NCERT Solutions for Class 12 Biology Chapter 6 Molecular Basis of Inheritance

Q1. Group the following as nitrogenous bases and nucleosides:

Adenine, Cytidine, Thymine, Guanosine, Uracil and Cytosine.

Answer:

Nitrogenous bases- Adenine, thymine, uracil and cytosine

Nucleosides- Cytidine and guanosine

Q2. If a double stranded DNA has 20 per cent of cytosine, calculate the per cent of adenine in the DNA.

Answer:

By Chargaff's rule, we know that A=T and G=C. Since there are 20% cytosines, so guanines percentage will also be 20%. The G+C count is 20+20= 40%. Therefore, the remaining 60% will be contributed equally by adenine and thymine. Thus, the percentage of adenine and thymine are 30% each.

Q3. If the sequence of one strand of DNA is written as follows:
5'-ATGCATGCATGCATGCATGCATGCATGC-3'

Write down the sequence of complementary strand in $5' \rightarrow 3'$ direction.

Answer:

With regard to base pairs the DNA strand are complementary to each other. So, if the sequence of DNA is

5'-ATGCATGCATGCATGCATGCATGCATGC-3'

The sequence of the complementary strand will be

3`- TACGTACGTACGTACGTACGTACGTACG - 5`.

In 5' - 3' strand, it can be written as

5'- GCATGCATGCATGCATGCATGCATGCAT-3'

Q4. If the sequence of the coding strand in a transcription unit is written as follows:

5'-ATGCATGCATGCATGCATGCATGCATGC-3'

Write down the sequence of mRNA.

Answer:

The sequence of mRNA is the same as the coding strand of DNA except that thymine is replaced by uracil. Thus, the sequence of mRNA will be

5' - AUGCAUGCAUGCAUGCAUGCAUGCAUGC - 3'.

Q5. Which property of DNA double helix led Watson and Crick to hypothesise semi-conservative mode of DNAreplication? Explain.

Answer:

The property of DNA double helix which led Watson and Crick to hypothesise semi-conservative mode of DNA replication is that the two strands of DNA are antiparallel and complementary to each other in terms of their base sequences. This arrangement suggests that DNA replication is semiconservative. During replication, the two strands

unwind and each strand acts as a template for the synthesis of a new strand. At the end of replication, DNA of parental types and recombinant types are formed.

Q6. Depending upon the chemical nature of the template (DNA or RNA) and the nature of nucleic acids synthesised from it (DNA or RNA), list the types of nucleic acid polymerases.

Answer:

Depending upon the chemical nature of the template (DNA or RNA) and the nature of nucleic acids synthesised from it (DNA or RNA), two types of nucleic acid polymerases are found

1. DNA dependent DNA polymerase- It uses a DNA as a template to synthesise new strand of DNA.

2. DNA dependent RNA polymerase- It uses DNA as a template to synthesise RNA.

Q7. How did Hershey and Chase differentiate between DNA and protein in their experiment while proving that DNA is the genetic material?

Answer:

Alfred Hershey and Martha Chase (1952) worked with a virus that infects bacteria called bacteriophages. They used different radioactive isotopes to label DNA and protein. In their experiment, in one preparation, the protein part was made radioactive and in the other, nucleic acid (DNA) was made radioactive. These two phage preparations were allowed to infect the culture of*E.coli* . Soon after infection, before the lysis of cells, the *E.coli* cells were gently agitated in a blender, to loosen the adhering phage particles and the culture was centrifuged. The heavier infected bacterial cells pelleted to the bottom

and the lighter viral particles were present in the supernatant. It was found that when bacteriophage containing radioactive DNA was used to infect E.coli, the pellet contained radioactivity. If bacteriophage containing radioactive protein coat was used to infect E.coli, the supernatant contained most of the radioactivity. Their experiment showed that protein does not enter the bacterial cell while DNA gets transformed. Hence, they proved that DNA is the genetic material.

Q8. Differentiate between the followings:

(a) Repetitive DNA and Satellite DNA

Answer:

Repetitive DNA	Satellite DNA
Repetitive DNA refers to DNA sequences containing small segments that are repeated many times	DNA sequences containing highly repetitive DNA.

