Mutations

- **Mutations Are Inherited Alterations in the DNA Sequence**

- Mutation = change(s) in the nucleotide/base sequence of DNA; may occur due to errors in DNA replication or due to the impacts of chemicals or radiation to the DNA molecule

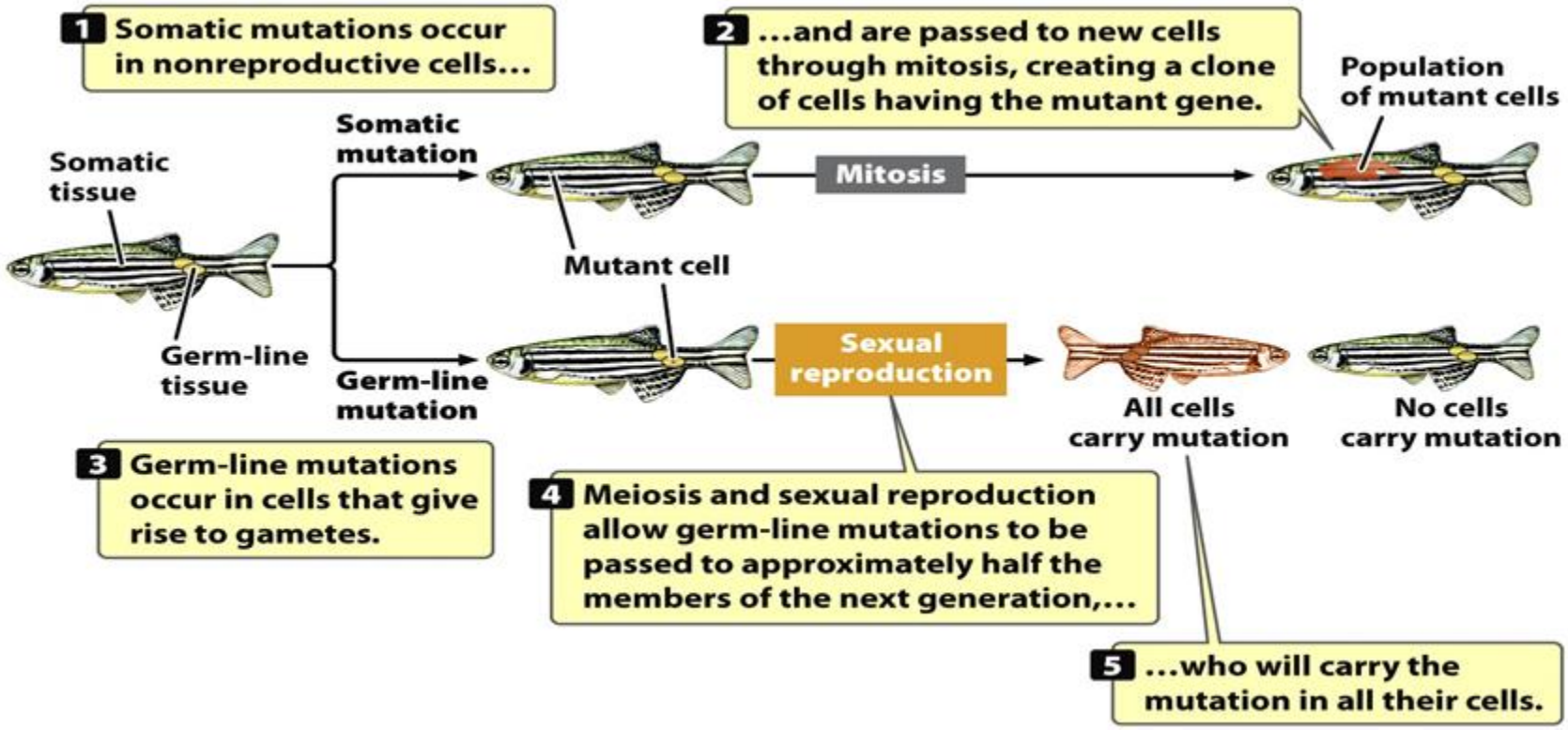
- Mutation may result in coding sequences for new amino acids in proteins or not!

