

## Cell Cycle and Mitosis Exam Reinforcement

### The Cell Cycle

The cell cycle, or cell-division cycle, is the series of events that take place in a eukaryotic cell between its formation and the moment it replicates itself. These events can be divided in two main parts: **interphase** (*in between divisions* phase grouping **G<sub>1</sub> phase**, **S phase**, **G<sub>2</sub> phase**), during which the cell is forming and carries on with its normal metabolic functions; the **mitotic phase** (M mitosis), during which the cell is replicating itself. Thus, cell-division cycle is an essential process by which a single-cell fertilized egg develops into a mature organism and the process by which hair, skin, blood cells, and some internal organs are renewed.

**Interphase** is a phase of the cell cycle, defined only by the absence of cell division. During interphase, the cell obtains nutrients, and duplicates its chromatids. Chromatids are connected by the **centromere** and have a **long and short arm**. *Label* the parts of the chromosome. Most eukaryotic cells spend most of their time in interphase. For example, human skin cells, which divide about once a day, spend roughly 22 hours in interphase. About 90 percent of cells are in interphase. Some cells, such as nerve cells, can stay in interphase for decades. There are 3 parts of interphase: **G<sub>1</sub>** (growth 1 in which the cell creates organelles and begins metabolism), **S phase** (DNA synthesis in which the chromosomes of the cell are copied) and **G<sub>2</sub>** (growth 2 in which the cell grows in preparation for cell division). *Draw an additional line in red* around those parts of the cell cycle diagram that are included in interphase.

The **G<sub>1</sub> phase** is a period in the cell cycle during interphase, after **cytokinesis** (process whereby a single cell is divided into two daughter cells) and before the S phase. For many cells, this phase is the major period of **cell growth** during its lifespan. During this stage **new organelles are being synthesized**, so the cell requires both structural proteins and enzymes, resulting in great amount of protein synthesis. *Color the G<sub>1</sub> phase green.*

The **S phase**, short for **synthesis phase**, is a period in the cell cycle during interphase, **between G<sub>1</sub> phase and the G<sub>2</sub> phase**. Following G<sub>1</sub>, the cell enters the S stage, when **DNA synthesis or replication** occurs. At the beginning of the S stage, each chromosome is composed of one coiled **DNA double helix** molecule, which is called a chromatid. At the end of this stage, each chromosome has two identical DNA double helix molecules, and therefore is composed of **two sister chromatids**. During S phase, the centrosome is also duplicated. *Color the S phase orange.*

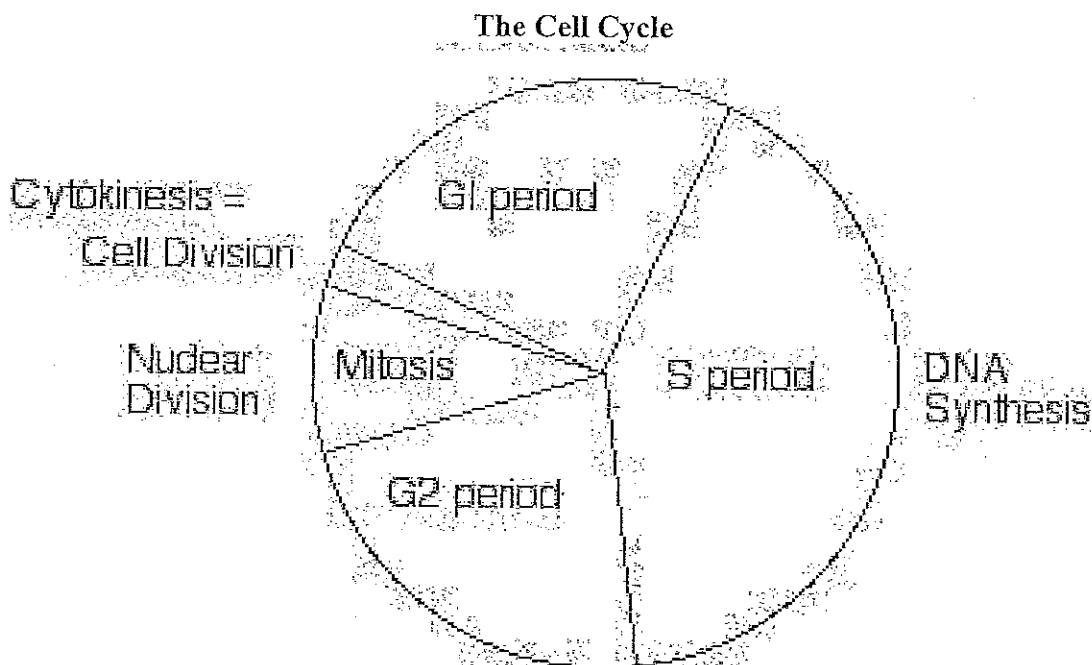
**G<sub>2</sub> phase** is the third, final, and usually the **shortest subphase** during interphase within the cell cycle in which the cell **undergoes a period of rapid growth to prepare for mitosis**. It follows successful completion of DNA synthesis and chromosomal replication during the S phase, and occurs during a period of often four to five hours. Although chromosomes have been replicated they cannot yet be distinguished individually because they are still in the form of loosely packed **chromatin fibers**. The G<sub>2</sub> phase prepares the cell for mitosis (M phase) which is **initiated by prophase**. *Color the G<sub>2</sub> phase light blue.*

