



## Lecture 5. Bacterial genetics

### Learning objectives

Upon completion of this lecture, student should be able to:

1. Describe the structure of DNA and RNA.
2. Discuss structures and functions of the plasmids.
3. Describe mutations.
4. Discuss various methods of gene transfer.

### Genetics

It is the study of **heredity and variation** to understand the cause of **resemblance** and **differences** between parents and their progeny.

### Structure of DNA

The DNA molecule is composed of **two strands of complementary nucleotides** wound together in the form of a **double helix**.

**Each DNA strand** has a:

1. Backbone of **deoxyribose** (sugar)
2. **Phosphate** group residues
3. Four **nitrogenous bases**:
  - Two **purines** (adenine and guanine)
  - Two **pyrimidines** (thymine and cytosine).

A molecule of DNA contains **as many units of adenine as thymine** and of **guanine as cytosine**.

**The ratio of adenine and thymine to guanine and cytosine is constant for each species, but varies widely between bacterial species.**

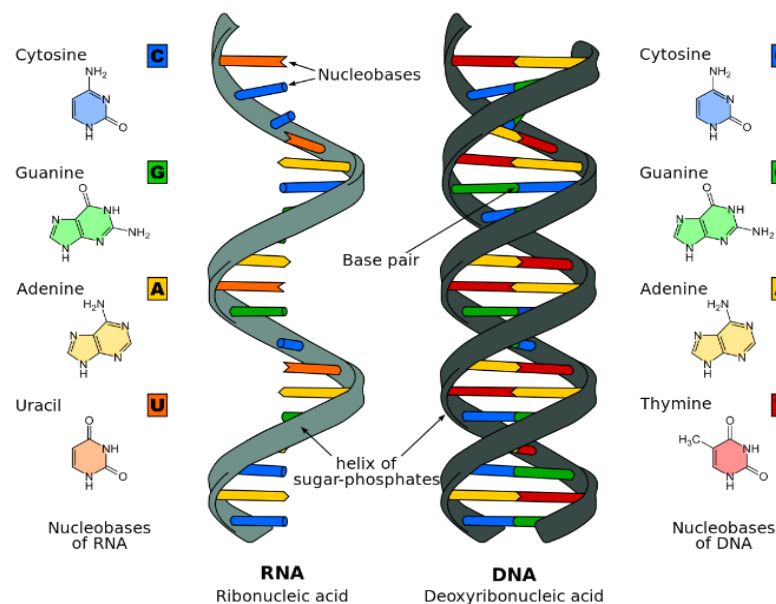
## Structure of RNA

The structure of RNA is similar to that of DNA **except:**

- Its **single stranded**
- The sugar is **D-ribose**
- Contains **uracil** instead of **thymine**

On the basis of **structure** and **function**, the RNA can be differentiated into:

- Messenger RNA (**mRNA**)
- Ribosomal RNA (**rRNA**)
- Transfer RNA (**tRNA**)





## Gene

It is a **segment of DNA** that carries **codons** specifying for a **particular polypeptide**.

A DNA molecule consists of a **large number of genes**, each of which contains hundreds of thousands of **nucleotides**.

The length of DNA is usually expressed as **kilobases**

– **1 kbp = 1000 base pairs (bp)**

**Bacterial DNA** measures usually **4000 kbp**

**Human genome** measures about **3 million kbp**

## Mutations

Mutation is a **random, undirected, and heritable variation** seen in DNA of the cell.

It is caused by a change in base sequence of DNA due to **addition, deletion, or substitution** of **one or more bases** in the nucleotide sequence of DNA.

Mutation results in **insertion** of a **different amino acid into a protein**, resulting in the appearance of an **altered phenotype**.

## Causative agents of mutations

Mutation can be caused by:

- **Viruses** (Bacterial viruses)
- **Radiation** (X-rays and ultraviolet light)
- **Chemicals** (nitrous acid, alkylating agents, etc)



## Effects of mutations

1. Mutation **alter drug susceptibility, antigenic structure, and virulence of mutant bacteria.**
2. Alter **susceptibility of bacteria to bacteriophages.**
3. Alter bacterial **colony morphology and pigment productions.**
4. Affect the ability of bacteria to **produce capsule or flagella.**

## Extra chromosomal DNA substances

### 1. Plasmids

- Extra chromosomal DNA substances varying from less than 5 to more than several 100 kbp

### 2. Transposons

- A type of mobile DNA of 2000–20,000 bp

## Functions of plasmids

1. **Resistance to one or several antibiotics**
2. **Production of toxins**
3. **Synthesis of cell surface structures required for adherence or colonization**



## Transfer of DNA between bacterial cells

Methods of transfer	Mechanism
<b>Transformation</b>	Recipient cell uptake of free DNA released into the environment
<b>Transduction</b>	Transfer of a portion of DNA from one bacterium to another by bacteriophage
<b>Conjugation</b>	Transfer of DNA from one living bacterium to another through the sex pilus