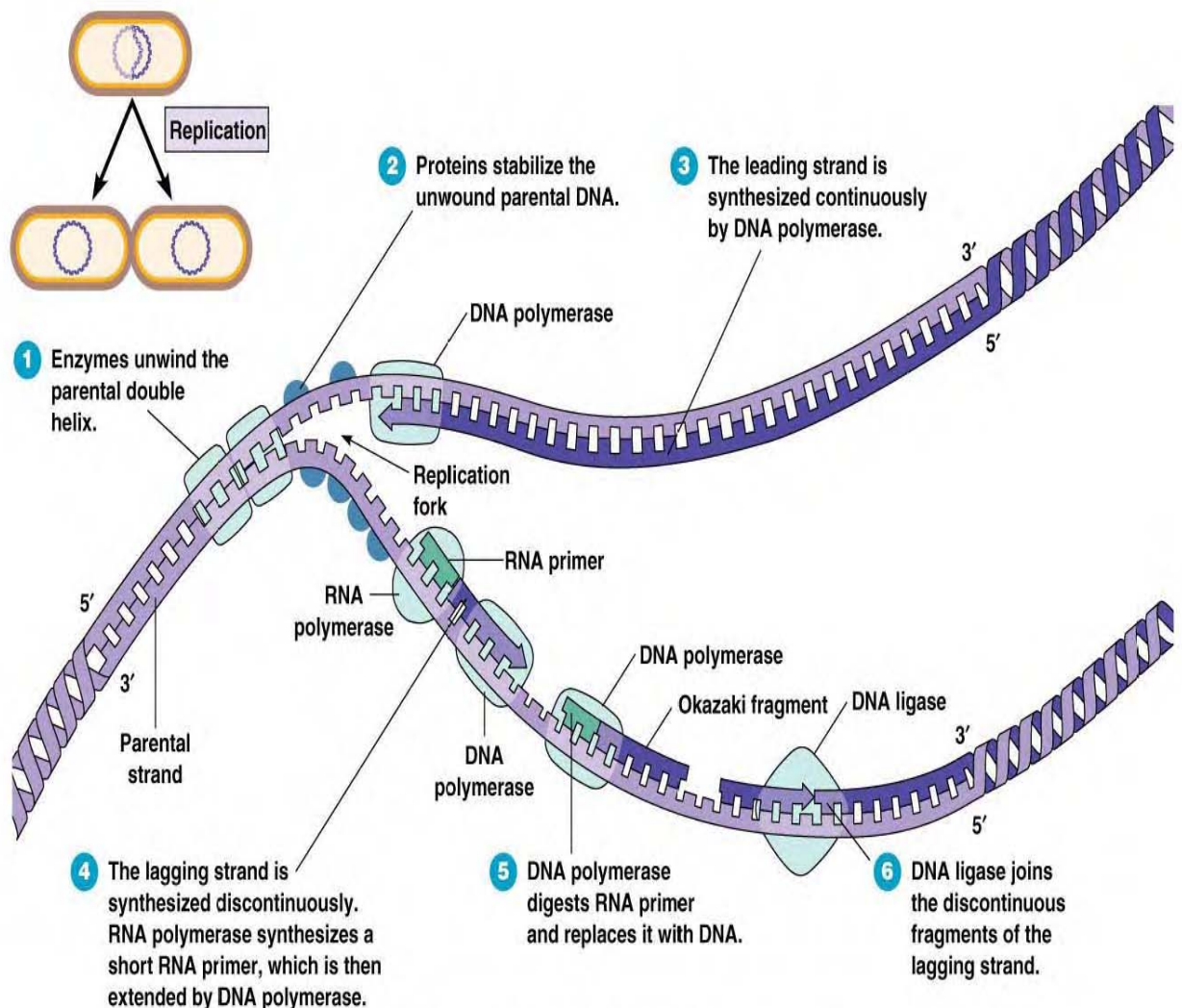
Each new DNA fragment requires an RNA primer:

Some important enzymes:

DNA Polymerase (synthesizes new DNA)

Primase (makes RNA primers)

