

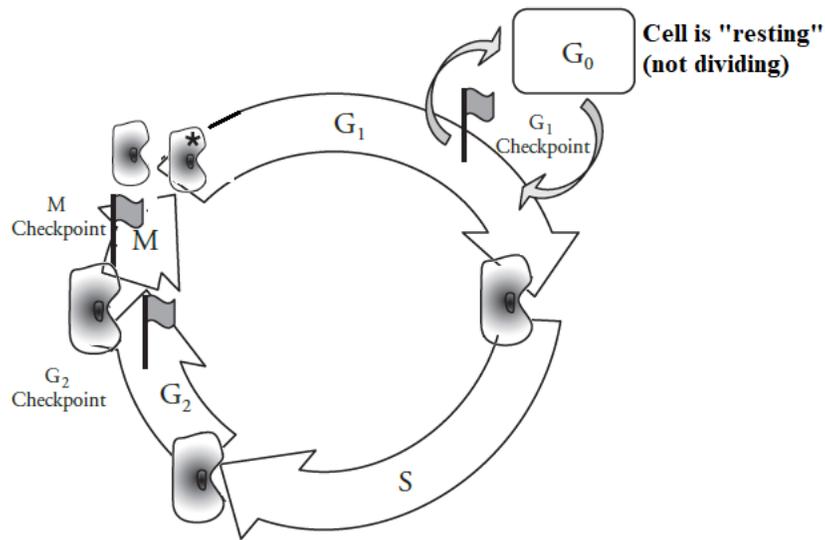
The Cell Cycle and Cancer

What controls the life and development of a cell?

Why?

Quality control inspectors typically do not limit their product testing to the final product at the end of the assembly line. They monitor all aspects of production in hopes of preventing larger problems down the line. Likewise, when cells are progressing through the cell cycle there are processes in place that check on the cell's progress. Is everything happening according to plan? Are there enough resources to complete the task of cell division? Tightly regulating the cell cycle keeps a multicellular organism healthy by conserving materials. This ensures that new cells receive accurate genetic information, and also prevents uncontrolled growth that may lead to diseases like cancer.

Model 1 - Checkpoints



1. If a cell does not enter the resting phase of G₀ it will be in a cycle known as the cell cycle. This cell is in the process of cellular division. Look at Model 1 and starting at the starred cell, what is the order of a cell that is actively dividing?

2. A cell can switch between not actively dividing (the G₀ phase) and the cell cycle where a cell is dividing. On Model 1, color the resting phase red and the phases of a cell dividing green.

3. Review the phases of the cell cycle in Model 1 by placing the abbreviated phase name (G₁, S, G₂ or M) next to the proper description.

_____ The cell grows by producing more proteins and organelles.

_____ DNA replication occurs.

_____ Mitosis and cytokinesis occurs.

4. Why might it be beneficial to an organism for damaged cells to enter G₀ instead of dividing once they exist?

5. Cancer, the uncontrolled growth of cells, often results in a tumor, or mass of abnormal cells because these cells continuously divide. According to Model 1, which portion of the cell cycle are these cells likely not entering? Why?

Read This!

There are three regulatory checkpoints built into the cell cycle. These checkpoints are a regular system of checks and balances that prevents damaged or mutated cells from proceeding to the next phase. One way an organism deals with the problems is to kill the damaged cell before it passes on the problem to its daughter cells. This is a normal process called apoptosis.

6. Name the three checkpoints as shown on Model 1.

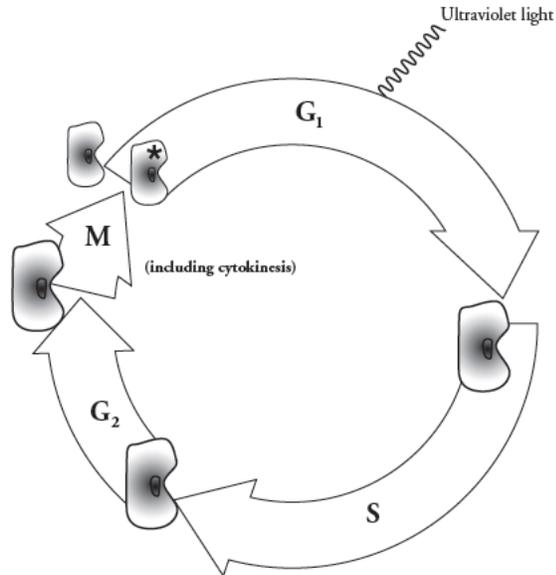
7. Progression through the cell cycle is dependent on both extra- and intracellular conditions. Consider the following conditions. Indicate which checkpoint(s) most likely responds to that condition.

- a. The DNA has been completely replicated and checked for errors. _____
- b. All chromosomes are attached to the spindle fibers and aligned in the middle of the cell. _____
- c. Regulates whether the cell is in G₀ or not. _____

8. Checkpoints makes sure everything is correct before a cell moves onto the next phase of the cell cycle. Some cancerous tumors consist of many cells that are much smaller than normal. Do you think that cancerous cells obey or disobey checkpoints within the cell cycle?

Justify or explain your reasoning.

Model 2- Radiation



9. According to Model 2, ultraviolet light is affecting a cell in which phase of the cell cycle?
10. Ultraviolet light may cause DNA damage, which is known as a mutation. How might such damage affect events taking place during the synthesis phase?
11. How might the DNA damage go on to affect the resulting cells if the cell does not die?
12. Some cells, like mature nerve cells or muscle cells, do not divide. Other cells will divide only when the cellular environment signals that it is necessary. According to Model 1, what “phase” of the cell cycle are these cells said to be in when they are not dividing or planning to divide?
13. Chemotherapy utilizes chemicals that disrupt various parts of the cell cycle, targeting rapidly growing cells. Paclitaxel (Taxol[®]) is one such drug that prevents the mitosis phase from taking place.
- How does this drug inhibit the growth of cancer?
 - Paclitaxel affects not only cancer cells, but normal cells as well. Would the effects of Paclitaxel be seen first in organs that have quickly dividing cells (like the intestine and hair follicles) or in organs that have slow or nondividing cells (like muscles and the nervous system). Justify your reasoning. Why?