BIOCHEMISTRY

FIFTH EDITION

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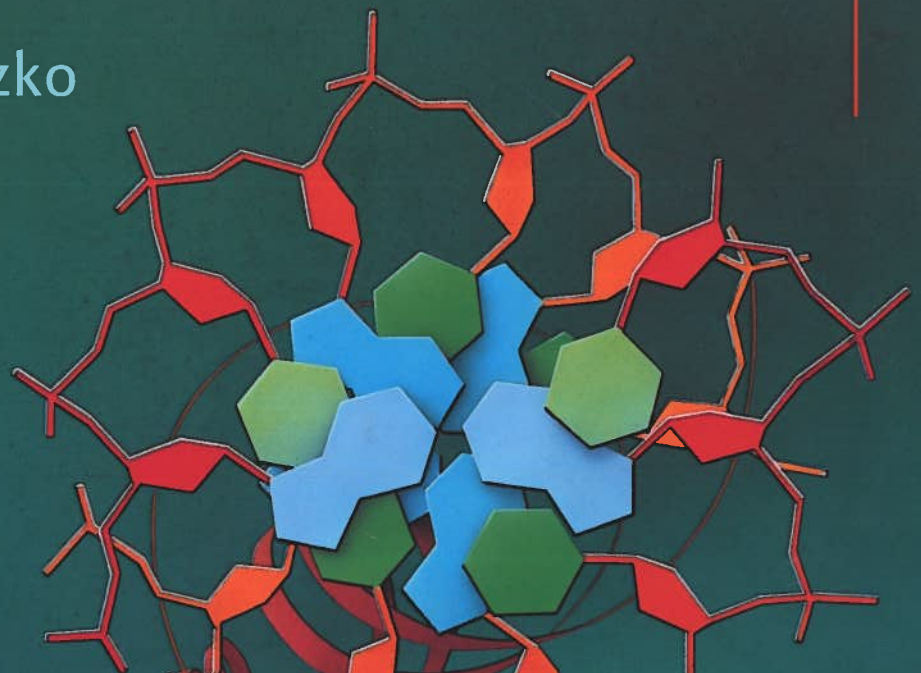

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3. *Selective advantage.* Suppose that a replicating RNA molecule has a mutation (genotypic change) and the phenotypic result is that it binds nucleotide monomers more tightly than do other RNA molecules in its population. What might the selective advantage of this mutation be? Under what conditions would you expect this selective advantage to be most important?

4. *Opposite of randomness.* Ion gradients prevent osmotic crises, but they require energy to be produced. Why does the formation of a gradient require an energy input?

5. *Coupled gradients.* How could a proton gradient with a higher concentration of protons inside a cell be used to pump ions out of a cell?

6. *Proton counting.* Consider the reactions that take place across a photosynthetic membrane. On one side of the membrane, the following reaction takes place:

$$4\,e^- + 4\,A^- + 4\,H_2O \longrightarrow 4\,AH + 4\,OH^-$$

whereas, on the other side of the membrane, the reaction is:

$$2\,H_2O \longrightarrow O_2 + 4\,e^- + 4\,H^+$$

How many protons are made available to drive ATP synthesis for each reaction cycle?

7. *An alternative pathway.* To respond to the availability of sugars such as arabinose, a cell must have at least two types of proteins: a transport protein to allow the arabinose to enter the cell and a gene-control protein, which binds the arabinose and modifies gene expression. To respond to the availability of some very hydrophobic molecules, a cell requires only one protein. Which one and why?

8. *How many divisions?* In the development pathway of *C. elegans,* cell division is initially synchronous—that is, all cells divide at the same rate. Later in development, some cells divide more frequently than do others. How many times does each cell divide in the synchronous period? Refer to Figure 2.26.

