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CELL DIVISION CYCLE

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CELL DIVISION CYCLE

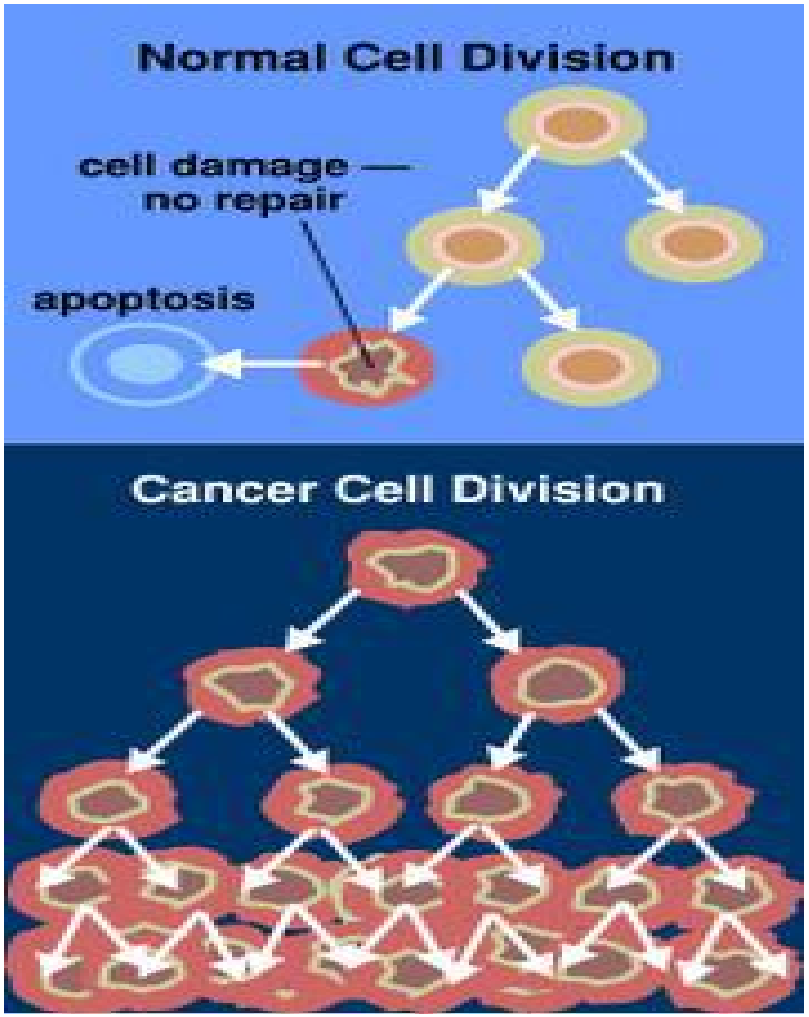
Cell division cycle is the process by which a cell grows, replicates its DNA and then divides to give two daughter cells.

In prokaryotes, the cell cycle occurs via binary fission.

