Molecular Basis of Inheritance

EXERCISES [PAGES 92 - 93]

Exercises | Q 1.01 | Page 92

Multiple Choice Question:

Griffith worked on _____.

1. Bacteriophage
2. Drosophila
3. Frog eggs
4. **Streptococci**

Solution: Griffith worked on **Streptococci**.

Exercises | Q 1.02 | Page 92

Multiple Choice Question:

The molecular knives of DNA are _____.

1. Ligases
2. Polymerases
3. **Endonucleases**
4. Transcriptase

Solution: The molecular knives of DNA are **Endonucleases**.

Exercises | Q 1.03 | Page 92

Multiple Choice Question:

Translation occurs in the _____.

1. nucleus
2. **cytoplasm**
3. nucleolus
4. lysosomes

Solution: Translation occurs in the **cytoplasm**.

Exercises | Q 1.04 | Page 92

Multiple Choice Question:

The enzyme required for transcription is _____.

1. DNA polymerase
2. **RNA polymerase**
3. Restriction enzyme
4. RNAase

Solution: The enzyme required for transcription is **RNA polymerase**.

Exercises | Q 1.05 | Page 92

Multiple Choice Question:

Transcription is the transfer of genetic information from _____.

1. DNA to RNA
2. tRNA to mRNA
3. **DNA to mRNA**
4. mRNA to tRNA

Solution: Transcription is the transfer of genetic information from **DNA to mRNA**.

Exercises | Q 1.06 | Page 92

Multiple Choice Question:

Which of the following is NOT part of protein synthesis?

1. **Replication**
2. Translation
3. Transcription
4. All of these

Solution: Replication

Exercises | Q 1.07 | Page 92

Multiple Choice Question:

In the RNA molecule, which nitrogen base is found in place of thymine?

1. Guanine
2. Cytosine
3. Thymine
4. **Uracil**

Solution: Uracil

Exercises | Q 1.08 | Page 92

Multiple Choice Question:

How many codons are needed to specify three amino acids?

1. **3**
2. 6
3. 9
4. 12

Solution: 3

Exercises | Q 1.09 | Page 92

Multiple Choice Question:

Which out of the following is not an example of an inducible operon?

1. Lactose operon
2. Histidine operon
3. Arabinose operon
4. **Tryptophan operon**

Solution: Tryptophan operon

Exercises | Q 1.1 | Page 92

Multiple Choice Question:

Place the following event of translation in the correct sequence

i. Binding of met-tRNA to the start codon.

ii. Covalent bonding between two amino acids.

iii. Binding of second tRNA.

iv. Joining of small and large ribosome subunits.

1. iii, iv, i, ii
2. **i, iv, iii, ii**
3. iv, iii, ii, i
4. ii, iii, iv, i

Solution: i, iv, iii, ii

Exercises | Q 2.1 | Page 92

Very Short Answer Question:

What is the function of an RNA primer during DNA synthesis?

Solution: RNA primers provide the starting point for DNA polymerase to initiate synthesizing a new DNA strand.

Exercises | Q 2.2 | Page 92

Very Short Answer Question:

Why the genetic code is considered as commaless?

Solution: Genetic code is commaless: There is no gap or punctuation mark between successive/ consecutive codons.

Exercises | Q 2.3 | Page 92

Very Short Answer Question:

What is genome?

Solution:

The term genome refers to the total genetic constitution of an organism.

OR

It is a complete copy of genetic information (DNA) or one complete set of chromosomes (monoploid or haploid) of an organism.

Exercises | Q 2.4 | Page 92

Very Short Answer Question:

Which enzyme does remove supercoils from replicating DNA?

Solution: Super helix relaxing enzyme removes supercoils from replicating DNA.

Exercises | Q 2.5 | Page 92

Very Short Answer Question:

Why are Okazaki fragments formed on lagging strand only?

Solution:

1. The two strands in DNA are antiparallel i.e. one strand runs in 5’ → 3’ direction whereas the other runs in 3’ → 5’.
2. The DNA polymerase synthesizes a new DNA strand in 5’ → 3’ direction only.

3. Leading template is synthesized continuously and lagging template is synthesized discontinuously.
4. Due to 5’ → 3’ polymerizing activity of DNA polymerase Okazaki fragments are formed only on lagging strand only.

Exercises | Q 2.6 | Page 92

Very Short Answer Question:

When does DNA replication takes place?

