MB502 – MOLECULAR BIOLOGY

MID TERM MOST IMPORTANT QUESTIONS

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1. What is telomeres and its function?

Telomeres:
Repeated DNA sequences found at the ends of linear chromosomes in eukaryotic cells. Typically composed of repetitive sequences such as TTAGGG in humans.

Functions:

- They form a protective cap at the end of each chromosome.
- They protect chromosome ends from degradation during DNA replication. Also, prevent the loss of essential genetic information.
- Act as a cellular clock, limiting the number of cell divisions. Telomeres naturally shorten with each cell division. Critical shortening triggers replicative senescence, leading to cell cycle arrest.
- Safeguard against uncontrolled cell growth and cancer development. Cells with damaged or insufficient telomeres are more prone to undergo programmed cell death (apoptosis).
- Telomere length is associated with cellular age. Shortened telomeres are linked to age-related diseases.

2. What is nucleotide excision repair? Write five steps.

Nucleotide Excision Repair (NER):
Nucleotide excision repair is a DNA repair mechanism that corrects a wide range of DNA lesions, including those caused by UV light and chemical carcinogens. The repair process involves the removal and replacement of a damaged region of DNA. Here are five key steps involved in nucleotide excision repair:

1. Recognition of DNA Damage:
DNA damage is initially recognized by a complex of proteins, including XPC (xeroderma pigmentosum group C) and RAD23. This recognition can be facilitated by the distortion of the DNA helix caused by lesions such as thymine dimers induced by UV light.

2. Incision and Excision of Damaged DNA Strand:
Once the damage is recognized, a complex of proteins, including XPA (xeroderma pigmentosum group A), TFIIH, and XPG (xeroderma pigmentosum group G), assembles at the site. TFIIH unwinds the DNA around the damaged area, and XPG makes incisions on both sides of the damaged region. This results in the removal of a short single-stranded DNA segment containing the lesion.

3. Excision of Oligonucleotide:
The damaged DNA segment, or oligonucleotide, is excised by the endonuclease activity of the proteins involved in the recognition and incision steps. This creates a gap in the DNA strand that spans the lesion.

4. DNA Resynthesis and Ligation:
DNA polymerase fills in the gap by synthesizing a new DNA strand using the intact strand as a template. DNA ligase then seals the nick in the sugar-phosphate backbone, completing the repair process. The result is the restoration of an intact, undamaged DNA strand.

5. Verification and Surveillance:
The repaired DNA undergoes verification to ensure the accuracy of the repair. Additional surveillance mechanisms may monitor the repaired site to confirm its stability and functionality. If necessary, further repair processes or cell cycle checkpoints may be activated.

3. Why C-N bond of peptide cannot rotate freely?

The C-N bond in a peptide cannot rotate freely due to the presence of a partial double bond character resulting from resonance. This resonance creates a fixed, rigid structure, restricting rotation and influencing the overall conformation of peptides and proteins.

4. How phosphodiester bond is formed?

Phosphodiester bonds are formed through a condensation reaction between the 3' hydroxyl group of one nucleotide and the 5' phosphate group of another nucleotide, catalyzed by DNA or RNA polymerase. The reaction releases a water molecule and forms a covalent bond, linking the sugar-phosphate backbone in DNA or RNA.

5. How would Harshey and Chase learn weather genes were made of DNA or proteins?

Martha Chase and Alfred Hershey conducted the Hershey-Chase experiment in 1952 to determine whether genes were made of DNA or proteins. They used the T2 bacteriophage (a type of virus that infects bacteria) and labeled its DNA and proteins with different radioactive isotopes. The experiment had the following steps:

1. Labeling DNA and Proteins:
T2 bacteriophages were grown in two separate media. In one set, radioactive sulfur-35 (^{35}S) was used to label the proteins of the bacteriophage. In the other set, radioactive phosphorus-32 (^{32}P) was used to label the DNA of the bacteriophage.