## Mitosis

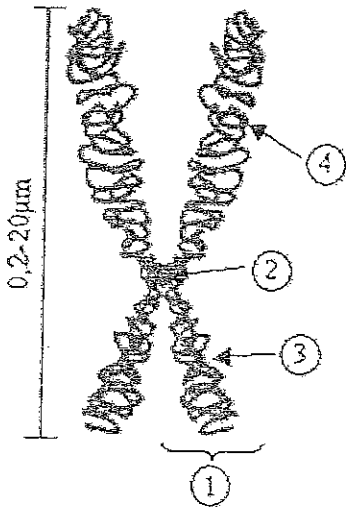
**Mitosis** is the process in which a cell duplicates its chromosomes to generate two, **identical cells**. It is generally followed by **cytokinesis** which divides the cytoplasm and cell membrane. This results in two identical cells with an equal distribution of organelles and other cellular components. Mitosis and cytokinesis jointly define the **mitotic (M) phase** of the cell cycle, the division of the parent cell into two daughter cells, each with the **genetic equivalent of the parent cell**. Mitosis occurs most often in eukaryotic cells. In multicellular organisms, the **somatic cells** (body cells) undergo mitosis, while **germ cells** — cells destined to become sperm in males or ova in females — divide by a related process called **meiosis**. **Prokaryotic cells** (bacteria), which lack a nucleus, divide by a process called **binary fission**.

The process of **mitosis (division of the nucleus)** is divided into **four stages (Prophase, Metaphase, Anaphase, and Telophase)**. Immediately following nuclear division (mitosis), the **cell membrane** must also divide (**cytokinesis**). Animal cells divide the cytoplasm by constricting the cell membrane in the middle to form a **cleavage furrow**. Plant cells form a **cell plate** in the center to divide the cytoplasm. At Interphase, there is only one cell, but after cytokinesis there are two identical cells.

During **prophase**, the DNA molecules are progressively shortened and condensed by coiling, to form **chromosomes**. Spindle fibers form which will attach to the chromosomes. **Enzymes** break down the nuclear membrane and nucleolus which are no longer visible. At **metaphase**, the spindle fibers attach themselves to the centromeres of the chromosomes and align the chromosomes at the **equator** (middle of the cell). **Anaphase** is the next stage. The spindle fibers shorten and the centromere splits separating the two sister chromatids. During **telophase**, the chromosomes pairs (chromatids are pulled to opposite poles of the cell. The nuclear envelope and nucleolus reform before the chromosomes uncoil. The spindle fibers disintegrate.



