

The exam will be a combination of multiple choice, true/false, short-answer questions and 1 essay question. You will need to bring a 100-question scantron and a #2 pencil to the exam. You do not need a blue book. There will be approximately 50 multiple choice (1 pt each), 10 True/False (1 pt each), 8 short-answer questions (3 pts each) and 1 essay (15 pts). Potential Essay questions are listed below. I will choose one of these essay questions and present it to you on the test with exactly this wording.

I will also provide you a list of short-answer sample questions. The sample questions may or may not appear on the test with the exact wording. Furthermore, this is not an exhaustive list of all the questions you might be asked, but I hope it will help guide your studies.

### Potential Essay Questions

1. Discuss protein structure. For full credit include a discussion of peptide bonds, forces that drive protein folding, the common folding patterns that emerge, the levels of higher ordered structure observed (primary –quaternary structure) and the concept of the protein domain.
2. Describe the 3 dimensional structure of DNA. For full credit describe the composition of nucleotides, how nucleotides are covalently bonded, the positions of the bases, specific base-pairing between strands and the orientation of the stands relative to each other.
3. Describe the process of DNA replication. Include in your discussion the roles of DNA polymerase, primase, helicase, topoisomerase, single-stranded binding proteins, ligase, Okasaki fragments, and origins of replication. You may include a drawing, but you must describe the process in narrative form. Tell me how this works.
4. Discuss the DNA repair mechanism called Strand-Directed Mismatch Repair. For full credit, discuss the nature of the mutation, the means by which the cell distinguishes the mutated strand from the normal strand and the mechanism by which the mutation is repaired.
5. Explain the process of transcription in Prokaryotes. Include in your answer, a discussion of the structure of the gene, the role of the promoter, and a detailed description of initiation, elongation and termination of transcription
6. Describe the process of translation in Prokaryotes. For full credit, discuss the roles of the Shine-Delgarno Sequence, tRNA, codons, anticodons, the small ribosomal subunit, the large ribosomal subunit, amino acids, peptide bonds, and releasing factors. Frame your answer chronologically in the context of the three temporal phases of translation: Initiation, Elongation, and Termination.
7. Explain how the Lac Operon is regulated under the following conditions:
  - a. Lactose is absent from the environment
  - b. Lactose is present and glucose is absent
  - c. Lactose and glucose are both present in the environmentInclude in your answer the roles of the Repressor, CAP, RNA Polymerase and lactose.

## Short-Answer Sample Questions

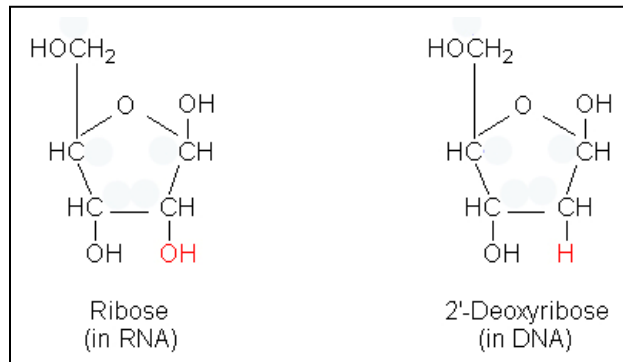
1. What are the general characteristics of a Protein Domain?
2. How do hydrophobic interactions affect protein folding?
3. List the types of non-covalent bonds that function to stabilize the 3 dimensional structure of proteins.
4. List the general characteristics of enzymes.
5. How can duplication and divergence result in the evolution of families of related proteins?
6. Describe the structure of an  $\alpha$  helix found in a polypeptide?
7. Erwin Chargaff provided Watson and Crick with important information that helped them to solve the 3D structure of DNA. What was the basis of Chargaff's Rules?
8. The strands of DNA within the double helix run antiparallel to each other. Draw a simple picture that illustrates the antiparallel nature of double-stranded DNA. Use the symbols 5' and 3' to indicate polarity of the molecule.
9. What is a gene?
10. Genes contain promoters. What is the function of a promoter?
11. What is the importance of the +1, -10 and -35 sequences found in the promoters of prokaryotic genes?
12. What role does the sigma factor ( $\sigma$  factor) play during transcription in prokaryotes?
13. What kind of enzyme is the Rho factor and how does it function to terminate transcription in prokaryotes?
14. What is a codon? What does it specify?
15. Replication errors can result in mismatched bases on the parental (template) and daughter strands. In the example below, the thymines in bold are mismatched.

5'-GATCACCTGG-3' Parental strand  
3'-CTAGTGGTCC-5' Daughter strand

How does the Strand-Directed Mismatch Repair system distinguish the parental strand from the daughter strand so it knows which strand to repair?

16. DNA replication is semiconservative. What do we mean by the term semiconservative?

17. Number the carbons 1'-5' on the ribose and deoxyribose sugar



18. What is the energy source for the addition of new nucleotides to the growing daughter strand during DNA replication?

19. What is the function of the following proteins in DNA replication?

- DNA polymerase
- Helicase
- Single stranded binding proteins
- Primase
- Topoisomerase
- ligase

20. What are the major causes of DNA damage.

21. Draw a nucleotide sequence that is homologous to 5'TTGGAACC3'. Include the 5' and 3' designations to show polarity.

22. Draw a nucleotide sequence that is complementary to 5'TTGGAACC3'. Include the 5' and 3' designations to show polarity.

23. What is a transposon and how does it jump from one region of DNA to another?

24. Explain how retroviruses such as HIV infect cells and integrate their genomes into the host chromosome.

25. What are the fundamental differences between RNA and DNA?

26. What are the functions of mRNA, tRNA and rRNA?

27. How does a tRNA become charged with the appropriate amino acid?

28. How does the Shine-Delgarno sequence help the ribosome to initiate translation at the proper AUG codon?

29. What are releasing factors and how do they catalyze the release of a completed polypeptide from the ribosome?

30. How does a polycistronic mRNA differ from a monocistronic mRNA?
31. What is lactose and how is it altered by  $\beta$ Galactosidase?
32. What is the role of permease in lactose metabolism?
33. In the absence of lactose
  - a. is the repressor bound to the operator?
  - b. Can RNA polymerase bind the Lac promoter?
  - c. Are the LacZ, LacY and LacA genes being transcribed?
34. When lactose is present and glucose is absent
  - a. is the repressor bound to the operator?
  - b. Can RNA polymerase bind the Lac promoter?
  - c. Are the LacZ, LacY and LacA genes being transcribed?
  - d. Are c-AMP levels high or low?
  - e. Is the Catabolite Activator Protein (CAP) bound to the Lac Operon?
35. What is the functional difference between a constitutive promoter and a regulated promoter?
36. How do gene regulatory proteins recognize and bind specific DNA sequences?