Mutation is important for evolution

- If no changes to genomes occur over time, there would be no evolution
  - Too much change in the DNA is harmful
  - Too little does nothing
  - A balance exists between the amount of new variation and the overall health (adaptiveness) of the new variant individual
- Differences between closely related organisms show closely matched DNA sequences that diverged at some past time and that was adaptive for a given environment

Categories of Mutations

- Somatic mutations-occur in “body” of organism. Result in mosaic pattern of cells, but not passed down.
- Germ-line mutations-occur in cells producing gametes. Mutation is typically passed to half of offspring.



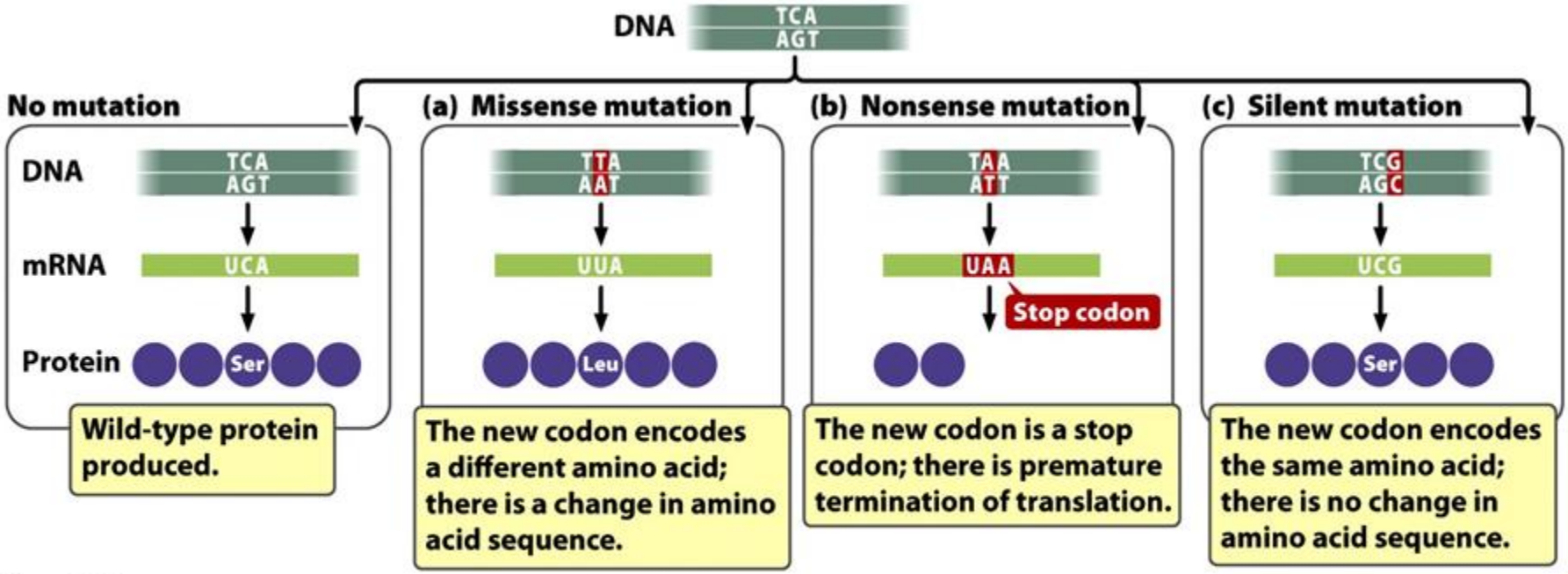
1. Point mutations affect single sites on DNA

- Substitution of 1 base for another
- Deletion/addition of a single base
- Deletion/addition of a small number of bases

  - **Transition substitution:** If purine (A/G) or pyrimidine (T/C) substitutes for itself
  - **Transversion substitution:** If purine substitutes for pyrimidine or vice versa

