Genetics Engineering (Zoo-455)

Lecture-1

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Aims of the genetics engineering course

- To study the structure of DNA , and the process of gene expression.
- To understand the process of DNA cloning.
- To design the primer of the gene cloning using NCBI database.
- To understand the types and function of restriction enzymes.
- To understand the types of vectors using in DNA cloning.
- To create a recombinant DNA containing the gene of interest.
- To study the steps of PCR technique and gel electrophoresis.
- To study the human genome and the types of gene therapy.
- To study the genetically modified organisms.
- To study the regulation of genetic modification.

Time table for weekly planning for genetic engineering

Lectures	Syllabus view
1	Structure of DNA and gene expression
2	DNA cloning
3	Primer design
4	Restriction enzymes (types and functions)
5	Types of vectors using in DNA cloning
6	Creating of a recombinant DNA
7	PCR technique and gel electrophoresis
8	human genome and the types of gene therapy
9	Written Exam
10	The genetically modified organisms
11	the regulation of genetic modification

Assessment

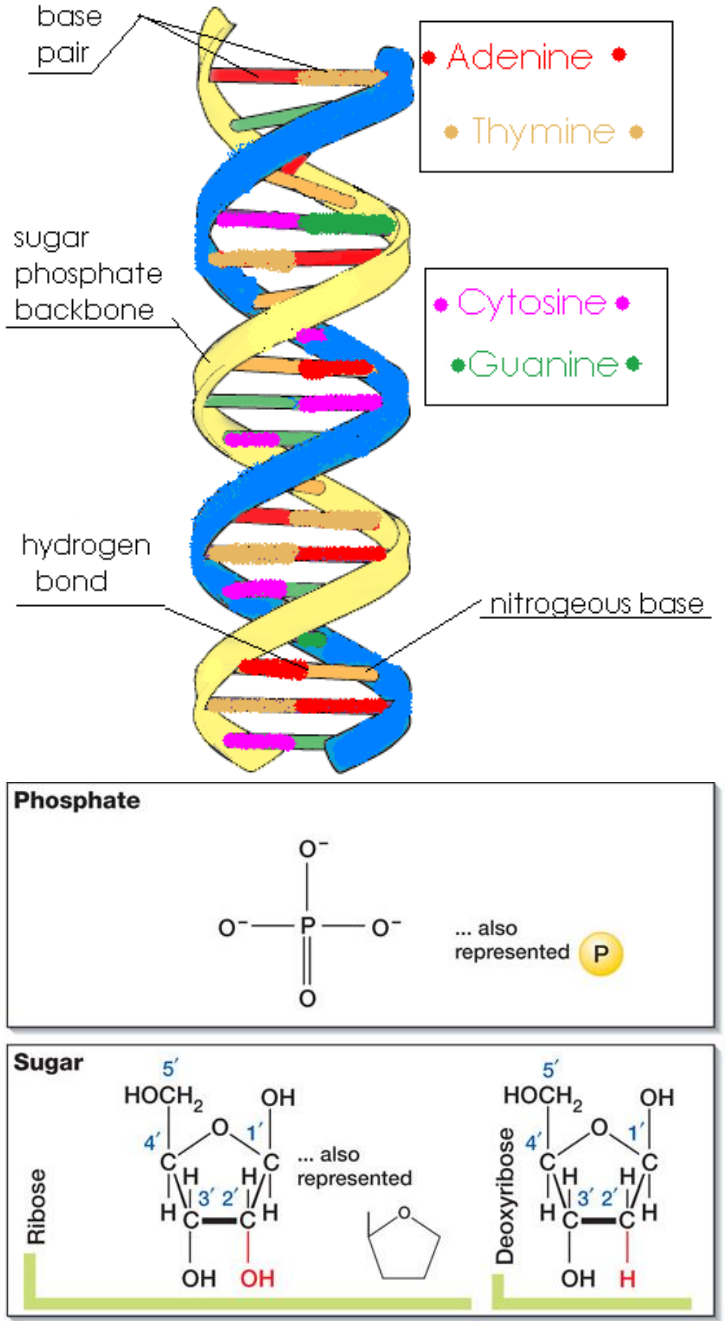
- Lecture
  - Monthly exam (20%)
  - Attendance, participation, and homework (10%)
  - Final exam (40%)
  - 70% of total grade

