Chapter 2-15: The Cell Cycle

The cells of all living things grow and multiply through a cycle that's made up of four phases. During three of these phases, the cell is growing and is metabolically active. During the fourth phase, it is undergoing division, which yields two new cells. In this plate, we examine the four phases of the cell cycle and note the important characteristics and subdivisions of each phase. A subsequent plate explores the phases of mitosis in detail.

As you look over this plate, note that it contains numerous subdivisions that represent phases of the cell cycle. Bold colors may be used for these phases since there is little overlap and there are no fine details to obscure.

The **cell cycle (A)** takes place over different periods of time in different types of cells, and as you know, different types of cells coexist in many organisms. For example, in human fibroblast cells, the cell cycle may encompass about fifteen hours, while in brain cells, the cycle may take many years to complete.

The two major periods of the cell cycle are **interphase (B)** and the M phase (also known as the phase of **cell division (C)**). As the plate indicates, interphase encompasses three smaller periods and is the period of time between cell division. The same bold color may be used for all three portions of interphase, and a different color should be used for the M phase. Reds, blues, greens, or purples are suggested.

During interphase, the cell is extremely active and carries on routine cellular and physiological activities. For examples, cells of the pancreas are actively producing insulin, which facilitates the passage of glucose molecules into cells. During the M phase of cell division, the rate of metabolism is reduced and the cell undergoes division to form two cells.

We now focus on the three phases of interphase during the cell cycle. As before, bold colors should be used.

Three shorter phases make up the interphase period of the cell cycle. The first phase is known as the **G_1 phase (D)**. During this time period, metabolism is occurring at a high rate, many proteins are synthesized, and cell growth is vigorous; the G stands for growth. The cell's organelles also increase in number and size.

The second phase of interphase is the **S phase (E)**. In the S phase, some activities related to cell division take place (S stands for synthesis). The cell's DNA replicates, ensuring that future cells obtain similar copies of its hereditary material, and proteins associated with the DNA are produced during this phase.

The cell prepares to reproduce during the **G_2 phase (F)**. More of the proteins that are essential for cell division are produced during this brief phase, and these proteins move to appropriate sites. The centrioles used for cell division complete their replication during this phase. In addition to these activities, the cell continues its growth and many of its physiological processes.

Not all cells continue the cell cycle at this point; some cells leave the cell cycle and do not undergo cell division. Red blood cells (erythrocytes) are an example.

We complete the plate by focusing on the process of cell division that takes place during the M phase. More detailed descriptions of cell division are given in the next plate; a brief overview is given here.

At the conclusion of the G_2 phase, the cell enters its M (mitosis) phase of cell division. This phase consists of two main processes: the first is **mitosis (H)**, in which the chromosomes separate and segregate themselves on opposite sides of the cell, and the second is **cytokinesis (G)**, in which the cell actually splits. The results of cytokinesis and mitosis are shown in the plate.

Mitosis occurs as a series of events that are separated into four phases, and the process is continuous through these four phases. During **prophase (H_1)**, distinct chromosomes appear as a result of the uncoiling of the chromatin material (which is made up of DNA and protein). During **metaphase (H_2)**, the chromosomes line up along the equator. During **anaphase (H_3)**, the chromosomes separate, and one member of each pair moves to opposite poles of the cell. Lastly, during **telophase (H_4)**, the chromosomes arrive at the opposite poles of the cell and two distinct nuclei begin to form.

The processes that take place during the M phase of the cell cycle lead to new cells that are referred to as daughter cells. A single **mother cell (a)** has passed through the G_1, S, and G_2 phases and enters cell division to produce **two daughter cells (b)**. Each of the two new cells will now enter interphase and the cycle will be repeated.