

- **PHYSICALLY PRINT OUT** this PDF and **HANDWRITE** (with a black or blue pen) your answers directly on this PDF. Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.
- **Importantly, study guides are NOT GROUP PROJECTS!!!** You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.
- **SCAN** physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie. Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.
- **READ FOR UNDERSTANDING** and not merely to complete an assignment. **First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.

1. a. A cell's **Cell Cycle** can be divided into two main phases. (A & B in the figure to the right). What are these 2 phases?

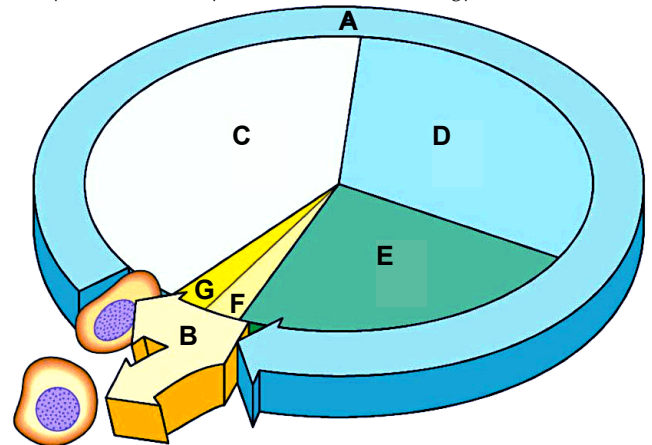
A = _____

B = _____

- b. Each of these two main phases can be divided into sub-phases. What are the **sub-phases of the growth phase of the cell cycle where cells spend 90% of their cycle** (labeled C, D, E in the figure to the right).

C = _____

D = _____



E = _____

- c. What are the **sub-phases of the phase of the cell cycle where the original parent cell physically divides into two daughter cells** (labeled F & G in the figure above)?"

F = _____

G = _____

2. Let's review some of the activities that take place during the various sub-phases of Interphase. **STUDY THIS!**

1. G₁

- Cell accomplishes **most of its growth**, getting bigger in size (reaching its normal "adult" volume and shape).
- **Normal every day metabolic (chemical) processes take place** as cells engage in their specialized functions.
- Proteins (and new organelles) are made as needed to support the specialized functions the cell is to complete.
- Cell makes some proteins that may be needed for future DNA replication (even if the proteins are not active during G₁), DNA replication activating only after G₁ and only **IF** the cell gets the message to physically divide.

2. S

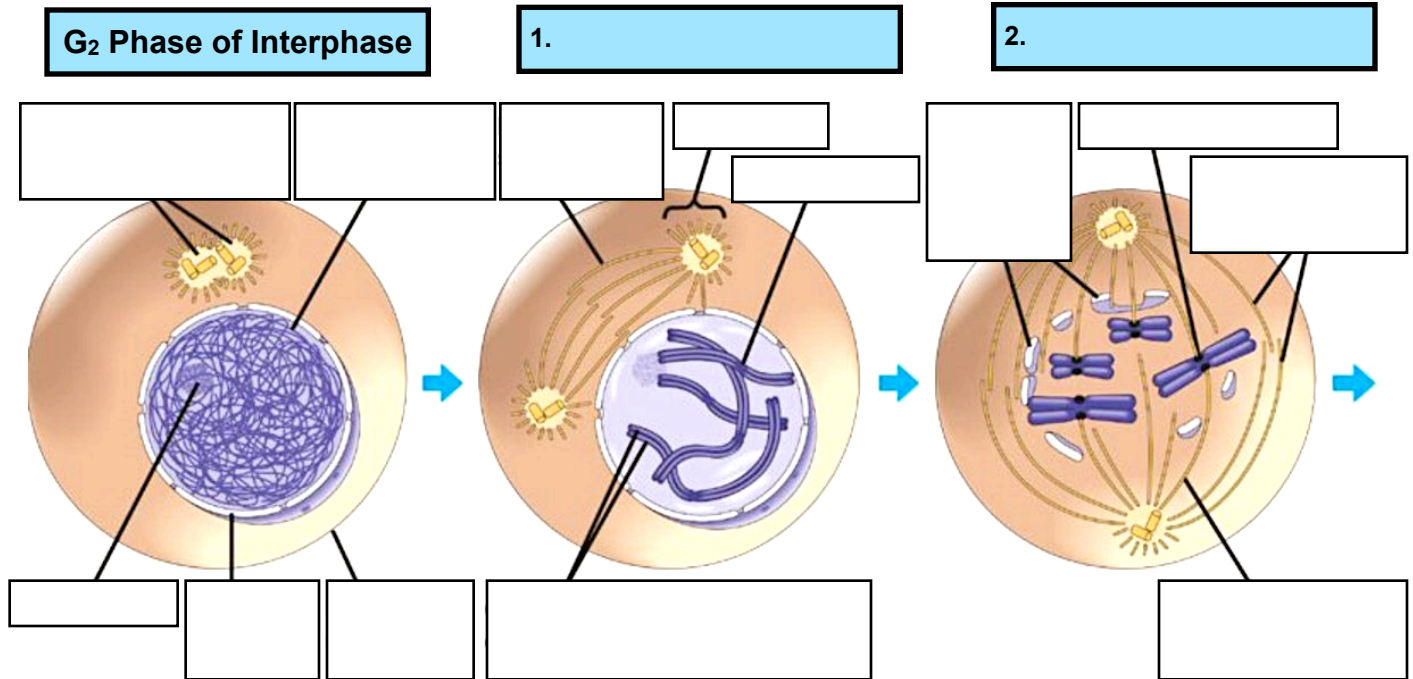
- Cell engages in **DNA synthesis** (formally called **DNA Replication**), duplicating/copying all its nuclear DNA content.
- The **amount of DNA the cell has effectively doubles, even though its ploidy (= number of sets of chromosomes in the cell), remains the same**, every chromosome considered a duplicated chromosome by the end of S phase.
- DNA replication results in the formation of identical pairs of (double-stranded) DNA molecules (dsDNA) from each original chromosome. The DNA copies are referred to as **sister chromatids**, which are attached at their centromeric regions by cohesin proteins.
- Throughout interphase, including during S & G₂ phase, nuclear eukaryotic DNA remains in a semi-condensed (non-supercoiled) **chromatin** configuration.