- Laboratory
  - 30% of total grade

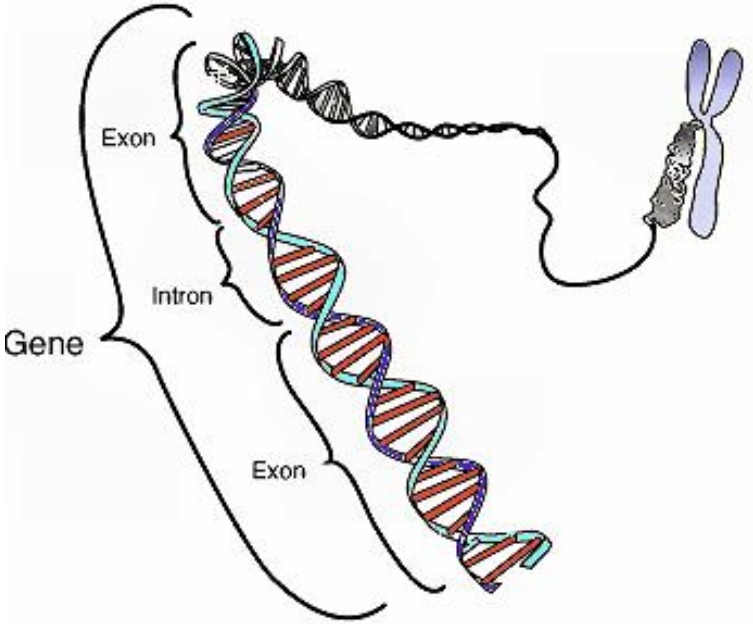
Introduction to Genetics Engineering

DNA= Deoxyribonucleic Acid

- DNA is a very large molecule, made up of smaller units called nucleotides
- Each nucleotide has three parts: a sugar (deoxyribose), a phosphate molecule, and a nitrogenous base.
- DNA polymerization only occurs in the 5′ to 3′ direction.
- The nitrogenous base is the part of the nucleotide that carries genetic information
- The bases found in DNA are four: adenine, cytosine, guanine, and thymine.
- Base-pairing is accomplished by hydrogen bonding between DNA BASE PAIR. Watson-Crick base-pairing dictates the base pairs in DNA are: A-T, C-G.



- A gene is a stretch of DNA that codes for a type of protein that has a function in the organism.
- It is a unit of heredity in a living organism. All living things depend on genes
- Genes hold the information to build and maintain an organism's cells and pass genetic traits to offspring.

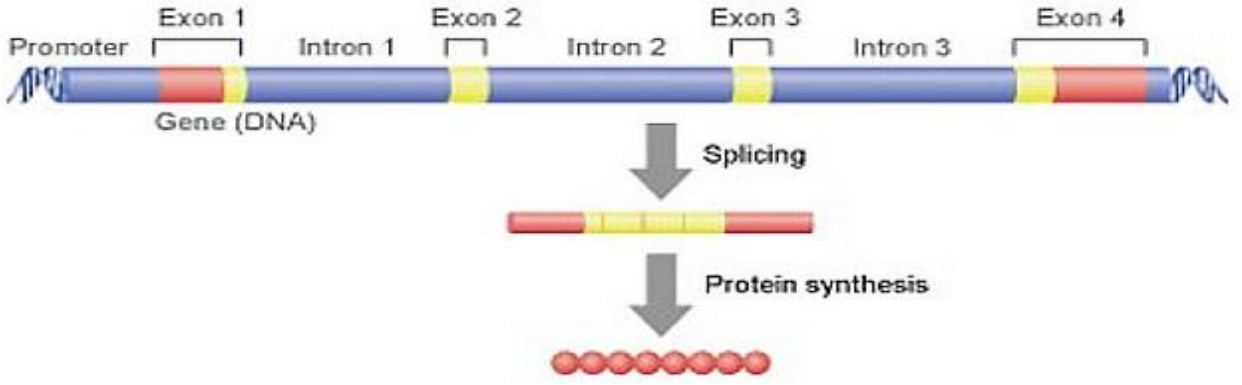


Genes contain:

EXONS: a set of coding regions.