In Eukaryotes, the cell cell cycle can be divided into two brief period-------

1. Interphase----------during which the cell grows, accumulating nutrients needed for mitosis and duplicating its DNA

2. Mitosis (M) phase----------during which the cell splits itself into daughter cells.



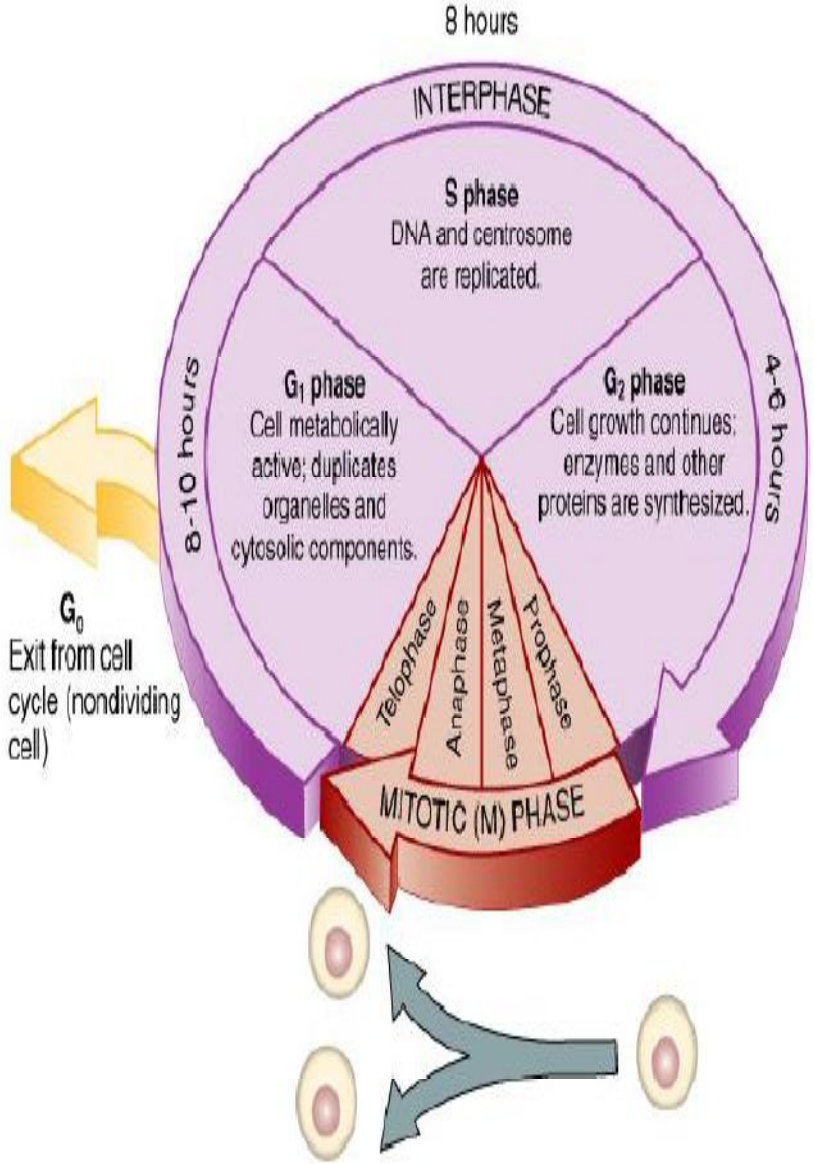
CELL DIVISION CYCLE

Cell cycle consists of 4 distinct phases---------- G1 phase, S phase (synthesis), G2 phase (collectively known as interphase) and M phase (Mitosis).

It is often considered that the two most important of these are S phase, when DNA replication occurs and mitosis (also known as M phase), when the cell undergoes division to give two daughter cells.

In fact a key concept of the cell cycle is that S phase must always follow M phase and that M phase must not start until S phase has been completed.

In other words, DNA replication must not commence until mitosis is complete and mitosis must not begin until the previous round of DNA replication has ended, thus, the integrity of the genome is maintained.