### Chromosome

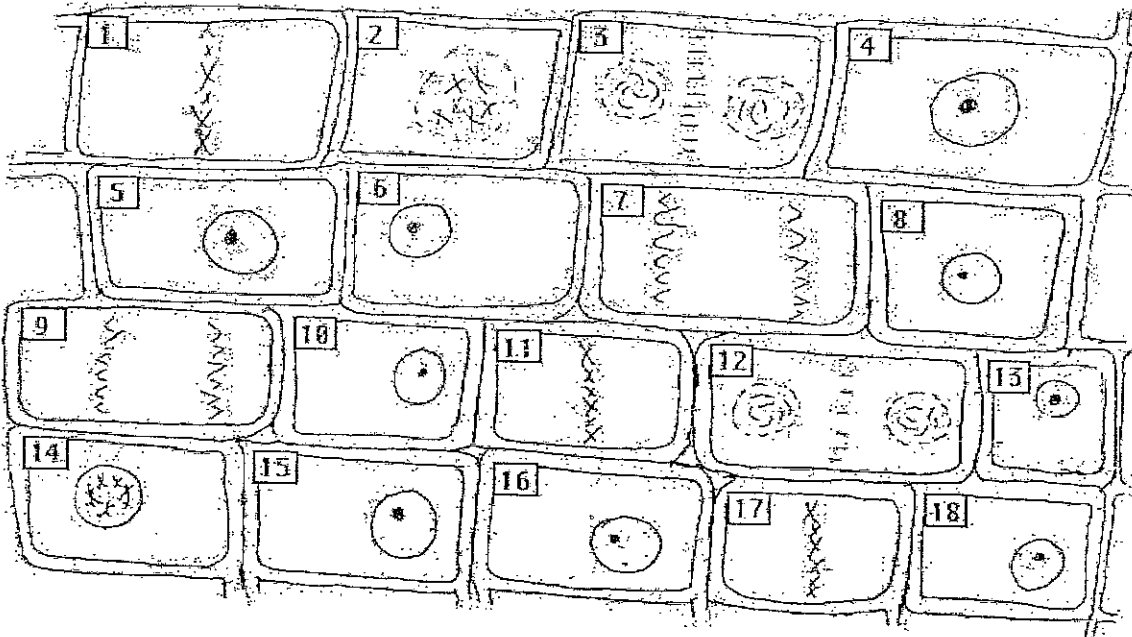


1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

*Name each numbered stage in the plant cell mitosis diagram:*

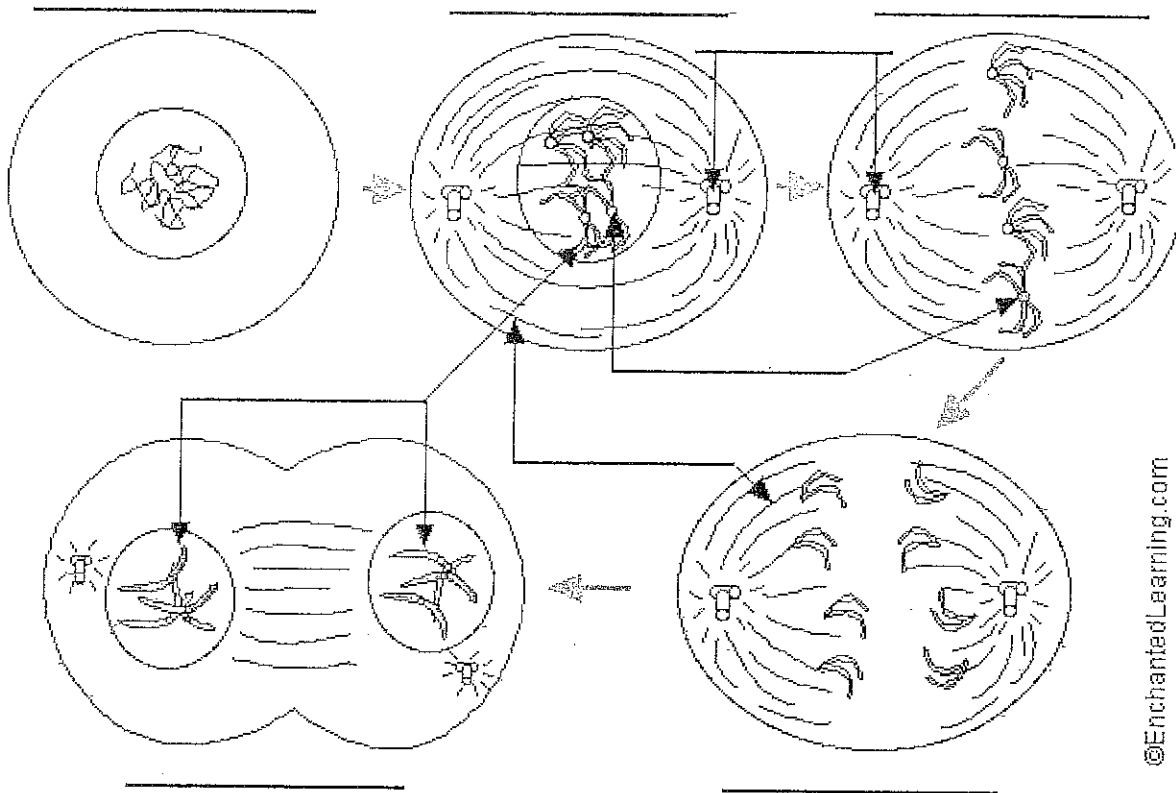
- |    |     |     |
|----|-----|-----|
| 1. | 7.  | 13. |
| 2. | 8.  | 14. |
| 3. | 9.  | 15. |
| 4. | 10. | 16. |
| 5. | 11. | 17. |
| 6. | 12. | 18. |

### Plant Cells in Mitosis



Label the stages of mitosis. Color the stages in the plant cell and animal cell as follows: interphase-pink, prophase-light green, metaphase-red, anaphase-light blue, and telophase-yellow.

## Mitosis of an Animal Cell



**Questions:** Answer questions on an additional sheet of paper. You may need to use chapter 5 of the Biology textbook for additional assistance

1. What are the 2 main parts of the cell cycle and what is happening to the cell in each stage?
2. When during the cell cycle are chromatids duplicated and why is this so important?
3. About how long does a human skin cell stay in interphase? in mitosis & cytokinesis?
4. Name and explain the 3 parts of interphase.
5. During what stage can chromosomes be seen clearly?
6. What forms to help attach and move chromatids to the opposite poles of the cell?
7. During what phase of the cell cycle does a lot of protein synthesis take place?
8. Chromosomes are made of what molecule? What is the shape of this molecule?
9. When do chromatids line up at the equator of a cell?
10. Do bacteria reproduce by mitosis? Explain your answer.
11. When does the nuclear membrane and nucleolus disappear? When do they reappear?
12. Explain the difference in cytokinesis of a plant cell and an animal cell.