Proteins

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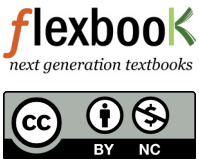

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CHAPTER 1 Proteins

- Describe the composition of a protein.
- Distinguish between the four levels of protein structure.
- Summarize significant protein functions.

You may have been told proteins are good for you. Do these look good to you?

Proteins as food. To you, these may not look appetizing (or they might), but they do provide a nice supply of amino acids, the building blocks of proteins. Proteins have many important roles, from transporting, signaling, receiving, and catalyzing to storing, defending, and allowing for movement. Where do you get the amino acids needed so your cells can make their own proteins? If you cannot make it, you must eat it.

Proteins

A **protein** is an organic compound made up of small molecules called **amino acids**. There are 20 different amino acids commonly found in the proteins of living organisms. Small proteins may contain just a few hundred amino acids, whereas large proteins may contain thousands of amino acids. The largest known proteins are titins, found in muscle, which are composed from over 27,000 amino acids.

Protein Structure

When amino acids bind together, they form a long chain called a **polypeptide**. A protein consists of one or more polypeptide chains. A protein may have up to four levels of structure. The lowest level, a protein's primary structure, is its sequence of amino acids. Higher levels of protein structure are described in **Figure** 1.2. The complex structures of different proteins give them unique properties, which they need to carry out their various jobs in living organisms. You can learn more about protein structure by watching the animation at the following link: http://www.stolaf.edu/people/giannini/flashanimat/proteins/protein%20structure.swf .

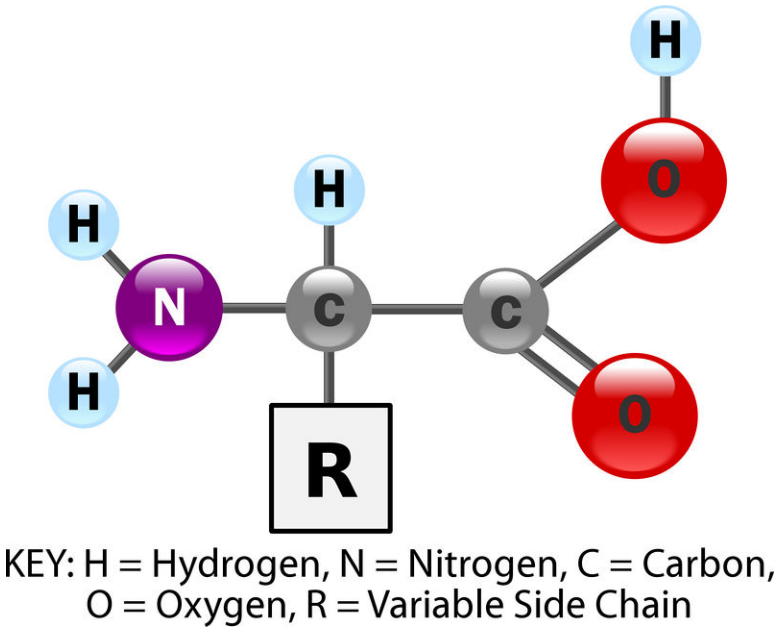


FIGURE 1.1

General Structure of Amino Acids. This model shows the general structure of all amino acids. Only the side chain, R, varies from one amino acid to another. For example, in the amino acid glycine, the side chain is simply hydrogen (H). In glutamic acid, in contrast, the side chain is CH_2CH_2COOH. Variable side chains give amino acids different chemical properties. The order of amino acids, together with the properties of the amino acids, determines the shape of the protein, and the shape of the protein determines the function of the protein. KEY: H = hydrogen, N = nitrogen, C = carbon, O = oxygen, R = variable side chain

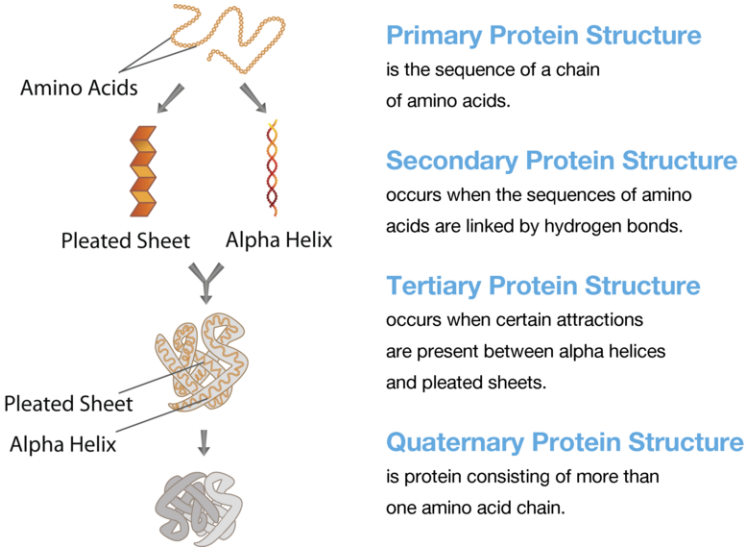


FIGURE 1.2

Protein Structure. The structure of a protein starts with its sequence of amino acids. What determines the secondary structure of a protein? What are two types of secondary protein structure?