DNA Ligase ("stitches" fragments together)



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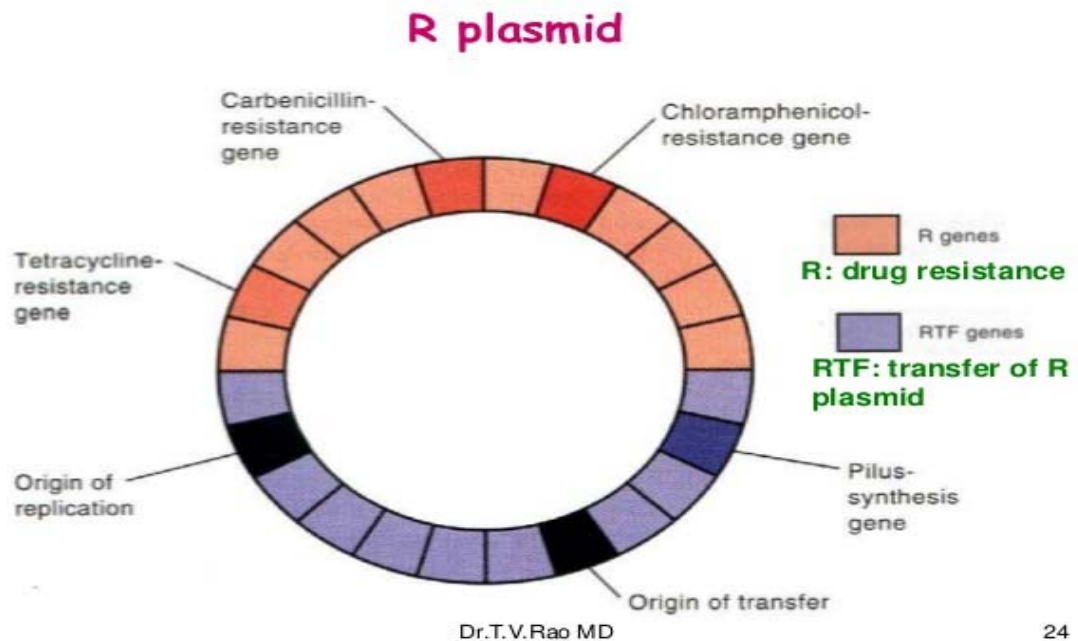
**Genetic code** (codon): Is a triplet code ,each codon consists of three DNA nucleotides

**Gene** – A sequence of nucleotides on a chromosome. Genes are passed on from parents to offspring and are the determinants of an organism's traits.

**Extra-chromosomal DNA:**

**Plasmid:** Circular, extra-chromosomal DNA and self replicated, found in bacteria and some fungi .They carrying genes that are not usually essential for the cell survival. Multiple copies of the same plasmid may be present in each bacterial cell. Plasmids code the genes of antibiotic resistance, production of toxins and bacteriocins and degrading enzymes .

The best example of plasmid is **Resistance factor** or (**R Factor**) which consisting of : resistance transfer factor (RTF) , genes of plasmid replication and conjugation plus resistance genes (r-determinant) .