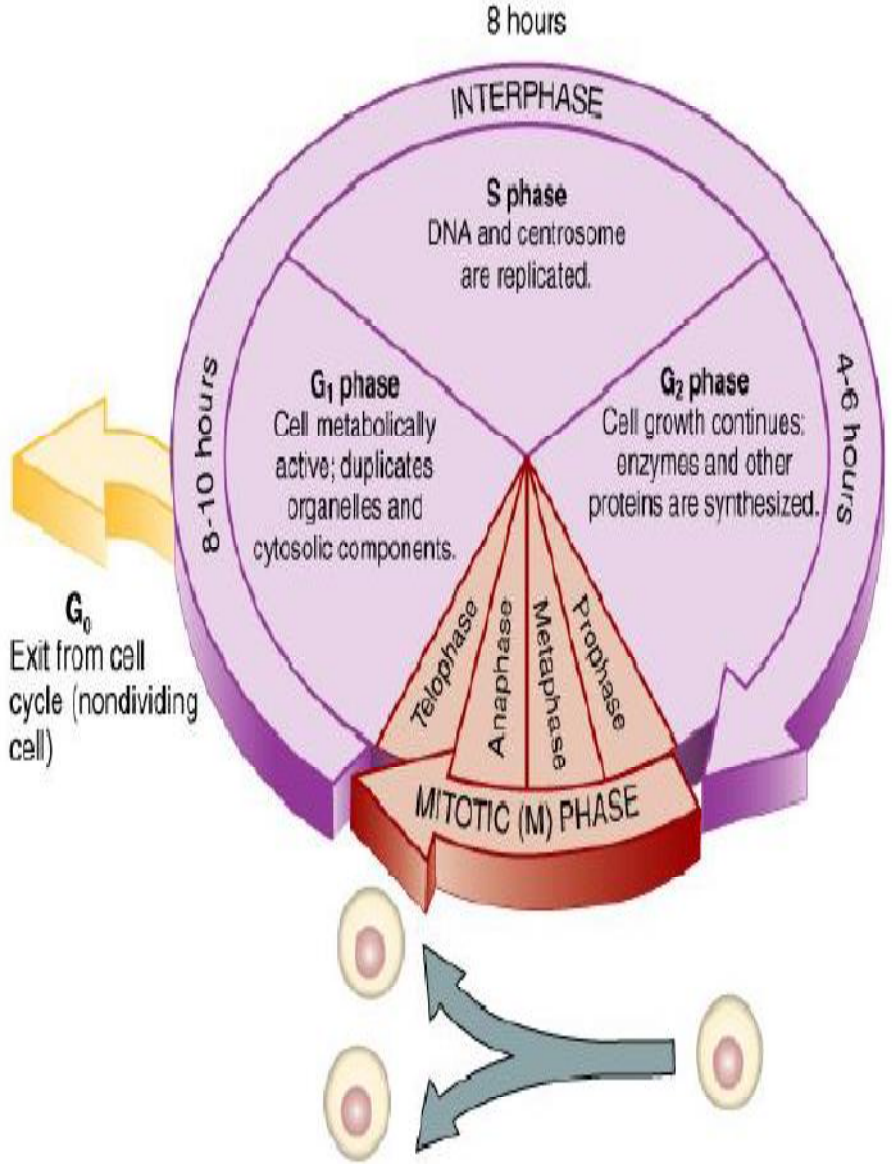
CELL DIVISION CYCLE

In-between S and M phase are two gaps G_1 and G_2.

G1 follows on from mitosis and is a time during the cell cycle when the cell is responsive to both positive and negative growth signals.

G_2 is the gap after S phase, when the cell prepares for entry into mitosis.

Finally, there is a fifth state, G_0 (also known as quiescence) into which the cell may reversibly exit from G_1, if it is deprived of the appropriate growth-promoting signals.



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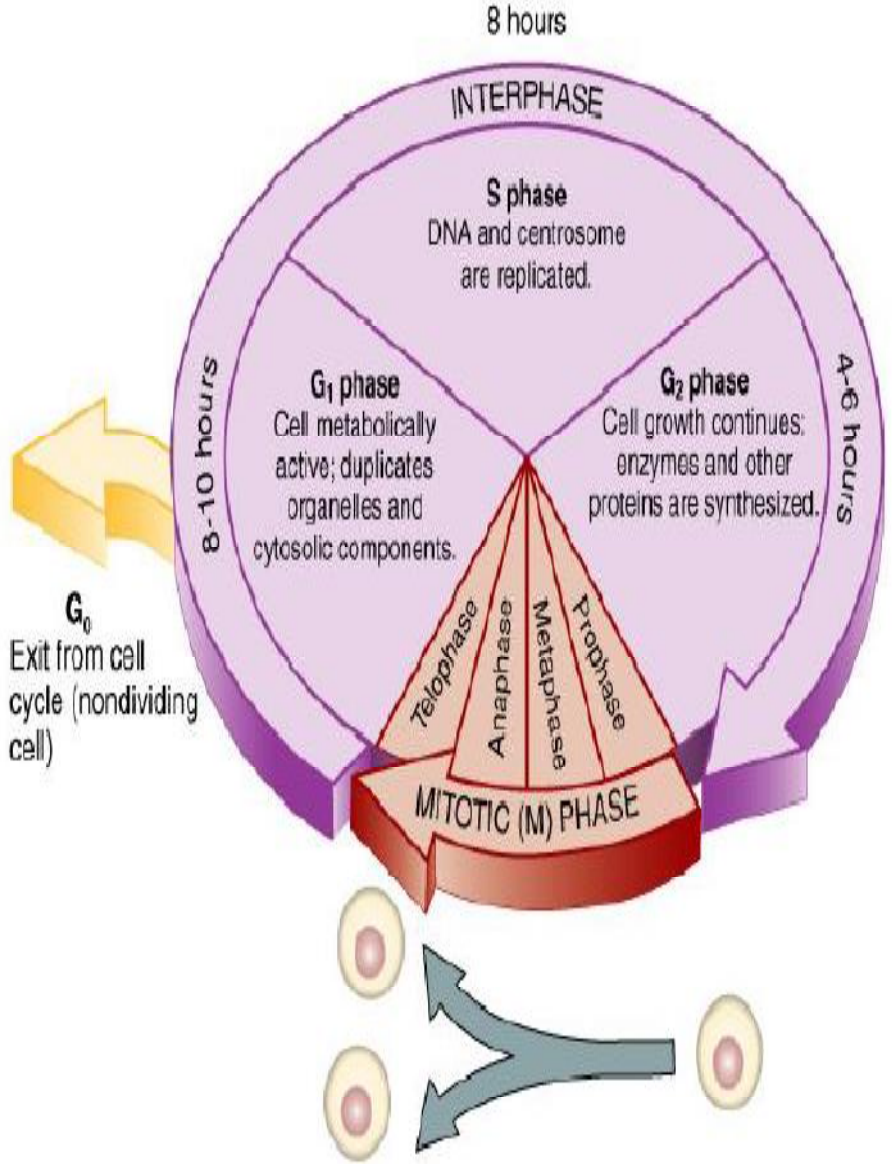
G_o---Resting phase

