Study guide chapter 5:  
The Structure and Function of Macromolecules


**Concept checks:** All

**0. Application**

1. Why do kids suffering from protein malnutrition suffer from a swollen abdomen, weight and hair loss?

**I. The big picture**

2. So far we have considered the inside of cells as mostly water with 25 elements floating around. In this chapter we will see how cells organize atoms into four classes of large ordered molecules with particular shapes which support the activities necessary for sustaining and perpetuating life. Each cell has thousands of different kinds of macromolecules (mostly proteins) – what makes such diversity necessary?

**II. Principles of polymers**

3. Distinguish between the four major classes of organic compounds found in cells, their monomers, their main functions, and the elements they are composed of. Give an example for each (see page 90). Note that you will encounter our CHNOPS elements again.

<table>
<thead>
<tr>
<th>Class</th>
<th>Monomer</th>
<th>Example</th>
<th>Main function</th>
<th>Elements present in all molecules of this class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td></td>
<td></td>
<td></td>
<td>C, H, O</td>
</tr>
<tr>
<td>Lipids</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Draw diagrams to illustrate **condensation** and **hydrolysis** reactions (Figure 5.2). Which of these reactions is usually exergonic, which is usually endergonic? What role do **enzymes** play in these reactions? Also see the tutorial assigned in Mastering Biology quiz chapter 5.

5. How can the huge variety of **polymers** (more than a million antibody proteins) in cells be built from a small set of monomers?
III. Carbohydrates
6. Describe glucose as precisely as you can (include alpha- and beta, D and L, discuss chain and ring forms) (Fig. 5.3-5.5).
7. Compare and contrast the starch amylose, glycogen, and cellulose (structure, function, occurrence). Explain why the differences are biologically important (5.7-5.8).

IV. Lipids Are a Diverse Group of Hydrophobic Molecules
8. Describe the building-block molecules, structure, and biological importance of fats, phospholipids, and steroids (Fig. 5.10, 5.12-5.14).
9. Distinguish between saturated, monounsaturated, polyunsaturated, hydrogenated, cis and trans fatty acids (Fig. 5.11).
10. What causes atherosclerosis? Remember that you should be able to define bold-faced terms.

V. Proteins Have Many Structures and Many Functions
11. Distinguish between a protein and a polypeptide.
12. List and describe the four major components of an amino acid.
13. Explain how amino acids may be grouped according to the physical and chemical properties of the R group (Figure 5.16). Note: you do not need to learn amino acids by heart, but you should be able to recognize their main chemical property from their depiction.
14. What are essential amino acids (refer to Application question)?
15. Give an example of food items with complimentary essential amino acids.
16. Define primary structure. Which parts of amino acids and which bonds are involved?
17. The secondary protein structure consists of only few, very regular forms while the tertiary level leads to a huge variety of forms. Why is that (again, consider parts of amino acids and bonds involved)?
18. Define quaternary protein structure and distinguish between globular and fibrous proteins. Know examples for each.
19. What is the advantage of having the huge variety of protein shapes?
20. What happens when a protein denatures (Figure 5.23). List four conditions under which proteins may be denatured.
21. What role do chaperonins play in the process of protein folding?
22. What is meant by biological specificity? Refer to key concept handout.
23. What does biological specificity depend upon (Figure 5.20)?
VI. Nucleic Acids (on your own)

24. Compare and contrast DNA and RNA (Structure and function, Figure 5.26).

25. List the major components of a nucleotide, and describe how these monomers are linked to form a nucleic acid (Figure 5.27). Know which bases bond with which bases in DNA. See also the two activities in the Mastering Biology chapter 5 quiz.

VII. Apply your knowledge

26. Name the principal energy storage molecules of plants and animals.

27. Predict consequences of a change in primary protein structure. Distinguish between a change in the active site of an enzyme (Figure 5.16) or the groove of a lysozyme (Figure 5.19) versus a change in the purple “bulk”. Distinguish between a change from glycine to alanine in the receptor part of a transmembrane protein versus a change from glycine to tyrosine (Figure 5.17).

28. Recognize to which class a particular molecule belongs. See the last question in the Mastering Biology chapter 5 quiz.

Essay question
Describe the process of protein folding using a protein with quaternary structure. Discuss which intramolecular properties and interactions define the final shape. How is misfolding prevented and why is this important? Explain all technical terms you are using.

Note that this week’s online quiz includes watching a Bioflix animation. Watch it to see whether it is helpful, and if so, check out the other Bioflix animations available to you.