Results of point mutations

- **Silent mutations** = due to redundancy of the Genetic Code, most point mutations are silent – do not code for a different amino acid
- **Missense mutations** = produces change in amino acid in protein but does not change the function of the protein
- **Nonsense mutations** = produces a STOP codon in the midst of the mRNA transcript; can produce a non-functional protein



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2. Chromosomal mutations change the structure of whole chromosomes

- Chromosomal mutations are more extensive, altering the entire chromosomal structure
- These kinds of mutations occur through:

1. Deletions
2. Duplications
3. Inversions
4. Translocations

Deletion

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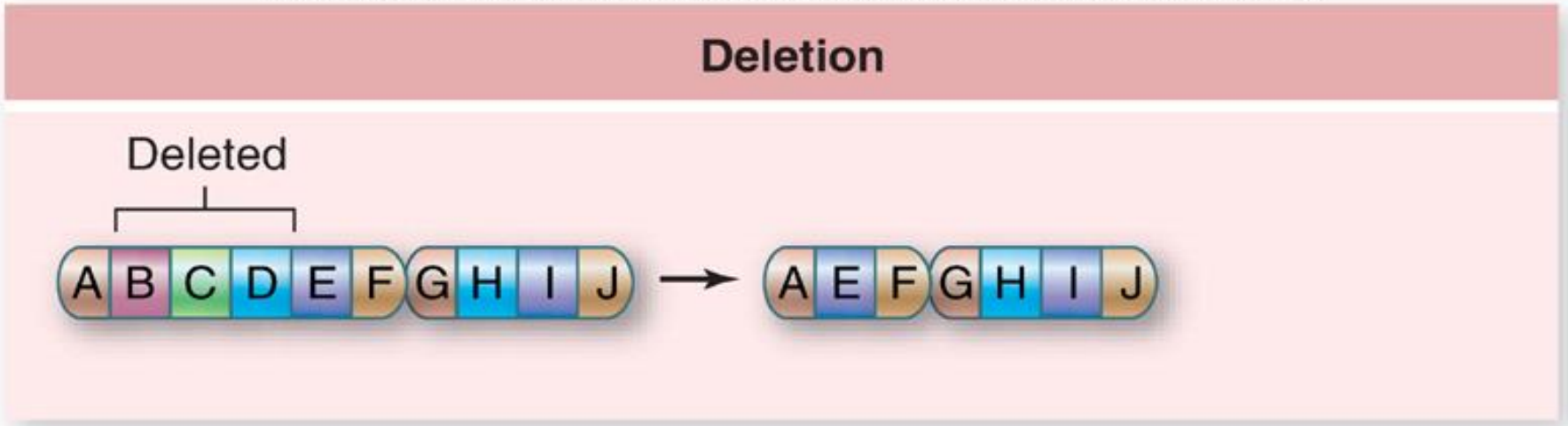

a.

If too much information is lost, it may be fatal to the organism and may result in early death (e.g., Cri-du-chat syndrome – large deletion from chromosome #5)

