

**Belarussian State Pedagogical University named
after M. Tank**

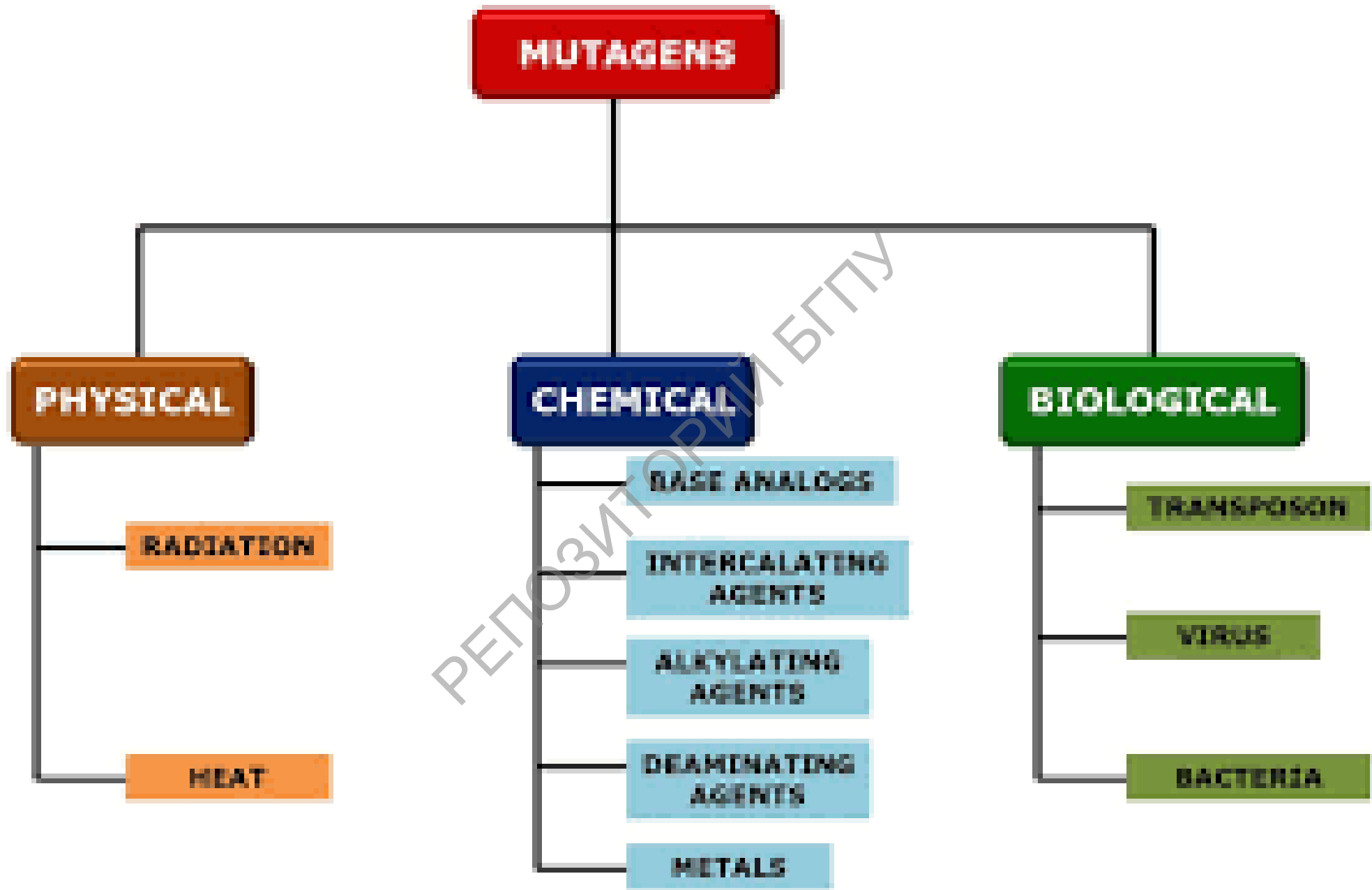
**Inclusive Education Institute
Correction and Development Technologies
Department**

