Quiz 1

Covers Lectures 1 to 4

On 5th April 2023 for both D3 and D4

Full name	
Roll number	
Department	
Division	
Tutorial Batch	

SUGGESTED ANSWERS

Question paper + Answer script

Write answers in the space provided after each question

1. *Innovative experiments that laid the foundation for modern biology*

(1.5 × 3 = 4.5 marks)

Write the inference drawn from each of the experiments listed below:

(a) Hershey and Chase who used the radioisotopes ^{32}P and ^{35}S

DNA is the genetic material.

^{32}P radioactivity was detected in pellet (inside cell) and ^{35}S radioactivity was detected in supernatant (outside cell). Hence, we can conclude that DNA (having ^{32}P) is transferred into the cell.

(b) Meselson and Stahl who used the heavy isotope ^{15}N

DNA replication follows the semiconservative model where the newly synthesized DNA will be a hybrid of parental and new strands.

(c) Gregor Mendel who used pea plants

A hereditary “factor” is transferred stably from parent to offspring through gametes which determine the traits of the offspring. These factors occur in pairs (dominant and recessive alleles).

2. *Paradigm changes in biology* (1 + 2 = 3 marks)

A paradigm is a set of concepts and ideas. Any observation or experimental result that leads to a change in these set of concepts and ideas is said to bring about a paradigm change or a paradigm shift.

(a) We discussed a few observations that led to paradigm changes. Mention any one such observation.

Discovery of a bacterium/planctomycetes (*Gemmata obscuriglobus*) with a nucleus and a nuclear membrane.

(there are other observations also)

(b) What is the paradigm change that this observation brought about?

It was believed that compartmentalization (presence of nucleus and membrane bound organelles) was exclusive to eukaryotes. However, this discovery revealed that some prokaryotes can exhibit compartmentalization.

(answer to (b) depends obviously on the observation one chooses to mention for (a))

3. *Reductionistic approach in biology* (1 + 1.5 = 2.5 marks)

(a) What is meant by reductionistic approach?

Reductionist approach refers to breaking down (i.e., reducing) a complex system into its components to better understand them.

(b) What is the outcome of reductionistic approach?

The outcome of this type of approach is a detailed understanding of the components that make up a cell. This led to the identification of key processes.

Note: by reducing the complexity, one looses out on studying emergent properties of the sysstem.

4. *Cell crowding* (2.5 marks)

We discussed that sizes of cells vary but still all cells are inferred to be crowded. On what basis was this inference drawn?

Knowing the volume of a cell and back-of-the-envelope calculation of its components, assigning size/volume to the components.

Note: The inference that all cells are crowded was drawn based on the fact that the cytoplasm of a cell is filled with various organelles, macromolecules, and other components, which occupy a significant portion of the available space within the cell. This can be verified by calculating the volume of the cell as well as the combined volume of all its components. This revealed that regardless of size, cells tend to be crowded.

5. *Population genetics* (0.5 + 2 = 2.5 marks)

Ten members of an extended family were screened for the prevalence of a gene. Given below is the sequence of the relevant stretch of the gene.

Serial number of the family member	DNA sequence
1	5’- A G C T G C T G A -3’
2	5’- A G C T T C T G A -3’
3	5’- A G C T G C T G A -3’
4	5’- A G C T G C T G A -3’
5	5’- A A C T G C T G A -3’
6	5’- A G C T G C T G A -3’
7	5’- A G C T T C T G A -3’
8	5’- A G C T G C T G A -3’
9	5’- A A C T T C T G A -3’
10	5’- A G C T G C T G A -3’
	1 2 3 4 5 6 7 8 9 This numbering marks the position of nucleotides. It is included for ease of identifying various positions

(a) How many alleles of the gene are present in this family?

Four (4) alleles of this gene are present in this family.

(b) How did you arrive at the answer to (a) above?

In the sequences given, variation in the nucleotides are observed only at positions 2 and 5. This results in 4 variable forms of this gene which are called alleles. These alleles are as follows:

1. 5’- A G C T G C T G A -3’
2. 5’- A G C T T C T G A -3’
3. 5’- A A C T G C T G A -3’
4. 5’- A A C T T C T G A -3’

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