18.2: Proteins and Their Functions- An Overview

Learning Objectives

- Describe the different structural classes of proteins.
- Understand the different functional roles of proteins.

The ability to serve a variety of functions is characteristic of most biomolecules. Nowhere is this versatility better exemplified than by the proteins. Perhaps because of their many functions, proteins are the most abundant organic molecules in living cells, constituting more than 50 percent of the mass once water is removed. It is estimated that the human body contains well over a million different kinds of protein, and even a single-cell organism contains thousands. Each of these is a polymer of amino acids which has a highly specific composition, a unique molecular weight (usually in the range from 6000 to 1 000 000) and its own sequence of different amino acids along the polymer chain.

Proteins may be subdivided on the basis of their *molecular shape* or *conformation*. In the **fibrous proteins**, long polymer chains are arranged parallel or nearly parallel to one another to give long fibers or sheets. This arrangement results in physically tough materials which do not dissolve in water. The fibrous proteins are fundamental components of structural tissues such as tendons, bone, hair, horn, leather, claws, and feathers.

By contrast, polymer chains of the **globular proteins** fold back on themselves to produce compact, nearly spherical shapes. Most globular proteins are water soluble and hence are relatively mobile within a cell. Some examples are enzymes, antibodies, hormones, toxins, and substances such as hemoglobin whose function is to transport simple molecules or even electrons from one place to another. The enzyme trypsin, is a typical globular protein.

Another class of proteins are the **membrane proteins**, which, as the name would suggest, reside in a cell's lipid bilayer membrane. Such proteins can act as channels for ions or other molecules unable to pass through the lipid bilayer; as signal transducers, able to respond to signal molecules on one side of a membrane to begin a molecular response on the other side of the membrane; or as anchors of other molecules to the cell membrane, to name a few exemplars of membrane protein function. Because these proteins interface with non-polar portions of the lipid bilayer, they do no maintain function and structure in an aqueous solution, making them far more difficult to study than globular proteins or fibrous proteins.

Proteins are also classified based on their function as listed in Table 18.2.1 below. As you will see in the following chapters, the structure and function of a protein are directly related, meaning that if a protein adopts a certain structure, the general function of that protein can be predicted with a good amount of certainty.

Table 18.2.1: Classes of Proteins by Function

Type	Function	Example
Enzymes	Catalyze biochemical reactions	*Amylase* – helps digest carbohydrates
Hormone proteins	Regulate and coordinate cell functions	*Insulin* – controls the amount of sugar (glucose) in the blood
Storage proteins	Storage and release of essential substances	*Myoglobin* – stores oxygen in muscle tissue
Transport proteins	Carries substances through the body	*Hemoglobin* – transports oxygen between the lungs and other tissues
Structural proteins	Provides structural shape and support	*Keratin* – main structural component of hair, nails, feathers, hooves, etc.
Defense proteins	Protects the body against foreign invaders	*Immunoglobulin* – recognizes and binds to foreign matter, aiding in destruction
Contractile proteins	Mediate contractile processes, i.e., movement	*Actin* and *Myosin* – control the movement of muscles