Solution:

DNA replication occurs in the S-phase of the interphase of the cell cycle, prior to cell division.

Exercises | Q 2.7 | Page 92

Very Short Answer Question:

Define term- codon and codogen.

Solution: Codon:

A sequence of three adjacent nucleotides in mRNA that codes for one amino acid are known as a codon.

Codogen:

It is the smallest possible sequence (triplet) of nucleotides present on the DNA strand which can specify one particular amino acid.

Exercises | Q 2.8 | Page 92

Very Short Answer Question:

What is degeneracy of genetic code?

Solution:

Usually, the single amino acid is encoded by a single codon. However, some amino acids are encoded by more than one codon. e.g. Cysteine has two codons, while isoleucine has three codons. This is called the degeneracy of the code. Degeneracy of the code is explained by the Wobble hypothesis. Here, the first two bases in different codons are identical but the third one varies.

Exercises | Q 2.8 | Page 92

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Exercises | Q 2.9 | Page 92

Very Short Answer Question:

Which are the nucleosomal 'core' histones?

Solution:

The nucleosome core is made up of two molecules of each of four types of histone proteins viz. H2A, H2B, H3 and H4.

Exercises | Q 3.1 | Page 92

Short Answer Question:

Write a short note on DNA packaging in the eukaryotic cell.

Solution:

1. The organization of DNA is much more complex in eukaryotes.
2. Histone proteins are rich in lysine and arginine residues which are basic in nature and are positively charged.
3. These histones organize themselves to make a unit of 8 molecules known as histone octamer.
4. The negatively charged helical DNA is wrapped around the positively charged histone octamer, forming a structure known as a nucleosome.
5. The nucleosome core is made up of two molecules of each of four types of histone proteins viz. H2A, H2B, H3 and H4. H1 protein binds the DNA thread where it enters (arrives) and leaves the nucleosome.
6. One nucleosome approximately contains 200 base pair long DNA helix wound around it.
7. About 146 base pair long segment of DNA remains present in each nucleosome.
8. Nucleosomes are the repeating units of chromatin, which are threadlike, stained (coloured) bodies present in nucleus. These look like ‘beads-on-string’, when observed under an electron microscope.
9. DNA helix of 200 bp wraps around the histone octamer by 1¾ turns.

10. Six such nucleosomes get coiled and then form solenoid that looks like coiled telephone wire.
11. The chromatin is packed to form a solenoid structure of 30 nm diameter (300Å) and further supercoiling tends to form a looped structure called chromatin fiber, which further coils and condenses at the metaphase stage to form the chromosomes.
12. The packaging of chromatin at higher levels, needs an additional set of proteins that are called Non-Histone Chromosomal proteins (NHC).

Exercises | Q 3.2 | Page 92

Short Answer Question:

Enlist the characteristics of genetic code.

Solution:

Genetic code of DNA has certain following characteristics:

1. Genetic code is a triplet code:

The sequence of three consecutive bases constitutes a codon, which specifies one particular amino acid. The base sequence in a codon is always in 5' → 3' direction. In every living organism, genetic code is a triplet code.

2. Genetic code has distinct polarity:

Genetic code shows definite polarity i.e. direction. It is always read in 5' → 3' direction and not in 3' → 5' direction. Otherwise the message will change e.g. 5' AUG 3'

3. Genetic code is non-overlapping:

Code is non-overlapping i.e. each single base is a part of only one codon. Adjacent codons do not overlap.

4. Genetic code is commaless:

There is no gap or punctuation mark between successive/ consecutive codons.

5. Genetic code has degeneracy:

Usually, the single amino acid is encoded by a single codon. However, some amino acids are encoded by more than one codon. e.g. Cysteine has two codons, while isoleucine has three codons. This is called the degeneracy of the code. Degeneracy of the code is explained by the Wobble hypothesis. Here, the first two bases in different codons are identical but the third one varies.

6. Genetic code is universal:

In most of the living organisms, the specific codon specifies the same amino acid. e.g. Codon AUG always specifies amino acid methionine.

7. Genetic code is non-ambiguous:

The specific amino acid is encoded by a particular codon. Alternatively, two different amino acids will never be encoded by the same codon.

8. Initiation codon and termination codon:

AUG is always an initiation codon in any and every mRNA. AUG codes for amino acid methionine. Out of 64 codons, three codons viz. UAA, UAG, and UGA are termination codons that terminate/ stop the process of elongation of a polypeptide chain, as they do not code for any amino acid.

