Name: Answer key 40 Date: Mon. May 9

Cell Cycle and Mitosis *(modified 2015)*

THE CELL CYCLE

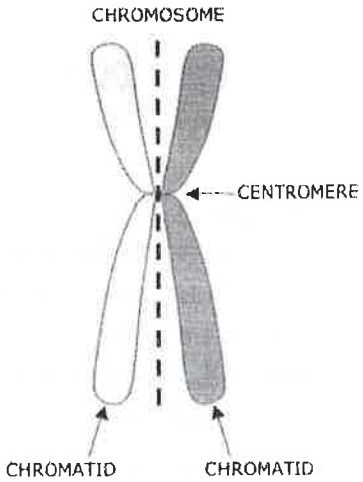
The **cell cycle**, or **cell-division cycle**, is the series of events that take place in a **eukaryotic cell** between its formation and the moment it replicates itself. These events can be divided in **two** main parts: **interphase** (*in between divisions* phase grouping **G_1 phase, S phase, G_2 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 formed.

1. What is meant by the cell cycle or cell division cycle?
   The series of events that occur in a eukaryotic cell between its formation & the moment it replicates.
2. In what type of cells --- prokaryotes or eukaryotes --- does the cell cycle occur?
3. Name the 2 main PHASES of the cell cycle. Interphase & Miotic Phase
4. Interphase is in between the times when a cell is dividing.
5. What is occurring in a cell during interphase?
   growth, synthesis of more DNA, normal metabolic functions
6. What is occurring during the mitosis phase?
   cell replicates itself
7. A fertilized cell develops into a mature organism during the cell cycle.
8. Name three things that form during the cycle.
   hair, skin, blood cells

INTERPHASE

Interphase is a phase of the cell cycle, defined only by the absence of cell division. During interphase, the cell **obtains nutrients**, and **duplicates (copies) its chromatids** (genetic material). The genetic material or chromatids are located in **the nucleus** of the cell and are made of the **molecule DNA**.

9. What process NEVER occurs in interphase? Cell division
10. Cells obtain nutrients and duplicate or copy their chromatids or genetic material during interphase.
11. Where are chromatids found in a cell? nucleus
12. Chromatids are made of a molecule called DNA.



Chromatids are connected by the **centromere** and have a **LONG AND SHORT ARM**. 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_1** (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_2** (growth 2 in which the cell grows in preparation for cell division). ***Find the cell cycle drawing*** on this worksheet and ***draw an additional line in red*** around those parts of the cell cycle diagram that are included in interphase.

13. In what PHASE do most cells spend the majority of their lifetime?
Interphase
14. How often do human skin cells divide each day?
once a day
15. How many hours per day is a human skin cell in interphase?
22 hrs
16. What type of cell may spend decades in interphase instead of dividing?
nerve cells

17. Name the 3 stages in interphase.
G_1 S G_2

18. What does G_1 stand for and what occurs in this stage?
growth 1 - cell creates organelles & begins metabolism

19. What does S stand for and what occurs in this stage?
Synthesis of DNA - copies of chromosomes are made

20. What does G_2 stand for and what occurs in this stage?
Growth 2 - cell grows in preparation for division

Sometimes the cells exit the cell cycle (usually from G_1 phase) and enter the **G_0 phase**. In the G_0 phase, **cells are alive and metabolically active**, but do not divide. In this phase cells do not copy their DNA and do not prepare for cell division. Many cells in the human body, including those in **heart muscle**, eyes, and brain are in the G_0 phase. **If these cells are damaged they cannot be replaced. Again find**

the cell cycle drawing on this worksheet and ***draw an arrow in black*** on the cell cycle showing where a cell would enter the G_0 phase.

21. From stage of the cell cycle do cells sometimes EXIT? G_1

22. What happens to cells that enter the G_0 stage?

don't divide OR prepare for cell division
still alive & metabolically active though

23. Name 3 types of cells that enter the G_0 phase when they are mature?

heart
brain
eyes

24. What happens if these cells are damaged during your lifetime?

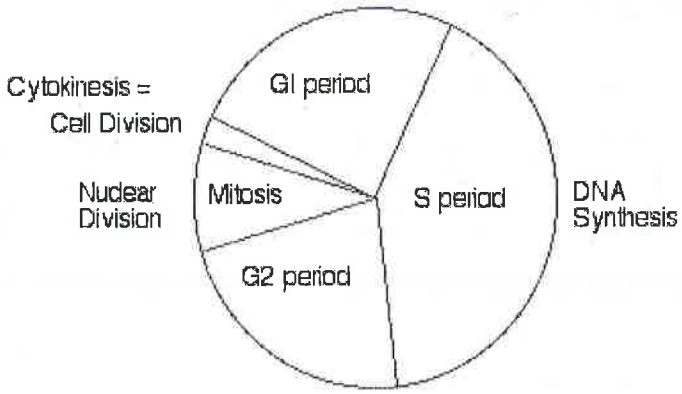
can not be replaced

The **G_1 phase** is a period in the cell cycle during interphase, after **cytokinesis** (process whereby a single cell is divided into two identical daughter cells whenever the **cytoplasm** is divided) 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 (made)**, so the cell requires both structural proteins and enzymes, resulting in great amount of protein synthesis. ***Color the G_1*** phase **green** on the cell cycle drawing.

The **S phase**, short for **synthesis phase**, is a period in the cell cycle during interphase, **between G1 phase and the G2 phase**. Following G1, 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_2 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_2 phase continues growth of the cell and prepares the cell for mitosis (M phase) by producing all of the enzymes that the cell will need in order to divide. ***Color the G_2*** phase light blue.