**Human Genetics Foundations
Mutagens**

D. L. Nikolaev, associate professor

Introduction

- Definition- **Mutagen** is a physical or chemical agent that causes mutation i.e. changes the genetic material, usually DNA of an organism
- Not all mutations are caused by mutagens only induced mutations were caused by mutagens. Spontaneous mutations are naturally occurring mutations.
- Mutagens causing cancer, are likely to be known as carcinogens

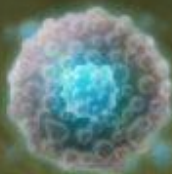




MUTAGENS



LESSER CRITICAL EFFECTS M... 0.1 7



CONCENTRATION MUTAGEN

MUTAGEN

LESSER VITALITY MUTAGEN 0.1 13

GREATER CRITICAL EFFECTS ... 0.1 33

STRENGTH MUTAGEN 0.1 18

CRITICAL EFFECTS MUTAGEN 0.1 13

14 LESSER ENHANCEMENT MUT... 1.4 126

CONCENTRATION MUTAGEN

Mutagen

EPIC

Damage bonus on Signs +1

ORENS 44

WEIGHT 0.1

Sources for mutation:



Radiation

UV Radiation
 From natural sunlight
 and tanning beds



X-Rays
 Medical, dental,
 airport security screening



Chemicals

Cigarette Smoke
 Contains dozens of
 mutagenic chemicals



Benzoyl Peroxide
 Common ingredient
 in acne products

**Nitrate & Nitrate
 Preservatives**
 in hot dogs and
 other processed meats

Barbecuing
 Creates mutagenic
 chemicals in foods

Infectious Agents

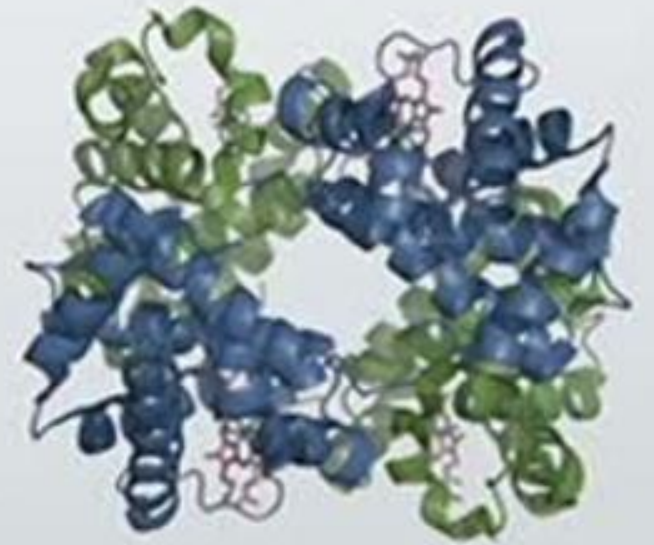
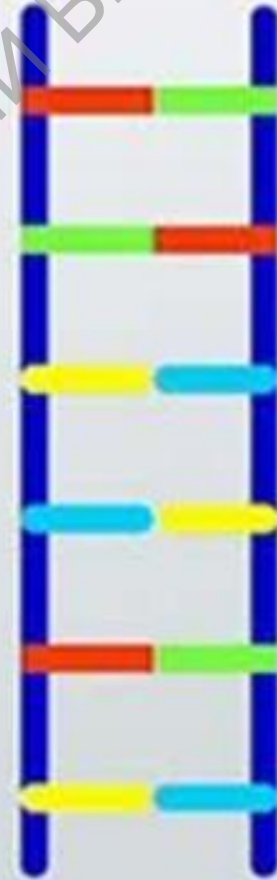
**Human Papillomavirus
 (HPV)**
 Sexually transmitted virus