3. G₂

- Cell **replenishes its energy stores (ATP) by conducting cellular respiration and synthesizes proteins necessary for chromosome manipulation and physical cell division**, which will occur during the mitotic (M) phase, following G₂.
- Some new/additional copies of **cell organelles** (for the future daughter cells) **may be formed as needed**.
- There may be some **additional cell growth** occurring as and if needed.
- **DNA damage may be repaired** in this sub-phase of interphase just as it can be throughout the earlier phases of Interphase.
- Final cytoplasmic preparations for the mitotic (M) phase are completed.

M phase of the cell cycle tends to be the shortest and Interphase the longest. **Which interphase sub-phase is the most variable in terms of the amount of time different cell types spend in that particular sub-phase of interphase?**

3. **Get to know the steps of Mitosis by studying well Figure 12.7.** Then, test your knowledge of the events that take place at the end of G₂ of Interphase and during M phase by naming of each stage of M phase, labeling the key cell structures visible during each phase, and **summarizing the key defining features and events** witnessed during that phase.



<u>Key Feature & Events</u>
1.
2.
3.
4.

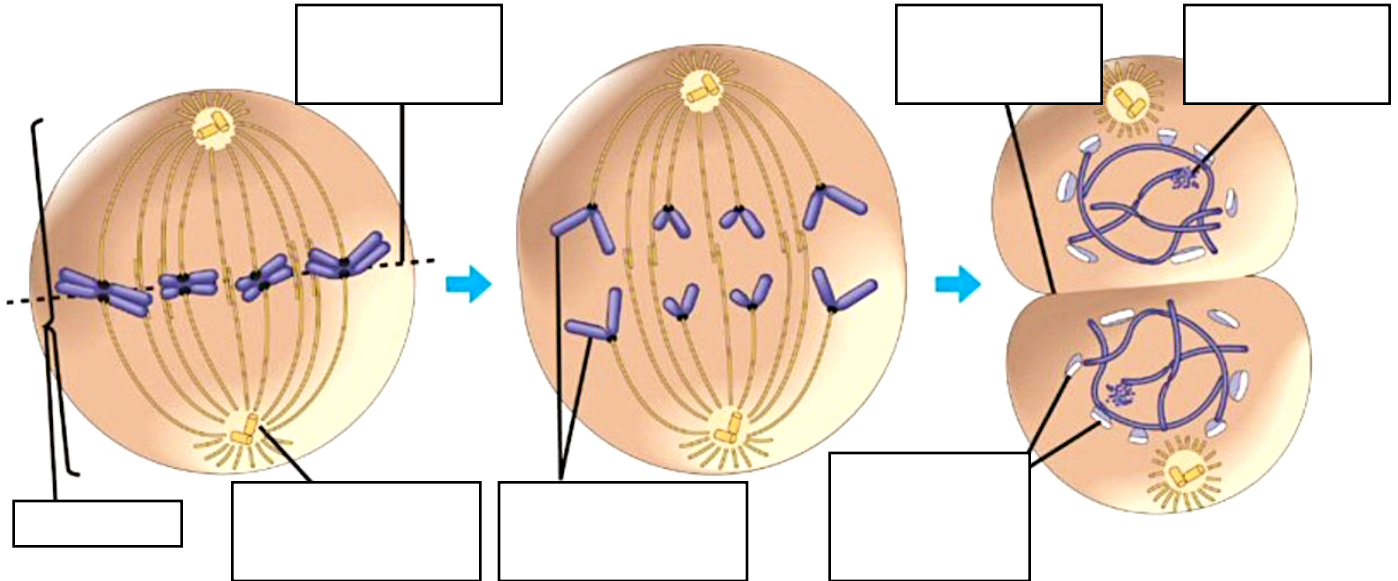
<u>Key Feature & Events</u>
1.
2.
3.
4.
5.

