

Chap.3 Doc.1 Mutations and the Environment

Mutation is a sudden and unpredictable change in the sequence of nucleotides of DNA to produce a new allele that will result in a new phenotype that may be beneficial or harmful.

Mutation could be:

a. Spontaneous

Mutation can happen naturally without an external cause; it happens as a result of an error in DNA replication system.

or

Induced:

Caused by mutagenic agent like stressful environmental conditions: UV ray, or chemical factors : Polycyclic hydrocarbons.

b. Effective

Effective mutation occurs at the level of DNA or genotype or genome and leads to a modification or alternation at the level of the phenotype.

or

Ineffective

Is a mutation that modifies the genotype or DNA but such modification has no effect on phenotype.

- It could be repaired by specific repair enzymes or proteins.

- Unnoticed- silent.

c. Beneficial (Favorable)

A mutation is said to be beneficial when it leads to the appearance of a normal allele starting from abnormal one or it leads to the creation of new alleles at the level of the population enabling the organisms to adapt with the modifications or changes that occur at the level of the surrounding environmental factors or conditions.

or

Harmful

However, harmful mutations are those that lead to the appearance of abnormal alleles causing the appearance of hereditary diseases or abnormalities (anomalies/maladies).

- It may lead to cell damage or tumor like cancer.

d. Not transmitted:

Mutations occurring in **somatic cells** are **never transmitted** from one generation to another (they are not hereditary). Only the daughter cells of the original somatic cell submitted to mutation inherit such mutation.

or

Transmitted (inherited):

However, mutation occurring in **germ line cell** **could be transmitted** from one generation to another (due to random fertilization and gene expression). All the cells, somatic and germ, of this individual inherit this mutation.

Example: A hole in the ozone layer permits the passage of U.V radiation (photon) which causes the formation of thymine dimer T-T.

This leads to skin cancer ☹.

Thank God for the presence of enzyme ERCC3 which breaks this T-T dimer & recovers this mutation.

Before

After

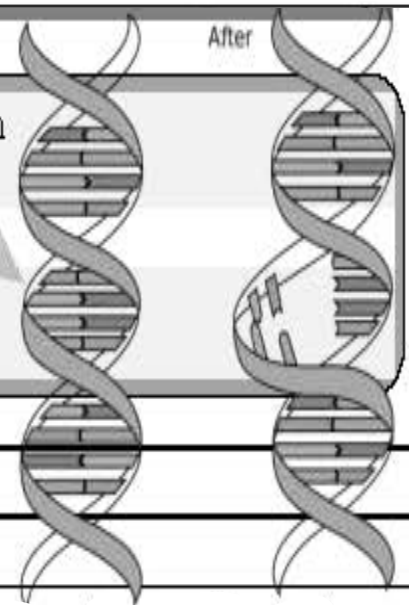
Incoming
UV Photon

3 Factors that cause:
Diversity, genetic variation &
polymorphism

1- Gene Mutation

2- Fertilization

3- Meiosis



Main notions: - Mutations can be beneficial, harmful or unnoticed.

- Mutations in germ cells, but not in somatic cells, are transmitted to the offsprings.

Probing the activity p.59

1. No, mutations are not always transmitted; in fact mutations occurring in the somatic cells of the body are not transmitted to the offspring. Only mutations in germ cells can be transmitted to the offspring.
2. Mutations are not always harmful, like in the case of peppered moths. A gene mutation has yielded a generation of dark-colored moths. This has allowed moths to overcome environmental changes, thus ensuring the continuity of the species.
3. An overexposure to UV-B rays causes mutations in genes that code for repair proteins responsible for the correction of replication errors. Therefore, repair proteins cannot correct the damage. This leads to abnormal DNA molecules, i.e. to mutant genes.
On the other hand, mutations can also occur in genes that control tumor growth. These mutations (in DNA repair genes and tumor control genes) will ultimately lead to skin cancer in the overexposed areas.
4. The phenomenon referred to in the question is the ozone depletion of the earth's atmosphere. The ozone layer forms a "filtering" umbrella that prevents harmful UV rays (UV-B rays) from reaching the earth's atmosphere. Its depletion could eventually mean increased exposure of the earth's inhabitants to UV-B rays. These might induce mutations by affecting the DNA structure and hence increase the incidence of cancer (UV light favors the cross-linking of adjacent pyrimidine dimers, primarily thymine dimers, on the DNA).