Cell Cycle

The cell cycle is the complex sequence of events by which cells **grow** and **divide**. In eukaryotic cells, this process includes a series of four distinct phases. These phases consist of the **Mitosis phase (M), Gap 1 phase (G 1), Synthesis phase (S),** and **Gap 2 phase (G 2)**. The G 1, S, and G 2 phases of the cell cycle are collectively referred to as **interphase**.

The dividing cell spends most of its time in **interphase** as it grows in preparation for cell division. The mitosis phase of the cell division process involves the **separation** of nuclear chromosomes, followed by **cytokinesis** (division of the cytoplasm forming two distinct cells). At the end of the mitotic cell cycle, two distinct daughter cells are produced. Each cell contains identical genetic material.

The time it takes for a cell to complete one cell cycle varies depending on the type of cell. Some cells, such as blood cells in bone marrow, skin cells, and cells lining the stomach and intestines, divide **rapidly** and **constantly**. Other cells divide **when needed** to replaced damaged or dead cells. These cell types include cells of the kidneys, liver, and lungs. Still other cell types, including nerve cells, stop dividing once mature.

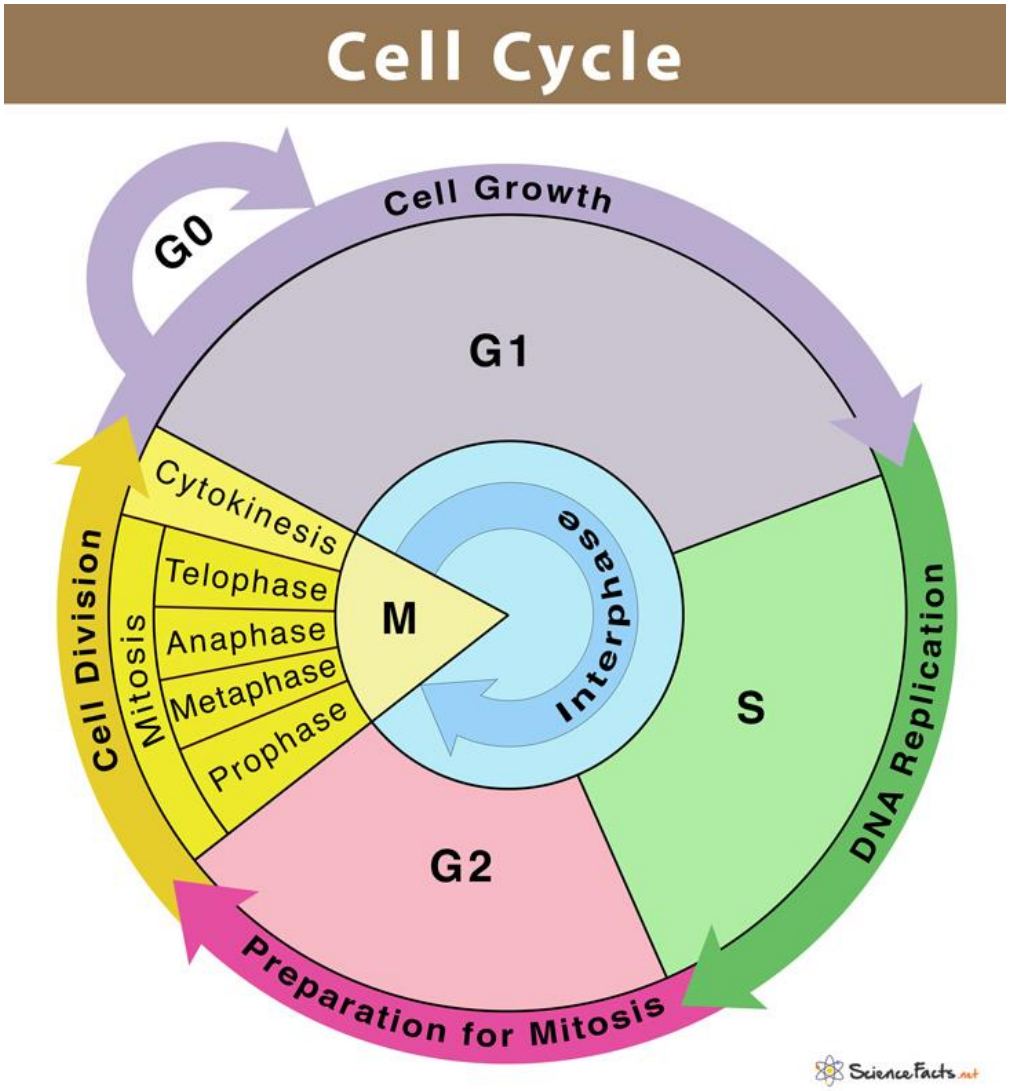
Phases of the Cell Cycle

The **two** main divisions of the cell cycle are **interphase** and **mitosis**.

1. Interphase