Primary structure

Proteins are the most crucial functions in e alysts, they transpor vide mechanical sup erate movement, the control growth and text will focus on un they perform these f

Several key prop such a wide range of

1. *Proteins are linea amino acids.* The con ecules from a limited is a recurring theme tion depend on the function of a protei dimensional structu

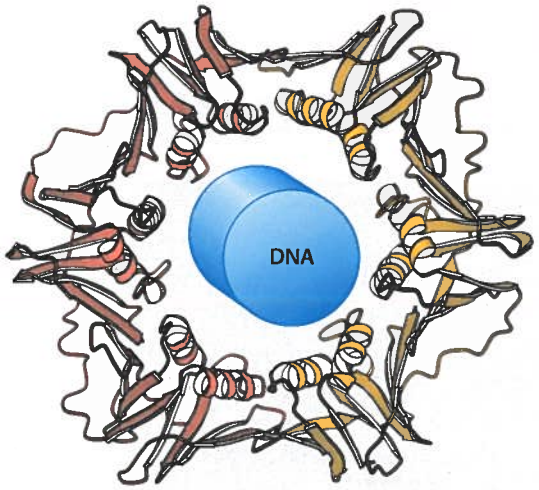


FIGURE 3.1 Structure dictates function. A protein component of the DNA replication machinery surrounds a section of DNA double helix. The structure of the protein allows large segments of DNA to be copied without the replication machinery dissociating from the DNA.

acids, carboxamides, and a variety of basic groups. When combined in various sequences, this array of functional groups accounts for the broad spectrum of protein function. For instance, the chemical reactivity associated with these groups is essential to the function of *enzymes,* the proteins that catalyze specific chemical reactions in biological systems (see Chapters 8–10).

3. *Proteins can interact with one another and with other biological macromolecules to form complex assemblies.* The proteins within these assemblies can act synergistically to generate capabilities not afforded by the individual component proteins (Figure 3.2). These assemblies include macromolecular machines that carry out the accurate replication of DNA, the transmission of signals within cells, and many other essential processes.

4. *Some proteins are quite rigid, whereas others display limited flexibility.* Rigid units can function as structural elements in the cytoskeleton (the internal scaffolding within cells) or in connective tissue. Parts of proteins with limited flexibility may act as hinges, springs, and levers that are crucial to protein function, to the assembly of proteins with one another and with other molecules into complex units, and to the transmission of information within and between cells (Figure 3.3).

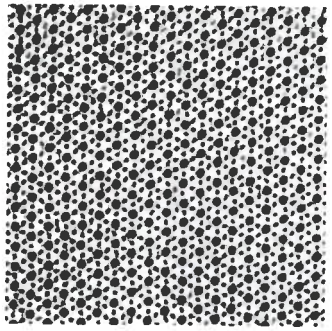
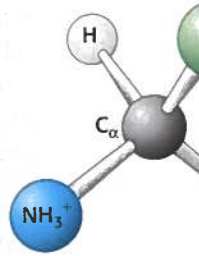


FIGURE 3.2 A complex protein assembly. An electron micrograph of insect flight tissue in cross section shows a hexagonal array of two kinds of protein filaments. [Courtesy of Dr. Michael Reedy.]

3.1 PROTEINS ARE
OF 20 AMINO ACID

Amino acids are the buildi
of a central carbon atom, c
carboxylic acid group, a hy
group is often referred to a
nected to the tetrahedral α
mirror-image forms are ca

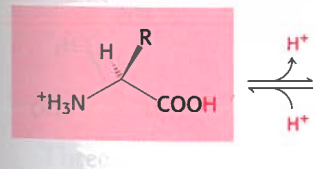


L isomer

FIGURE 3.4 The L and D isome
The L and D isomers are mirror in

Only L amino acids are c
the L isomer has *S* (rather
though considerable effort
proteins have this absolute
been arrived at. It seems p
trary but, once made, was

Amino acids in solutio
ions (also called *zwitterions*)
ated ($-NH_3^+$) and the carb
ization state of an amino a
(e.g., pH 1), the amino grou
is not dissociated (–COOH
first group to give up a pr
form persists until the pH



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