

Nucleic Acids

1. What is a nucleotide composed of and which types of nucleotides are found in DNA and RNA and how do they differ?
2. Explain the composition and structure of DNA. How do the DNA ends look like?
3. Explain major and minor groove of the DNA.
4. What do you know about base pairing in D/RNA?
5. Explain the denaturation of DNA, and explain how the G/C content influences it.
6. Describe the polymerase chain reaction.
7. Explain the terms gene, chromosome and genome.
8. Describe the organization of DNA in eukaryotic and prokaryotic cells.
9. Explain DNA replication
10. What is a plasmid?
11. What is the polymerase chain reaction?
12. How can DNA differ between two individuals and for which analyses can this information be used?
13. Explain the structure of a gene.
14. Explain the structure of different types of RNA.
15. Compare DNA and RNA, and list at least three differences.
16. What is gene expression and which steps are involved in gene expression?
17. What is "transcription"? How does it occur?
18. Explain RNA splicing.
19. What is translation, what does it require and where does it occur?
20. Explain the structure of a ribosome.
21. Explain the structure of the transfer-RNA, and how it confers specificity between the genetic code and the amino acid sequence of proteins.
22. What is the "genetic code", and why does it "wobble"?

Proteins

23. Explain the "peptide bond". How does it influence the structure of the final protein?
24. What is the N-Terminus and C-Terminus of a protein?
25. What kind of secondary structures of proteins do you know – how do these structures arise?
26. What are the main differences between alpha-helix and β -sheets?
27. How can β -sheets be stabilized?
28. Explain the terms "motif" and "domain" in protein structures.
29. List the three most common types of protein motifs and explain their structure.
30. What is the Greek Key motif?
31. What is the Helix-turn-helix motif?
32. What is the EF-hand motif?
33. What is the β -hairpin motif?
34. What is the β - α - β motif?
35. Explain the structure of alpha-domain proteins. Give examples. What stabilizes their structure?
36. Twisted-sheet vs. closed barrel – explain how these structures arise.
37. Explain antiparallel β -sheets, and give examples. Which structures can be formed and why?

38. What is “denaturation of a protein”? Give examples.
39. Explain the process of denaturation of a protein on the basis of –S-S-groups in proteins.
40. What is protein glycosylation? What are the two most common types of glycosylation?
41. What type of molecule is keratin and where does it occur? Explain its structure.
42. Explain the structure of collagen and where it can be found in nature.
43. Describe the structure of silk.
44. Describe the structure of immunoglobulin IgG.
45. Compare the structure of the domains in IgG.
46. Provide a brief sketch of the immune response.
47. Which functions do B-cells and T-cells have?
48. By which defect is sickle cell anemia caused?
49. What causes the Creutzfeld-Jakob disease?

Enzymes

50. What is a catalyst? What is an enzyme? Explain and compare
51. Explain the function of an enzyme and highlight the importance of the activation energy
52. Explain how an enzyme can reduce the activation energy for a reaction
53. What are cofactors? Give examples.
54. What are coenzymes and how can they be grouped? Give at least 3 examples for each group.
55. What is the active center of an enzyme?
56. Explain the “transition state” of an enzymatic reaction.
57. Name the six classes of enzymes, and give examples for at least three classes
58. Describe the nomenclature of enzymes
59. What is the Michaelis-Menten equation?
60. What does the Michaelis-Menten constant mean to biochemistry? How can it be used?
61. Explain the estimation of K_m and V_{max} by the Lineweaver Burk plot
62. Explain why an enzyme’s activity is temperature dependent
63. Explain why an enzyme’s activity is pH-dependent
64. List and explain in one sentence different types of enzyme inhibition.
65. Describe competitive and non-competitive enzyme inhibition.
66. Describe how irreversible enzyme inhibition works
67. Explain the allosteric behavior of an enzyme.
68. Explain the biological functions of enzymes and how is enzyme activity controlled.
69. Give at least 5 examples for industrial enzymes.
70. Explain the term ‘protein engineering’.
71. What do you know about biotechnological insulin production?

Metabolism

72. Explain and compare the principles of catabolism and anabolism. How do coenzymes aid in these processes?
73. Explain the “steady state equilibrium” of metabolism. What generates the flow into one direction?

74. What is an “energy rich compound”, and why is it needed for metabolism. Explain on behalf of ATP.
75. What is the main difference between transporters and channels?
76. Explain the three principal types of transport processes across membranes?
77. Explain uniport, symport and antiport
78. Explain “passive and active transport” – how does it work?
79. What are NAD and NADP, and how are they involved in metabolism?
80. What are vitamins, and how are they related to coenzymes?
81. What is glycolysis? (Describe in words).
82. What is the citric acid cycle? Describe its characteristics.
83. What is the respiratory chain and what is the principle of its function.
84. How can ATP be synthesized?
85. Via which pathways can glucose metabolism occur? What are the limitations and benefits of the separate pathways?
86. Compare aerobic and anaerobic metabolism of glucose.
87. Compare energy metabolism in red and white muscle fibers.
88. How is metabolism regulated?
89. Explain the regulation of metabolism at the level of gene expression – how does it work?
90. What is regulation by covalent modification? Give an example.
91. What is regulation by non-covalent modification? Give an example.
92. What is a signal transduction cascade?
93. Explain how metabolism can be regulated by feedback inhibition. Why are allosteric enzymes involved as targets?