

3.2: Different Genetic Damages or Mutations

Learning Objectives

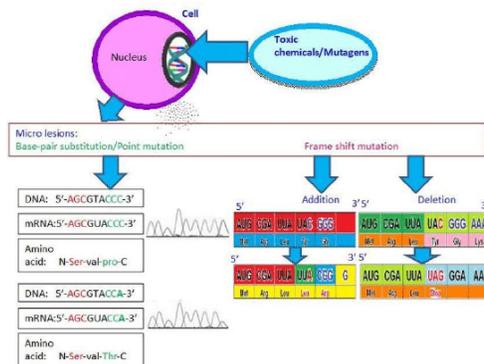
- 1: Know different types of genetic damages or mutations.
- 2: Know how different mutations resulted in the cells by mutagens.

Do you know how many mutations or damages are possible by mutagens in the cells?

Mutations can be:

- Microlesions (gene mutation)
- Macro lesions (Chromosomal mutation)

2.1: Microlesions (Gene Mutation)



Microlesions are the damages or mutations in DNA bases. These mutations are with invisible phenotypic changes. The types of microlesions are illustrated in the figure on the right.

Base-pair substitution mutation (qualitative change in nucleotide pairs)

- In this mutation, single base nucleotide is replaced by another nucleotide.

Frame shift (quantitative change in nucleotide pairs)

- In this mutation, addition or deletion of nucleotide in the DNA sequence resulted to shift or change the entire DNA or amino acid sequence.

Figure 3.2.1: Micro lesions mutation by mutagens.

2.2 Macro Lesions (Chromosomal Mutation)

Macro lesions are chromosomal mutations with mutagens and are with distinct morphological changes in the phenotype. These morphological changes of chromosomes can be cytologically visible under microscope. Macro lesions are following types:

Numerical changes in chromosomes

- Polyploidy: Duplication of entire set of chromosome to triploid or tetraploid.
- Aneuploidy: Changes of single missing chromosome to **monosomy** or three copies of a single chromosome to **trisomy**.

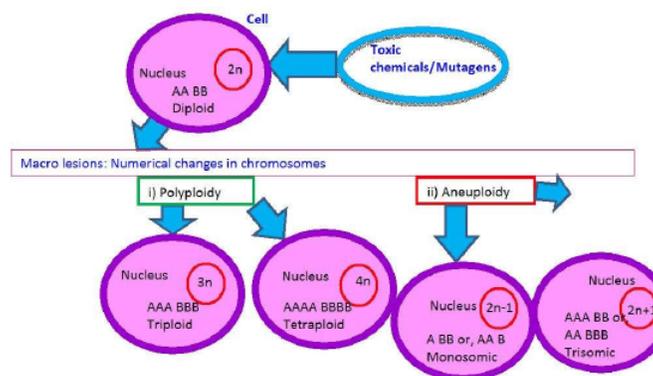


Figure 3.2.2: Macro lesions mutation by mutagens.

Structural changes in chromosomes

- Deletion: loss of chromosome segment
- Translocation: A segment of one chromosome becomes attached to a non homologous chromosome. It can be one way transfer as simple translocation and two way transfer as reciprocal translocation.
- Inversion: A change in the direction of material along a single chromosome.

- Duplication: Repetition of chromosome segment

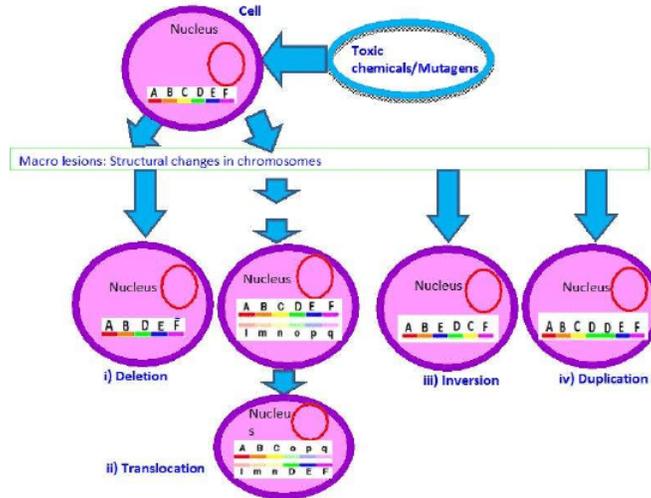


Figure 3.2.3: Structural changes in chromosomes resulted to macro lesions mutation.

Micronuclei changes

- Micronuclei (MN) are the damaged chromosome fragments or whole chromosomes that were not incorporated into the cell nucleus and stayed as the extra-nuclear bodies after the cell division.
- MN can be resulted by the defects of the cell repair machinery and by the accumulation of damaged DNA and chromosomal aberrations.genetic.html

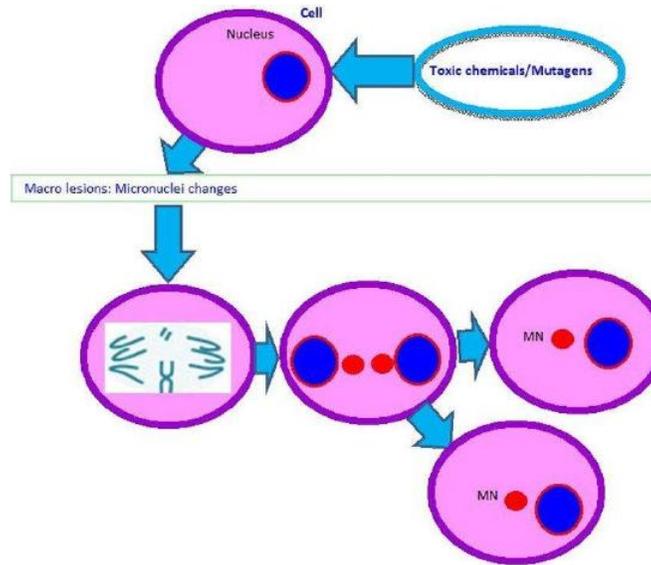


Figure 3.2.4: Micronuclei changes resulted to macro lesions mutation.

Topic 2: Key Points

In this section, we explored the following main points:

- 1: Different types of Microlesions (gene mutation) and Macro-lesions (Chromosomal mutation).
- 2: How toxic agents or mutagens modulate the two different microlesions namely base pair substitution and frame shift mutation.
- 3: Genotoxic mutagens involve also in different macro-lesions namely numerical or structural changes in chromosomes or changes of micronuclei in cell.

Knowledge Check

1. What is monosomy?

- Duplication of entire set of chromosome .
- Single missing chromosome from diploid set.
- Three copies of a single chromosome.

Answer

Single missing chromosome from diploid set.

2. In base-pair substitution mutation, single base nucleotide is replaced by another nucleotide.

- True
- False

Answer

True

3. What are the structural changes in chromosomes caused by toxicants?

- Deletion
- Translocation
- Inversion
- Duplication
- All of the above

Answer

All of the above

4. Micronuclei (MN) changes are the damaged chromosome fragments or whole chromosomes that were not incorporated into the cell nucleus and stayed as the extra-nuclear bodies after the cell division.

- True
- False

Answer

true

5. Frame shift mutation, resulted to shift or change of entire DNA or amino acid sequence by:

- addition of nucleotide in the DNA.
- deletion of nucleotide in the DNA.
- addition or deletion of nucleotide in the DNA

Answer

addition or deletion of nucleotide in the DNA

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