9. Codon and anticodon:

A codon is a part of DNA e.g. AUG is codon. It is always represented as 5' AUG 3'. Anticodon is a part of tRNA. It is always represented as 3'UAC 5'.

Exercises | Q 3.3 | Page 92

Short Answer Question:

Write a note on applications of DNA fingerprinting.

Solution:

1. In forensic science, DNA fingerprinting is used to solve problems of rape and some complicated murder cases.
2. DNA fingerprinting is used to find out the biological father or mother or both, of the child, in case of disputed parentage.
3. DNA fingerprinting is used in the pedigree analysis in cats, dogs, horses and humans.

Exercises | Q 3.4 | Page 92

Short Answer Question:

Explain the role of lactose in 'Lac Operon'.

Solution:

1. A few molecules of lactose enter into the cell by an enzyme permease.
2. A small amount of this enzyme is present even when the operon is switched off.
3. A few molecules of lactose, act as inducer and bind to the repressor.
4. This repressor – inducer complex fails to join with the operator gene, which is then turned on.
5. Structural genes produce all enzymes. Thus, lactose acts as an inducer of its own breakdown.
6. When the inducer level falls, the operator is blocked again by the repressor. So structural genes are repressed/inactivated again. This is negative feedback.

Exercises | Q 4.1 | Page 92

Short Answer Question:

Write a note on Human genome project (HGP).

Solution:

The human genome project was initiated in 1990 under the International administration of the Human Genome Organization (HUGO).
This project was coordinated by the US Department of Energy and the National Institute of health. Additional contributors included universities across the United States and international partners in the United Kingdom, France, Germany, Japan and China.
The Human Genome Project was completed in 2003.

Following are the main aims of the human genome project:

1. Mapping the entire human genome at the level of nucleotide sequences.

2. To store the information collected from the project in databases.

3. To develop tools and techniques for analysis of the data.

4. Transfer of the related technologies to the private sectors, such as industries.

5. Taking care of the legal, ethical and social issues which may arise from the project

Exercises | Q 4.2 | Page 93

Short Answer Question:

Describe the structure of ‘Operon’.

Solution:

The concept of the operon was first proposed by Jacob and Monod. A unit of genetic material that functions in a coordinated manner by means of a regulator, an operator, a promoter, and one or more structural genes that are transcribed together is called an operon. The clusters of genes with related functions are called operons.

Components of operon:

1. Regulator gene:

i. This gene controls the operator gene in cooperation with an inducer present in the cytoplasm.

ii. The regulator gene precedes the promoter gene. It may not be present immediately adjacent to the operator gene.

iii. The regulator gene produces a protein called repressor protein.

iv. The repressor binds with the operator gene and represses (stops) its action. Therefore, it is called regulator protein.

2. Promoter gene:

i. This gene precedes the operator gene. It is present adjacent to the operator gene.

ii. RNA polymerase enzyme binds to the promoter gene.

iii. The promoter gene base sequence determines which strand of DNA acts a template.

iv. When the operator gene is turned on, the enzyme moves over the operator gene and transcription of structural genes starts.

3. Operator gene:

i. This gene lies adjacent to the structural genes and controls their functioning.

ii. When the operator gene is turned on by an inducer, the structural genes produce mRNA.

iii. The operator gene is turned off by a product of the repressor gene.

4. Structural gene:

i. When lactose is added to the E. coli culture, the structural genes produce mRNA which in turn produces polypeptides, on the ribosomes.

ii. The polypeptides formed, act as enzymes to metabolize lactose in the cell.

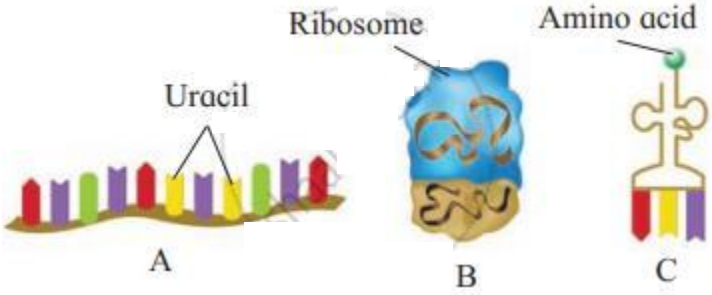
iii. There are 3 structural genes in the sequence lacZ, lacY and lacA.

iv. Enzymes produced by these genes are β-galactosidase, permease, and transacetylase respectively.