Duplications within chromosome

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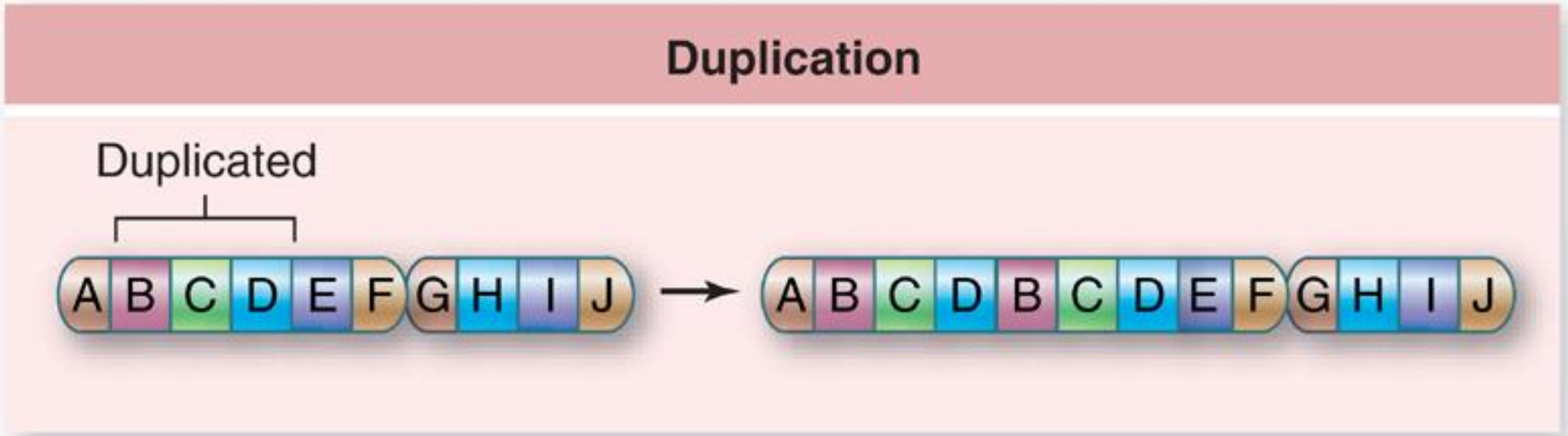

b.

Effect of base duplications depend on location within the chromosome – whether or not duplication resides in coding or non-coding region of DNA

Inversions within chromosome

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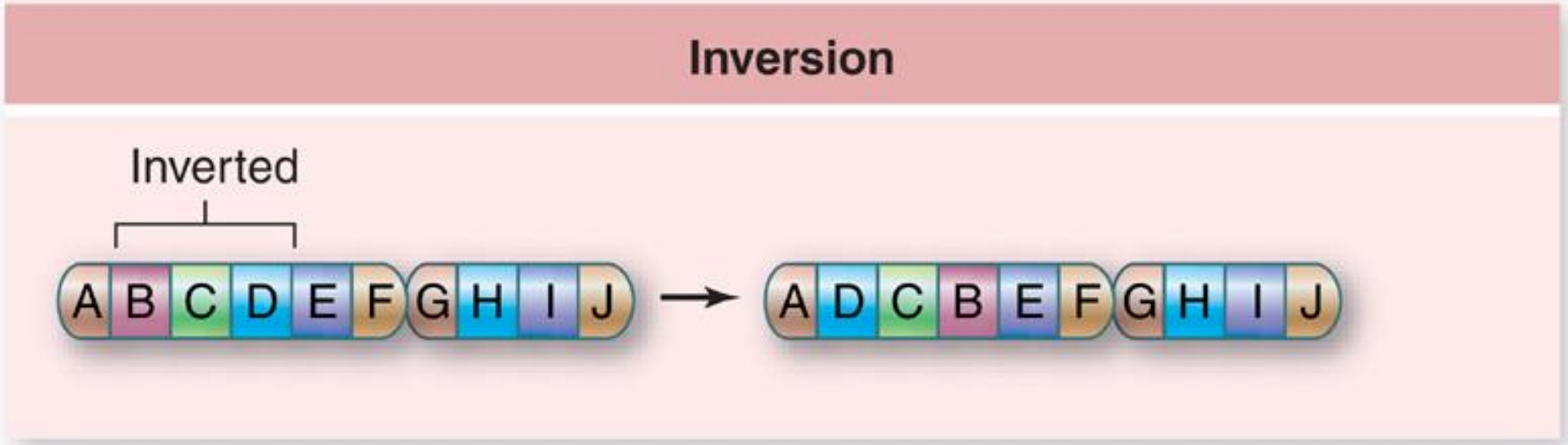

c.