2. Infecting Bacteria:
The labeled T2 bacteriophages were allowed to infect Escherichia coli (E. coli) bacteria.

3. Blending and Centrifugation:

After the infection cycle, the bacterial cells were harvested and blended to separate viral protein coats from bacterial cell debris. The mixture was then centrifuged to separate heavier bacterial cells from lighter phage protein coats.

4. Observing the Results:

The results showed that when radioactive ^{35}S-labeled protein was used, most of the radioactivity remained with the bacterial cell debris. In contrast, when radioactive ^{32}P-labeled DNA was used, the radioactivity was found in the viral protein coats that remained with the bacterial cells.

5. Conclusion:

The key observation was that the genetic material (DNA) of the bacteriophage, carrying the genetic information from one generation to the next, entered the bacterial cells. This finding supported the hypothesis that DNA, not protein, is the hereditary material.

6. Significance:

The Hershey-Chase experiment provided strong evidence that DNA, rather than protein, is the genetic material. This laid the foundation for the understanding of the structure and function of DNA and confirmed its role in carrying genetic information.

6. Write salient features of DNA polymerase.

- DNA polymerase is an enzyme involved in the synthesis of DNA strands during processes such as DNA replication and repair.
- It catalyzes the addition of nucleotides to the growing DNA chain in the 5' to 3' direction.
- DNA polymerase synthesizes DNA in a template-dependent manner, using an existing DNA strand as a template.
- Many DNA polymerases possess 3' to 5' exonuclease activity for proofreading, allowing correction of errors during replication.
- It exhibits high processivity, remaining attached to the DNA template for an extended period during replication.
- Different DNA polymerases may have specialized roles, such as replicative functions, repair functions, or involvement in translesion synthesis.
- It forms complexes with other proteins (e.g., sliding clamps, primases) to create functional replisomes during DNA replication.
- It recognizes the template DNA and primer-template junction for accurate nucleotide incorporation.
- DNA polymerase exhibits high fidelity, ensuring accurate replication of the template sequence with minimal errors.
- It also discriminates between correct and incorrect base pairing during nucleotide addition.
- It participates in the termination of DNA replication at specific sequences.
- It is also involved in various DNA repair mechanisms, including base excision repair and nucleotide excision repair.
- DNA polymerases are evolutionarily conserved enzymes found in diverse organisms.
- It comprises distinct structural domains, including palm, thumb, and fingers domains, contributing to catalytic activity and substrate binding.

7. What are UV radiation and its types?

UV Radiation (Ultraviolet Radiation):

UV radiation is a form of electromagnetic radiation with wavelengths shorter than visible light. It is categorized into three types:

1. ***UVA (320–400 nm):*** Penetrates skin deeply, linked to aging and skin cancer.
2. ***UVB (280–320 nm):*** Penetrates outer skin layer, causes sunburn, linked to skin cancer.
3. ***UVC (100–280 nm):*** Mostly absorbed by the atmosphere, used for germicidal purposes.

8. Why Aflatoxin B1 can lead to replication error?

Aflatoxin B1 forms DNA adducts, causing structural distortions in DNA. These adducts interfere with normal DNA replication, leading to errors such as misincorporation of nucleotides and the formation of mutations, ultimately contributing to the development of cancer.

9. Differentiate between Pentose sugar of ribose and deoxyribose.

The main difference between the pentose sugar of ribose and deoxyribose is the presence or absence of an oxygen atom at the 2' carbon of the sugar molecule:

- Ribose (RNA)contains a hydroxyl (-OH) group at the 2' carbon.
- Deoxyribose (DNA): Lacks an oxygen atom at the 2' carbon, having a hydrogen (-H) instead.

10. Write topology of chromosomes.

The topology of chromosomes refers to their three-dimensional arrangement within the nucleus:

- ***Primary Structure:*** Linear DNA wrapped around histone proteins, forming nucleosomes.
- ***Secondary Structure:*** Nucleosomes coil to create chromatin fibers.
- ***Tertiary Structure:*** Chromatin undergoes further folding and looping.
- ***Quaternary Structure:*** Maximal condensation during cell division, forming visible chromosomes.
- ***Interchromosomal Interactions:*** Chromosomal territories and interactions influence gene regulation.
- ***Nuclear Organization:*** Interaction with the nuclear lamina and nuclear pores.