Exercises | Q 4.3 | Page 93

Short Answer Question:

In the figure below A, B and C are three types of _____.



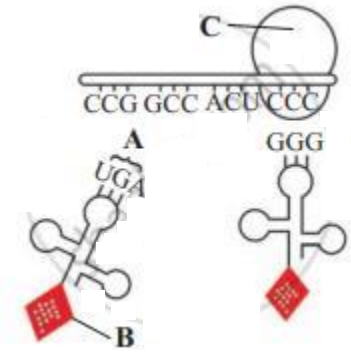
Solution:

In the given figure A (Messenger RNA), B (Ribosomal RNA) and C (Transfer RNA) are three types of **Ribonucleic acids (RNA)**.

Exercises | Q 4.4 | Page 93

Short Answer Question:

Identify the labeled structures on the following diagram of translation.



- Part A is the _____
- Part B is the _____
- Part A is the _____

Solution:

- Part A is the **Anticodon present on the anticodon loop of tRNA.**
- Part B is the **Amino acid**
- Part A is the **Large subunit of ribosome**

Exercises | Q 4.5 | Page 93

Short Answer Question:

Match the entries in column I with those of column II and choose the correct answer.

Column I	Column II
A. Alkali treatment	i. Separation of DNA fragments on gel slab
B. Southern blotting	ii. Split DNA fragments into single strands
C. Electrophoresis	iii. DNA transferred to nitrocellulose sheet
D. PCR	iv. X-ray photography
E. Autoradiography	v. Produce fragments of different sizes
F. DNA treated with REN	vi. DNA amplification

Solution:

Column I	Column II
A. Alkali treatment	ii. Split DNA fragments into single strands
B. Southern blotting	iii. DNA transferred to nitrocellulose sheet

C. Electrophoresis	i. Separation of DNA fragments on gel slab
D. PCR	vi. DNA amplification
E. Autoradiography	iv. X-ray photography
F. DNA treated with REN	v. Produce fragments of different sizes

Exercises | Q 5.1 | Page 93

Long Answer Question:

Explain the process of DNA replication.

Solution:

The process by which DNA duplicates to form identical copies is known as replication.

Semi-conservative method of replication:

1. After replication, each daughter DNA molecule has one old and other new strands.

2. As parental DNA is partly conserved in each daughter's DNA, the process of replication is called semi-conservative.

3. The model of semi-conservative replication was proposed by Watson and Crick.

4. The semi-conservative model of DNA replication using the heavy isotope of nitrogen N15 and E. coli was experimentally proved by Meselson and Stahl (1958).

Mechanism of replication is as follows:

a. Activation of Nucleotides:

i. The four types of nucleotides of DNA i.e. dAMP, dGMP, dCMP and dTMP are present in the nucleoplasm.

ii. They are activated by ATP in presence of an enzyme phosphorylase.

iii. This results in the formation of deoxyribonucleotide triphosphates i.e. dATP, dGTP, dCTP and dTTP. This process is known as Phosphorylation.

b. Point of Origin or Initiation point:

i. Replication begins at a specific point ‘O’ origin and terminates at point ‘T’.

ii. Origin is flanked by ‘T’ sites. The unit of DNA in which replication occurs is called replicon.

iii. In prokaryotes, there is only one replicon however in eukaryotes, there are several replicons in tandem.

iv. At the point ‘O’, enzyme endonuclease nicks one of the strands of DNA, temporarily.

v. The nick occurs in the sugar-phosphate backbone or the phosphodiester bond.

c. Unwinding of DNA molecule:

i. Enzyme DNA helicase breaks weak hydrogen bonds in the vicinity of ‘O’.

ii. The strands of DNA separate and unwind. This unwinding is bidirectional and continues as ‘Y’ shaped replication fork.

iii. Each separated strand acts as a template.

iv. The two separated strands are prevented from recoiling (rejoining) by SSBP (Single-strand binding proteins).

v. SSB proteins remain attached to both the separated strands for facilitating the synthesis of new polynucleotide strands.

d. Replicating fork:

i. The point formed due to the unwinding and separation of two strands appears like a Y-shaped fork, called replicating/ replication fork.