Helicobacter pylori
 Bacteria spread through
 contaminated food


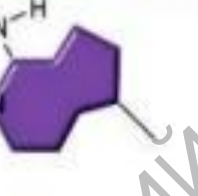

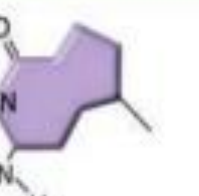
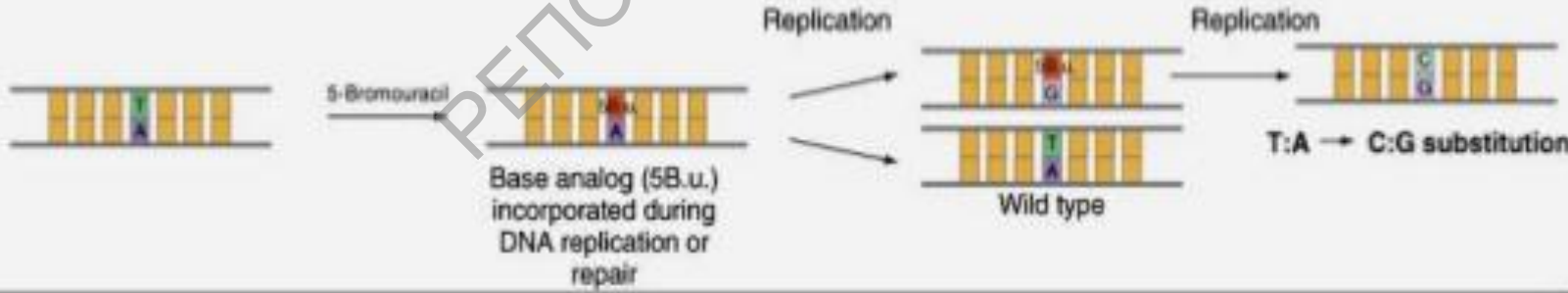
Chemical Mutagens