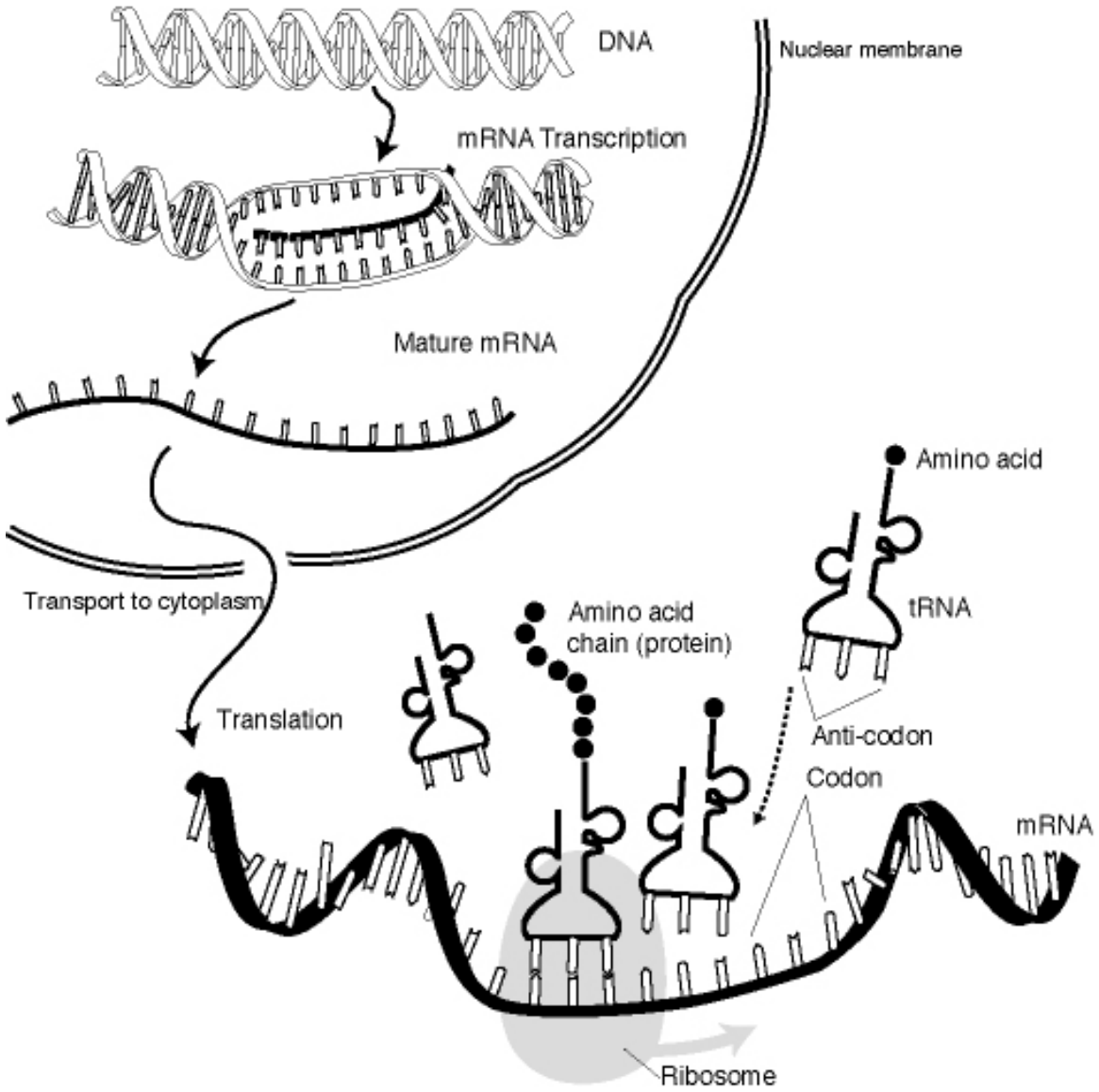
INTRONS: Non-coding regions removed sequence and are therefore labeled split genes (splicing).

Genome: The genetic complement of an organism, including all of its GENES, as represented in its DNA



