SBI4U UNIT 4 REVIEW - MOLECULAR GENETICS DVORSKY

Use your notebook, your textbook and our website to review the following questions. Key diagrams should be labeled multiple times for practice. Key terms should be defined using as much detail (maybe even a sketch) as possible. Please note that solutions will NOT be provided. These questions are only intended as a guide to help you study for the unit test.

SHORT ANSWER

1. The History of DNA. Key people and events.
2. List, explain and draw the events of DNA replication.
3. Explain the differences and similarities of how DNA is organized in Prokaryotes vs. Eukaryotes
4. List and explain the key events of protein synthesis.
5. Using your genetic code...given the DNA triplet on the template strand is TAC, what are a) the corresponding mRNA codon, b) tRNA anticodon, and c) amino acid?
6. Using your genetic code...given the tRNA anticodon is UUC, what are the corresponding a) DNA triplet on the template strand, b) mRNA codon, and c) amino acid?
7. Be able to identify the types of mutations and the effect that each mutation can produce.
8. The following fragments of DNA were obtained after digestion of a sequence using restriction enzymes: 3 kb, 5 kb, and 7 kb. Sketch the resulting gel after running the fragments using gel electrophoresis. Assume that the fragments were all run in one lane. Label the positive and negative electrodes. Which fragment moved the fastest and why? How many cuts were made on the original sequence of DNA to produce this number of bands? (Longer fragments move through the gel slower)
9. If a cycle of the PCR takes 15 minutes, how many copies of a single DNA fragment will there be after the reaction has been run for two hours?
10. If the percentage of thymine in a DNA molecule is 30%, what is the percentage composition of cytosine?

KEY DIAGRAMS TO LABEL & INTERPRET

1. semi-conservative DNA replication
2. gel from electrophoresis
3. active spliceosome
4. ribosome / translation
5. Hershey & Chase's expt

KEY TERMS TO DEFINE

1. DNA vs RNA
2. amino acid
3. Central Dogma
4. chromosomal mutation
5. complimentary base pairing
6. Hayflick limit
7. helicase
8. frameshift mutation
9. genes
10. histone
11. insertion & deletion
12. introns & exons
13. leading & lagging strand
14. LINES & SINES
15. antagonistic pleitropy
16. missense mutation
17. mutagens
18. nonsense mutation
19. topoisomerase
20. dNTP ddNTP
21. PCR technology
22. phosphodiester bond
23. plasmid
24. point mutation
25. recombinant DNA
26. replication fork
27. restriction endonucleases
28. RNA (mRNA, tRNA)
29. RNA primer
30. silent mutation

31. CRISPR/cas9
32. SSBs
33. substitution
34. *Taq* polymerase
35. transcription
36. translation
37. translocation
38. VNTRs

Sample Questions:
Answer the following questions, check your answers and good luck!

1. What is the difference between DNA and proteins? Describe the experiments leading up to the discovery that DNA was the hereditary molecule, noting the names of the researchers involved. Use a timeline or chart to organize this information. (See summary on pg. 215)

2. Describe the physical and chemical characteristics of DNA. A diagram would be useful for this question.

3. In numbered steps, describe DNA replication.

4.. What is the difference between a purine and a pyrimidine? Give specific examples to support your answer.

5. What is the difference between semi-conservative and conservative DNA replication? Use a diagram to support your answers.

6. Describe Meselson and Stahl's experiment on DNA replication. What is the significance of their discovery?

7. What is the difference between the lagging strand and the leading strand in DNA replication?

8. How does DNA ligase work? (name and describe the bond and it's formation).

9. What enzyme ensures "quality control" in DNA replication? How does it accomplish this?

10. What is the relationship between DNA, RNA and protein? What are their specific roles in protein synthesis?

11. What is the difference between DNA and RNA?

12. Why do genes need control mechanisms that turn them on and off?

13. Explain how mutations can be beneficial or detrimental, and provide examples for each.

14. Why do we age?

15. What is the Hayflick limit?

16. **What is the "Central Dogma"?**

17. **In a numbered list, outline protein synthesis, noting the location of all processes, beginning with DNA.**

19. **How is mRNA protected when it leaves the nucleus?**

20. **Why does life bother with transcribing DNA to RNA?**

21. **When and how are introns removed from RNA? What happens to introns once they are removed?**

22. **Describe the structure of a ribosome. Draw a diagram of a ribosome binding an mRNA strand, noting the direction translation moves.**

23. **What is the role of tRNA? Where does the amino acid bind? Where the polypeptide bond form?**

24. **How is translation terminated?**

25. **What is a *lac* Operon? How does it control gene expression in *E. coli*?**

26. **How is the *trp* Operon different from the *lac* Operon? Why is it considered a** co-repressor?

27. **What is a mutation? Make a chart outlining the different mutation types, and provide examples for each one.**

28. **What is a mutagen? Provide an example and describe how it induces mutation.**

29. **If all of the chromosomes in your body were unwound, they would stretch to be approximately 1.8 m long. How do they fit into a nucleus that has a five micrometer diameter? Be specific.**

30. **What is the role of restriction endonucleases in the formation of recombinant DNA?**

31. **What is the difference between sticky and blunt ends?**

32. **Why are recognition sites between 4 to 8 bases long, never longer or shorter?**

33. **Why did restriction endonucleases evolve, and how do bacterial cells protect their own DNA from being digested?**

34. **Describe the process of gel electrophoresis. How do researchers know the size of each fragment? Be specific.**

35. **What is a plasmid, and how are they important to genetics research?**

36. **Why is it good to have a high copy number when you're cloning plasmids?**

37. **Why do researchers want to work with plasmids that have a multiple-cloning site?**

38. **What is meant by the term recombinant DNA.**

39. **Describe the process of PCR.**

40. **Why is PCR such a significant breakthrough for geneticists?**

41. **Why can the polymerase used in PCR withstand high temperatures without being denatured?**

42. **Describe the process of gel electrophoresis**

43. **What is CRISPR/Cas9**

44. **Be able to sequence DNA using the Sanger dideoxy method.**