

BT301 – INTRODUCTION TO BIOTECHNOLOGY

MID TERM MOST IMPORTANT QUESTIONS

Prepared by: Sir Mughal Admin (BS ZOOLOGY ANNOUNCEMENT)

<https://chat.whatsapp.com/BjC6W0jZx8o9yaC2ISh1Gu>

1. Explain Chargaff rule.

Erwin Chargaff and his colleagues provided a most important clue to the structure of DNA. The work of Chargaff led him to following conclusions, also called “Chargaff Rules”.

Chargaff's Rules:

1. Base composition of DNA varies from one species to another.
2. The DNA isolated from different tissues of the same species has the same base composition.
3. The base composition of DNA in a given species does not change with an organism's age, nutritional state, or changing environment.
4. In DNA, the number of adenosine residues is equal to the number of thymidine (A=T) and the number of guanosine residues is equal to the number of cytidine (G=C).

It means that the sum of the purine residues equals the sum of the pyrimidine residues (AG=TC).

2. What is RM system?

Restriction-modification (R-M) systems are rudimentary bacterial immune systems. The main components include restriction enzyme (R), which cuts specific unmethylated DNA sequences, and the methyltransferase (M), which protects the same DNA sequences.

- Restriction system allows bacteria to monitor the origin of incoming DNA.
- When the incoming DNA is a bacteriophage genome, the effect is to reduce the efficiency of plating i.e. to reduce the number of plaques in plating test.
- The phenomenon of restriction and modification were well illustrated and studied by the behavior of phage λ on two E. coli strains E. coli C and E. coli K.
- Restrictive host must, of course protects its own DNA from restriction endonucleases by modification
- Modification involves methylation of certain bases that constitute recognition sites.

3. Write names of types of structure in protein.

Proteins fold into stable three-dimensional shapes, or conformations, that are determined by their amino acid sequence. The complete structure of a protein can be described at four different levels of complexity: primary, secondary, tertiary, and quaternary structure.

4. Name types of eukaryotic DNA.

- Protein coding genes
- Tandemly repeated genes
- Repeated DNA
- Unclassified spacer DNA
- Protein coding genes can also be in the form of: Duplicated and diverged genes
- Functional gene families and non-functional pseudo-genes
- Tandemly repeated genes encoding rRNA, 5sRNA, tRNA and histones.

5. What is nick?

A nick is a break in a phosphodiester bond in one strand of a double-helix. In the presence of Mn^{2+} , DNase I behaves differently and generates cuts in both strands of the DNA at approximately the same site.

6. What happens when Ethidium bromide touches our body?

When Ethidium bromide contacts the skin, it can cause irritation and be absorbed, presenting potential mutagenic risks. Immediate washing with water is essential, and the use of protective equipment, such as gloves and lab coats, is crucial to minimize the risk of adverse effects associated with this fluorescent dye used in molecular biology.

7. What are benefits of genetic variations?

Genetic variations, the diversity in DNA sequences among individuals, offer several benefits:

1. **Adaptation to Environment:** Genetic variations enable populations to adapt to changing environments, promoting survival and resilience in the face of environmental challenges.
2. **Disease Resistance:** Genetic diversity can confer resistance to certain diseases. Individuals with diverse genetic backgrounds may have varying levels of susceptibility to different pathogens.
3. **Evolutionary Advantage:** Genetic variations are the basis of evolution, driving the development of new traits and species over time, leading to increased biodiversity.
4. **Population Health:** In populations with high genetic diversity, the likelihood of harmful recessive traits being expressed is reduced, contributing to overall population health.
5. **Improved Reproductive Success:** Genetic diversity can enhance reproductive success by reducing the risk of inbreeding, preventing the expression of deleterious recessive alleles.
6. **Survival of Species:** Genetic variations increase the chances of species survival during environmental changes, ecological shifts, or other challenges.
7. **Ecosystem Stability:** In plants and animals, genetic diversity within a species contributes to ecosystem stability by supporting various ecological roles and functions.

8. Define electroporation technique.

Electroporation is rapid and simple technique for introducing cloned genes into a wide variety of microbial, plant and animal cell, including *E. coli*, is electroporation. In electroporation, electric field is applied to cells in order to increase permeability of the cell membrane to take DNA.

9. What is difference between pBR322 and pBR325?

pBR322 and pBR325 are both plasmids used in genetic engineering, but they differ in their antibiotic resistance genes. pBR322 carries ampicillin and tetracycline resistance genes, while pBR325 carries only the ampicillin resistance gene. Additionally, pBR322 has a unique PstI restriction site, allowing for efficient DNA manipulation. In contrast, pBR325 lacks this site. These differences make pBR322 versatile for cloning experiments with various antibiotic selections and molecular techniques, while pBR325 is more straightforward, suitable for studies where ampicillin resistance is sufficient.

10. What are benefits of genome in medicines?

- Improve diagnosis of disease
- Detect genetic predispositions to disease (cancer, diabetes etc.)
- Create drugs based on molecular information
- Use gene therapy and control systems as drugs

11. What is restriction mechanism?

Restriction enzymes, also called restriction endonucleases, recognize a specific sequence of nucleotides in double stranded DNA and cut the DNA at a specific location. They are indispensable to the isolation of genes and the construction of cloned DNA molecules.

12. What are linkers and adapters?

Linkers are chemically synthesized oligonucleotides that have two blunt ends. Adaptors are chemically synthesized oligonucleotides with one blunt and one sticky end. No single-stranded tail is present. The main difference between linker and adaptor is that former having blunt ends while later have one cohesive end.

