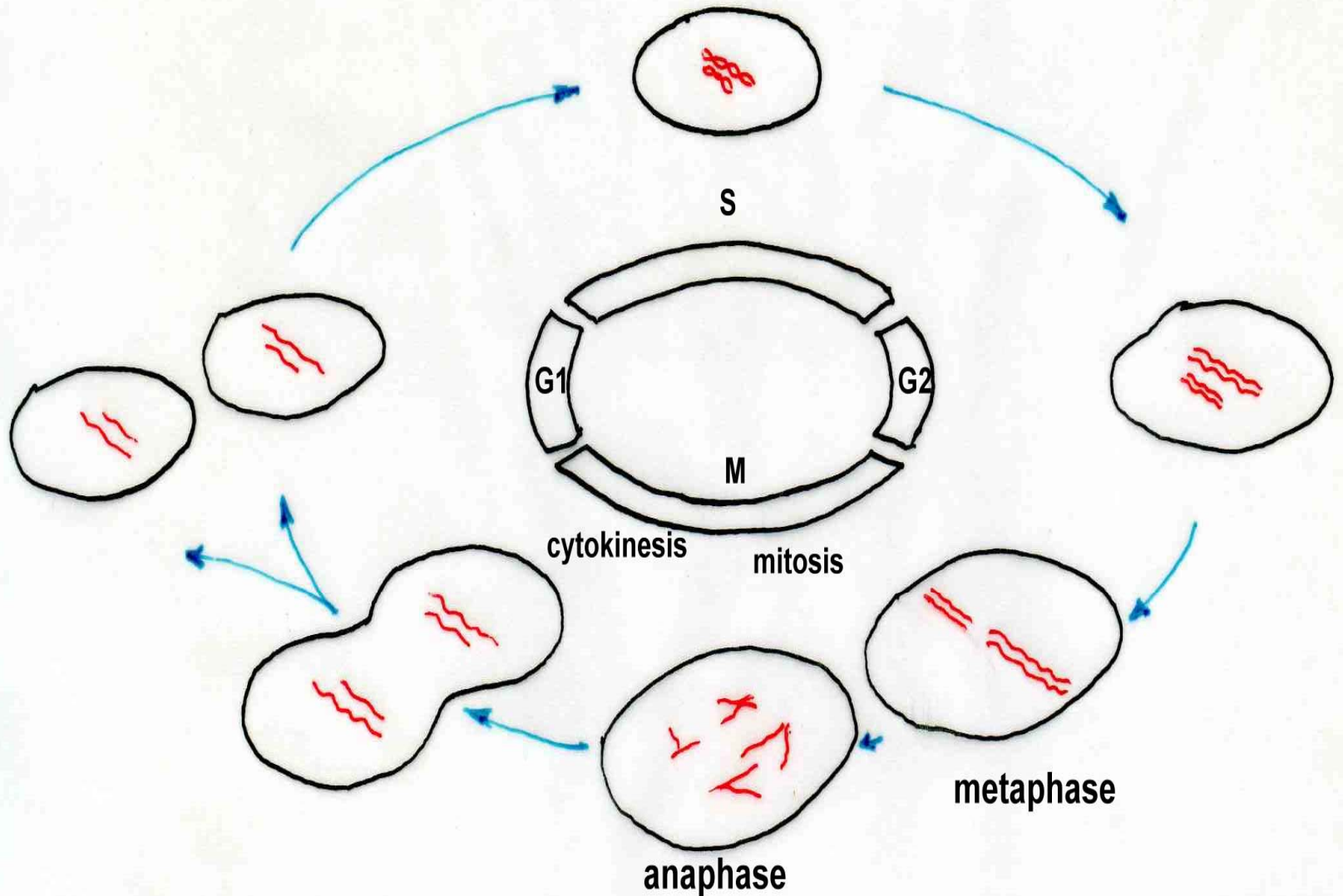


Cell Cycle

Andrew Ying-Siu Lee, MD, PhD.



- **Cell cycle = sequences of events leading to reproduction of cell**

- **First major phase of cell cycle (=S phase):-**

At specific "replication origins" sites, proteins open the DNA helix exposing to enzymes that carry out DNA synthesis.

Histones package the DNA into sister chromatids(=chromosome duplication).

DNA replication and chromosome duplication = S phase.

