

Mutations – Ch. 14 Lesson 4



Types of Mutations

Mutations: are heritable changes in genetic information.

- Can involve changes in the sequence of nucleotides in DNA or changes in the number or structure of chromosomes

Mutations fall into two basic categories:

- Gene mutations – involve changes in the nucleotide bases
 - **Point mutations:** occurs at a single point in the DNA sequence
 - **Frameshift mutations:** occurs when there is a shift in the reading frame of the genetic message
- Chromosomal mutations – involve changes in the number or structure of chromosomes

Gene Mutations: Point Mutations

A point mutation is a change in a single nucleotide.

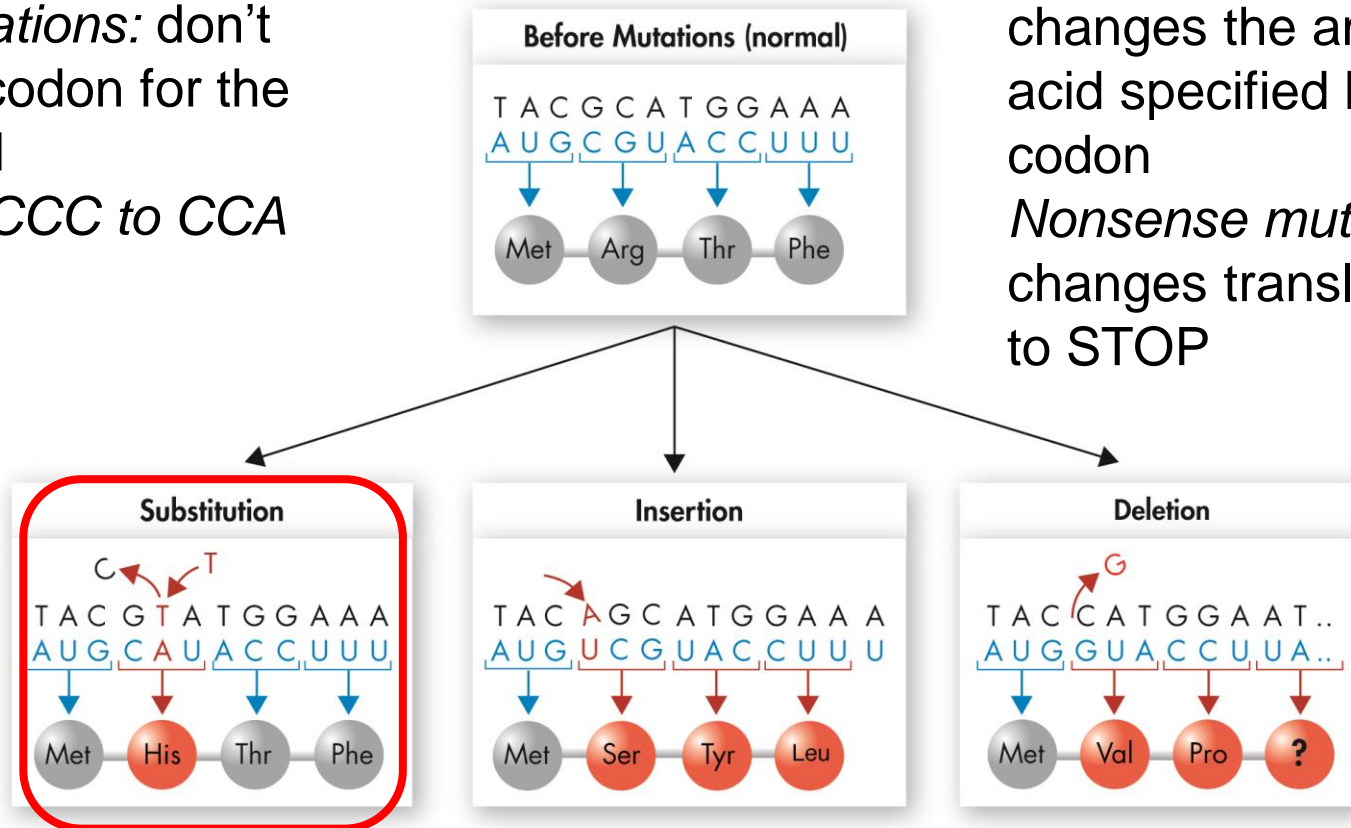
Substitution mutations usually affect no more than a single amino acid and sometimes have no effect at all.