<u>Key Feature & Events</u>
1.
2.
3.
4.
5.
6.

3.

4.

5.



Key Feature & Events

1.

2.

3.

Key Feature & Events

1.

2.

3.

4.

5.

Key Feature & Events

1.

2.

3.

4.

5.

Cytokinesis

1.

2.

4. a. Based on the illustrations in question #3 above, **how many chromosomes are there in the prometaphase** drawing?
(Remember, a **uplicated chromosome**, made up of **two sister chromatids**, is still considered **1** chromosome!)
- b. How many **DNA double helices (sister chromatids/DNA molecules)** are there **per chromosome in prometaphase**?
- c. How many **double helices (DNA molecules)** are there **per chromatid** of a duplicated chromosome?

- d. Based on the illustrations in question #3, how many **chromosomes are there in the anaphase** drawing?
(Remember, once separated, sister chromatids are **each** considered independent chromosomes in their own right!)
- e. Based on the illustrations in question #3, **how many chromosomes will each daughter cell's nucleus contain?**
(Both daughter nuclei will contain **UNDUPLICATED** chromosomes just like the parent cell once had when the parent cell was in G1, before its DNA got copied in S phase of Interphase & prior to entering M phase & dividing!)
5. During which stage(s) of the cell cycle, does each **chromosome consist of two identical chromatids**? *Check your answer by going to the [Ch.12.2 Concept Check Question #3](#) answer in Appendix A)*
6. a. **Where AND when does the Mitotic Spindle begin forming?**
- b. What are the **components of the Mitotic Spindle**?
- c. In animal cells, where does the **assembly of spindle microtubules start**?
- d. What is a **nickname** for this region in the cell cytoplasm?
7. Describe what happens to the cell's **centrosome** during Interphase and then during Prophase and Prometaphase?
- During Interphase:**
- During Prophase & Prometaphase (Late Prophase):**
8. a. What is a **kinetochore**?
- b. **Where do kinetochores form** in early mitosis (Prometaphase)?
- c. Make a fully **labeled** sketch below that shows two **replicated chromosomes, each with two kinetochores** and some attached **kinetochore spindle fibers from opposite poles**. (*Label the kinetochores, kinetochore microtubules, sister chromatids, chromosomes, & centrosomes*)

9. a. What are **nonkinetochore microtubules**?

b. **Kinetochore and nonkinetochore microtubules have different functions during mitosis.** Describe how each type of microtubule accomplishes its particular function.

Kinetochore microtubules =

Nonkinetochore microtubules =

10. a. Produce a numbered list of step-by-step sequential descriptions of the activities that takes place in order to accomplish **cytokinesis in animal cells**. *Include a labeled sketch along with your description of the process.*

b. Produce a numbered list of step-by-step sequential descriptions of the activities that takes place in order to accomplish **cytokinesis in plant cells**. *Include a labeled sketch along with your description of the process.*

11. How do **bacterial chromosomes differ from eukaryotic chromosomes** in terms of number of chromosomes and shape of chromosomes inside the cells?

- **Number of chromosomes inside bacterial cell's nucleoid region =**
- **Shape of DNA double-helix-based chromosome inside bacterial cell's nucleoid region =**

12. What is the **origin of replication** on the bacterial chromosome?

13. **Only eukaryotic cells use the process of mitosis.** What is the **process prokaryotes use to reproduce asexually** called?

14. Describe **how a bacterium divides** using the illustration to the right.

1.

2.

3.