13. What is pregnancy test?

Pregnancy test:

- Barley grows – male child
- Wheat grows – female child

A papyrus described a test in which a woman who might be pregnant could urinate on wheat and barley seeds over the course of several days: “If the barley grows, it means a male child. If the wheat grows, it means a female child. If both do not grow, she will not bear at all.” Testing of this theory in 1963 found that 70 percent of the time, the urine of pregnant women did promote growth, while the urine of non-pregnant women and men did not. Scholars have identified this as perhaps the first test to detect a unique substance in the urine of pregnant

women, and have speculated that elevated levels of estrogens in pregnant women's urine may have been the key to its success

14. Explain green biotechnology with examples?

Green Biotechnology:

It is concerned with the modification of the genetic composition of plants to enhance existing traits or add new ones. An additional gene was inserted into the normal genome of this corn that triggers the production of proteins that then protect the plant from harmful insects. This reduces the need for pesticides and increases crop yields Green Biotechnology.

Example: Bt corn from Syngenta & Bt cotton from Monsanto

15. Write functions of chloroplast gene?

Functions of Chloroplast Genes

Most cp genes fall into two functional groups:

- ii- Genes involved in replication, transcription, translation
- iii- Genes involved in photosynthesis

16. What are major and minor grooves?

The major groove is a wider gap that spirals up the length of the molecule, while the minor groove is a smaller gap that runs in parallel to the major groove. The base pairs are found in the center of the helix, while the sugar-phosphate backbones run along the outside.

17. Explain in detail primary structure of protein.

Primary structure or covalent structure of protein refers to the amino acid sequence of its polypeptide chain. Each type of protein has a unique amino acid sequence. Proteins are different from one another on the basis of their amino acid sequence.

Peptide Bond Is Rigid and Planar

- Linus Pauling and Robert Corey carefully analyzed the peptide bond.
- Their findings laid the foundation for our present understanding of protein structure.
- They demonstrated that the peptide C - N bond is somewhat shorter than the C - N bond in a simple amine.
- The six atoms of the peptide group are co-planar i.e., lie in a single plane, with the oxygen atom of the carbonyl group and the hydrogen atom of the amide nitrogen trans to each other.
- Pauling and Corey concluded that the peptide C - N bonds are unable to rotate freely because of their partial double-bond character.
- Rotation is permitted about the N - C and the C - C bonds.
- The bond angles resulting from rotations at C are labelled (ϕ) for the N - C bond and (ψ) for the C - C bond.
- In principle, and can have any value between $+180^\circ$ & -180° .

18. What is Gaucher's disease?

Gaucher disease is a rare genetic disorder passed down from parents to children (inherited). When you have Gaucher disease, you are missing an enzyme that breaks down fatty substances called lipids. Lipids start to build up in certain organs such as your spleen and liver.

19. What is role of plasmid in antibiotic?

Plasmids play a crucial role in antibiotic resistance. They often carry genes encoding resistance to antibiotics. Bacteria containing these plasmids can survive antibiotic exposure, allowing for the selection of transformed cells during genetic engineering experiments. Plasmids serve as vectors for gene cloning and expression while conferring resistance to antibiotics as a selectable marker.

20. Explain Watson and Crick model of DNA.

James Watson and Francis Crick postulated a three dimensional model of DNA structure in 1953. They were awarded Nobel Prize in the same year, for their discovery. The major features of this model are as follow:-

- 1) DNA consists of two helical polynucleotide strands which are wound around the same axis to form a right handed double helix.
- 2) The hydrophilic backbones of alternating deoxyribose and phosphate groups are on the outside of the double helix, facing the surrounding water.
- 3) The hydrophilic backbones of alternating deoxyribose and phosphate groups are on the outside of the double helix, facing the surrounding water.
- 4) The pairing and coiling of the two strands create a major groove and minor groove on the surface of the helix.
- 5) Each nucleotide base of one strand is paired in the same plane with a base of the other strand.
- 6) They also found that G pairs with C and A pairs with T due to the reason that they fit best within the structure.
- 7) The two strands in DNA are present in antiparallel orientation i.e. their 5,3-phosphodiester bonds run in the opposite directions.
- 8) The two antiparallel strands of double-helical DNA are complementary to each other.

21. Explain Western Blotting principle?

- It involves the transfer of electrophoresed protein bands from a gel on to a membrane.
- The bounded proteins are then available for analysis.
- Most commonly, antibodies are used to detect specific antigens.

22. Explain Fredrick Griffith experiment.

In 1928 Fredrick Griffith tried to transform cells and he was successful to some extent. He was able to transform non-pathogenic strains of streptococcus pneumonia by transferring the genetic material from pathogenic strains of streptococcus pneumonia. He mixed non-pathogenic strains with the solution of heat killed streptococcus pneumonia and then he realized that something transferred from pathogenic heat killed cells to non-pathogenic cells that transformed non-pathogenic cells into virulent strains. Griffith that time didn't know about transforming principle. Now scientists discovered that transforming principle was the genetic material like DNA. In 1970 a few workers were able to transform E.Coli in the presence of Calcium Chloride and they transformed it with the help of Bacteriophage lambda DNA. In 1972 E.Coli was transformed with the plasmid DNA by scientists.

Factors that can influence transformation efficiency:

1. Concentration of chemical that is used i.e. Calcium chloride
2. Temperature

23. Write importance of Genome sequencing.

Genome sequencing is a powerful tool that allows researchers to examine the entire genomic sequence of an individual, including both coding and non-coding regions. This comprehensive approach can provide insights into the genetic basis of complex traits, such as antidepressant response. Genome sequencing is an important step toward correlating genotypes with phenotypic characters. Sequencing technologies are important in many fields in the life sciences, including functional genomics, transcriptomics, oncology, evolutionary biology, forensic sciences, and many more.

24.