11. Explain Fred Griffith transformation experiment.

Fred Griffith's transformation experiment, conducted in 1928, played a pivotal role in the discovery of DNA as the genetic material. Griffith worked with Streptococcus pneumoniae, a bacterium that causes pneumonia in mammals. The experiment demonstrated the transfer of hereditary information between different strains of bacteria and laid the groundwork for the understanding of bacterial transformation.

Experimental Setup:

1. Strain Types:
Griffith used two strains of Streptococcus pneumoniae: the virulent S (smooth) strain and the non-virulent R (rough) strain. The S strain had a smooth polysaccharide capsule, making it pathogenic and lethal to mice. The R strain lacked the capsule, rendering it nonpathogenic.

2. Experiment Phases:
Griffith conducted the experiment in two phases: the "heat-killed" phase and the "mixture" phase.

Experimental Procedure:
1. Heat-Killed S Strain:
Griffith heat-killed the virulent S strain, destroying its ability to cause infection while preserving its external components.

2. Mixture with Live R Strain:
Griffith injected mice with a mixture containing heat-killed S strain and live R strain. Individually, neither the heat-killed S strain nor the live R strain caused fatal pneumonia in mice.

3. Observations:
Surprisingly, mice injected with the mixture of heat-killed S and live R strains died. Griffith recovered live, virulent S strain bacteria from the blood of these mice.

4. Conclusion - Transformation:
Griffith hypothesized that something in the heat-killed S strain transformed the live R strain into a virulent form. This implied a transfer of genetic material, transforming the harmless R strain into the lethal S strain.

12.Define Oligomer, Multimer and Promoter.

1. Oligomer:
An oligomer refers to a molecule, typically a polymer, composed of a small number of repeating subunits or monomers. It is a short-chain polymer, containing a few monomer units.

2. Multimer:
A multimer is a molecular complex formed by the association of identical or similar subunits, which can be monomers or oligomers. Multimers can consist of repeated units of the same molecule.

3. Promoter:
A promoter is a region of DNA that initiates the transcription of a particular gene. It serves as a binding site for RNA polymerase and transcription factors, facilitating the initiation of gene expression. Promoters play a crucial role in regulating gene activity by controlling when and how strongly a gene is transcribed into RNA. They are essential components of the gene regulatory machinery.

13. What are topoisomerase?

Topoisomerases are enzymes that play a crucial role in the regulation of DNA structure and topology within cells. DNA, the genetic material in cells, is a long double-stranded molecule that needs to be properly organized and regulated to carry out essential cellular functions, such as replication, transcription, and repair. Topoisomerases help manage the twisting and tangling of DNA strands by introducing transient breaks in the DNA strands and then resealing them.

14. Explain UV types that affect the earth.

Ultraviolet (UV) radiation from the sun is classified into three main types based on wavelength: UVA, UVB, and UVC. These types of UV radiation differ in their ability to penetrate the Earth's atmosphere and affect living organisms.

1. UVA (320-400 nm):

UVA has the longest wavelength among the three types of UV radiation. It constitutes the majority of the UV radiation reaching the Earth's surface. UVA can penetrate deep into the skin and is associated with skin aging and wrinkling. While it is less energetic than UVB, it can contribute to skin damage and is linked to an increased risk of skin cancer. UVA is less affected by the ozone layer and can penetrate through clouds and glass.

2. UVB (280-320 nm):

UVB has a shorter wavelength and higher energy compared to UVA. A significant portion of UVB is absorbed by the Earth's ozone layer, but some reaches the surface. UVB is more biologically active than UVA and is a major cause of sunburn. Prolonged exposure to UVB is a significant risk factor for skin cancer. UVB is also involved in the synthesis of vitamin D in the skin.