(b) mRNA and tRNA

Answer:

mRNA or messenger RNA	tRNA or transfer RNA

It acts as the template for the translation of proteins.	tRNA acts as the adapter molecule that carries specific amino acid to mRNA for the synthesis of a polypeptide.

(c) Template strand and Coding strand

Answer:

Template strand	Coding strand
It is the template for the synthesis of mRNA during transcription	Strand of DNA having the same sequence as mRNA (thymine in DNA is replaced by uracil in RNA
Its polarity is 3' to 5'	Its polarity is 5' to 3'

Q9. List two essential roles of ribosome during translation.

Answer:

The ribosome is a complex structure made up of ribonucleoproteins. It consists of two subunits i.e. a larger subunit and a smaller subunit. The essential roles of ribosomes during translation are as follows:

1. Ribosome acts as the site of protein synthesis. The larger subunit of ribosome act as an amino acid binding site while small subunit attaches to the mRNA.

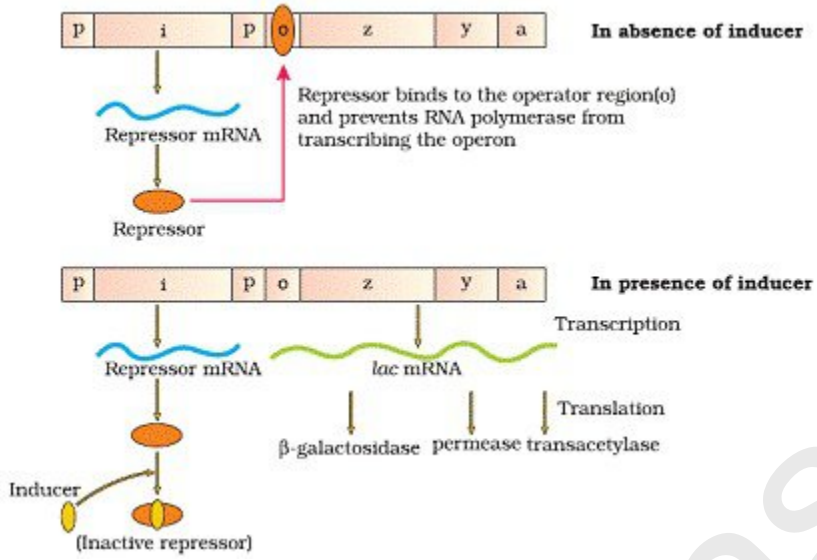
2. Ribosome acts as a catalyst for forming peptide bonds.

Q10. In the medium where E. coli was growing, lactose was added, which induced the lac operon. Then, why does lac operon shut down sometime after addition of lactose in the medium?

Answer:

Lac operon refers to a segment of DNA which consists of one regulatory gene (i) and three structural genes (y,z and a). Among the three structural genes, the z gene code for enzyme beta-galactosidase, that is responsible for the hydrolysis of the disaccharide lactose into its monomeric units, galactose and glucose. Gene y code for enzyme permease, which increases the permeability of the cell. The gene a encode for enzyme transacetylase. Lactose which is called the inducer is the substrate for enzyme beta-galactosidase and it regulates switching on and off of the operon. The regulatory gene, i code for the repressor of the lac operon. Lactose can bind to the repressor an inactivate it. When lactose is bound to the repressor, the RNA polymerase binds to the promoter of the lac operon. As a result of this, the transcription of three structural genes takes place and they form their respective enzymes. Further, these enzymes metabolize the lactose and lead to the formation of glucose and galactose. When the lactose metabolism is at its highest, the repressor protein is set free to bind with the operator gene. As a result of

this, the transcription of lac operon stops. Therefore, lac operon shut down sometime after addition of lactose in the medium.



Q11. Explain (in one or two lines) the function of the followings:

(a) Promoter

Answer:

Function of promoter

Promoter gene refers to the site where the RNA polymerase enzyme binds and transcription of mRNA starts.

(b) tRNA

Answer:

Function of tRNA

tRNA plays a major role in the process of protein synthesis. It reads the genetic code present on mRNA.

(c) Exo

Answer:

Exons are the coding sequences on DNA that transcribe into proteins.

