
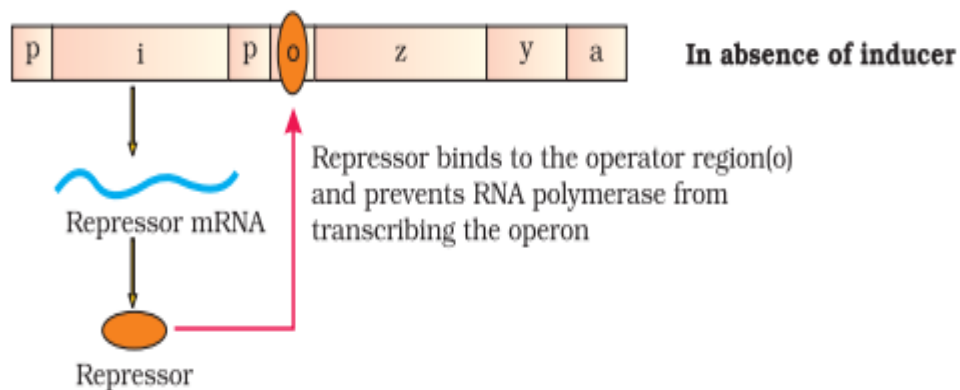
	INDIAN SCHOOL AL WADI AL KABIR		
Class: XII	Department: SCIENCE 2023 -2024	Date of submission: Second week of August	
	SUBJECT: BIOLOGY		
Worksheet no.5	CHAPTER: MOLECULAR BASIS OF INHERITANCE	Note: A4 FILE FORMAT	
NAME OF THE STUDENT		CLASS & SEC:	ROLL NO.

CASE STUDY-Lac Operon

The diagram given below illustrates the Lac operon, answer the questions in relation to it.



1. The inducer in the figure is

- Beta-galactosidase
- Permease
- Lactose
- Glucose

2. Identify the incorrect statement about the lac operon

- i gene codes for the activator of the lac operon.
- The z gene codes for beta-galactosidase (β -gal)
- The y gene codes for permease.
- The a gene encodes a transacetylase

3. The RNA polymerase binds to the----- in the presence of the inducer

- Operator

- b) Structural genes
- c) Promoter
- d) i gene

4.Assertion: All the three gene products in lac operon are required for metabolism of lactose

Reason: The genes present in the operon are needed together to function in the same or related metabolic pathway

- a. Both assertion and reason are true, and reason is the correct explanation of assertion.
- b. Both assertion and reason are true, but reason is not the correct explanation of assertion.
- c. Assertion is true but reason is false.
- d. Both assertion and reason are false.

5. The elucidation of the lac operon was also a result of a close association between a geneticist

- a) Francois Jacob and Jacque Monod
- b) Watson and Crick
- c) Marshall Nirenberg's
- d) Frederick Griffith

Assertion and Reasoning (Objective type 1-mark question)

1.Assertion: A codon is unambiguous

Reason: Some amino acids are coded by more than one codon

- a. Both assertion and reason are true, and reason is the correct explanation of assertion.
- b. Both assertion and reason are true, but reason is not the correct explanation of assertion.
- c. Assertion is true but reason is false.
- d. Both assertion and reason are false.

2. Assertion: Amino acids are added one by one and translated into a polypeptide.

Reason: The ribosome moves from codon to codon along the mRNA

- a. Both assertion and reason are true, and the reason is the correct explanation of the assertion.
- b. Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
- c. Assertion is true but reason is false.
- d. Both assertion and reason are false

3.

Assertion: Replication and transcription occur in the nucleus but translation occurs in the cytoplasm.

Reason: mRNA is transferred from the nucleus into the cytoplasm where ribosomes and amino acids are available for protein synthesis.