chemicals that cause changes to DNA sequences

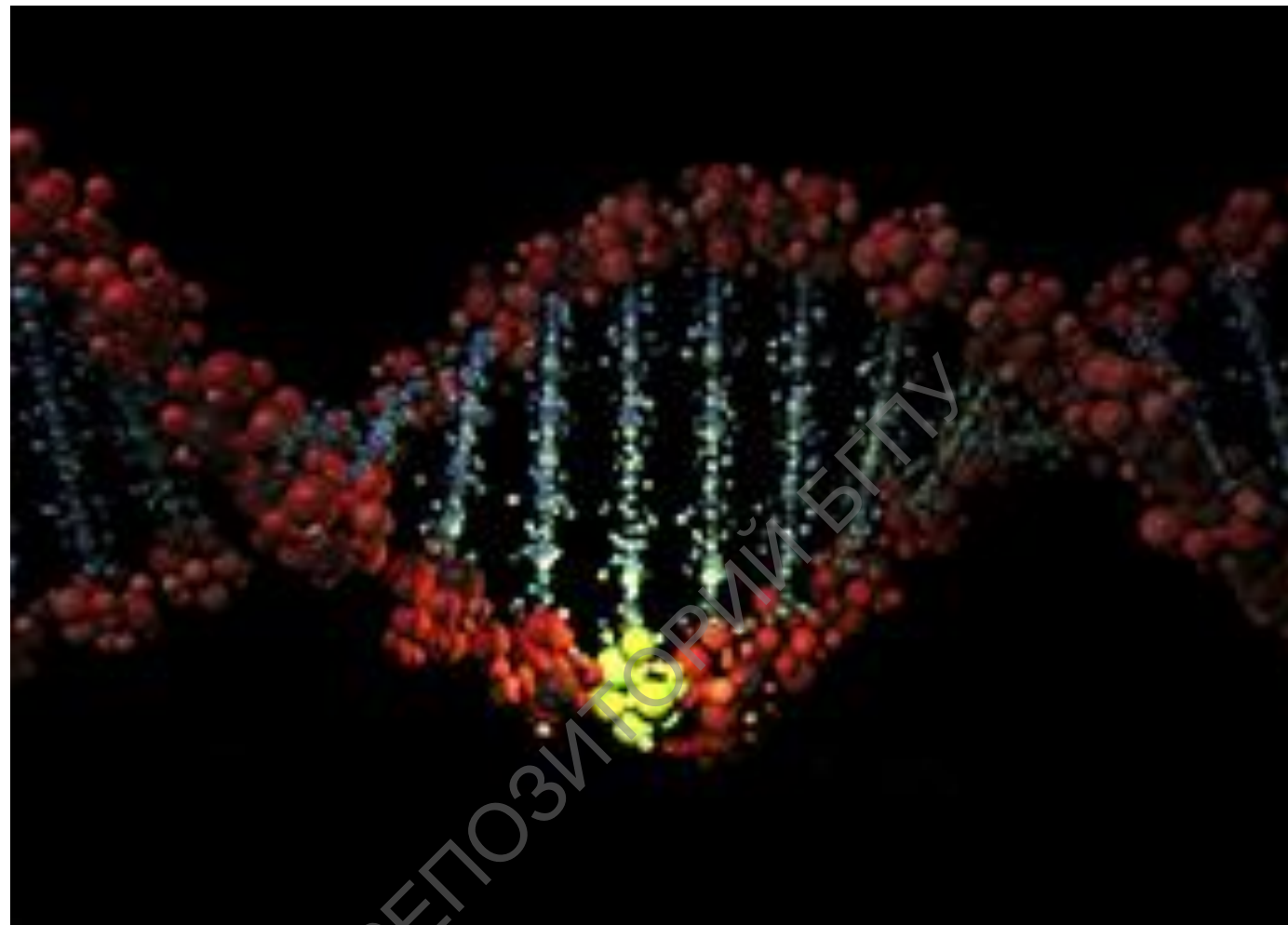


Chemical Mutagens

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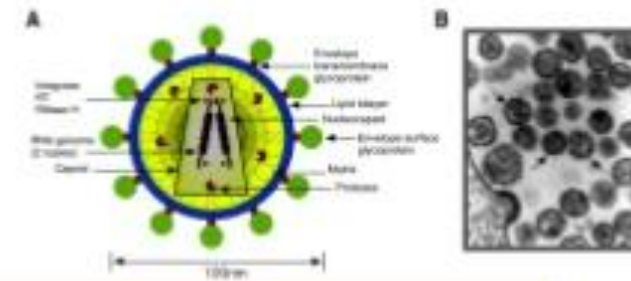
| Type of mutagen | Chemical action of mutagen |
|--|---|
| <p>(a) Replace a base: Base analogs have a chemical structure almost identical to that of a DNA base.</p> | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>5-Bromouracil—normal state, behaves like thymine</p> </div> <div style="text-align: center;">  <p>Adenine</p> </div> <div style="text-align: center;">  <p>5-Bromouracil—rare state, behaves like cytosine</p> </div> <div style="text-align: center;">  <p>Guanine</p> </div> </div> <p>5-Bromouracil: almost identical to thymine. Normally pairs with A; in transient state, pairs with G.</p> |
| How mutagens induce mutations | |
|  <p style="text-align: center;">Replication Replication</p> <p style="text-align: center;">Base analog (5B.u.) incorporated during DNA replication or repair</p> <p style="text-align: center;">Wild type</p> <p style="text-align: right;">T:A → C:G substitution</p> | |