It's the phase where the cell leaves the cycle and quit dividing. It may be a temporary resting period or more permanent. An example of a permanent case is a cell that has reached an end stage of development and will no longer divide (e.g Neuron)

G_1 Phase : First phase within interphase from the end of the previous M phase until beginning of DNA synthesis is callec G1. Thus G1 phase intervenes between Mitosis and S phase

- Cells are metabolically active
- Organelle duplication, but no DNA replication
- Duration variable – usually between 6 - 12 hrs
- Cell prepares for S phase



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S Phase

- Committed to cell division once the S phase starts
- DNA and centrosome replication
- Semi-conservative replication of DNA: two identical daughter genomes

Duration of S- phase is between 6 -8 hrs, though it is relatively constant among cells of same species

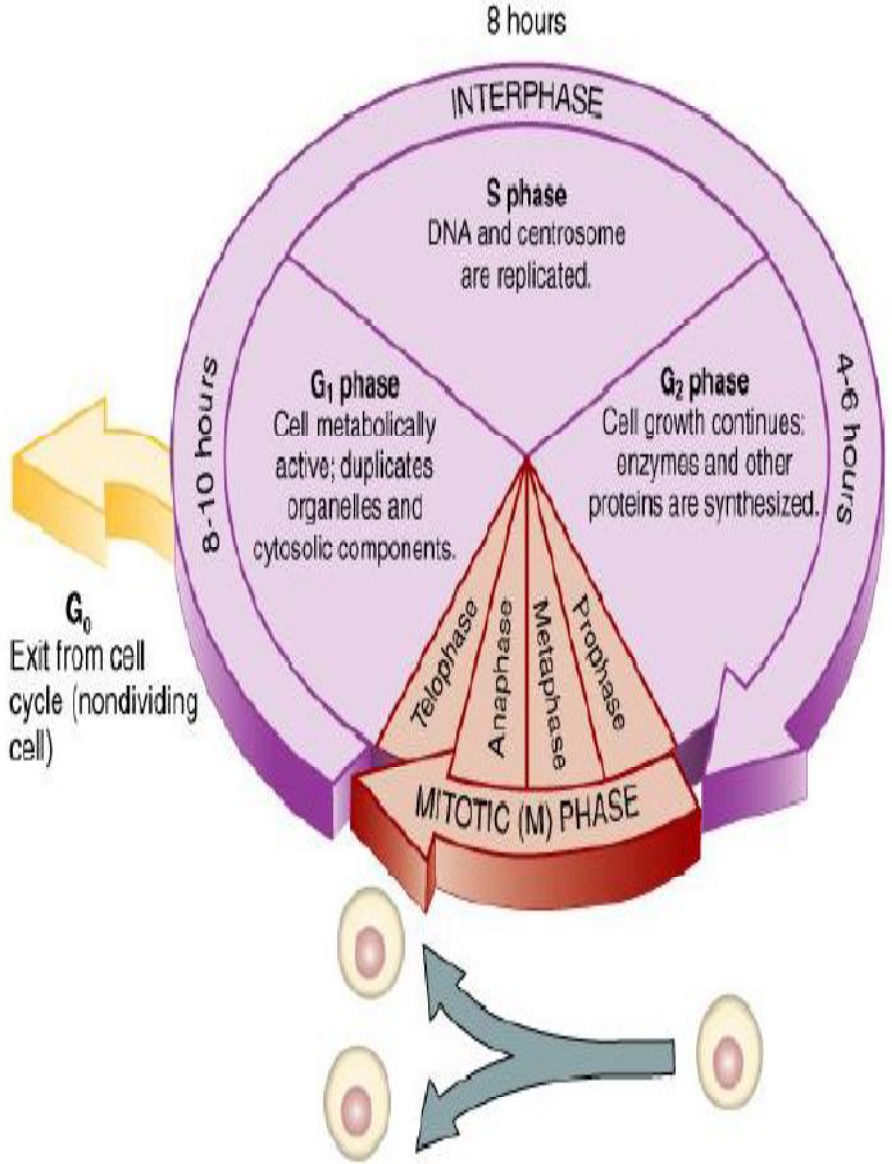
G_2 Phase (between S phase and M phase)

- Growth continues
- Enzymes and proteins for cell division are synthesized

Significant protein synthesis mainly microtubules productions occurs in G_2 phase.

Inhibition of protein synthesis during G_2 phase prevents the cell from undergoing mitosis.

G_2 phase last between 3 – 4 hrs in most cells



CELL DIVISION CYCLE

Mitotic (M) Phase (Mitosis plus Cytokinesis)

Mitosis is much shorter than interphase, lasting only 1 -2 hrs.

