

# Mutations

## What Are Mutations?

- Changes in the nucleotide sequence of DNA
- May occur in somatic cells (aren't passed to offspring)
- May occur in gametes (eggs & sperm) and be passed to offspring

### **Are Mutations Helpful or Harmful?**

- Mutations happen regularly
- Almost all mutations are neutral
- Chemicals & UV radiation cause mutations
- Many mutations are repaired by enzymes

### **Are Mutations Helpful or Harmful?**

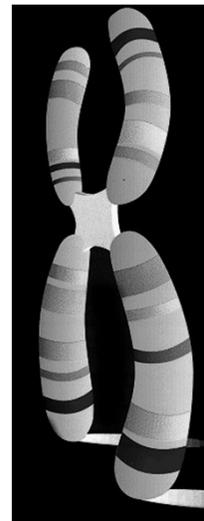
- Some type of skin cancers and leukemia result from somatic mutations
- Some mutations may improve an organism's survival (beneficial)

# Types of Mutations

- **Chromosome Mutations**
- **Gene Mutations**

## Chromosome Mutations

- May Involve:
  - **Changing the structure** of a chromosome
  - The **loss or gain** of part of a chromosome

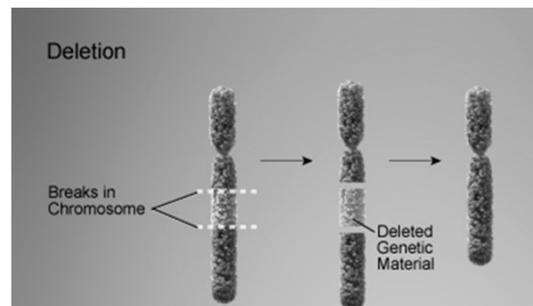


## Chromosome Mutations

- Five types exist:
  - **Deletion**
  - **Inversion**
  - **Translocation**
  - **Nondisjunction**
  - **Duplication**

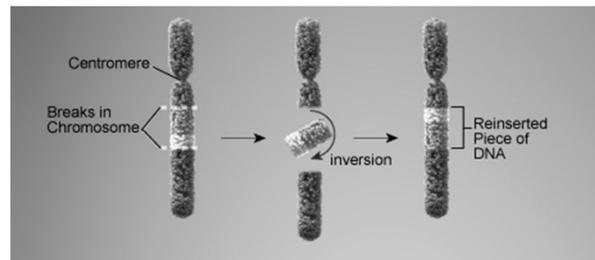
## Deletion

- Due to **breakage**
- A **piece** of a chromosome is **lost**



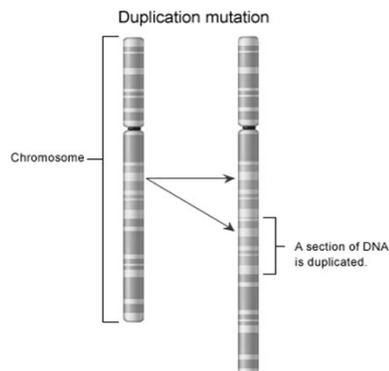
## Inversion

- Chromosome segment **breaks off**
- Segment flips around **backwards**
- Segment **reattaches**



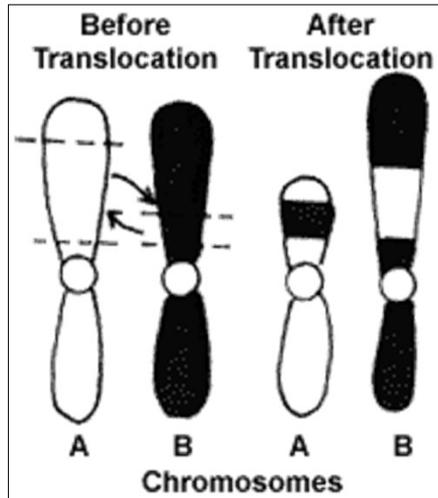
## Duplication

- Occurs when a gene **sequence is repeated**



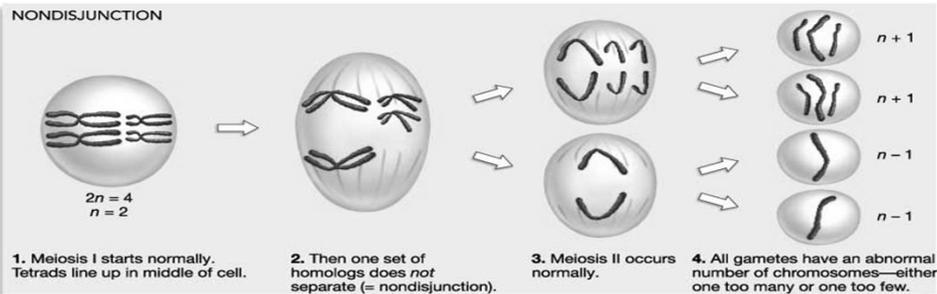
## Translocation

- Involves **two chromosomes** that aren't homologous
- **Part** of one chromosome is **transferred to another** chromosomes



## Nondisjunction

- **Failure** of chromosomes **to separate** during meiosis
- Causes gamete to have **too many or too few chromosomes**



# Chromosome Mutation Animation



## Original Chromosome



## Duplication



## Deletion



## Inversion



## Inversion



## **Gene Mutations**

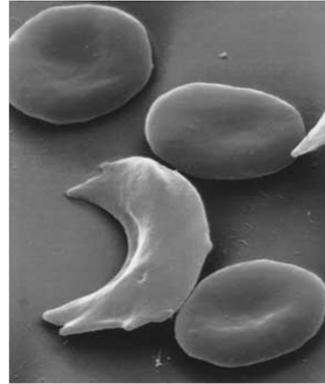
- Change in the **nucleotide sequence** of a gene
- May only involve a single nucleotide
- May be due to **copying errors, chemicals, viruses, etc.**

## **Types of Gene Mutations**

- Include:
  - Point Mutations
  - Substitutions
  - Insertions
  - Deletions
  - Frameshift

## Point Mutation

- Change of a **single** nucleotide
- Includes the deletion, insertion, or substitution of **ONE** nucleotide in a gene
- **Sickle Cell disease** is the result of one nucleotide substitution
- Occurs in the **hemoglobin gene**



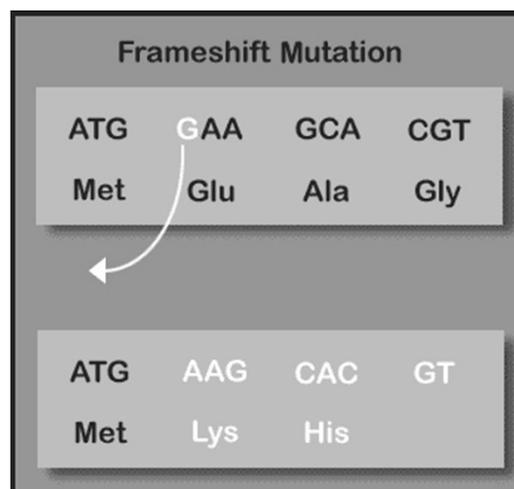
## Frameshift Mutation

- **Inserting or deleting** one or more nucleotides
- Changes the “**reading frame**” like changing a sentence
- **Proteins built incorrectly**

## Frameshift Mutation

- Original:
  - The fat cat ate the wee rat.
- Frame Shift (“a” added):
  - **The fat caa tet hew eer at.**

## Amino Acid Sequence Changed



# Gene Mutation Animation