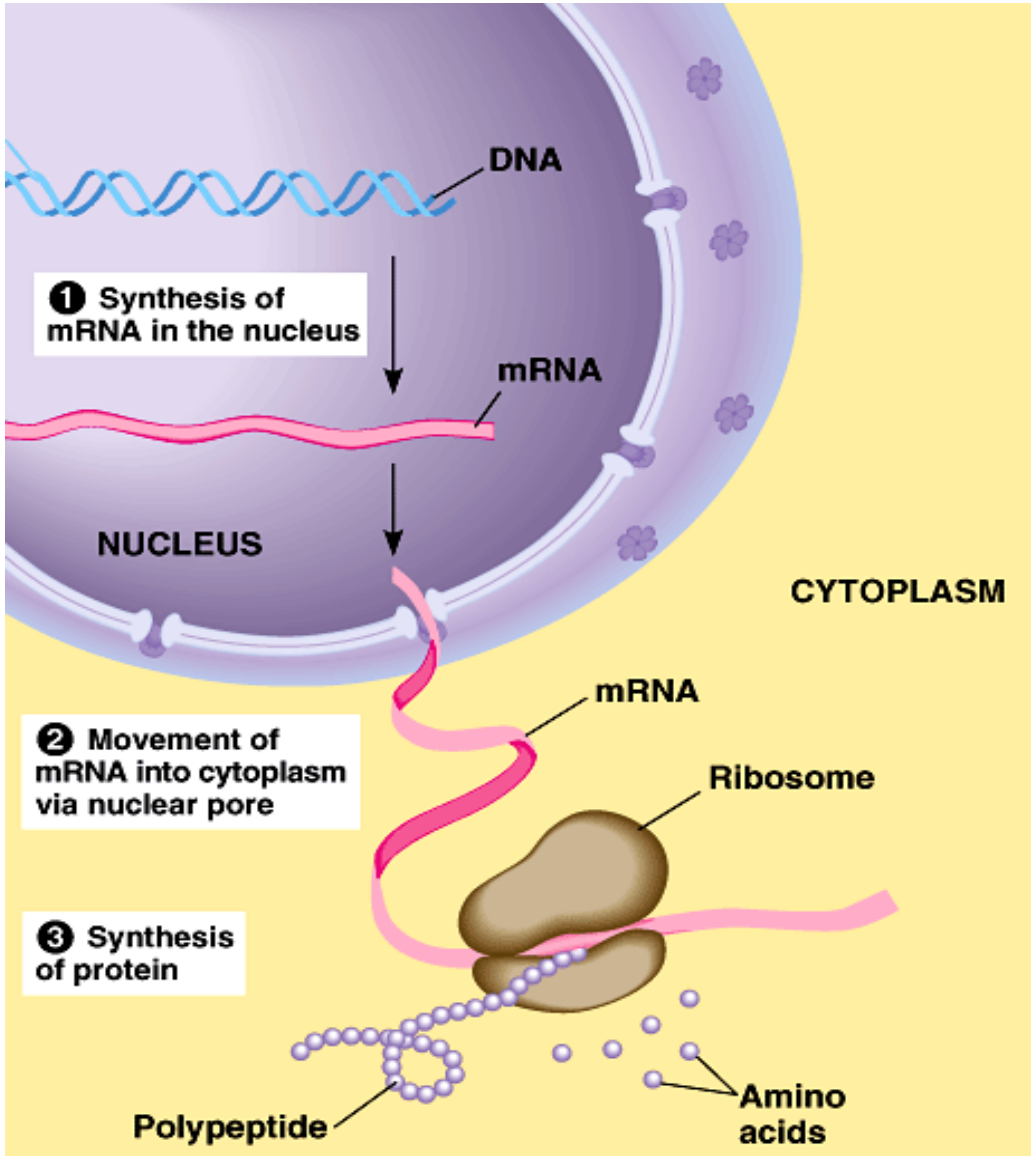
Gene Expression:

- Is the process by which information from a gene is used in the synthesis of a functional gene product (proteins)
- The process of gene expression is used by all known life - eukaryotes , prokaryotes , and viruses - to generate the macromolecular machinery for life.