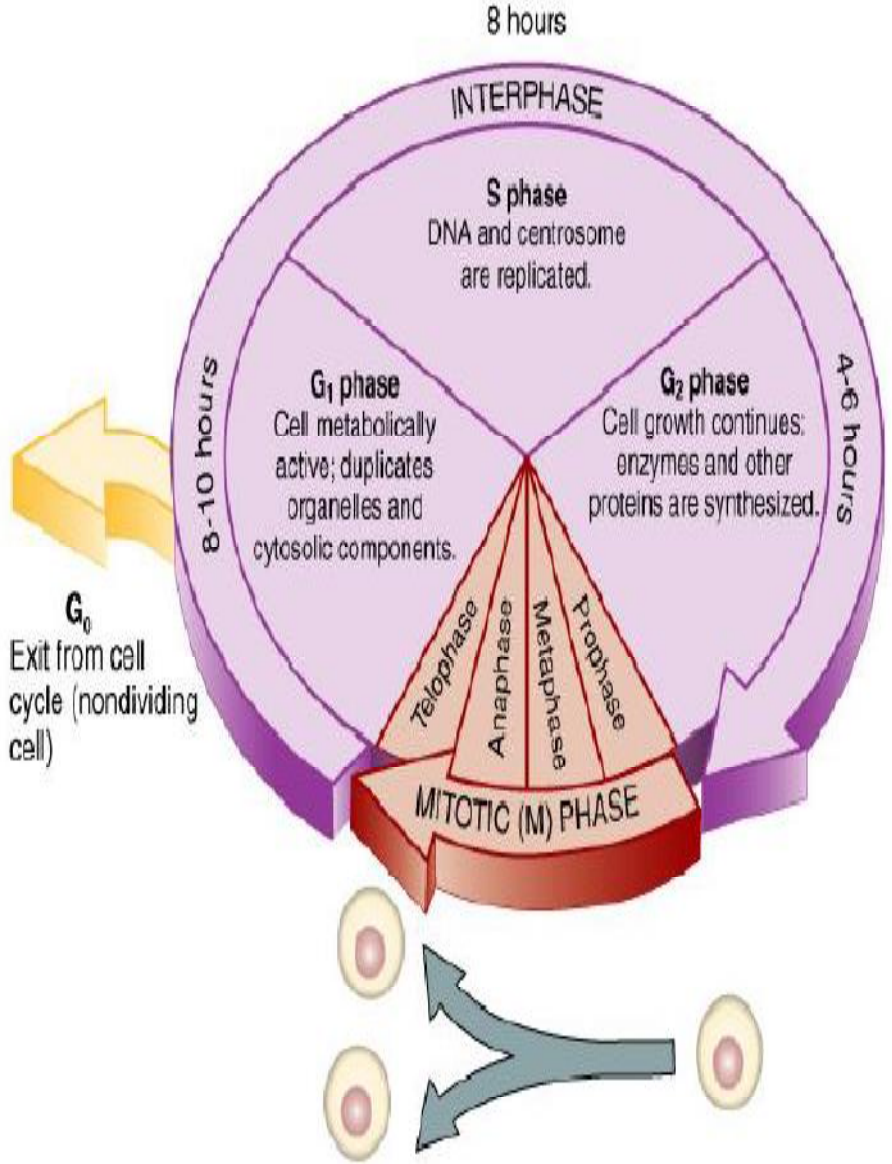
Cell growth and protein production stops at this stage.