Translocations within chromosome

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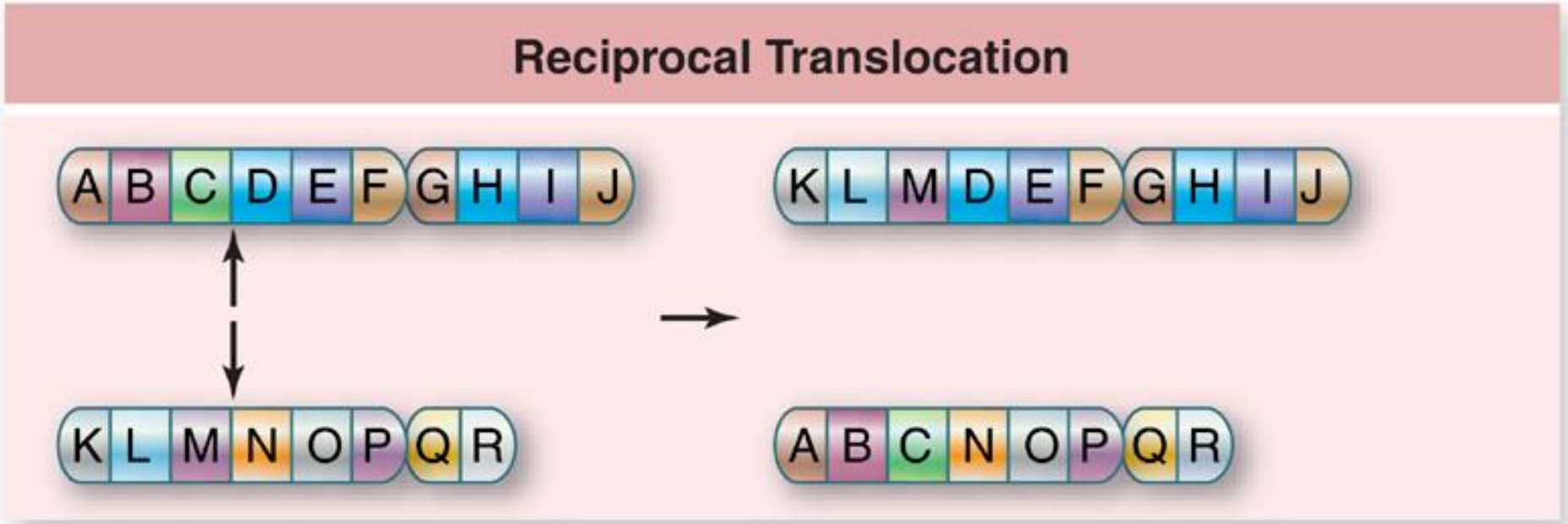


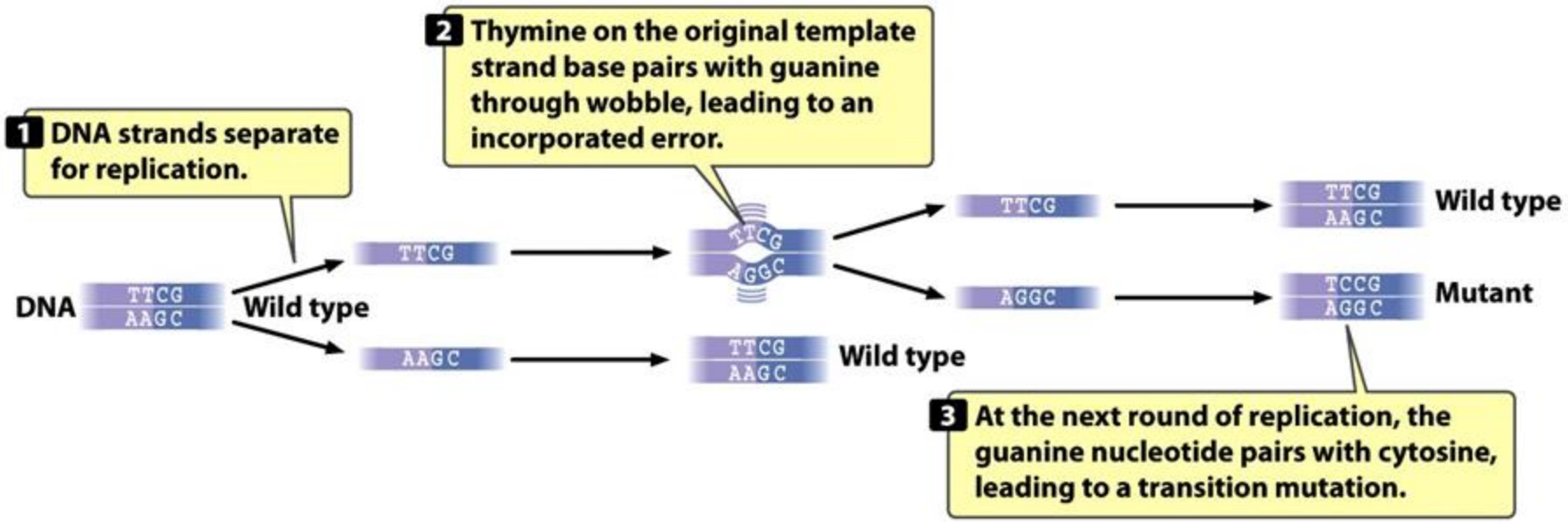
d.