- a. Both Assertion and Reason are true
- b. Both Assertion and Reason are true
- c. Assertion is true, but Reason is false
- d. Both Assertion and Reason are false

MCQs 1-mark question

1. The DNA of a certain organism has cytosine as 20% of its bases. What percentage of its bases would be thymine?

- a) 80%
- b) 30%
- c) 20%
- d) 10%

2. Pyrimidines in DNA are:

- a) Adenine and guanine
- b) Cytosine and thymine
- c) Adenine and thymine
- d) Thymine and uracil

3. Each new amino acid is added to a growing protein by

- a) an ionic bond
- b) an RNA bond
- c) a peptide bond
- d) a hydrogen bond

4. In a DNA strand the two nucleotides are linked together by:

- a. glycosidic bonds
- b. phosphodiester bonds
- c. peptide bonds
- d. hydrogen bonds

5. A nucleoside differs from a nucleotide. It lacks the:

- a. base
- b. sugar
- c. phosphate group
- d. hydroxyl group

6. Both deoxyribose and ribose belong to a class of sugars called:

- a. trioses
- b. hexoses
- c. pentoses
- d. polysaccharides

7.The fact that a purine base always paired through hydrogen bonds with a pyrimidine base leads to, in the DNA double helix:

- a. the antiparallel nature
- b. the semiconservative nature
- c. uniform width throughout DNA
- d. uniform length in all DNA

8.The net electric charge on DNA and histones is:

- a. both positive
- b. both negative
- c. negative and positive, respectively
- d. zero

9.The promoter site and the terminator site for transcription are located at:

- a. 3' (downstream) end and 5' (upstream) end, respectively of the transcription unit
- b. 5' (upstream) end and 3' (downstream) end, respectively of the transcription unit
- c. the 5' (upstream) end
- d. the 3' (downstream) end

10.Which of the following statements is the most appropriate for sickle cell anaemia?

- a. It cannot be treated with iron supplements
- b. It is a molecular disease
- c. It confers resistance to acquiring malaria
- d. All of the above

2 Marks questions

1. Differentiate between introns and exons.
2. Explain the dual function of AUG codon. Give the sequence of bases it is transcribed from and its anticodon.
3. Write any four salient features of genetic code?
4. Explain how DNA is packed in Prokaryotes.
5. With the help of a flow chart illustrate the components of DNA.
6. If the length of E. coli DNA is 1.36 mm, calculate the number of base pairs in E. coli?

3 Marks questions

1. List 3 differences in structure in RNA, compared to the structure of DNA.

1.	
2.	
3.	

2. Fill in the following table:

DNA									
mRNA	G	G	U	G	U	A	A	U	U
anticodon									
amino acid									

3. Explain briefly the structure of ribosomes.

4. (a) In human genome which one of the chromosomes has the most genes and which one has

the fewest?

(b) Scientists have identified about 1.4 million single nucleotide polymorphs in human genome. How is the information of their existence going to help the scientists?

5. RNA splicing is an important step in the process of transcription in eukaryotes. What is the role of this process?

6. During the process of DNA replication, synthesis in one strand is continuous while in other strand is discontinuous. How the second strand become continuous?

7. With the help of a labelled diagram explain the structure of nucleosome.

5 Marks questions

1. Draw a labelled schematic sketch of replication fork of DNA. Explain the role of the enzymes involved in DNA replication.

2. (a) Draw a schematic representation of the structure of a transcription unit and show the following in it:

(i) Direction in which the transcription occurs

(ii) Polarity of the two strands involved

(iii) Template strand

(iv) Terminator gene

(b) Mention the function of promoter gene in transcription.

3. In a maternity clinic, for some reasons the authorities are not able to hand over the two new-borns to their respective real parents. Name and describe the technique that you would suggest to sort out the matter

4. With the help of example explain negative regulation in the regulation of gene expression.

5. State any three salient features of the double helix structure of DNA.

6. Explain how DNA is packed to form the double helix structure in Eukaryotes.

Previous Years Board Questions

1. Recently a girl baby has been reported to suffer from haemophilia. How is it possible?
Explain with the help of a cross.
2. How did Morgan explain linkage of genes?
3. (a) Mention the contributions of the following scientists:
 - (i) Maurice Wilkins and Rosalind Franklin
 - (ii) Erwin Chargaff
4. Draw a double stranded dinucleotide chain with all the four nitrogen bases. Label the polarity and the components of the dinucleotide.
5. (a) State the arrangement of different genes that in bacteria is referred to as operon.
 - (b) Draw a schematic labelled illustration of lac operon in a 'switched on' state.
 - (c) Describe the role of lactose in lac operon.
- 6 a) Briefly explain the Transforming principle experiment.
 - b) How did Alfred Hershey and Martha Chase arrive at the conclusion that DNA is the genetic material?
- 7.a) Explain the Meselson and Stahl's experiment.
 - b) Illustrate the result with diagrams.