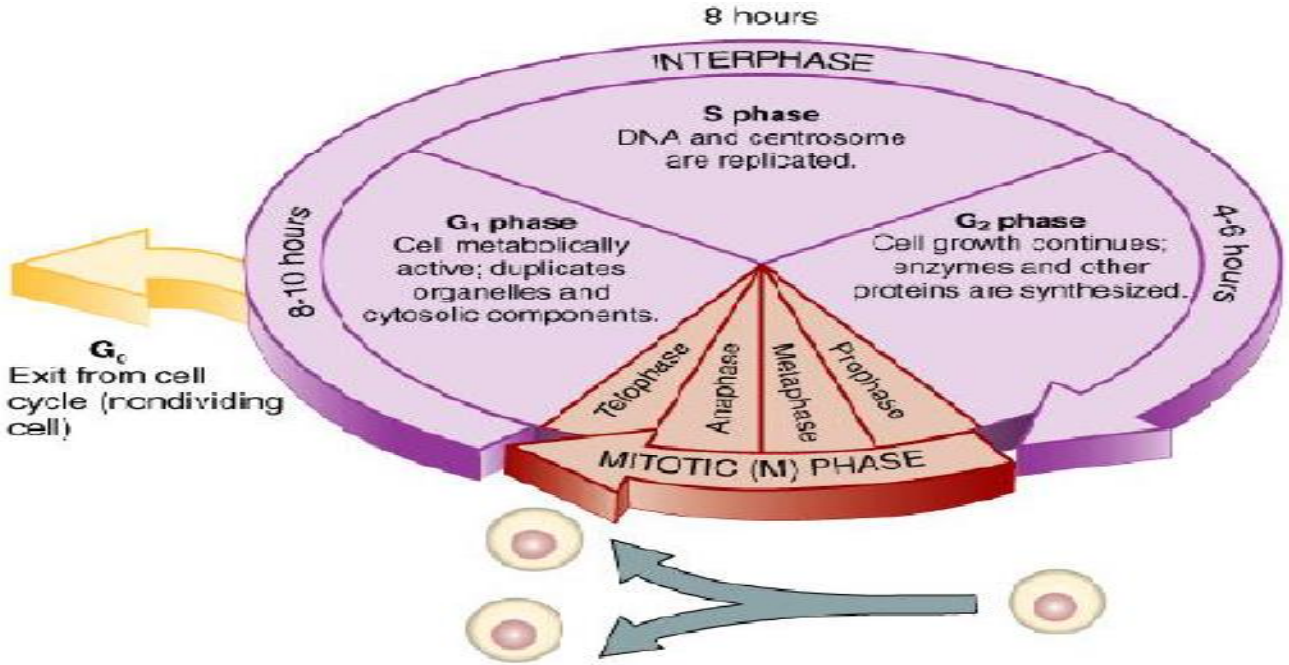
Mitosis (nuclear division) and cytokinesis (cell division) yields two daughter cells.

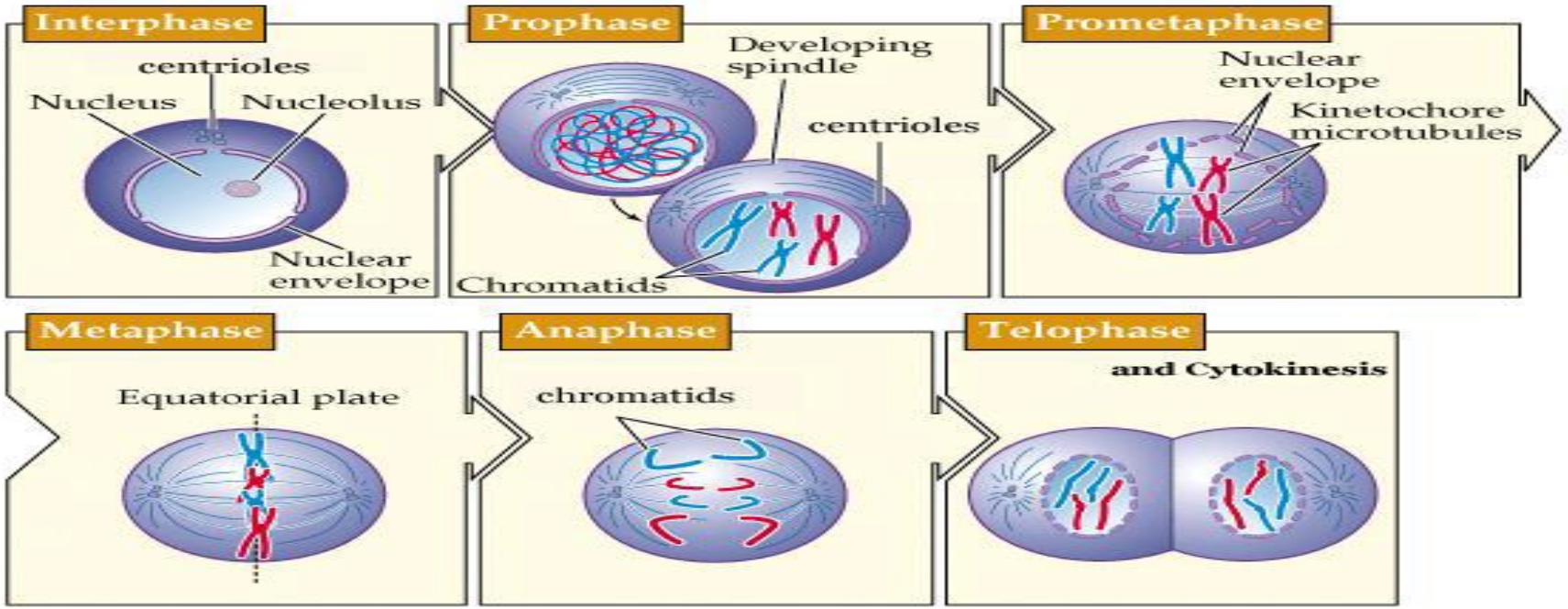
–Mitosis (karyokinesis)- The division of the nucleus that results in identical complete copies of chromosmes packaged into two new nuclei