Can be caused due to abnormal synapsis event at Meiosis I by incorrect chromosomes coming together.

Associated with 2 forms of leukemia – oncogenes translocated to incorrect regions within chromosomes of leukocytes (white blood cells)

Spontaneous Replication Errors

1. Caused by mispairing through wobble



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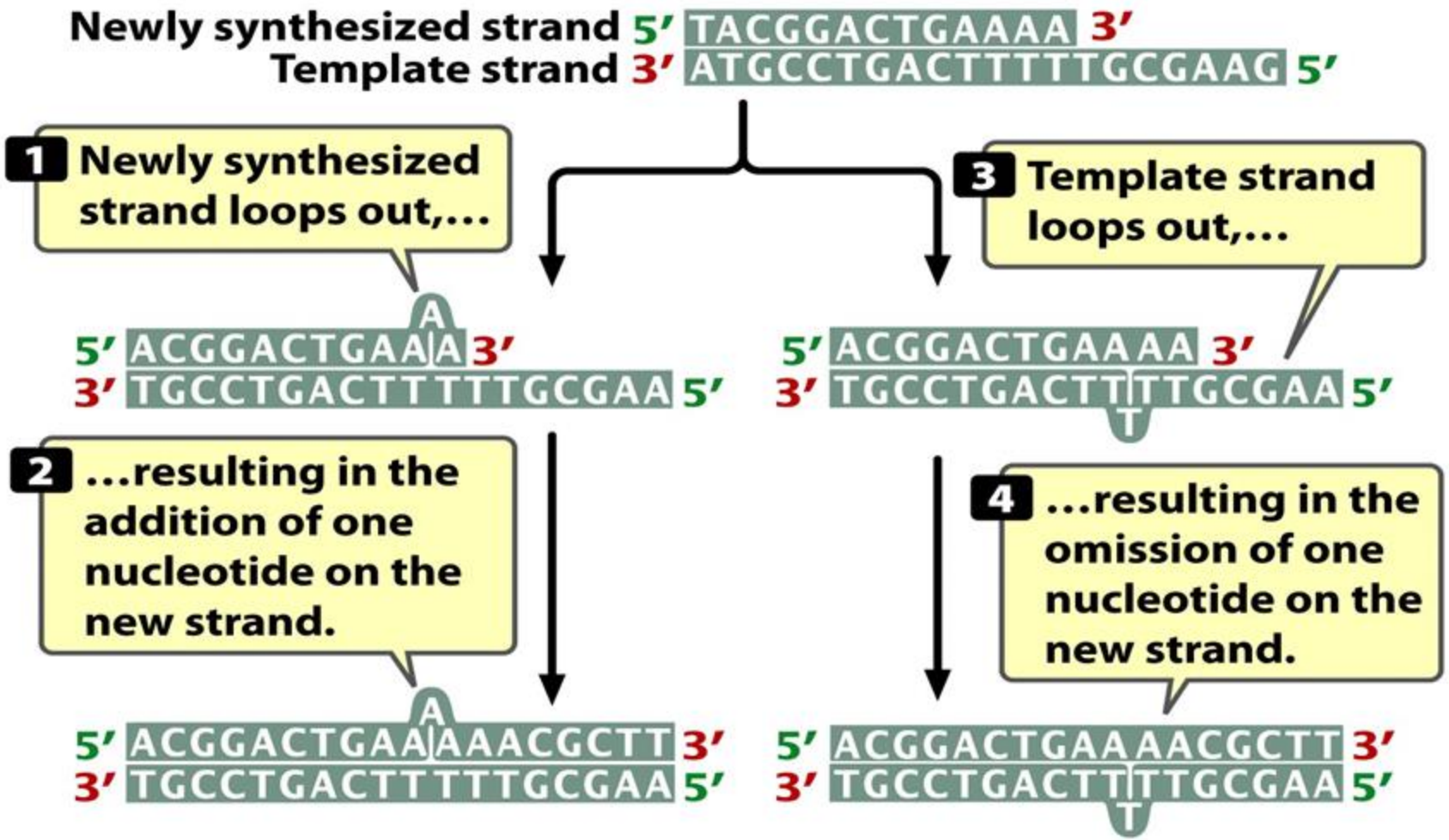
2. Insertions and deletions may result from strand slippage.