Hints for some answers

MCQ's 1 to 10

1-b	2-b	3-c	4-b	5-c	6-c	7-c	8-c	9-b	10-b
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Hints for 2-mark questions

1. Introns are non-coding sequence of protein, absent in a mature processed mRNA
Exons are coding sequence of protein, present in a mature processed mRNA
- 2) AUG for methionine & Start codon, Sequence of base (DNA) –TAC, anticodon---UAC
- 3) (i) Triplet in nature (ii) Non-ambiguous (iii) no punctuation (comma) (iv) Universality – any 4

Hints for 3-mark questions

- 1.(i)Based on the nature of pentose sugar, two types of nucleosides are formed - ribonucleotide and deoxyribonucleotides
(ii) Uracil is present in RNA and in DNA in place of Uracil, Thymine is present.

(iii) In RNA, Pentose sugar is ribose and in DNA, it is Deoxyribose

2.

DNA									
mRNA	G	G	U	G	U	A	A	U	U
anticodon	C	C	A	C	A	U	U	A	A
amino acid	Gly			Val			Ile		

3.

(i) Cellular factory responsible for synthesizing proteins

(ii) Brief explanation of the ribosome structure- large subunit and small subunit.

4.a) Chromosome 1 has most gene 2968 and Y has fewest 231

b) Disease-associated sequences and tracing human history

5. maturation of hnRNA to mRNA----- removal of introns -----exons are joined in a defined order

6.Explain the semiconservative method of DNA replication ----function of DNA dependent DNA polymerase in 5'----3' direction----- fragments of okazaki-----function of DNA ligase

7.i) There is a set of positively charged proteins called Histones

ii)Histones are organized to form a unit of 8 molecules called histone octamer

iii)The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called Nucleosome

iv)Nucleosome is the basic repeating structural (and functional) unit of chromatin

v)The Nucleosome in the chromatin is packed to form Chromatin Fibers

5 Marks Questions-Hints

1.Diagram refer fig. 6.8 pg. 107, (i) Deoxyribose nucleotides needed for formation of new DNA strands are present in nucleoplasm (ii) The RNA primer attaches itself to the old strand and attracts the enzymes (DNA polymerase III) which add new nucleotides through base complementation (iii) Helicase----unwinding (iv) DNA ligase—join the fragments of okazaki

2a) A transcription unit in DNA is defined primarily by the three regions in the DNA:

(i) A Promoter (ii) The Structural gene (iii) A Terminator

b)i)provides binding site for RNA polymerase

ii)It also defines the template and coding strand

3.DNA finger printing also known as DNA profiling. Description please refer to the notes

5. i) Two nucleotides are joined by 3'-5' Phosphodiester linkage to form Dinucleotide.

ii) The two chains are coiled in a right-handed fashion; the pitch of the helix is 3.4nm with roughly 10b.p

iii) The two strands of DNA (called DNA duplex) are antiparallel and complementary, one in 5'->3' direction and the other in 3'->5' direction

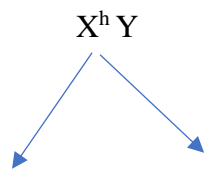
6. Refer to answer 7 of three marks

Previous Board Questions -Hints

1.i) Father haemophilic and mother carrier

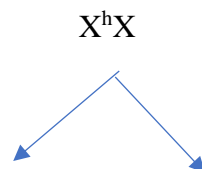
ii) Not possible in real life as male doesn't usually live till he reaches puberty

iii) Father



X

Mother



X^h

Y

X^h

Y

$X^h X^h$ (haemophilic daughter)

