1.1 Introduction

The cell is the basic unit of life in all forms of living organisms, from the smallest bacterium to the most complex animal. On the basis of microscopic and biochemical differences, living cells are divided into two major classes: prokaryotes, which include bacteria, blue-green algae, and rickettsiae, and eukaryotes, which include yeasts and plant and animal cells. Eukaryotic cells are far more complex internally than their bacterial ancestors, and the cells are organized into compartments or organelles, each delineated by a membrane (Fig. 1.1a,b). The DNA of the cell is packaged with protein into compact units called chromosomes that are located within a separate organelle, the nucleus. In addition, all eukaryotic cells have an internal skeleton, the cytoskeleton of protein filaments that gives the cell its shape, its capacity to move, and its ability to arrange its organelles and that provides the machinery for movement.

The entire human body contains about 100 trillion cells that are generated by repeated division from a single precursor cell. Therefore, they constitute clones. As proliferation continues, some of the cells become differentiated from others, adopting a different structure, a different chemistry, and a different function. In the
human body, more than 200 distinct cell types are assembled into a variety of types of tissues such as epithelia, connective tissue, muscle, and nervous tissue. Each organ in the body is an aggregate of many different cells held together by intercellular supporting structures. Although the many cells of the body often differ markedly from each other, all of them have certain basic characteristics that are alike. Each cell is a complex structure whose purpose is to maintain an intracellular environment favorable for complex metabolic reactions, to reproduce itself when necessary, and to protect itself from the hazards of its surrounding environment.

1.2 Cell Structure and Function

The different substances that make up the cell are collectively called protoplasm, which is composed mainly of water, electrolytes, proteins, lipids, and carbohydrates. The two major parts of the cell are the nucleus and cytoplasm. The nucleus is separated from the cytoplasm by a nuclear membrane, while the cytoplasm is separated from the extracellular fluid by a cell membrane. The major organelles in the cell are of three general kinds: organelles derived from membranes, organelles involved in gene expression, and organelles involved in energy production. The important subcellular structures of the cell and their functions are summarized in Table 1.1.