Silent mutations: don't affect the codon for the amino acid

Example: CCC to CCA

Missense mutations: a mutation that changes the amino acid specified by a codon

Nonsense mutation: changes translation to STOP

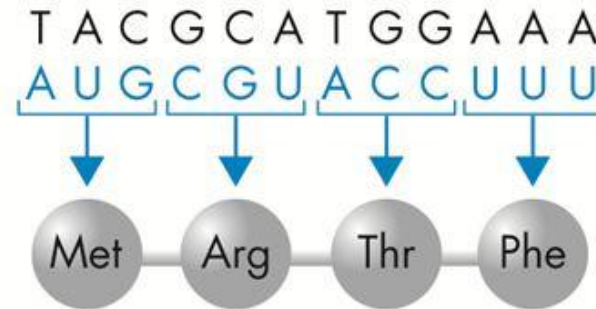


Frameshift Mutations: Insertions and Deletions

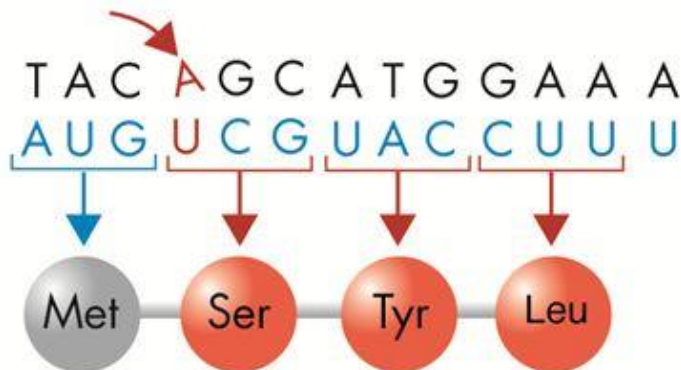
Insertion mutation: when a single extra base is added into the code

Deletion mutation: when a single base is removed from the code

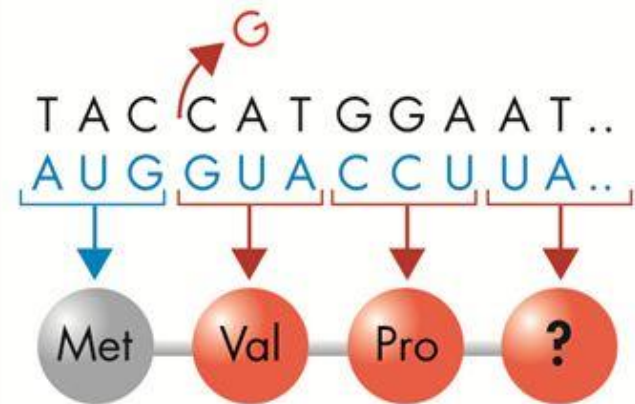
Before Mutations (normal)