Cytokinesis - The division of the cytoplasm that results in two daughter cells

• Mitosis is divided in 4 phases: Prophase, Metaphase, Anaphase, Telophase







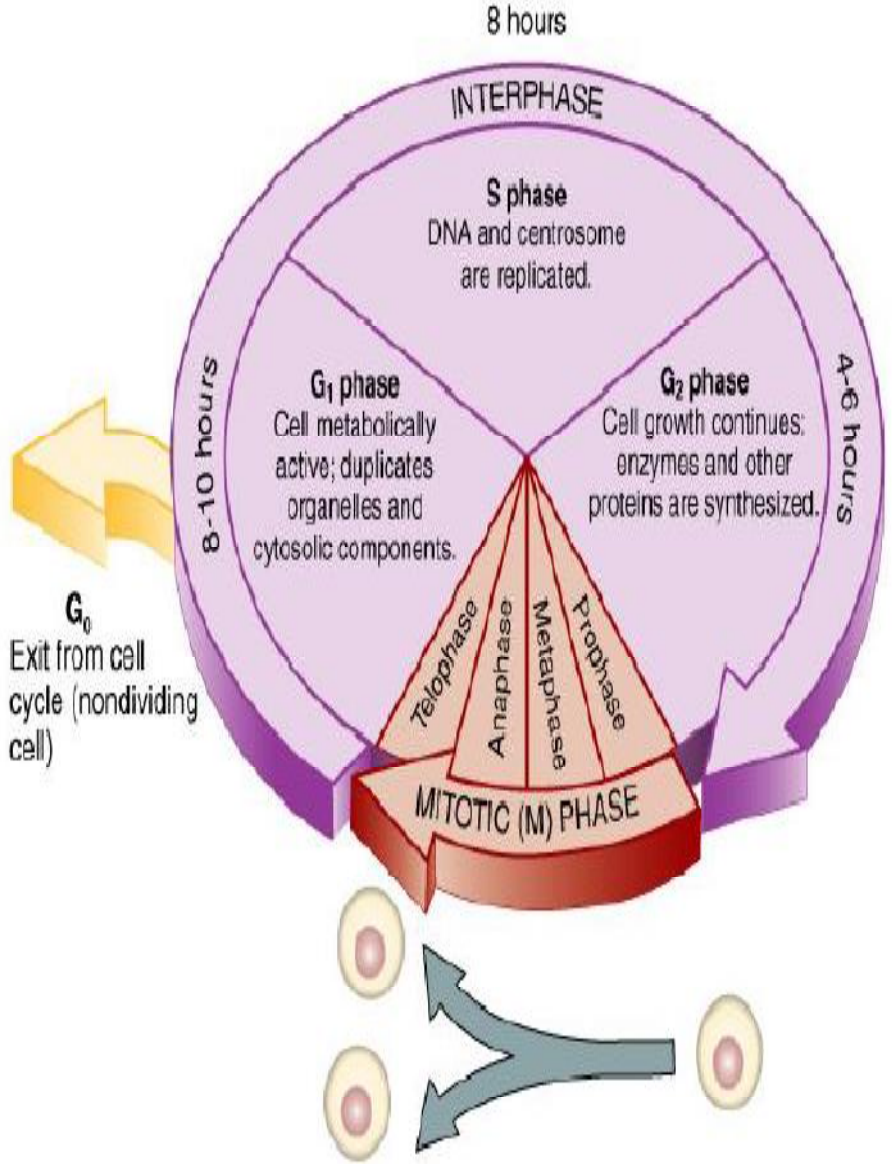
Activation of each phase of cell cycle is dependent on the proper progression and completion of the previous one. Cells that have temporarily or reversibly stopped dividing are said to have entered a state of quiescence called Go phase.

After cell division, each of the daughter cell begins the interphase of a new cycle. Alternatively, they may stop cycling temporarily or permanently.

The two key decisions are when to enter the S-phase and subsequently the M-phase.

Mitosis begins only after DNA synthesis has been completed and requires major changes in cell architecture------breakdown of the nuclear envelope, condensation of chromatin and extensive reorganization of the cytoskeleton.