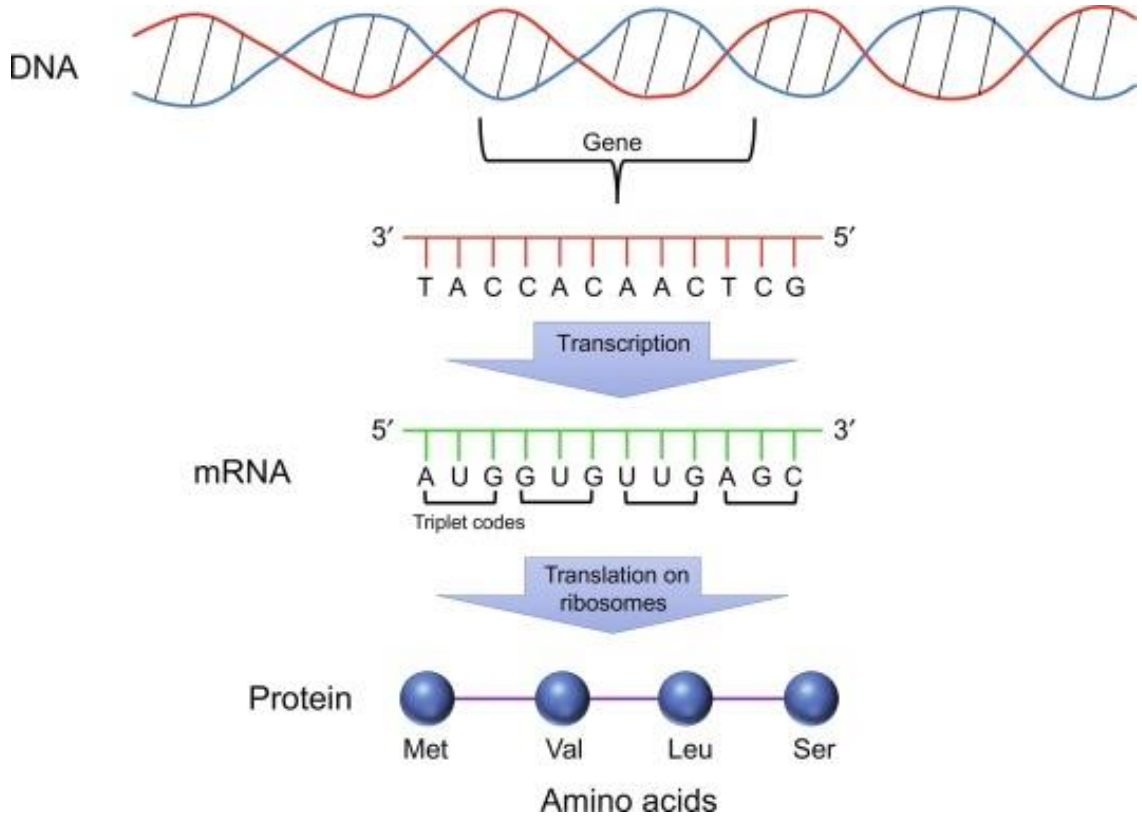
Steps of gene expression

- (1) Transcription (mRNA synthesis),
- (2) Post-transcriptional process (RNA splicing),
- (3) Translation (protein synthesis)
- (4) Post-translational modification of a protein.



The genetic code is universal…

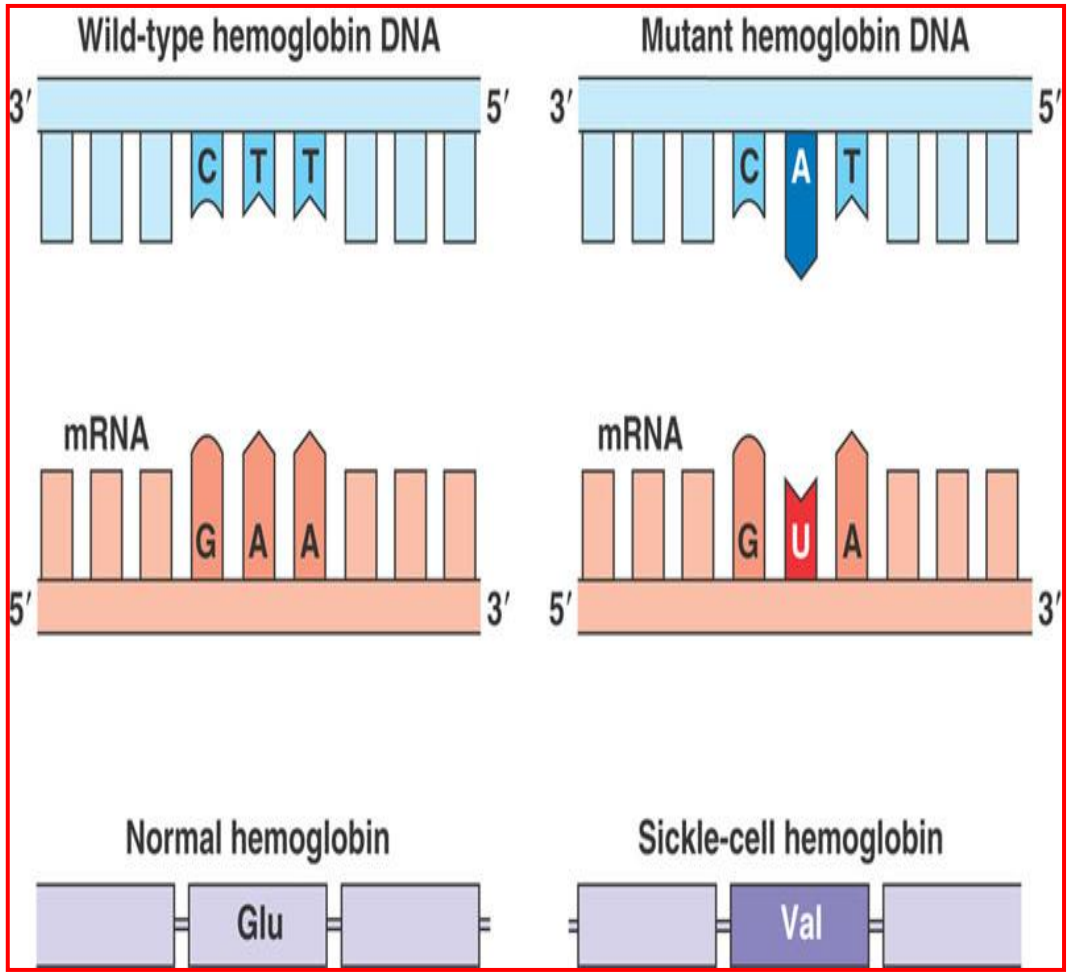
- All living organisms…
  - Use the same DNA
  - Use the same code
  - Read their genes in the same way