3. UVC (100-280 nm):

UVC has the shortest wavelength and the highest energy. Fortunately, almost all UVC radiation is absorbed by the Earth's atmosphere and does not reach the surface. Artificial UVC sources, such as germicidal lamps, are used for disinfection purposes because of their ability to damage the DNA and RNA of microorganisms.

15. How many standard amino acids are there? Name any five of them.

There are 20 standard amino acids that serve as the building blocks of proteins. Here are the names of five of them:

1. Alanine (Ala)
2. Glycine (Gly)
3. Valine (Val)
4. Leucine (Leu)
5. Phenylalanine (Phe)

16. What is NER ? Name its 3 functions.

Nucleotide Excision Repair (NER):

NER is a DNA repair mechanism that functions to correct damage caused by various DNA-damaging agents, such as UV light and certain chemicals. The process involves the removal and replacement of damaged nucleotides in the DNA strand. While there isn't a single enzyme called "NER," there are several enzymes involved in the NER pathway. One of the key enzymes is DNA helicase, which unwinds the DNA strands, allowing other enzymes to recognize and repair the damaged region.

Functions of Nucleotide Excision Repair (NER):

1. Recognition of DNA Damage:

The first step in NER involves the recognition of DNA damage. Enzymes, such as XPC-RAD23B complex in eukaryotes, identify and bind to distortions or lesions in the DNA structure.

2. Excision of Damaged DNA Segment:

After recognition, a set of endonucleases, including XPF and XPG in eukaryotes, make incisions on both sides of the damaged DNA segment. This results in the removal of the damaged DNA fragment.

3. DNA Resynthesis and Ligation:

The gap left after the removal of the damaged segment is then filled in by DNA polymerase, and the remaining nick is sealed by DNA ligase. This ensures the integrity of the DNA strand.

17. What is base excision repair mechanism?

1. Base Excision Repair (BER):

Base Excision Repair is a DNA repair pathway that specifically addresses damaged or incorrect bases in the DNA molecule. In BER, specific enzymes recognize and remove damaged bases, creating an apurinic or apyrimidinic (AP) site. The AP site is then processed by other enzymes to remove the damaged region, and the gap is filled in by DNA polymerase and sealed by DNA ligase.

18. Differentiate between heterochromatin and euchromatin.

Heterochromatin and euchromatin are two distinct forms of chromatin, the complex of DNA and proteins in the cell nucleus. Heterochromatin is densely packed, transcriptionally inactive, and often localized near the nuclear periphery. It contains repetitive DNA sequences and plays a role in maintaining chromosome structure. Euchromatin, on the other hand, is loosely packed, transcriptionally active, and dispersed throughout the nucleus. It contains genes that are actively transcribed, allowing for essential cellular processes. The dynamic interconversion between these states regulates gene expression, with euchromatin facilitating active transcription and heterochromatin maintaining genomic stability.

19. What is Chargaff's rule?

Chargaff's rule, formulated by biochemist Erwin Chargaff, describes the regularity found in the ratios of nucleotide bases in DNA. The rule states that in a DNA molecule:

1. The amount of adenine (A) is roughly equal to the amount of thymine (T).
2. The amount of guanine (G) is roughly equal to the amount of cytosine (C).

In other words, the base pairs A-T and G-C are present in approximately equal proportions.

20. Write functions of mRNA.

Messenger RNA (mRNA) plays a crucial role in the process of protein synthesis within cells. Its primary function is to carry genetic information from the DNA in the cell's nucleus to the ribosomes in the cytoplasm, where proteins are synthesized. Here are the key functions of mRNA:

1. Transcription:

mRNA is transcribed from a DNA template during the process of transcription. RNA polymerase synthesizes a complementary mRNA strand based on the sequence of nucleotides in the DNA.

2. Genetic Code Transfer:

mRNA carries the genetic code from the DNA to the ribosomes. The sequence of nucleotides in mRNA serves as a template for the synthesis of a complementary sequence of amino acids during translation.

3. Translation Initiation:

mRNA provides the template for the initiation of protein synthesis at the ribosome. The start codon (AUG) in mRNA signals the beginning of translation.