ii. The unwinding of strands imposes strain which is relieved by the super-helix relaxing enzyme.

e. Synthesis of new strands:

i. Each separated strand acts as a mould or template for the synthesis of a new complementary strand.

ii. It requires a small RNA molecule, called RNA primer.

iii. RNA primer attaches to the 3’ end of the template strand and attracts complementary nucleotides from the surrounding nucleoplasm.

iv. These nucleotides bind to the complementary nucleotides on the template strand by forming hydrogen bonds (i.e. A=T or T=A; G = C or C = G).

v. The newly bound consecutive nucleotides get interconnected by phosphodiester bonds, forming a polynucleotide strand.

vi. The synthesis of a new complementary strand is catalyzed by enzyme DNA polymerase. 7. The new complementary strand is always formed in 5'→ 3' direction.

f. Leading and Lagging strand:

i. The template strand with free 3' end is called a leading template and with free 5' end is called a lagging template.

ii. The process of replication always starts at the C-3 end of the template strand and proceeds towards C-5 end.

iii. As both the strands of the parental DNA are antiparallel, new strands are always formed in 5' → 3' direction.

iv. One of the newly synthesized strands which develop continuously towards the replicating fork is called the leading strand.

v. Another new strand develops discontinuously away from the replicating fork and is called the lagging strand.

vi. Maturation of Okazaki fragments: DNA synthesis on the lagging template takes place in the form of small fragments called as Okazaki fragments (named after scientist Okazaki).

vii. Okazaki fragments are joined by the enzyme DNA ligase.

viii. RNA primers are removed by DNA polymerase and replaced by DNA sequence with the help of DNA polymerase-I in prokaryotes and DNA polymerase-α in eukaryotes.

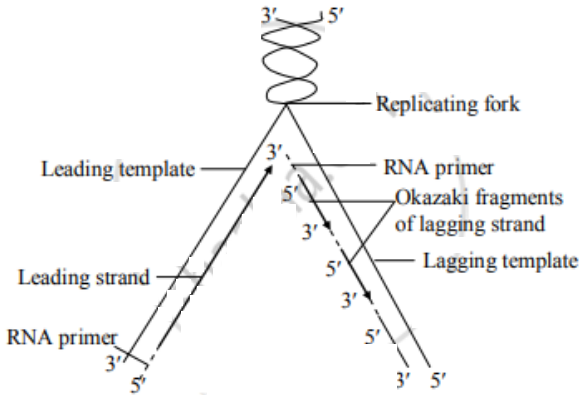
ix. Finally, DNA gyrase (topoisomerase) enzyme forms a double helix to form daughter DNA molecules.

g. Formation of daughter DNA molecules:

i. At the end of the replication, two daughter DNA molecules are formed.

ii. In each daughter's DNA, one strand is parental and the other one is totally newly synthesized.

iii. Thus, 50% is contributed by mother DNA. Hence, it is described as semiconservative replication.



Exercises | Q 5.2 | Page 93

Long Answer Question:

Describe the process of transcription in protein synthesis.

Solution:

The process of copying of genetic information from one (template) strand of DNA into a single-stranded RNA transcript is called transcription.

The process of transcription is as follows:

1. For transcription, promoter, structural gene, and terminator (together called transcription unit) are required.
2. The DNA strand used for the synthesis of RNA is called antisense or template strand which is oriented in 3' → 5' direction, while the other strand not involved in RNA synthesis is called the coding strand. It is oriented in 5' → 3' direction.
3. A small DNA sequence which provides a binding site for RNA polymerase is called promoter which is present towards 5' end/upstream, while a small DNA sequence which terminates the transcription process called terminator is present towards 3' end/downstream.
4. The process of transcription, in both prokaryotes and eukaryotes, involves three stages viz. Initiation, Elongation, and Termination.
5. During initiation, RNA polymerase binds to the promoter and moves along the DNA and causes local unwinding of DNA duplex into two chains in the region of the gene.
6. Exposed ATCG bases project into the nucleoplasm.
7. Only one strand functions as template (antisense strand) and the other strand is complementary which is actually a coding strand (sense strand).

8. During elongation, the ribonucleoside triphosphates join bases of the DNA template chain.
9. As transcription proceeds, the hybrid DNA-RNA molecule dissociates and makes mRNA molecules free.
10. As transcription proceeds, the hybrid DNA-RNA molecule dissociates and makes mRNA molecules free.