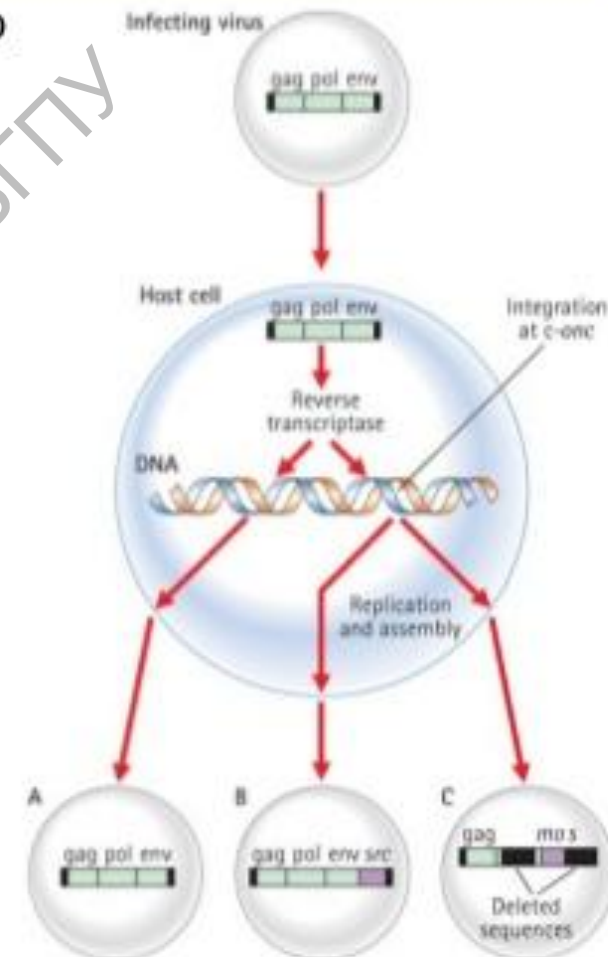
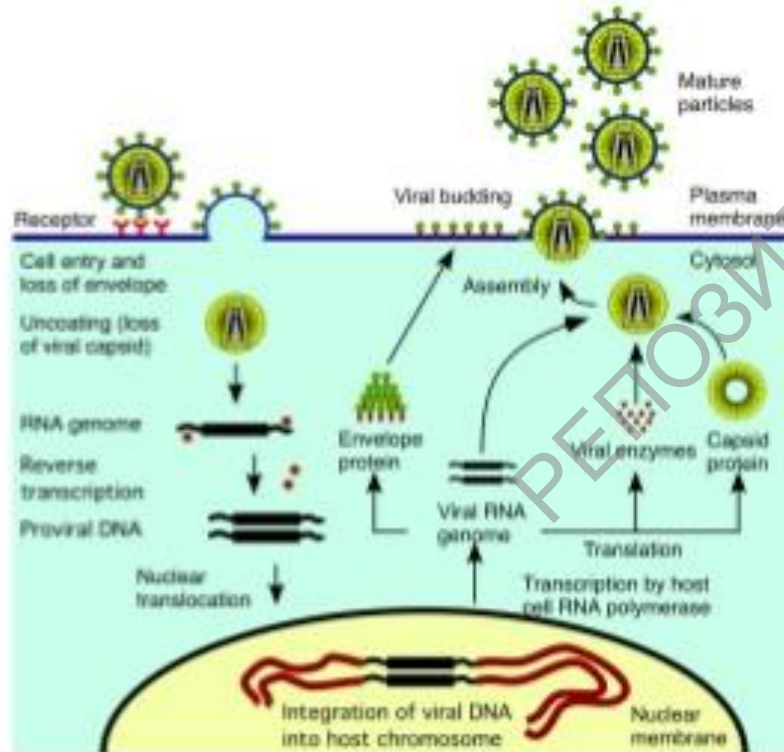


Mutagens are chemical agents
that alter the composition of
DNA.