Functions of Proteins

Proteins play many important roles in living things. Some proteins help cells keep their shape (structural proteins), some, such as connective and motor proteins, make up muscle tissues, and some transport items in and out of cells (transport proteins). Some proteins act as signals, and other proteins receive those signals. **Enzymes** are proteins that speed up chemical reactions in cells. Other proteins are **antibodies**, which bind to foreign substances such as bacteria and target them for destruction. Still other proteins carry messages or transport materials. For example, human red blood cells contain a protein called **hemoglobin**, which binds with oxygen. Hemoglobin allows the blood to carry oxygen from the lungs to cells throughout the body. A model of the hemoglobin molecule is shown in **Figure** 1.3.

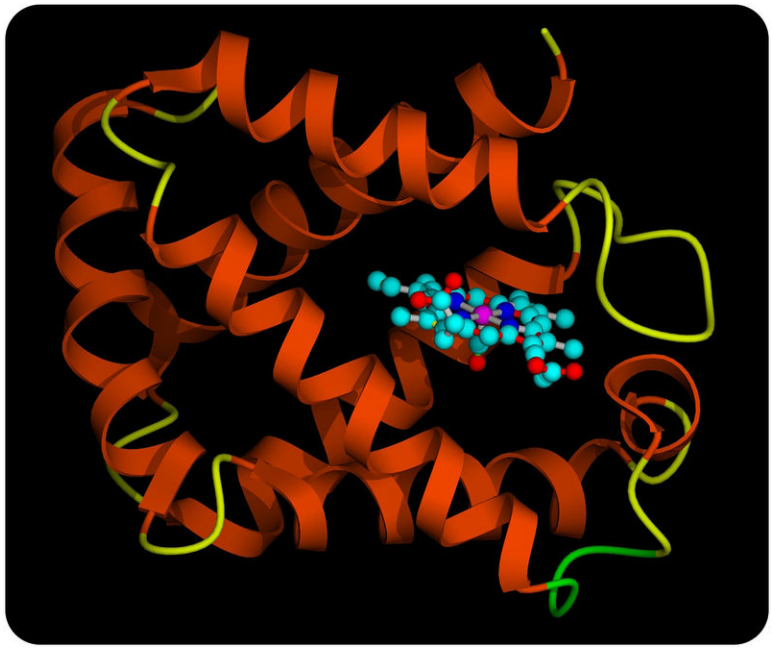
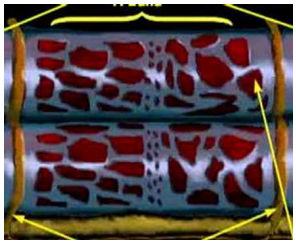


FIGURE 1.3

Hemoglobin Molecule. This model represents the protein hemoglobin. The purple part of the molecule contains iron. The iron binds with oxygen molecules.

A short video describing protein function can be viewed at http://www.youtube.com/watch?v=T500B5yTy58 (4:02).



MEDIA

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As you view *Protein Functions in the Body,* focus on these concepts:

1. the amount of protein in each cell,
2. the roles of different types of proteins.

Proteins and Diet

Proteins in the diet are necessary for life. Dietary proteins are broken down into their component amino acids when food is digested. Cells can then use the components to build new proteins. Humans are able to synthesize all but eight of the twenty common amino acids. These eight amino acids, called **essential amino acids**, must be consumed in foods. Like dietary carbohydrates and lipids, dietary proteins can also be broken down to provide cells with energy.

Summary

- Proteins are organic compounds made up of amino acids.

- A protein may have up to four levels of structure. The complex structures of different proteins give them unique properties.
- Enzymes are proteins that speed up biochemical reactions in cells. Antibodies are proteins that target pathogens for destruction.

Explore More

Use these resources to answer the questions that follow.

Explore More I

- **Biomolecules - The Proteins** at http://www.wisc-online.com/Objects/ViewObject.aspx?ID=AP13304 .

1. Give 3 examples of proteins.
2. What determines the primary structure of a protein?
3. What determines the protein's function?
4. How can a protein's conformation be disrupted?

Explore More II

- **What is a Protein?** at http://learn.genetics.utah.edu/content/molecules/ .

1. How many different proteins are in a cell?
2. What function do receptor proteins and structural proteins have in nerve cells?
3. What is the information used to make an individual protein?
4. What is the part of the cell where proteins are made?

Review

1. Proteins are made out of _____.
2. What determines the primary structure of a protein?
3. State two functions of proteins.
4. What are enzymes?
5. Describe the role of hemoglobin.

References

1. User:YassineMrabet/Wikimedia Commons. A model of the general structure of amino acids . Public Domain
2. Hana Zavadska, based on image from the National Human Genome Research Institute. Illustrates the different structures of proteins . CC BY-NC 3.0
3. Image copyright ynse, 2014. A model of the protein hemoglobin, which allows blood to carry oxygen throughout the body . Used under license from Shutterstock.com