Exercises | Q 5.3 | Page 93

Long Answer Question:

Describe the process of translation in protein synthesis.

Solution:

Definition:

The translation is the mechanism in which codons of mRNA are translated and specific amino acids in a sequence form a polypeptide on ribosomes.

The process of translation requires amino acids, mRNA, tRNA, ribosomes, ATP, Mg++ ions, enzymes, elongation, translocation and release factors.

1. About 20 different types of amino acids available in the cytoplasm are known to form proteins.
2. DNA controls the synthesis of proteins having amino acids in a specific sequence. This control is possible through the transcription of mRNA. Genetic code is specific for particular amino acids.
3. RNAs serve as intermediate molecules between DNA and protein.
4. Ribosomes serve as a site for protein synthesis. Each ribosome consists of large and small subunits. These subunits occur separately in the cytoplasm. Only during protein synthesis, in presence of Mg++ ions, these two subunits get associated together.

Mechanism of translation (Synthesis of polypeptide chain):

It involves three steps initiation, elongation and termination:

a. Initiation:

1. Activation of amino acids is essential before translation initiates.

2. The amino acid is activated by utilizing energy from ATP molecule. This amino acid binds with the amino acid binding site of tRNA and forms of tRNA- amino acid complex.

3. A small subunit of ribosome attaches to the mRNA at 5’ end.

4. The initiator codon, AUG is present on mRNA which initiates the process of protein synthesis.

5. Initiator charged tRNA (with activated amino acid methionine) binds with the initiation codon (AUG) by its anticodon (UAC) through hydrogen bonds.

6. It carries activated amino acid methionine (in eukaryotes) or formyl methionine (in prokaryotes).

7. It occupies the P site of the ribosome and the A- the site is vacant.

8. Now the large subunit of ribosome joins with the smaller subunit that requires Mg^{++} ions.

b. Elongations:

During this process, activated amino acids are added one by one to first amino acid (methionine). Addition of Amino acid occurs in 3 Step cycle -

1. Codon recognition- Amino acyl tRNA molecule enters the ribosome at A-site. Anticodon binds with the codon by hydrogen bonds.

2. Amino acid on the first initiator tRNA at P-site and amino acid on tRNA at A-site join by peptide bond. Here enzyme Ribozyme acts as a catalyst. At this time first tRNA at 'P' site is kicked off.

3. **Translocation-**
The tRNA at A-site carrying a dipeptide at A-site moves to the P site. This process is called translocation. In translocation, both the subunits of ribosome move along in relation to tRNA and mRNA. Hence, tRNA carrying dipeptide now gets positioned at 'P' site of the ribosome, making 'A' site vacant. At this site, then next charged tRNA molecule carrying amino acid will be received. During this process, the first uncharged tRNA is discharged from E-site. This process of arrival of tRNA- amino acid complex, the formation of the peptide bond, ribosomal translocation, and removal of the previous tRNA, are repeated.

c. Termination and release of polypeptide:

1. Towards the 3' end of mRNA, there is a stop codon (UAA/ UAG/ UGA). It is exposed at the A-site.

2. It is not read and joined by the anticodon of any tRNA.

3. The release factor binds to the stop codon, thereby terminating the translation process.

4. The polypeptide is now released in the cytoplasm.

5. Two subunits of ribosome dissociate and last tRNA is set free in the cytoplasm.

6. mRNA also has some additional sequences that are not translated and are referred as untranslated regions (UTR).

7. The UTRs are present at both 5'-end (before start codon) and at 3'- end (after stop codon). They are required for an efficient translation process.

8. Finally, mRNA is also released in the cytoplasm. It gets denatured by nucleases immediately. Hence mRNA is short-lived.

Exercises | Q 5.4 | Page 93

Long Answer Question:

Describe the ‘Lac-operon’.

Solution:

1. Lactose or lac operon of E. coli is an inducible operon. The operon is switched on when a chemical inducer- lactose is present in the medium.

2. Jacob and Monad proposed the classical model of Lac operon.

3. The Lac operon consists of the promoter site (P), regulatory site (i), and operator site (O).

4. It also has three structural genes, namely z, y and each producing an enzyme.

5. The following three enzymes are required for the metabolism of lactose in the cell.

Name of gene	Enzyme produced	Function
lac z	β-galactosidase	βLactose→β-galactosidaseGlucose+Galactose
lac y	Permease	Entry of lactose in the cell
lac a	Transacetylase	Transfers acetyl group from Acetyl CoA to β-galactosidase

6. If glucose is not available for cells, they will require another source of energy such as lactose.

7. If lactose is not available, the repressor protein produced by repressor gene will attach to the operator and block RNA polymerase.