4. Translation Elongation:

As the ribosome moves along the mRNA, reading the codons, transfer RNA (tRNA) molecules bring in the corresponding amino acids. mRNA guides the ribosome in selecting the appropriate amino acids based on the codons.

5. Translation Termination:

mRNA includes stop codons (UAA, UAG, UGA) that signal the termination of protein synthesis. The presence of a stop codon causes the ribosome to release the completed polypeptide chain.

6. mRNA Stability and Degradation:

mRNA molecules have specific lifetimes, and their stability is regulated. Cellular mechanisms, such as exonucleases and endonucleases, control the degradation of mRNA when it is no longer needed.

21. Write features of Watson and Crick model.

The Watson-Crick model of DNA, proposed by James Watson and Francis Crick in 1953, is a double-helix structure that explains the molecular architecture of DNA. Here are some features of the Watson-Crick model:

- DNA is depicted as a double helix, consisting of two antiparallel strands coiled around a central axis. The helical structure is stabilized by hydrogen bonds between complementary base pairs: adenine (A) with thymine (T), and guanine (G) with cytosine (C).
- The two DNA strands run in opposite directions (antiparallel). One strand has a 5' to 3' orientation, while the other has a 3' to 5' orientation.
- Adenine (A) pairs with thymine (T) through two hydrogen bonds. Guanine (G) pairs with cytosine (C) through three hydrogen bonds. This complementary base pairing ensures specificity in the genetic code.
- The helical structure creates grooves along the DNA molecule. There are major and minor grooves where regulatory proteins and enzymes can interact with the DNA.
- The diameter of the DNA double helix is consistent throughout its length. This uniformity is achieved through the complementary base pairing.
- The helix has a right-handed twist, meaning that as you move along the axis, the helix turns in a clockwise direction.
- The specificity of base pairing ensures accurate replication and transmission of genetic information during cell division.
- The complementary base pairing and antiparallel orientation provide a structural basis for the accurate and semiconservative replication of DNA.

22. What is semi conservative model of DNA?

The semi-conservative model of DNA replication describes the process by which DNA duplicates itself. Proposed by James Watson and Francis Crick, along with Maurice Wilkins and Rosalind Franklin, in the early 1950s, this model suggests that each newly replicated DNA molecule consists of one original (parental) strand and one newly synthesized (daughter) strand. In other words, during replication, the two strands of the DNA molecule separate, and each strand serves as a template for the synthesis of a complementary strand.

The key steps in the semi-conservative replication model are:

1. Strand Separation:
2. Template Strand Synthesis:
3. Complementary Strand Synthesis:
4. Formation of Two DNA Molecules:

23. Name three enzymes involved in base excision.

Base Excision Repair (BER) is a DNA repair pathway that addresses damaged or incorrect bases in the DNA molecule. Several enzymes are involved in the different steps of BER. Here are three key enzymes in the base excision repair pathway:

1. DNA Glycosylase
2. AP Endonuclease (APE1)
3. DNA Polymerase β (Pol β)

24. What is primer template?

In molecular biology, the terms "primer" and "template" are often associated with DNA replication and polymerase chain reaction (PCR). Here's a brief explanation of each term:

1. Primer:
A primer is a short, single-stranded nucleic acid sequence that serves as a starting point for the synthesis of a complementary strand of nucleotides. In DNA replication or PCR, primers are typically short sequences (about 18-25 nucleotides long) that are complementary to specific regions on the template DNA. DNA polymerase, the enzyme responsible for synthesizing new DNA strands, requires a primer to initiate the synthesis.

2. Template:
The template is the existing DNA strand that serves as a guide for the synthesis of a new complementary strand. During DNA replication or PCR, the template is the strand of DNA that the DNA polymerase reads to add nucleotides in a complementary fashion to synthesize a new strand. The template strand determines the sequence of the newly synthesized strand.

