Cell Biology

Frameworksheet

Standards: 1a; 1c; 1e; 2a; 2b

> **1. a.** *Students know* cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.

The plasma membrane consists of two layers of lipid molecules organized with the polar (globular) heads of the molecules forming the outside of the membrane and the nonpolar (straight) tails forming the interior of the membrane. Protein molecules embedded within the membrane move about relative to one another in a fluid fashion. Because of its dynamic nature the membrane is sometimes referred to as *the fluid mosaic model* of membrane structure.

Cell membranes have three major ways of taking in or of regulating the passage of materials into and out of the cell: simple diffusion, carrier-facilitated diffusion, and active transport. Osmosis of water is a form of diffusion. Simple diffusion and carrier-facilitated diffusion do not require the expenditure of chemical bond energy, and the net movement of materials reflects a concentration gradient or a voltage gradient or both. Active transport requires free energy, in the form of either chemical bond energy or a coupled concentration gradient, and permits the net transport or "pumping" of materials against a concentration gradient.

Questions for Standard 1.a.

1. **Describe the structure of the plasma membrane.**
2. **How do proteins move through the plasma membrane?**
3. **What is the *fluid mosaic model* of plasma membrane structure?**
4. **What are the three ways of regulating materials in or out of the cell? Which of these requires energy to move materials against a concentration gradient? Which do not require energy?**

> **1. c.** *Students know* how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.

All living cells are divided into one of two groups according to their cellular structure. *Prokaryotes* have no membrane-bound organelles and are represented by the Kingdom Monera, which in modern nomenclature is subdivided into the Eubacteria and Archaea. *Eukaryotes* have a complex internal structure that allows thousands of chemical reactions to proceed simultaneously in various organelles. *Viruses* are not cells; they consist of only a protein coat surrounding a strand of genetic material, either RNA or DNA.

Questions for Standard 1.c.

5. **What are the two groups into which all living cells are divided?**
6. **What are the major characteristics of Prokaryotes?**
7. **What are the major characteristics of Eukaryotes?**
8. **What are the major characteristics of Viruses?**
9. **What are the major similarities between prokaryotic cells, eukaryotic cells, and viruses? What are the differences?**

1. e. *Students know* the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.

There are two types—rough and smooth—of endoplasmic reticulum (ER), both of which are systems of folded sacs and interconnected channels. *Rough ER* synthesizes proteins, and *smooth ER* modifies or detoxifies lipids. Rough ER produces new proteins, including membrane proteins. The proteins to be exported from the cell are moved to the Golgi apparatus for modification, packaged in vesicles, and transported to the plasma membrane for secretion.

Questions for Standard 1.e.

10. **What are the two types of endoplasmic reticulum?**
11. **What are the functions of the two types of endoplasmic reticulum?**
12. **Where are new proteins produced in a cell?**
13. **Describe the flow of proteins as they are produced, exported, modified, packaged, and transported in a cell.**

2. a. *Students know* meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.

Haploid gamete production through meiosis involves two cell divisions. During meiosis prophase I, the homologous chromosomes are paired, a process that abets the exchange of chromosome parts through breakage and reunion. The second meiotic division parallels the mechanics of mitosis except that this division is not preceded by a round of DNA replication; therefore, the cells end up with the haploid number of chromosomes. (The nucleus in a haploid cell contains one set of chromosomes.) Four haploid nuclei are produced from the two divisions that characterize meiosis, and each of the four resulting cells has different chromosomal constituents (components). In the male all four become sperm cells. In the female only one becomes an egg, while the other three remain small degenerate polar bodies and cannot be fertilized.

Chromosome models can be constructed and used to illustrate the segregation taking place during the phases of mitosis (covered initially in Standard 1.e for grade seven in Chapter 4) and meiosis. Commercially available optical microscope slides also show cells captured in mitosis (onion root tip) or meiosis (Ascaris blastocyst cells), and computer and video animations are also available.

Questions for Standard 2.a.

14. **How many sets of chromosomes does a haploid cell contain?**
15. **How many cell divisions does meiosis involve?**
16. **How is the second round of meiotic division different than mitosis? Why is this difference important?**
17. **What is the end product of meiosis in males?...in females?**

2. b. *Students know* only certain cells in a multicellular organism undergo meiosis.

Only special diploid cells, called *spermatogonia* in the testis of the male and *oogonia* in the female ovary, undergo meiotic divisions to produce the haploid sperm and haploid eggs.

Questions for Standard 2.b.

18. **How many sets of chromosomes does a diploid cell have (think!)?**
19. **Which diploid cells undergo meiosis in males?...in females?**
20. **How many sets of chromosomes does a haploid sperm cell or a haploid egg cell have?**