**Chapter Review**

**Chapter 1: Introduction to Cells and Cell Research**

1.1

The first cell is thought to have arisen at least 3.8 billion years ago by the enclosure of self-replicating RNA in a phospholipid membrane. The earliest reactions for generation of metabolic energy were a form of anaerobic glycolysis, followed by the evolution of photosynthesis and oxidative metabolism. Two domains of prokaryotic cells, Bacteria and Archaea, diverged early in evolution. Eukaryotic cells, which are larger and more complex than prokaryotic cells, contain a nucleus and cytoplasmic organelles. They evolved as a branch from the Archaea, with mitochondria and chloroplasts originating by endosymbiosis. Multicellular organisms then evolved from associations between unicellular eukaryotes, and division of labor led to the development of the many kinds of specialized cells that make up present-day plants and animals.

1.2

Some organisms are widely used in cell and molecular biology because they can easily be studied in the laboratory. *E. coli* is the basic model for fundamental aspects of biochemistry and molecular biology, and yeasts are the simplest model for eukaryotic cells. *C. elegans* and *Drosophila* are widely used for studies of animal development, and *Arabidopsis thaliana* is the model plant. The closest model for human biology is the mouse. Cell culture provides a way to study animal cells outside of intact organisms, and animal viruses are simple models for studies of many aspects of cell biology.

1.3

The light microscope, with a resolution of 0.2 *μ*m, can be used to visualize cells and larger subcellular organelles. Fluorescence microscopy and the use of GFP allows specific proteins to be visualized and their movements and interactions in living cells to be studied. The use of fluorescent probes in super-resolution microscopy provides a resolving power approximately tenfold greater than that of the light microscope. Electron microscopy, with a resolution a hundredfold greater than light microscopy, is used to analyze details of cell structure. Subcellular fractionation provides the tools to isolate organelles for biochemical analysis.