Biological mutagens

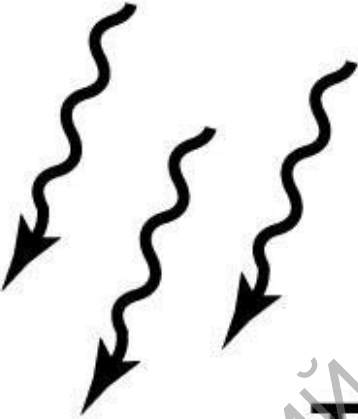


- ❑ Retroviruses can convert their RNA genome into DNA and integrates into the host genome
- ❑ Integration may cause insertional mutagenesis

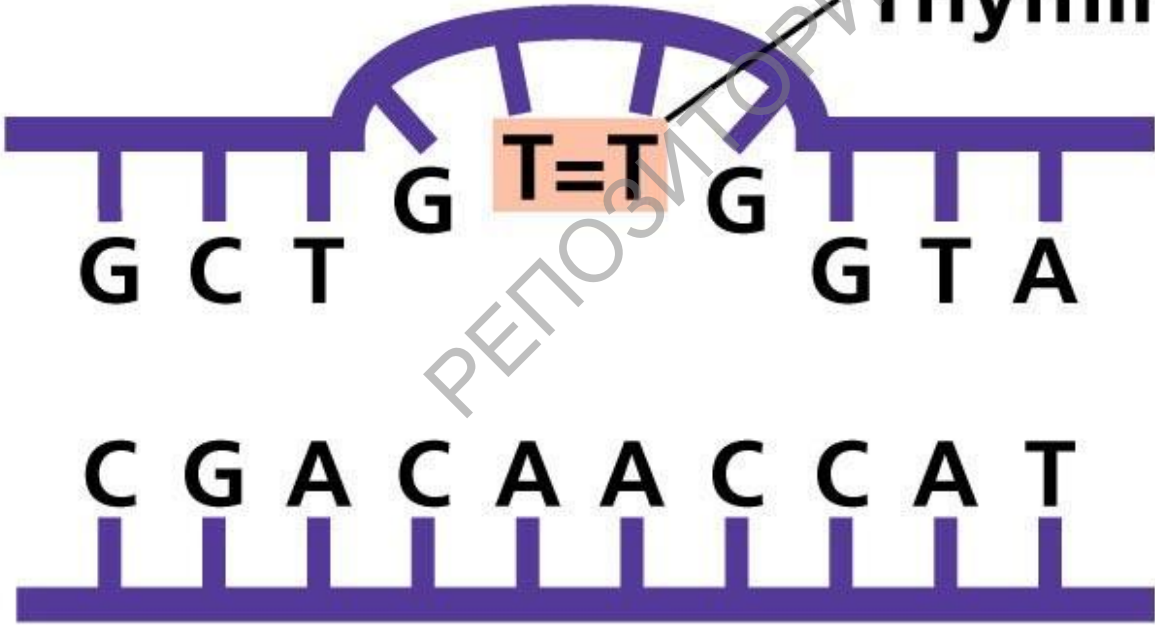


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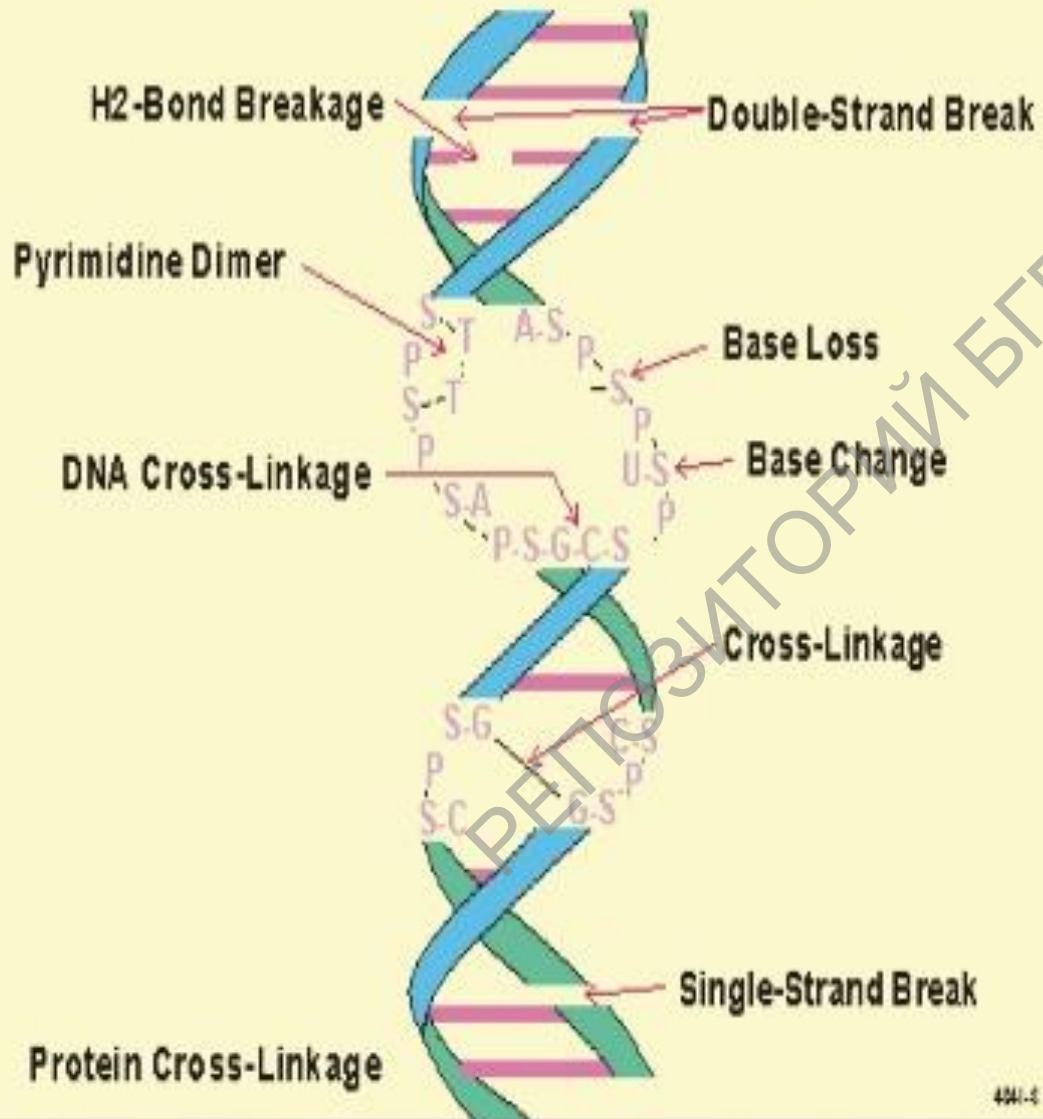
Ultraviolet light



Thymine dimer



RADIATION DAMAGE TO DNA



Physical Mutagens

Radiation was the first mutagenic agent known; its effects on genes were first reported in the 1920's.

Radiations are of two types.

- I. EM radiations
- II. Ionizing radiations

Mutagens : types, effects and examples

| Mutagens | Effects | Examples |
|-----------------------|--|--|
| Carcinogens | Carcinogenesis and tumor formation. | Chemical : Aflatoxins Biological : Retroviruses Physical : X-ray Irradiation |
| Clastogens | Chromosome breaks, deletions, rearrangements | Chemical : Bleomycin Biological : HIV virus Physical : UV waves |
| Teratogens | Congenital malformations. | Chemical : Valproate Biological : Toxoplasma gondii Physical : X-ray irradiation |
| Non-specific mutagens | Non-specific damage to the genetic material. | Chemical : Innumerable types Physical : X-ray irradiation Biological : Toxoplasma, Viruses |

Effects of mutagens

- Mutagens cause changes to the DNA that can affect the transcription and replication of the DNA, which in severe cases can lead to cell death.
- The mutagen produces mutations in the DNA, loss of function for a particular gene, and accumulation of mutations may lead to cancer.
- Powerful mutagens may result in chromosomal instability, causing chromosomal breakages and rearrangement of the chromosomes such as translocation, deletion, and inversion. Such mutagens are called **clastogens**