Insertion

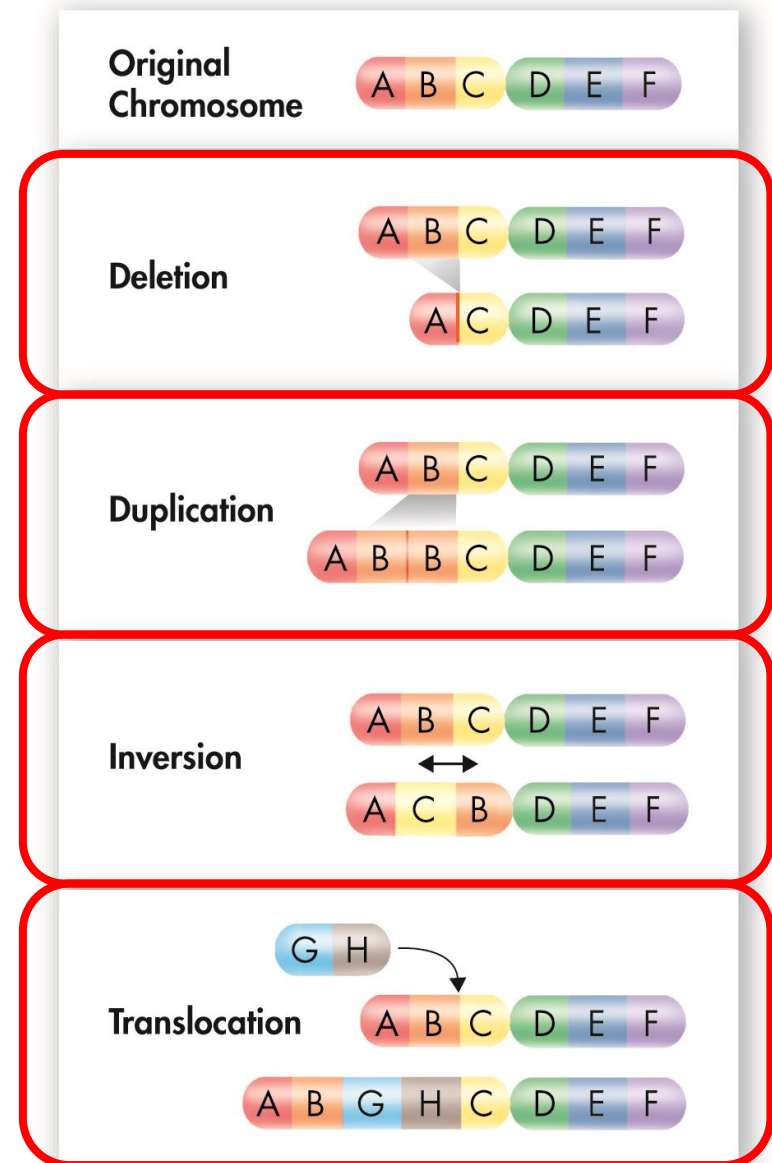


Deletion



Chromosomal Mutations

- *Deletion* involves the loss of all or part of a chromosome
- *Duplication* produces an extra copy of all or part of a chromosome
- *Inversion* reverses the direction of parts of a chromosome
- *Translocation* occurs when part of one chromosome breaks off and attaches to another



Effects of Mutations

Mutagen: chemical or physical agents in the environment

- Chemical mutagens include certain pesticides, tobacco smoke, and environmental pollutants
- Physical mutagens include some forms of electromagnetic radiation (ultraviolet light) and X-rays
 - Cells can repair some of the damage but when it cannot the DNA sequence is permanent

The effects of mutations on genes vary widely. Some have little or no effect, some produce beneficial variations, and some negatively disrupt gene function.



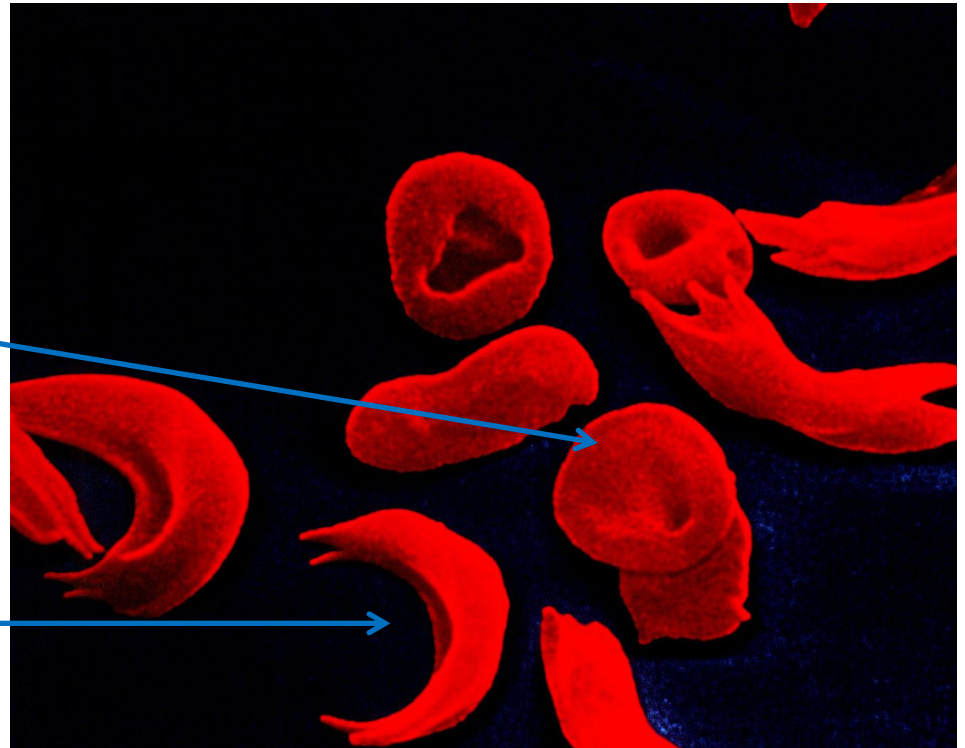
Effects of Mutations: Harmful

Some of the most harmful mutations are those that dramatically change protein structure or gene activity.

Example: Sickle cell disease affects the shape of red blood cells.

Normal red blood cell

Sickle cell



Some cancers are the product of mutations that cause the uncontrolled growth of cells.

Effects of Mutations: Beneficial

Mutations often produce proteins with new or altered functions that can be useful to organisms in different or changing environments.

An example includes a mutation in the mosquito genome has made some mosquitos resistant to the chemical pesticides that once controlled them. This is bad news for us but good for the insect.

Humans can have beneficial mutations involving the increase in bone strength and density

Important crop plants (bananas, limes, and strawberries) have mutations that result in larger and stronger plants for produce.