2. PARENTALS – 98.7% NON-PARENTALS- 1.3%

Brown, White males & females

Brown, Red males & females

Yellow, White males & females

Yellow, Red males & females

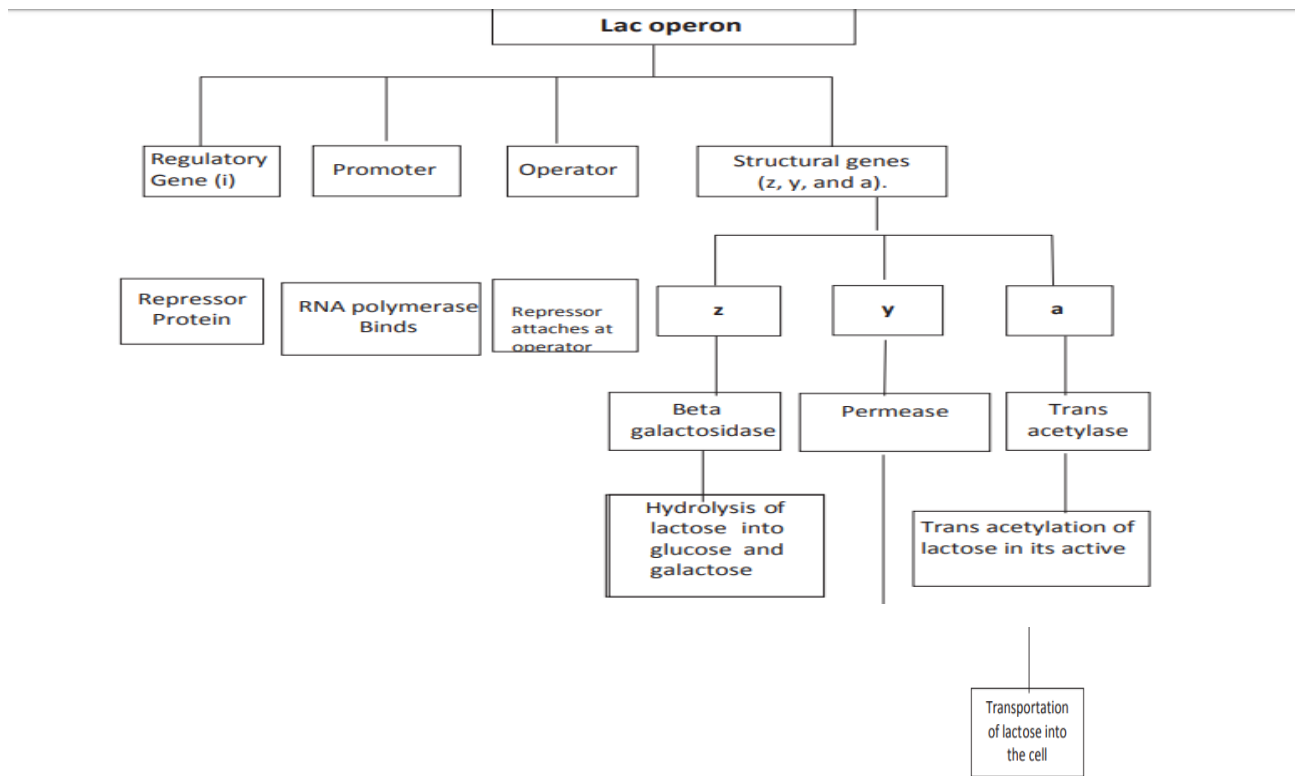
F2 ratio deviated from 9:3:3:1 situated on (X – CHROMOSOME)

Linkage – Physical association of genes on a chromosome. They are inherited as a single unit

3.i) Based on the X-ray diffraction produced by Maurice Wilkins and Rosalind Franklin, Watson and Crick proposed the **Double Helix** model for the structure of DNA

ii) Erwin Chargaff proposed that for the double stranded DNA, the ratio between A & T and G & C are constant and equal to one.

5a



C Inducer

6a) Two strains of bacteria are S-type and R-type cells.

*Living S-strain Injected into mice → Mice killed

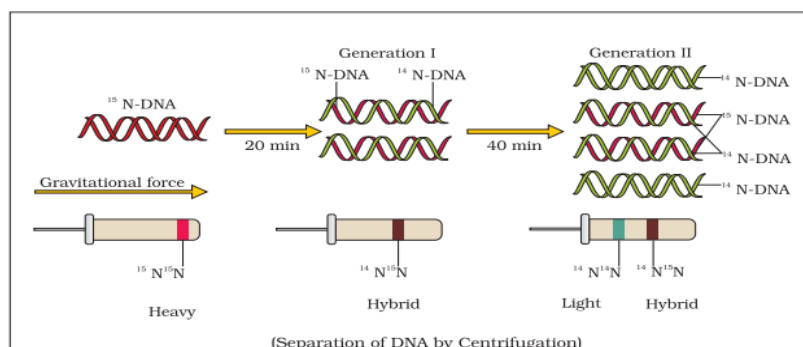
*Living R-strain Injected into mice → Mice lived

*Heat Killed S-strain Injected into mice → Mice lived

*Living R-strain + Heat Killed S-strain Injected into mice → Mice killed

Griffith concluded that R type bacteria is transformed into virulent form.

7b.



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