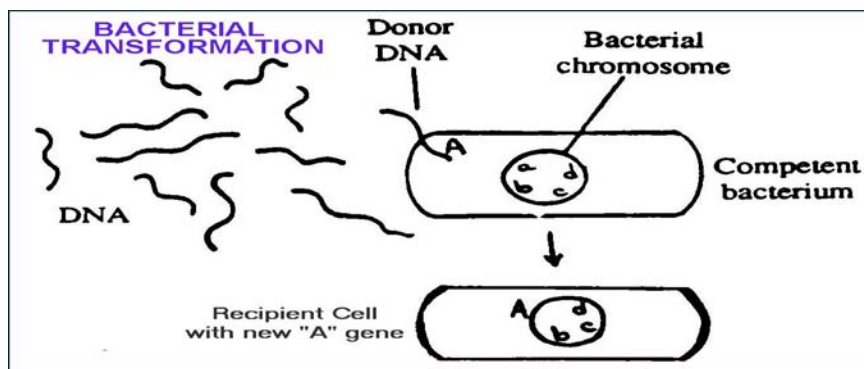


24

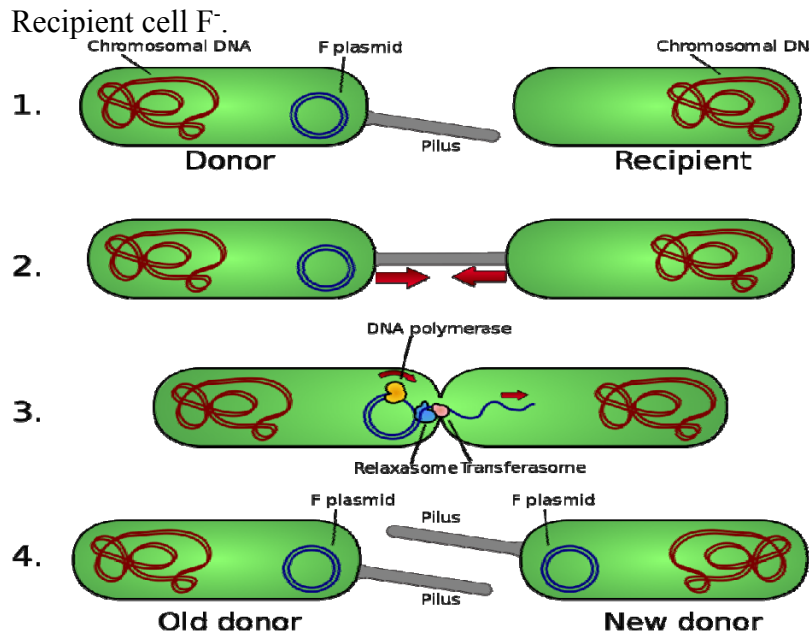
**Transposons** (jumping genes): Small segment of DNA that can move from one region of the same chromosome or to a different chromosome or plasmid .They carrying genes of antibiotic resistance and toxin production .

**Transfer of genetic material in bacteria :**

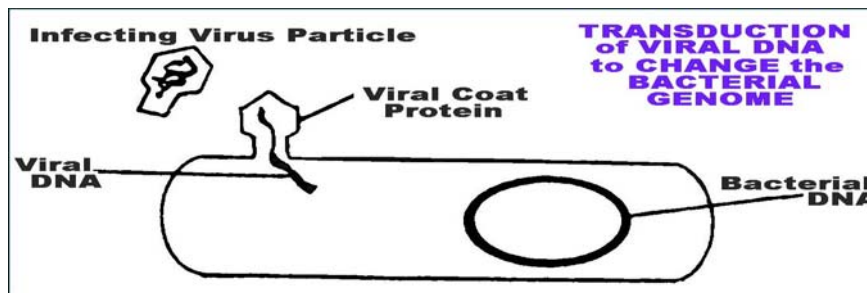
**1.Transformation:** Genes transferred from one bacterium to another (naked DNA) in solution .



**2.Conjugation:** Requires contact between donor cell F<sup>+</sup> &



**Transduction** :DNA is passed from one bacterium to another in bacteriophage.



### DNA Recombination Technology

**Recombinant DNA**: Recombine of different molecules of DNA from two different species and inserted into a host organism to produce new genetic combinations.

**Molecular cloning** is a basic technique in molecular biology and biotechnology to modify the gene, reintroduce the modified gene into the host to produce recombinant products. Many pharmaceutical products can be produced by this technology like; hormones, vaccines and enzymes.

Genetic modification needs:

1. DNA vector ex. **plasmids** .
2. **Restriction enzymes** :Cut DNA at specific sites, rather than just in random places along the DNA molecule.
3. **Ligase enzymes**: join pieces of DNA together at specific sites.

Recombinant Insulin is produced in the following way:

1. The gene for making insulin is cut from a length of human DNA using restriction enzymes.
2. It is inserted into a plasmid using ligase enzymes.

3. The plasmid goes into a bacterial cell.
4. The transgenic bacterium reproduces, resulting in millions of identical bacteria that produce human insulin.