During this segment of the cell cycle, a cell doubles its cytoplasm and synthesizes DNA. It is estimated that a dividing cell spends about **90-95** percent of its time in this phase.

- **G1 phase**: The period prior to the synthesis of DNA. In this phase, the cell increases in mass and organelle number in preparation for cell division. Animal cells in this phase are diploid, meaning that they have two sets of chromosomes.
- **S phase**: The period during which DNA is synthesized. In most cells, there is a narrow window of time during which DNA replication occurs. The chromosome content is doubled in this phase.
- **G2 phase**: The period after DNA synthesis has occurred but prior to the start of mitosis. The cell synthesizes additional proteins and continues to increase in size.



2. Mitosis

In mitosis and cytokinesis, the contents of the dividing cell are equally distributed between two daughter cells. Mitosis has four phases: **Prophase, Metaphase, Anaphase,** and **Telophase**.

Prophase: In this stage, changes occur in both the cytoplasm and nucleus of the dividing cell. The chromatin condenses into discrete chromosomes. The chromosomes begin to migrate toward the cell center. The nuclear envelope breaks down and spindle fibers form at opposite poles of the cell.

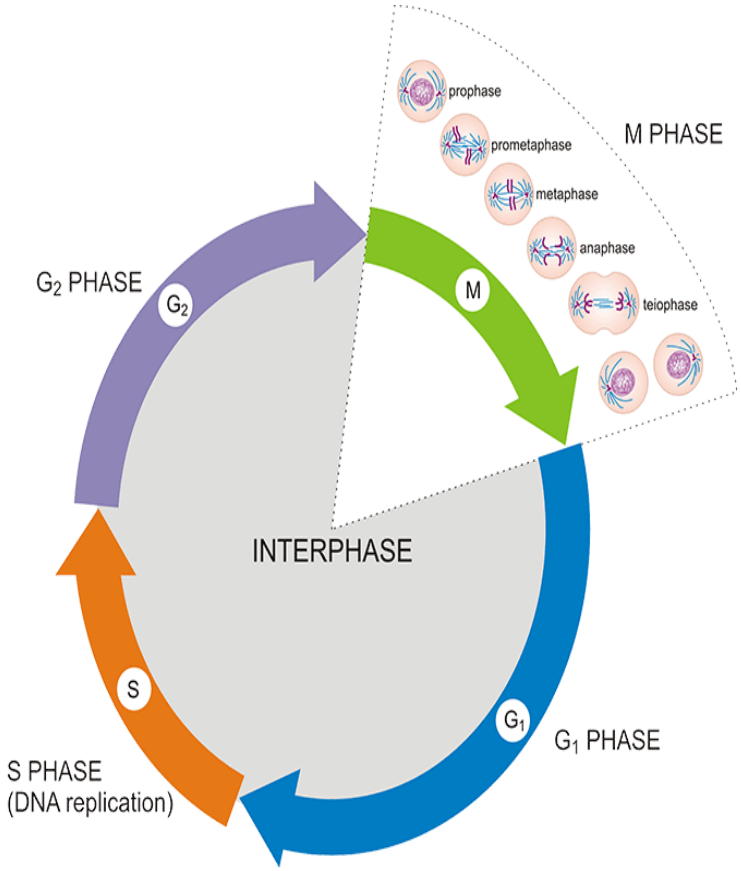
Metaphase: In this stage, the nuclear membrane disappears completely. The spindle fully develops and the chromosomes align at the metaphase plate (a plane that is equally distant from the two poles).

