

Regulation of the Cell Cycle

(TED - The Science of Cells that Never get Old)

(p.224) 12. Do all cells go through the cell cycle at the same rate or at the same frequency? Explain.

No. The frequency of cell division varies with the type of cell. Human skin cells divide frequently throughout life, where as liver cells maintain the ability to divide but keep it in reserve until an appropriate need arises - specialized cells such as mature nerve and muscle cells do not divide at all and remain in the nondividing G_0 phase.

(p.224-26) 3. What controls the cell cycle?

The cell cycle is controlled by specific chemical signals, cell cycle control systems and various checkpoints.

(p.226) 14. What is a cell cycle checkpoint?

A cell cycle checkpoint is a critical control point where STOP and GO-AHEAD signals regulate the cycle.

(Lab p.10) 15. Summarize what happens at each checkpoint and then label each in the diagram below.

(You may add to this as we discuss this in class.)

(a) G_1 - *The Restriction Point*

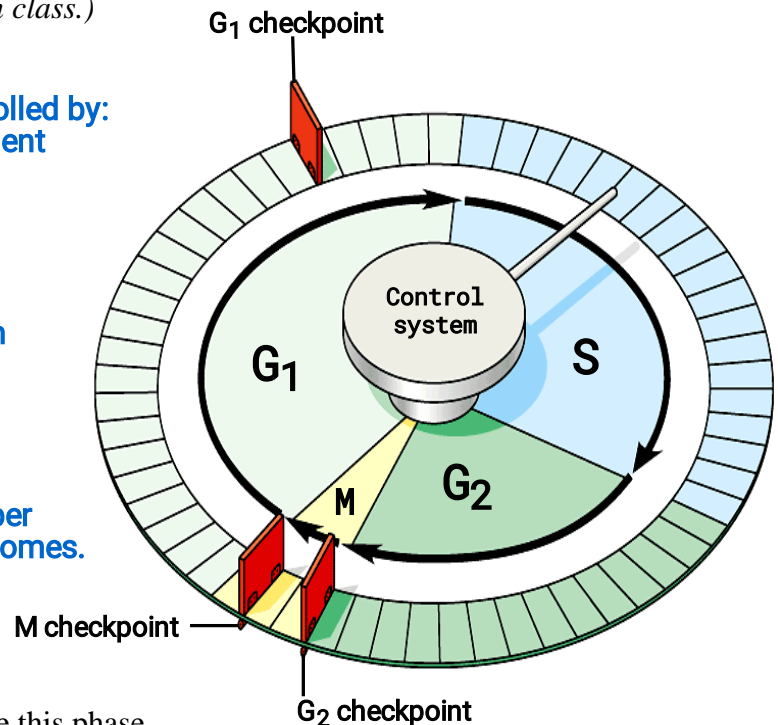
The cell cycle initiation checkpoint controlled by:
Cell Size - Growth factors - The Environment

(b) G_2 - G_2 to M transition checkpoint
controlled by:

- DNA replication completion
- DNA damage/mutations
- Cell Size

(c) M - *M-spindle Checkpoint*

This checkpoint is controlled by the proper attachment of spindle fibers to chromosomes.



(p.226) 16. What is meant by the G_0 phase? Describe this phase.

The G_0 phase is the nondividing phase. Cell stuck in this phase never receive the GO-AHEAD signal to continue with the cell cycle.

(p.226) 17. *Kinases* drive the cell cycle, but they must be activated by attachment of a cyclin.

(Cell Cycle Game)

(p.226)18. The activity of *cyclin-dependent kinases* (CDks) rises and falls. Why?

Cyclin-dependent kinases rise and fall with the changes in the concentration of its cyclin partner.

(p.226)19. What two things does MPF stand for and what does this molecule trigger?

MPF stands for "maturation-promoting factors" but we can think of MPF as "M-phase promoting factor" because it triggers the cell's passage past the G₂ checkpoint into M phase.

(p.227)20. What are *growth factors*?

Growth factors are proteins released by certain body cells that stimulate other cells to divide.

(p.227)21. What is PDGF and how does it stimulate fibroblast division?

Platelet-derived growth factor (PDGF) is made by platelets (cell fragments found in blood) and stimulates fibroblasts (a type of connective tissue cell) to divide by binding to PDGF receptors on their cell membranes (reception) triggering the signal-transduction pathway that leads to the stimulation of cell division by activating one or more components of the cell cycle control system.

(p.228)22. Cancer cells exhibit different behaviors than normal cells. Below are two normal behaviors they no longer show. Explain each behavior.

(a) **density-dependent inhibition** - The phenomenon in which crowded cells stop dividing. When a cell population reaches a certain density, the amount of required growth factors and nutrients available to each cell becomes insufficient to allow continued cell growth.

(b) **anchorage dependence** - In order to divide, most animal cells must be attached to a substratum or a foundation.