- **Second major phase of cell cycle (= M phase):-**

2 major events : nuclear division (= mitosis), that distribute the duplicated chromosomes into a pair of daughter nuclei
cytoplasmic division (= cytokinesis)

- **Gap phases (= period for cell growth and regulations):-**

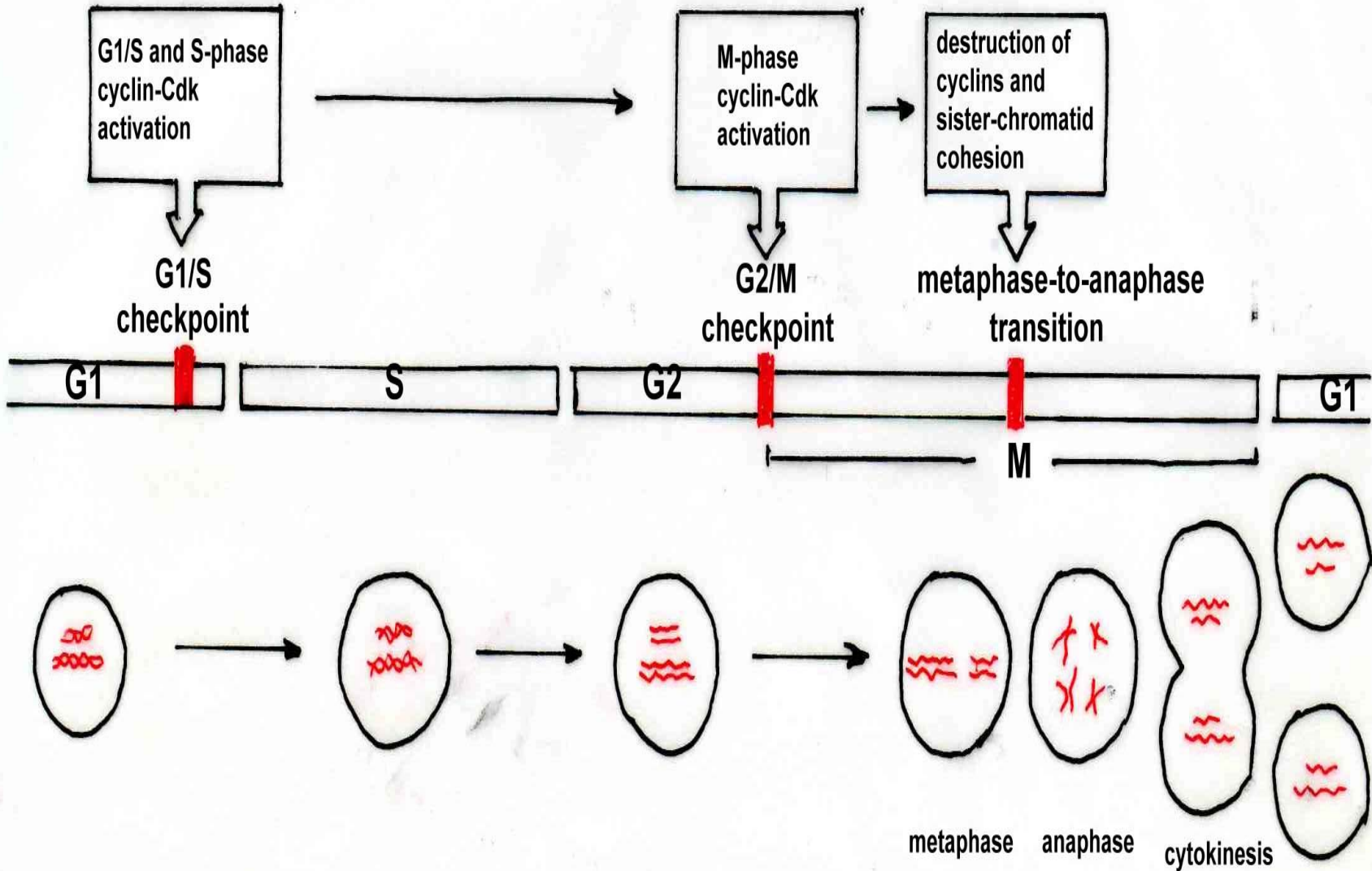
G1 = gap phase between M and S phases, occurs before S

