10.2A: Interphase

Cells must grow and duplicate their internal structures during interphase before they can divide during mitosis.

Learning Objectives

• Describe the events that occur during Interphase

Key Points

• There are three stages of interphase: G₁ (first gap), S (synthesis of new DNA), and G₂ (second gap).
• Cells spend most of their lives in interphase, specifically in the S phase where genetic material must be copied.
• The cell grows and carries out biochemical functions, such as protein synthesis, in the G₁ phase.
• During the S phase, DNA is duplicated into two sister chromatids, and centrosomes, which give rise to the mitotic spindle, are also replicated.
• In the G₂ phase, energy is replenished, new proteins are synthesized, the cytoskeleton is dismantled, and additional growth occurs.

Key Terms

• interphase: the stage in the life cycle of a cell where the cell grows and DNA is replicated
• sister chromatid: either of the two identical strands of a chromosome (DNA material) that separate during mitosis
• mitotic spindle: the apparatus that orchestrates the movement of chromosomes during mitosis
Interphase

During interphase, the cell undergoes normal growth processes while also preparing for cell division. In order for a cell to move from interphase into the mitotic phase, many internal and external conditions must be met. The three stages of interphase are called G1, S, and G2.

Figure 1: The Stages of Interphase and the Cell Cycle: The cell cycle consists of interphase and the mitotic phase. During interphase, the cell grows and the nuclear DNA is duplicated. Interphase is followed by the mitotic phase. During the mitotic phase, the duplicated chromosomes are segregated and distributed into daughter nuclei. The cytoplasm is usually divided as well, resulting in two daughter cells.

G1 Phase (First Gap)

The first stage of interphase is called the G1 phase (first gap) because, from a microscopic aspect, little change is visible. However, during the G1 stage, the cell is quite active at the biochemical level. The cell grows and accumulates the building blocks of chromosomal DNA and the associated proteins as well as sufficient energy reserves to complete the task of replicating each chromosome in the nucleus.

S Phase (Synthesis of DNA)

The synthesis phase of interphase takes the longest because of the complexity of the genetic material being duplicated. Throughout interphase, nuclear DNA remains in a semi-condensed chromatin configuration. In the S phase, DNA replication results in the formation of identical pairs of DNA molecules, sister chromatids, that are firmly attached to the centromeric region. The centrosome is duplicated during the S phase. The two centrosomes will give rise to the mitotic spindle, the apparatus that orchestrates the movement of chromosomes during mitosis. At the center of each animal cell, the centrosomes of animal cells are associated with a pair of rod-like objects, the centrioles, which are at right angles to each other. Centrioles help organize cell division. Centrioles are not present in the centrosomes of other eukaryotic species, such as plants and most fungi.
G₂ Phase (Second Gap)

In the G₂ phase, the cell replenishes its energy stores and synthesizes proteins necessary for chromosome manipulation. Some cell organelles are duplicated, and the cytoskeleton is dismantled to provide resources for the mitotic phase. There may be additional cell growth during G₂. The final preparations for the mitotic phase must be completed before the cell is able to enter the first stage of mitosis.