After the G_2 phase of interphase, the **cell is ready to start dividing**. The **nucleus and nuclear material** (chromosomes made of DNA) divide first during stage known as **MITOSIS**. Mitosis is also called **KARYOKINESIS** (*karyon* means nucleus) because only the nucleus is dividing. ***Color the Mitosis*** stage purple.



MITOSIS (KARYOKINESIS) – NUCLEAR DIVISION

Mitosis is the process in which a **eukaryotic cell** (cell containing a nucleus) separates its already **duplicated chromosomes** (copied during the S phase) into **two sets** of chromosomes so there will be **two identical nuclei**. It is generally followed by **cytokinesis** which divides the cytoplasm and cell membrane. ***Color the Cytokinesis stage*** yellow. This results in **two identical cells** (both have an identical set of chromosomes) with an equal distribution of organelles and other cellular components. The **mitotic (M) phase** and **cytokinesis** (C phase) together are called **cell division**, the division of the **parent cell** (original) into **two daughter cells** (new cells), each with the same **genetic information (chromosomes) as the parent cell**. Mitosis **does NOT occur in prokaryotic cells** that do **NOT** have a nucleus. In multicellular organisms, the **somatic cells** (body cells) undergo mitosis, while **germ cells** – cells destined to become sperm in males or ova (eggs) in females – divide by a related process called **meiosis**. **Prokaryotic cells** (bacteria), which lack a nucleus, divide by a process called **binary fission**.

1. When are chromosomes duplicated -- before or during mitosis?
2. What process follows mitosis? cytokinesis
3. The nucleus is divided during mitosis, while cytoplasm of the cell is divided during cytokinesis.
4. How do the two new cells compare with each other? identical
5. The two new cells are called daughter cells.
6. Does mitosis occur in prokaryotes? Explain why or why not.
   No – don't have a nucleus instead binary fission divides cell.

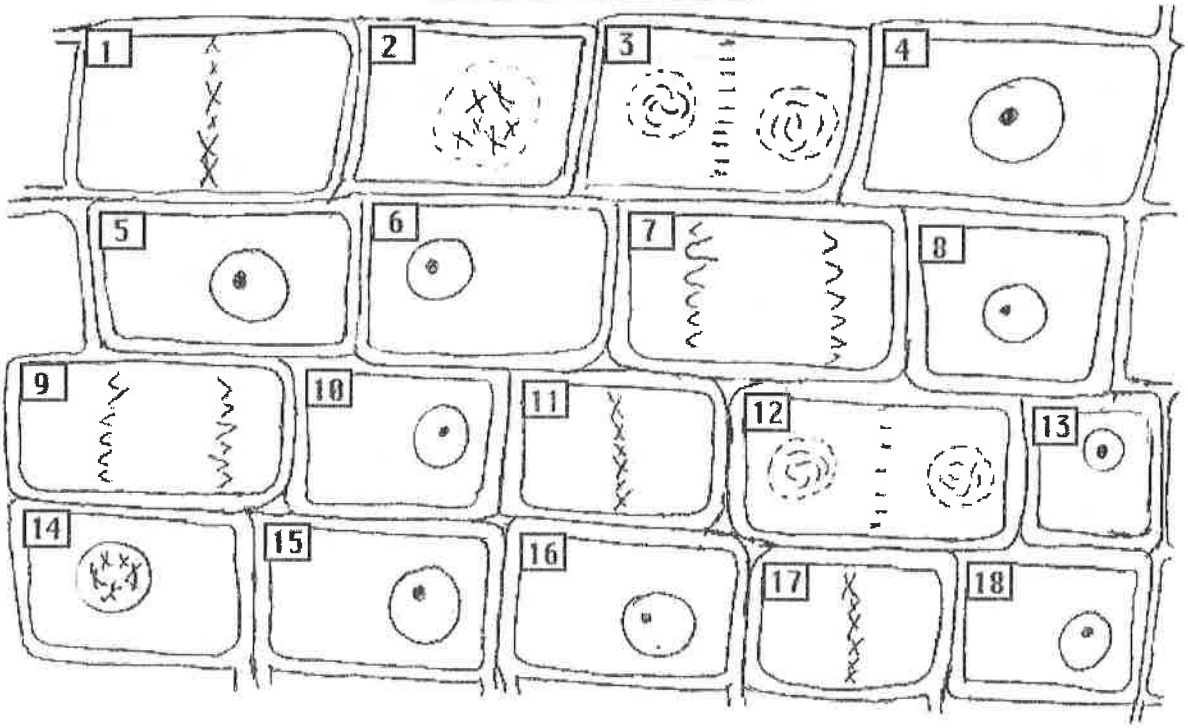
7. What process is used by bacteria to divide and reproduce? binary fission
8. Body cells are called somatic cells, while reproductive cells are known as germ cells.

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.

Name each numbered stage in the plant cell cycle diagram: (interphase, prophase, metaphase, anaphase, or telophase)

1. Metaphase
2. Prophase
3. Telophase
4. Interphase
5. Interphase
6. Interphase
7. Anaphase
8. Interphase
9. Anaphase
10. Interphase
11. Metaphase
12. Telophase
13. Interphase
14. Prophase
15. Interphase
16. Interphase
17. Metaphase
18. Interphase

Plant Cells in Mitosis



Below study the sketch of Mitosis occurring in an animal cell

Label the stages of the cell cycle & mitosis. ***LABEL and COLOR the stages in the animal cell. The stages should be colored as follows*** --- interphase-pink, prophase-light green, metaphase-red, anaphase-light blue, and telophase-yellow. Also label the CENTRIOLES, SPINDLE FIBERS, CENTROMERE, and CHROMOSOMES.

IPMAT

Mitosis of an Animal Cell