First base (5′ end)	Second base: U	Second base: C	Second base: A	Second base: G	Third base (3′ end)
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met or start	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

What is the difference between a mutation and a recombinant DNA?

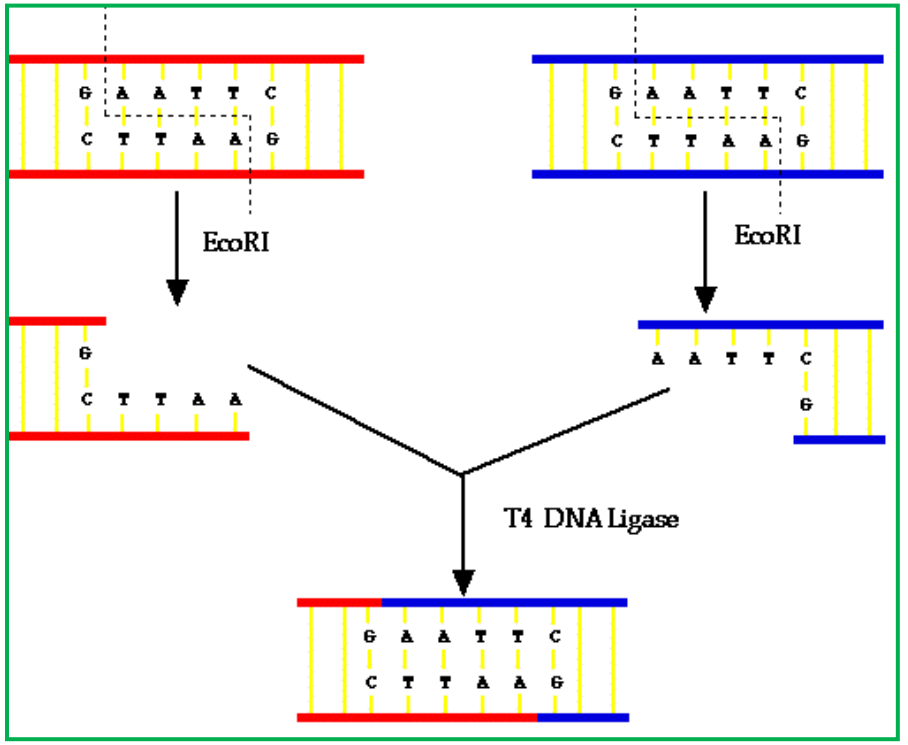
- A mutation: is a change in the nucleotide sequence of a short region of a genome.
- Many mutations are point mutations that replace one nucleotide with another; others involve **insertion** or **deletion** of one or a few nucleotides.
- Mutations result either from errors in DNA replication or viruses or from the damaging effects of mutagens, such as chemicals and radiation, which react with DNA and change the structures of individual nucleotides.



- Recombination: The exchange of corresponding DNA segments between adjacent chromosomes during the special type of cell division that results in the production of new genetic make up..

- In genetic engineering:
  - Recombination is the process of breaking and recombining segments of DNA from different organisms to create a recombinant DNA.
  - This recombination mechanism generates genetic variation at the gene level.
  - It represents species-specific variances in DNA sequences.

❖ Genetic engineering is also known as genetic modification, is the process of changing the DNA in an organism's genome.



https://www.youtube.com/watch?v=DIM38NlkWEo

Questions?