25. What are components of RNA?

RNA, or ribonucleic acid, is a nucleic acid similar to DNA but with several key differences. The components of RNA include:

1. Nucleotides:
RNA is composed of nucleotides, which are the building blocks of the RNA molecule. Each RNA nucleotide consists of three components: a phosphate group, a ribose sugar, and a nitrogenous base.

2. Phosphate Group:
The phosphate group is a negatively charged chemical entity that forms a covalent bond with the 5' carbon of the ribose sugar in the nucleotide.

3. Ribose Sugar:
Ribose is a five-carbon sugar that forms the backbone of the RNA molecule. It differs from the deoxyribose sugar found in DNA by having an additional oxygen atom.

4. Nitrogenous Bases:

RNA uses four nitrogenous bases, which are divided into two categories: purines and pyrimidines. Purines: Adenine (A) and Guanine (G). Pyrimidines: Cytosine (C) and Uracil (U). Unlike DNA, RNA does not contain thymine (T); instead, it has uracil, which pairs with adenine.

26. What are types of mutation?

Mutations are changes in the DNA sequence that can occur naturally or be induced by various factors. There are several types of mutations, classified based on their impact on the DNA sequence. Here are the main types:

1. Point Mutations:

Substitution: A single nucleotide is replaced with another, potentially altering the amino acid sequence in the corresponding protein.

Insertion: One or more nucleotides are added to the DNA sequence.

Deletion: One or more nucleotides are removed from the DNA sequence.

Point mutations can be silent (no change in the amino acid), missense (change in one amino acid), or nonsense (introduction of a premature stop codon).

2. Frameshift Mutations:

These mutations occur when the addition or deletion of nucleotides disrupts the reading frame of the genetic code, leading to a shift in the grouping of codons. Frameshift mutations often result in a nonfunctional or truncated protein.

3. Insertion/Deletion Mutations (Indels):

These mutations involve the addition or removal of one or more nucleotides in the DNA sequence, potentially causing a frameshift.

4. Duplication:

A segment of DNA is duplicated, leading to an increase in the number of copies of specific genetic material. Duplication events can contribute to evolutionary processes.

5. Inversion:

A segment of DNA is reversed, changing the order of nucleotides. Inversions may have varying effects depending on the location and size of the inverted segment.

6. Translocation:

Genetic material is exchanged between non-homologous chromosomes, leading to the relocation of a segment of DNA to a different chromosome.

7. Expanding Repeats:

In certain regions of the genome, a sequence of nucleotides is repeated several times. Expansion of these repeats beyond a certain threshold can cause diseases, such as Huntington's disease.

8. Spontaneous Mutations:
These mutations occur naturally due to errors in DNA replication, DNA repair, or environmental factors.

9. Induced Mutations:
Mutations can be induced by external factors such as radiation, chemicals, or certain drugs.

27. Write advancements of Molecular biology in agriculture.

Advancements in molecular biology have significantly impacted agriculture, leading to improved crop yield, resistance to pests and diseases, and enhanced nutritional content. Some key advancements include:

1. Genetically Modified (GM) Crops:
Molecular biology techniques have enabled the development of genetically modified crops with traits such as resistance to pests, diseases, and herbicides. Examples include Bt cotton, which produces a toxin harmful to certain pests, and herbicide-resistant crops, allowing for effective weed control.

2. Crop Improvement through Genetic Engineering:
Genetic engineering has facilitated the introduction of specific genes into crops to enhance desirable traits. Traits such as drought tolerance, salt tolerance, and resistance to specific environmental stresses have been targeted to improve crop performance.

3. Improved Disease Resistance:
Molecular techniques have enabled the identification and characterization of genes responsible for disease resistance in crops. This information is used to develop crops with enhanced resistance to various pathogens, reducing the need for chemical pesticides.

4. Enhanced Nutritional Content:
Genetic modification has been employed to enhance the nutritional content of crops. Examples include biofortified crops with increased levels of essential nutrients such as vitamins, minerals, and amino acids.