8. Lactose acts as an inducer. If lactose is available, it will prevent the repressor from binding the operator, by forming an inducer-repressor complex and allow RNA polymerase to transcribe mRNA.

9. RNA polymerase will attach to the promoter and will begin transcribing mRNA.

10. RNA polymerase first transcribes the lac z gene which is responsible for synthesizing β-galactosidase.

11. RNA polymerase moves on to the next gene, lac y that synthesizes the enzyme permease.

12. RNA polymerase finally moves to the lac a gene that is responsible for synthesizing transacetylase.

13. β-galactosidase, permease and transacetylase are enzymes in the metabolic pathway used to get energy from lactose.

14. After lactose is used up and levels decrease, the repressor will attach to the operator blocking the production of β-galactosidase, permease and transacetylase, so that lactose levels increase.

Exercises | Q 5.5 | Page 93

Long Answer Question:

Justify the statement. If the answer is false, change the underlined word(s) to make the statement true

The DNA molecule is double-stranded and the RNA molecule is single-stranded.

1. **True**
2. False

Solution:

True.

1. The DNA is responsible for storing genetic information and also preserving it for the next generation of cells. Thus, it needs to be stable and resistant to enzymatic or oxidative alteration.
2. The double-stranded DNA molecule is so designed that the part which stores the genetic information; the nitrogenous base pairs are stacked inward.
3. Phosphate groups (PO4-) keep the base pairs safe inside form the backbone. DNA is further wrapped up around histone proteins into chromosomes which keep it condensed. This would not be possible if it were only single-stranded.
4. RNA is not meant to last long and acts as a template carrying information which is copied from the DNA. Using protein-synthesizing machinery, it forms a protein. After which is disintegrates and digested.

Exercises | Q 5.5 | Page 93

Long Answer Question:

Justify the statement. If the answer is false, change the underlined word(s) to make the statement true

The process of translation occurs at the ribosome.

1. **True**
2. False

Solution:

True.

Ribosomes are sites for protein synthesis. Ribosome is responsible for holding mRNA incorrect position. Therefore, the process of translation occurs at the ribosomes.

Exercises | Q 5.5 | Page 93

Long Answer Question:

Justify the statement. If the answer is false, change the underlined word(s) to make the statement true

The job of mRNA is to pick up amino acids and transport them to the ribosomes.

1. True
2. **False**

Solution:

False.

The job of tRNA is to pick up amino acids and transport them to the ribosomes. mRNA carries message in the form of code from DNA.

Exercises | Q 5.5 | Page 93

Long Answer Question:

Justify the statement. If the answer is false, change the underlined word(s) to make the statement true

Transcription must occur before translation may occur.

1. **True**
2. False

Solution:

True.

Transcription is a process of formation of mRNA whereas translation is process of protein synthesis. For protein synthesis mRNA is required to act as a template. Therefore, transcription must occur before translation may occur.

Exercises | Q 5.6 | Page 93

Long Answer Question:

Guess (i) the possible location of DNA on the collected evidence from a crime scene and (ii) the possible sources of DNA.

Evidence	Possible location of DNA on the evidence	Sources of DNA
e.g. Eyeglasses	e.g. Ear pieces	e.g. Sweat, Skin
Bottle, Can, Glass	Sides, mouthpiece	_____
_____	Handle	Sweat, skin, blood
Used cigarette	Cigarette butt	_____
Bite mark	_____	Saliva
_____	Surface area	Hair, semen, sweet, urine

Solution:

Evidence	Possible location of DNA on the evidence	Sources of DNA
e.g. Eyeglasses	e.g. Ear pieces	e.g. Sweat, Skin
Bottle, Can, Glass	Sides, mouthpiece	**Saliva, sweat**
Door, baseball bat, a similar weapon	Handle	Sweat, skin, blood
Used cigarette	Cigarette butt	**Saliva**
Bite mark	**Persons skin or clothing**	Saliva
Blanket, pillow, bedsheet, dirty laundry	Surface area	Hair, semen, sweat, urine