

Science deals with studying the inheritance of microorganisms and branches to bacteria genetics and viruses.

When studying the inheritance of the heterogeneity of the organism it is necessary to identify all factors that help to understand the mechanisms of this object .

Scientific facts have shown that genetic factors in bacteria and higher organism are concentrated in specialized area in linear form , these factors can transfer from cell to another by several ways.

The changes that occur in the qualities of the bacteria as a result of recombination or mutation often related with components and functions of many parts of the cell.

Since these information responsible for these traits coded in microorganism genotype , known genome the sequence of DNA strand consisting of nucleotides.

At the beginning of the last century knew little about the DNA while the proteins were the only complex molecules in the cell , it was thought to be responsible for the transfer of genetic information , but the information that were known raised doubts about this belief , it was observed that all the cells of a single organism containing equal amounts of DNA while the various groups of cells in a single organism containing different types and amounts of proteins , which led to draw attention to the DNA material being nominated to carry the genetic information .

Scientific experiments have shown that DNA is the genetic material :

- Frederick Griffith experiment 1928 which discovered the phenomenon of transformation

- Avery, McCarty and McCleod experiment 1944 which showed that the DNA is responsible for transformation in bacteria .
- Hershey and Chase experiment 1952 which proved that DNA is responsible for genetic characteristics transfer in bacteriophages
- Chargaff discovery or Chargaff law 1947 which explain the nitrogenous bases rates $A\%=T\%$, $C\%=G\%$ and the percentage of these rates vary from one to another organism .
- For the first time in London laboratories Rosalind Franklin 1952 filmed DNA by X-rays which appeared the helical structure of DNA .
- Watson and Crick 1953 who described the construction of the first DNA sample depending on Chargaff law , this sample showed the nitrogenous bases binding $C\equiv G$, $A=T$, also shows that DNA chains or strands corresponds one to another in opposite direction one of them with 3' end while other with 5' end .

There are some types of bacteria , such as *Bacillus subtilis* , *E coli* ideal organisms for the study of DNA and genetic processes because of the simplicity of installation and short generation time , which saves a lot of time and effort , especially if the installation of DNA is similar between organisms if they prokaryotic or eukaryotic .

Bacteria is a single –cell microorganism surrounded by cytoplasmic membrane and cell wall . Cytoplasm contains the ribosomes which responsible for protein synthesis in addition to a number of soluble enzymes , as well as cytoplasm contains the genetic material DNA spreading in the cytoplasm because it doesn't surrounded by nuclear membrane so it called prokaryote.

The whole genetic material in bacteria or genome is a single chromosome which is circular double helix but swirled on so cannot observed the beginning from the end . In addition to the chromosome bacterial cell may contain genetic factors outside the

chromosome called plasmids which is a bout small pieces of double circular DNA and have the ability to self – replication , these plasmids carry genes not essential for life or growth , but give additional characteristics to the cell which has these plasmids may be important to the bacteria in certain cases such as :

- a- Antibiotic resistance by Resistance or R-plasmid
- b- Fertility or F- plasmid
- c- Colicin production by colicinogenic or col –plasmid .
- d- Antibiotic synthesis plasmid.
- e- Heavy metals resistance plasmid.

DNA Synthesis *In Vitro* or Polymerase Chain Reaction (PCR)

DNA synthesis *in vitro* became possible after isolation of DNA polymerase enzyme from thermophilic bacteria *Thermophilus aquaticus* due to detect many secrets of the DNA synthesis mechanism .

This process requires the following:

1. DNA template it can be single or double strand.
2. Primer which is short piece of DNA complete certain sequence of the template .
3. Four types of dNTPs: dCTP, dGTP, dATP, dTTP.
4. Mg⁺⁺ ions which act as cofactor for the enzyme
5. Buffer that acts as reaction medium with optimum pH
6. Energy for sugar –phosphate bond formation by breaking high energy phosphate bond pi pi which often occur in 3´-OH end .

DNA synthesis beings with primer annealing with its complementary sequence on the DNA template after that the DNA polymerase enzyme beings to add nucleotides one after the other to the 3´end of the primer according to the complementary sequence of the DNA template .