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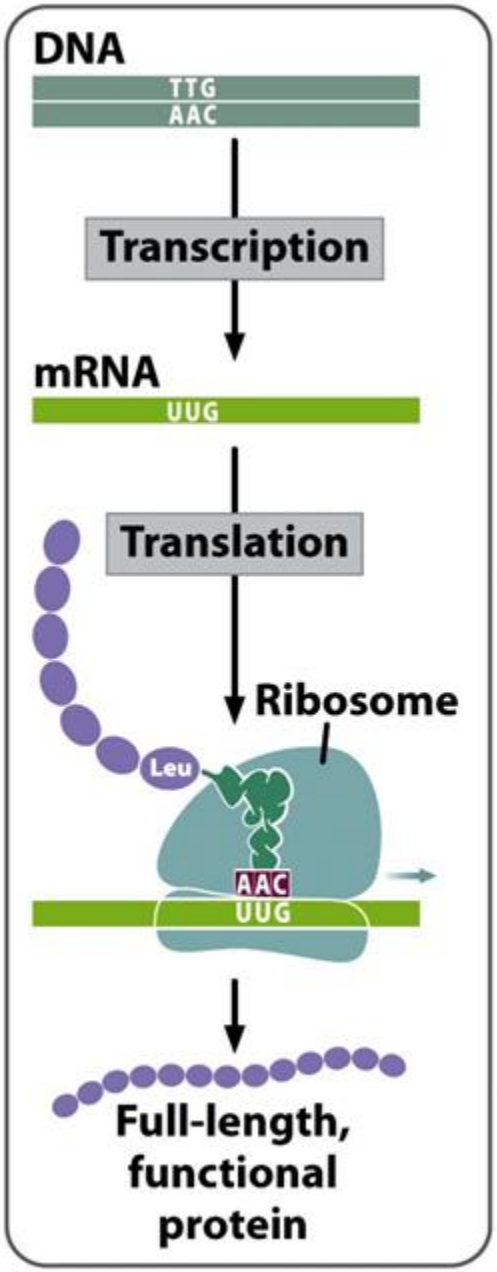
Phenotypic Effects of Mutations

- Lethal mutation-severe enough to cause premature death
- Suppressor mutation: a mutation that hides or suppresses the effect of another mutation
  - Intragenic-mutation in same gene as original mutation restores function
  - Intergenic-mutation in other gene restores function (sometimes in tRNA genes)