Q12. Why is the Human Genome project called a mega project?

Answer:

Human Genome project is called a mega project because its specific goal is to sequence every base pair in the human genome. HGP took approximately 13 years to accomplish in 2006. The main aim of HGP was to develop new technology and generate new information in genomic studies. Because of this project, many new areas have opened in genetics. Thus HGP is a mega project.

Q13. What is DNA fingerprinting? Mention its application.

Answer:

DNA fingerprinting is a very easy and quick way to compare the DNA sequence of any two individuals. It includes identifying differences in some specific regions in DNA sequence called as repetitive DNA sequences. In these regions, a small stretch of DNA is repeated many times and they are specific for every individual. The technique of fingerprinting was initially developed by Alec Jeffrey.

Applications of DNA fingerprinting

1. It is used in forensic science in order to identify individuals.

2. It can be used to establish paternity or maternity related disputes.

3. DNA fingerprinting is used to establish evolutionary relationships between organisms.

Q14 . Briefly describe the following:

(a) Transcription

Answer:

Transcription- It refers to the process of copying genetic information from one strand of DNA into mRNA. In transcription, only one strand is copied into the RNA. While copying, the place of adenine is taken up by uracil. The transcription of DNA includes a transcription unit. The transcription unit is consists of a promoter, the structural gene and a terminator. The strands that have polarity 3'-5' act as a template and called template strand while the other strand is called coding strand. A schematic structure of a transcription unit is given below.

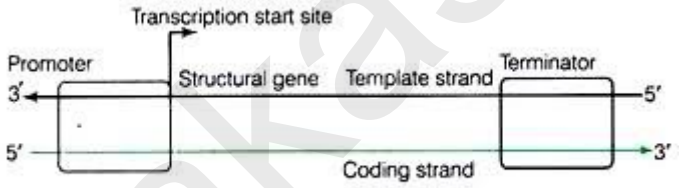


Fig. 6.9 Schematic structure of a transcription unit

The promoter is located at the 5' end and it binds the enzyme RNA polymerase to start transcription. Sigma factor also helps in initiation of the process of transcription.The terminator is located at 3'end of coding strand and usually defines the end of transcription where rho factor will bind to terminate transcription.

(b) Polymorphism

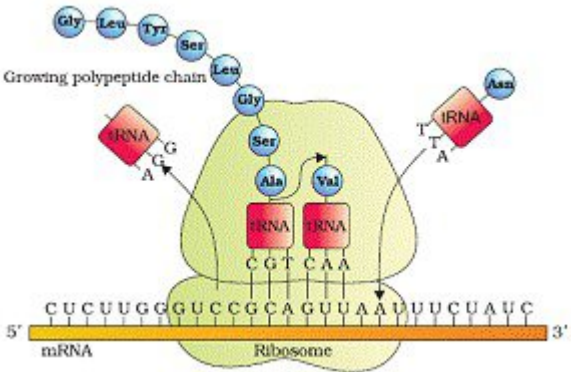
Answer:

Polymorphism- It refers to a special kind of genetic variation in which nucleotide sequence can exist at a particular site in a DNA molecule. This heritable mutation is caused due to a mutation in either somatic cell or in the germ cell. It ultimately results in the accumulation of various mutations at one site. Polymorphism brings revolution in the process of finding a location on the chromosome for disease-associated sequences and tracing human history.

14 . (c) Translation

Answer:

Translation- The process of polymerisation of amino acids into a polypeptide chain is referred to as translation. The order and sequence of amino acids in a polypeptide chain is dependent upon the base sequence of mRNA. Process of translation involves three steps i.e. initiation, elongation and termination. During the initiation, the ribosome binds to the mRNA at the start codon which is AUG. Ribosomes further move from codon to codon along the mRNA for elongation of the polypeptide chain. In the end, the release factors bind to the stop codon, leading to the termination of translation and release of the polypeptide from the ribosome.



(d) Bioinformatic

Answer:

Bioinformatics- It is a recent and very effective area in the field of biology. In this discipline, the knowledge from the DNA sequences is used for solving various doubt regarding organisms which can not be studied on them in real-time. Therefore, we can say that we utilize the biological information stored in the DNA of an organism.