G2 = gap phase between S and M phases, occurs before M

G0 = prolonged nondividing state from G1

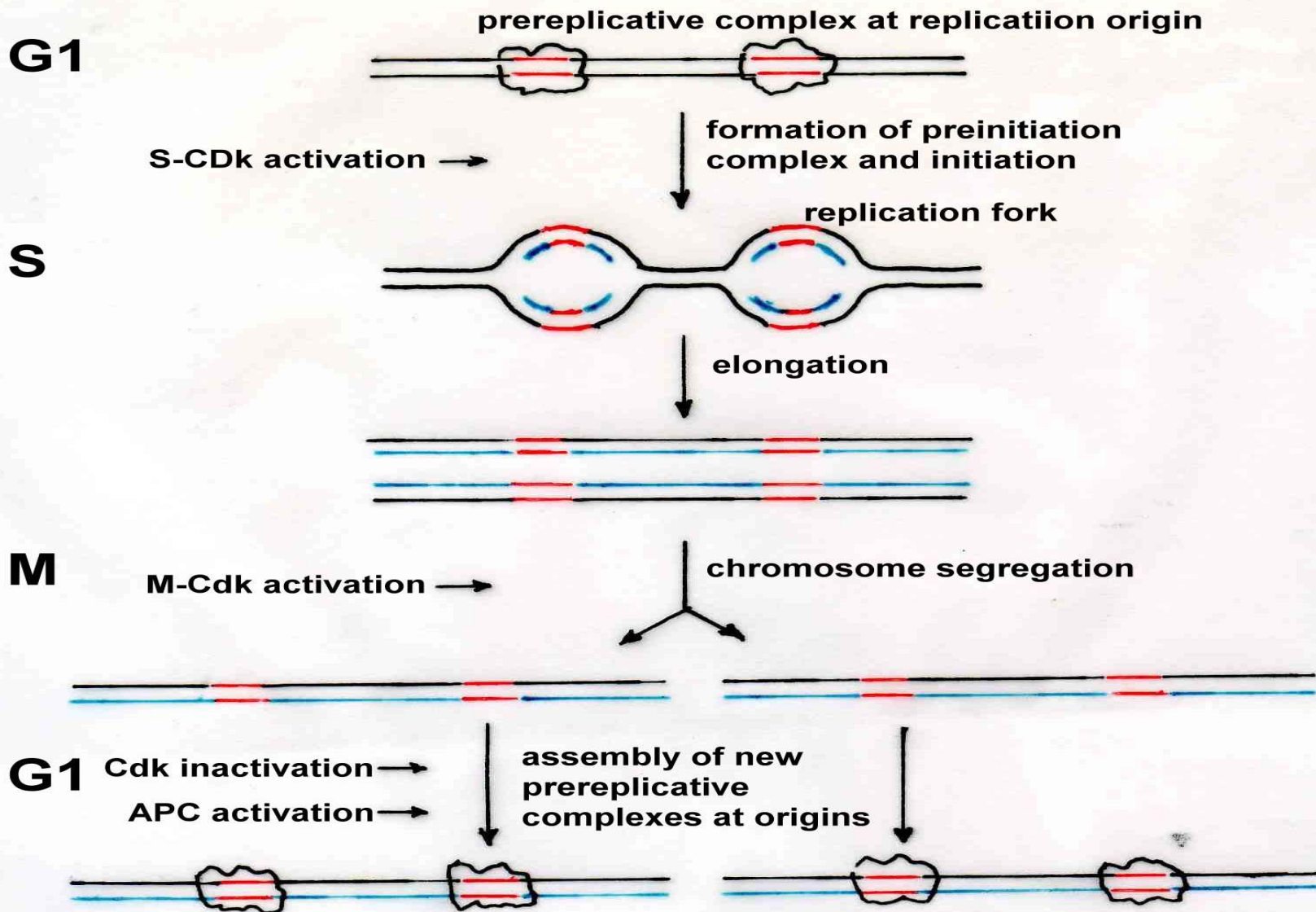
interphase= period between end of one M phase and beginning of the next

Cell-cycle control system



- **Cell-cycle control system = network of regulatory proteins (= cyclin-dependent kinases CdKs activated by cyclins = cyclin-CdK complexes and CdK-activating kinases) controlling timing and coordination of cell-cycle events at 3 regulatory checkpoints.**
- **Protein degradation in cell-cycle control (cyclins, CdK inhibitor proteins and other cell-cycle regulators) via ubiquitination by ubiquitins. The anaphase-promoting complex (APC) = giant ubiquitin-protein ligase that triggers the metaphase-to-anaphase transition**

Chromosome Duplication



- Prereplicative complexes assembled at “**replication origins**”
S-CdK activation > > **Preinitiation complex** DNA polymerases, initiator proteins, DNA helicase (unwinding of DNA helix) >>
replication fork --→ **elongation** M-CdK activation >>
chromosome segregation
- Chromatin (heterochromatin and euchromatin) = DNA-protein assembly by histones (histone-DNA and histone-histone interactions)
- Basic unit of chromatin = nucleosome

Mitosis

- Mitosis triggered by mitotic cyclin-CdK complexes and other protein kinases
- Chromosomes dramatically reorganized in mitosis via “chromosome condensation” (compacted sister chromatids) and “resolution” (sister chromatids easily pulled apart in anaphase due to decatenation of DNA by topoisomerase II)
- Chromosome segregation driven by mitotic spindle (microtubules) that pulls sister chromatids apart.