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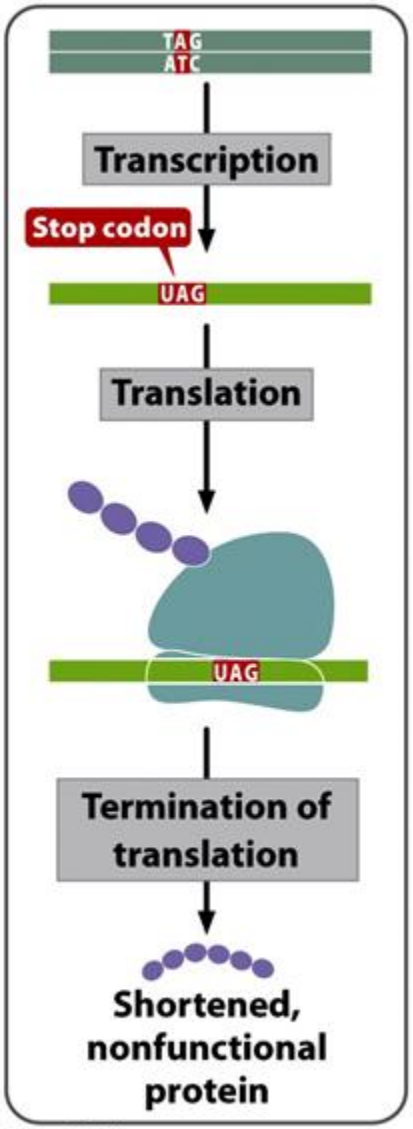
Wild-type sequence



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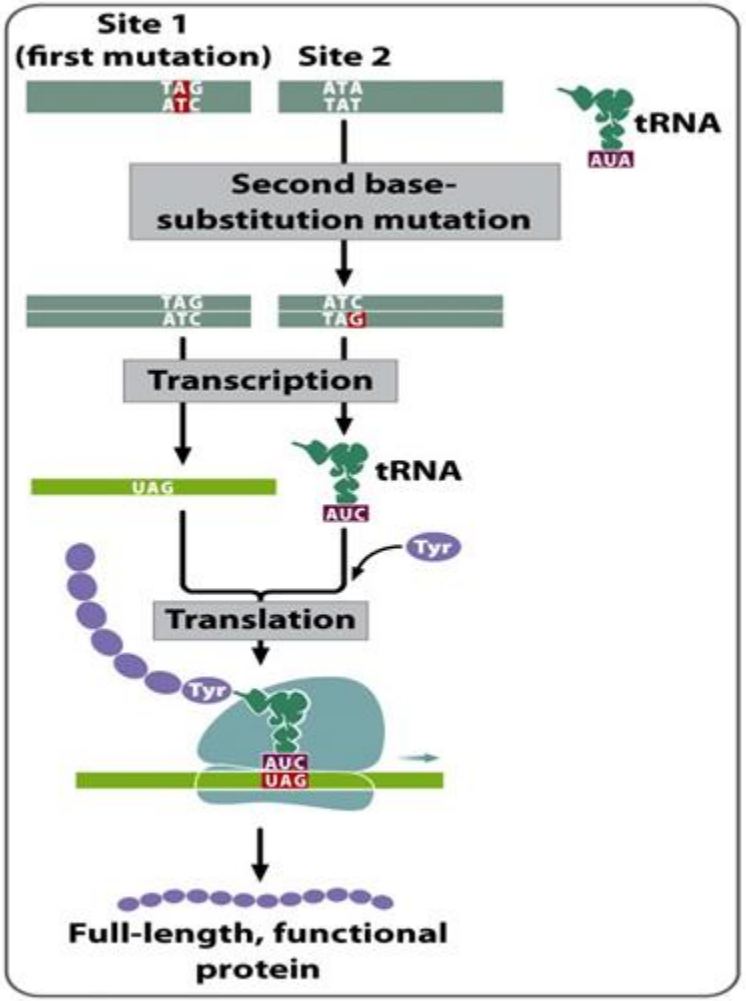
Base substitution

Base substitution at a second site



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