Anaphase: In this stage, paired chromosomes (sister chromatids) separate and begin moving to opposite ends (poles) of the cell. Spindle fibers not connected to chromatids lengthen and elongate the cell.

Telophase: In this stage, the chromosomes are cordoned off into distinct new nuclei and the genetic content of the cell is divided equally into two parts. Cytokinesis begins prior to the end of mitosis and completes shortly after telophase.

Once a cell has completed the cell cycle, it goes **back into the G 1 phase** and repeats the cycle again. Cells in the body can also be placed in a non-dividing state called the **Gap 0 phase (G 0)** at any point in their life. Cells may remain in this stage for very long periods of time until they are signaled to progress through the cell cycle as initiated by the presence of certain growth factors or other signals. Cells that contain genetic mutations are permanently placed in the G 0 phase to ensure that they are not replicated. When the cell cycle goes wrong, normal cell growth is lost.

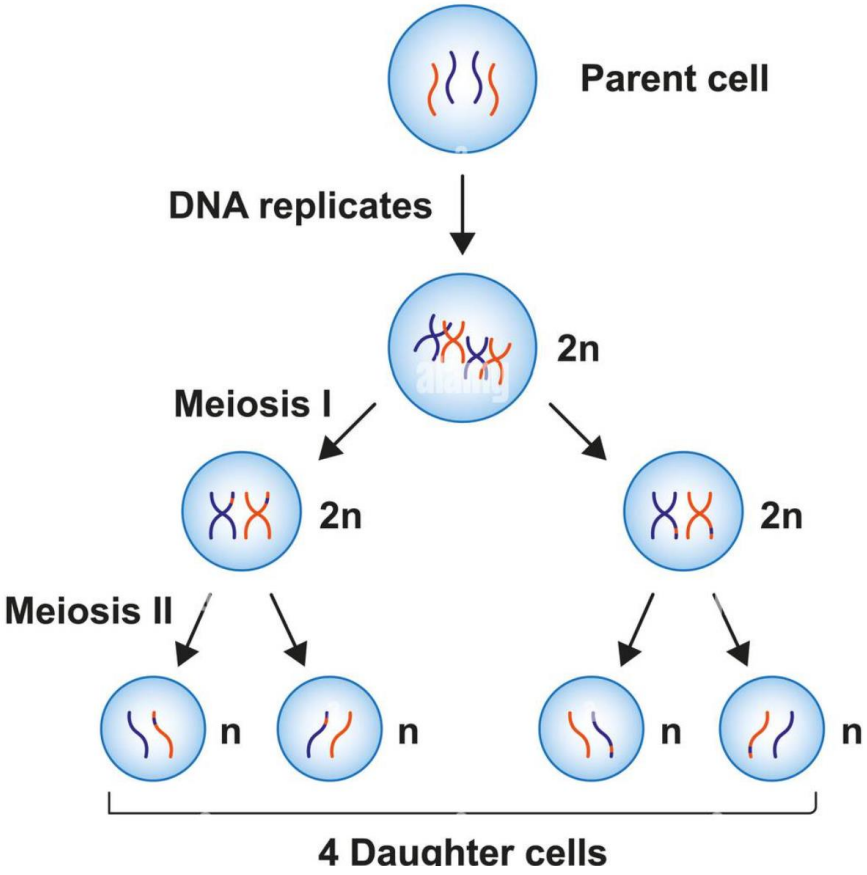
Cancer cells may develop, which gain control of their own growth signals and continue to multiply unchecked.



Cell Cycle and Meiosis

Not all cells divide through the process of mitosis. Organisms that reproduce **sexually** also undergo a type of cell division called **meiosis**. Meiosis occurs in sex cells and is similar in process to mitosis. After a complete cell cycle in meiosis, however, **four** daughter cells are produced. Each cell contains **one-half** the number of chromosomes as the original parent cell. This means that sex cells are haploid cells. When haploid male and female gametes unite in a process called **fertilization**, they form one diploid cell called **a zygote**.

MEIOSIS


Parent cell
DNA replicates
2n
Meiosis I
2n
2n
Meiosis II
n
n
n
n
4 Daughter cells