5. Precision Agriculture:
Molecular tools contribute to precision agriculture by providing accurate and rapid diagnostic tools for identifying diseases, pests, and nutrient deficiencies in crops. This allows farmers to implement targeted interventions, optimizing resource use and reducing environmental impact.

28. Write Franklin and Wilkins experiment.

Rosalind Franklin and Maurice Wilkins were contemporaneous researchers who worked at King's College London in the early 1950s. They both conducted X-ray crystallography experiments to study the structure of DNA, and their work was crucial in providing essential data for the discovery of the DNA double helix by James Watson and Francis Crick.

Here's an overview of their respective contributions:

1. Rosalind Franklin's X-ray Diffraction Studies:

- Rosalind Franklin used X-ray crystallography to analyze DNA fibers and obtain detailed diffraction patterns.
- In 1952, Franklin, along with her student Raymond Gosling, captured Photo 51, one of the most famous X-ray diffraction images of DNA. This image revealed a distinct cross-shaped pattern, indicating a helical structure.
- Franklin's work provided important insights into the dimensions and helical nature of DNA.

2. Maurice Wilkins' Contribution:

- Maurice Wilkins, working in the same laboratory as Franklin, conducted X-ray crystallography studies on DNA independently.
- Wilkins and Franklin had a complex working relationship, and at times, they had overlapping research interests.
- Wilkins obtained diffraction images of DNA fibers, and some of his data, including Franklin's Photo 51, were shared with James Watson and Francis Crick without Franklin's knowledge.

29. How Deoxynucleotides join?

Deoxynucleotides join during DNA replication through the formation of phosphodiester bonds catalyzed by DNA polymerase. The enzyme adds complementary deoxynucleotides to the growing DNA strand, creating a new strand that is complementary to the template strand. The phosphodiester bond forms between the 3' hydroxyl group of the existing DNA chain and the 5' phosphate group of the incoming deoxynucleotide. This process continues in the 5' to 3' direction, resulting in the synthesis of a complementary DNA strand.

30. Write chemical composition of protein.

Proteins are composed of amino acids linked by peptide bonds. Amino acids consist of an amino group (NH2), a carboxyl group (COOH), a hydrogen atom, and a variable side chain (R group). Peptide bonds form between the carboxyl group of one amino acid and the amino group of another. The primary structure is the linear sequence of amino acids, while secondary and tertiary structures arise from interactions like hydrogen bonding and disulfide bridges. Quaternary structure involves interactions between multiple polypeptide chains. Prosthetic groups may be present. The unique combination and sequence of amino acids determine a protein's structure and function.

31. What is base analogous and intercalcate agents?

Base analogs and intercalating agents are compounds that can interact with DNA, often causing structural alterations or errors during DNA replication or transcription. Here's a brief explanation of each:

1. Base Analog:

A base analog is a chemical compound that structurally resembles one of the four standard DNA bases (adenine, thymine, guanine, or cytosine). Base analogs can be incorporated into the growing DNA chain during replication in place of a natural base. Examples include 5-bromouracil, which is similar to thymine, and 2-aminopurine, which is similar to adenine. The incorporation of base analogs can lead to mutations and alter the genetic code.

2. Intercalating Agent:

Intercalating agents are molecules that can insert themselves between adjacent base pairs in the DNA double helix. These agents are often planar, aromatic compounds with dimensions that allow them to fit between the stacked bases of DNA. Examples include ethidium bromide and doxorubicin. Intercalation can result in the distortion of the DNA helix and lead to frameshift mutations during replication or transcription.

32. What is alkylation of DNA?

Alkylation of DNA involves the addition of alkyl groups (e.g., methyl or ethyl groups) to the DNA molecule. This chemical modification can occur due to exposure to alkylating agents, leading to changes in DNA structure and function. Alkylation is relevant in cancer treatment, as certain chemotherapy drugs are alkylating agents that damage DNA in rapidly dividing cells, ultimately causing cell death. It also plays a role in epigenetic regulation through DNA methylation. DNA repair mechanisms exist to correct alkylation damage, and understanding these processes is important for both toxicology and therapeutic applications.

33.