

## 4.2 Mutations

Mutations are sudden changes that occur in the genetic material of organisms. Mutations may occur naturally or may be caused by environmental factors. They are important in evolution because they create genetic variation in populations.

### 1. Definition of Mutation

A mutation is a sudden and permanent change in the DNA sequence or chromosome structure of an organism.

### 2. Causes of Mutations

Mutations can occur due to different factors called mutagens. **Radiation:** X-rays, ultraviolet rays, and radioactive materials can damage DNA. **Chemicals:** Certain chemicals may change DNA structure. **Errors during DNA replication:** Mistakes may happen when DNA copies itself. **Viruses:** Some viruses can alter genetic material.

### 3. Types of Mutations

Mutations are generally classified into two major groups.

#### A. Gene Mutation

Gene mutation occurs when there is a change in the nucleotide sequence of a gene. **Examples:** Substitution mutation Insertion mutation Deletion mutation Gene mutations may change the proteins produced by cells.

#### B. Chromosomal Mutation

Chromosomal mutation occurs when the structure or number of chromosomes changes. **Examples:** Deletion Duplication Inversion Translocation Chromosomal mutations can cause genetic disorders.

### 4. Effects of Mutations

Mutations may have positive, negative, or neutral effects. **Beneficial mutations:** Help organisms survive better. **Harmful mutations:** Cause diseases or abnormalities. **Neutral mutations:** Have no visible effect. **Examples:** Antibiotic resistance in bacteria is beneficial for bacteria. Sickle cell anemia is caused by mutation.

## 5. Importance of Mutations

Mutations are important because they: Create genetic variation. Support evolution and natural selection. Help organisms adapt to changing environments. Can lead to the development of new species.

## Summary

Mutations are sudden changes in genetic material. They may occur naturally or due to environmental factors. Mutations create genetic variation, which is important for evolution. Mutations can be beneficial, harmful, or neutral.

## Summary Questions and Answers

### 1. What is a mutation?

A mutation is a sudden and permanent change in genetic material.

### 2. What are mutagens?

Mutagens are factors that cause mutations.

### 3. Name two causes of mutations.

Radiation and chemicals are causes of mutations.

### 4. What is gene mutation?

Gene mutation is a change in the nucleotide sequence of a gene.

### 5. What is chromosomal mutation?

Chromosomal mutation is a change in chromosome structure or number.

### 6. Give one beneficial mutation.

Antibiotic resistance in bacteria is a beneficial mutation.

**7. Why are mutations important?**

Mutations create genetic variation and support evolution.