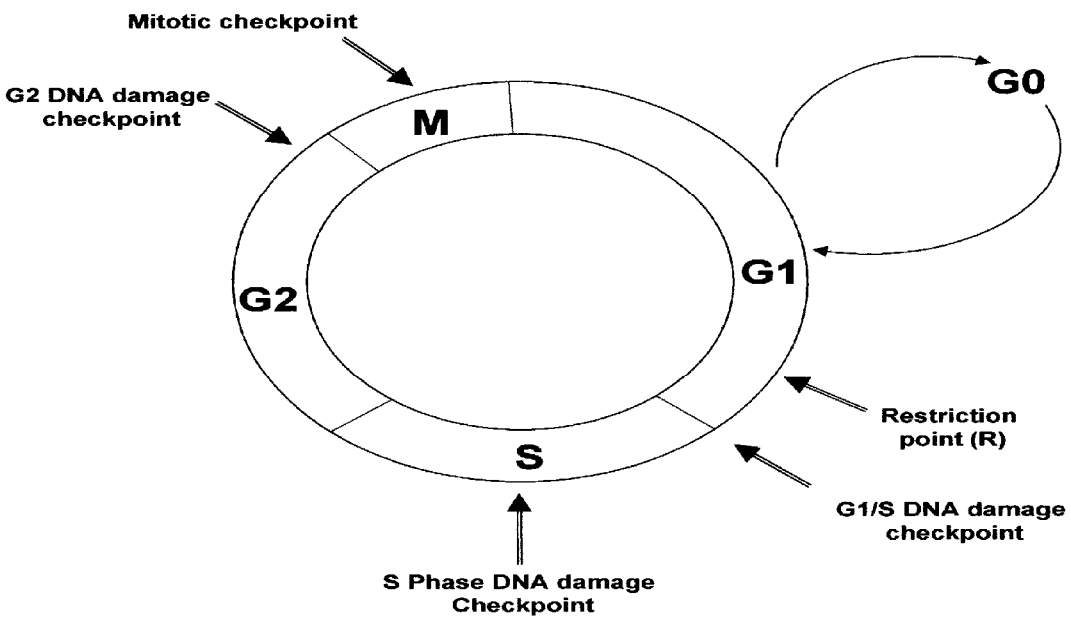
During the phases in the cell cycle, if something is wrong and cannot be corrected, the cell halts its progression through the cycle and may initiate apoptosis and close down.

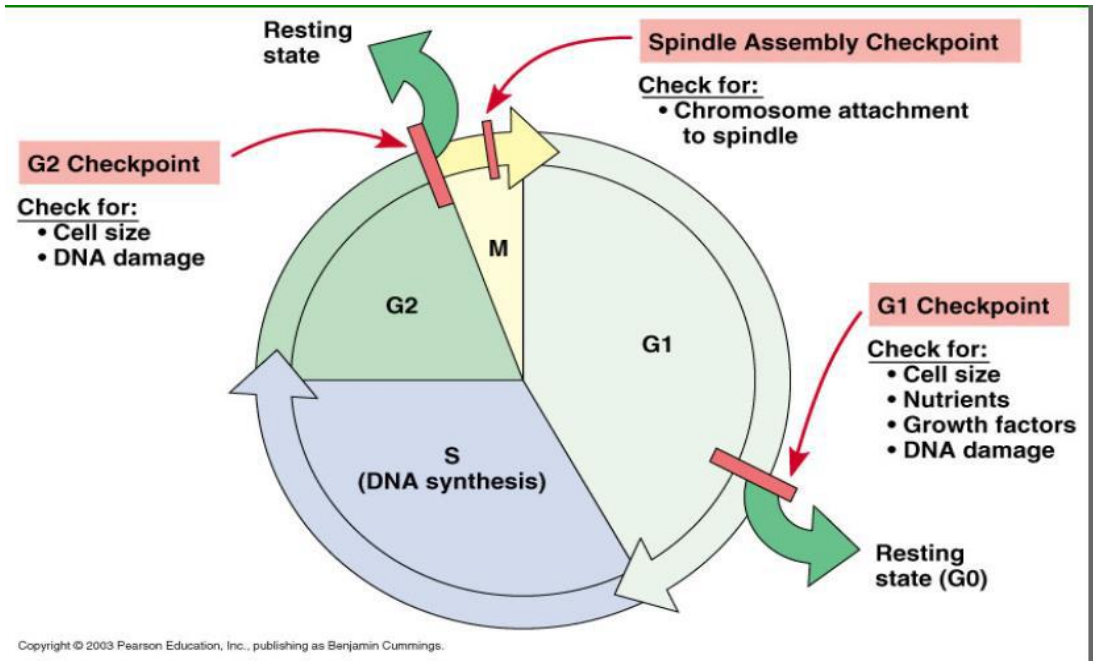


The cell cycle clock (CCC) is the executive decision maker of the cell and it runs amok in virtually all types of known cell.

At checkpoints, the CCC evaluates the health of the cell.

If the conditions are right, the clock activates certain proto-oncogenes which produce proteins that trigger the cell to enter the next phase of the cycle.





If conditions are not right, certain tumor suppressor genes produce proteins that prevent the cell from proceeding with cell division.

The CCC determines whether or not a cell should divide.

When the regulatory mechanisms that limit cell division are defective and cells undergo unregulated division, the result is catastrophic----------CANCER.