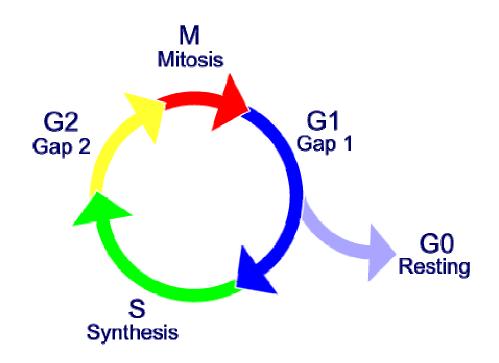
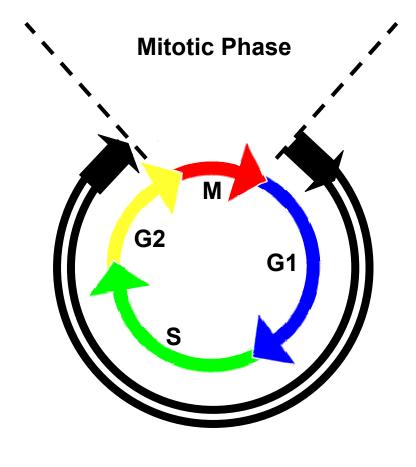
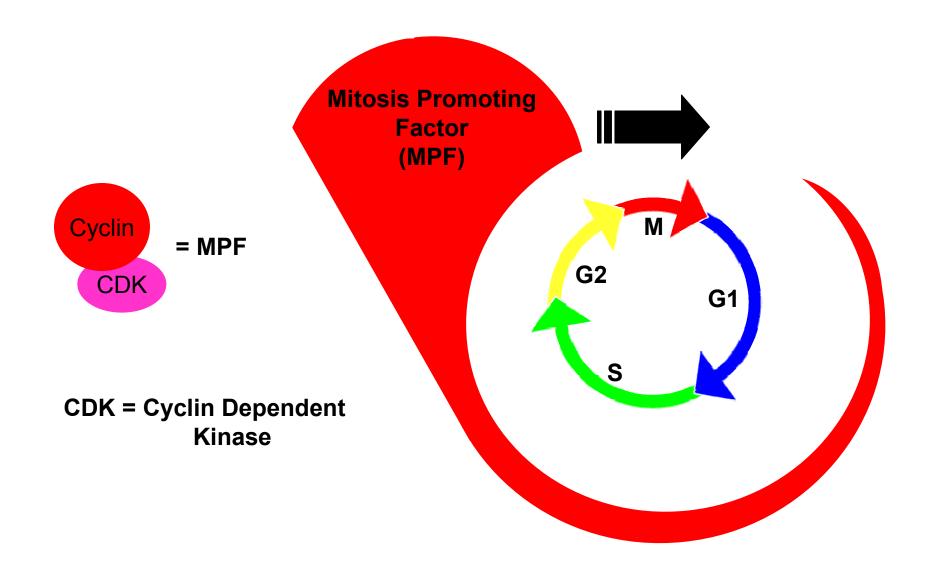
CELL CYCLE

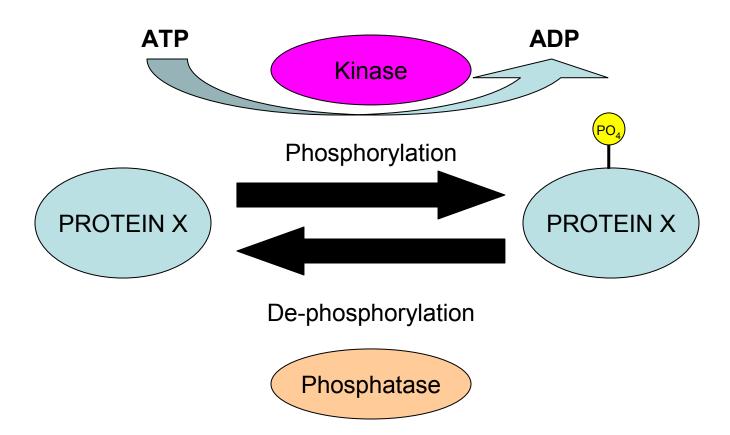


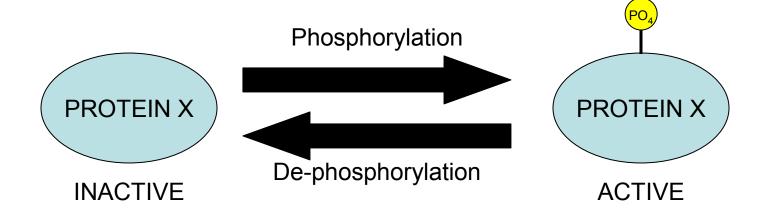


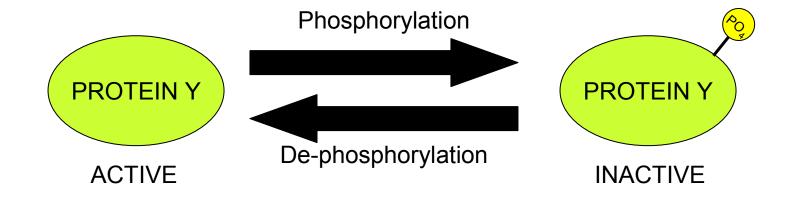
Interphase

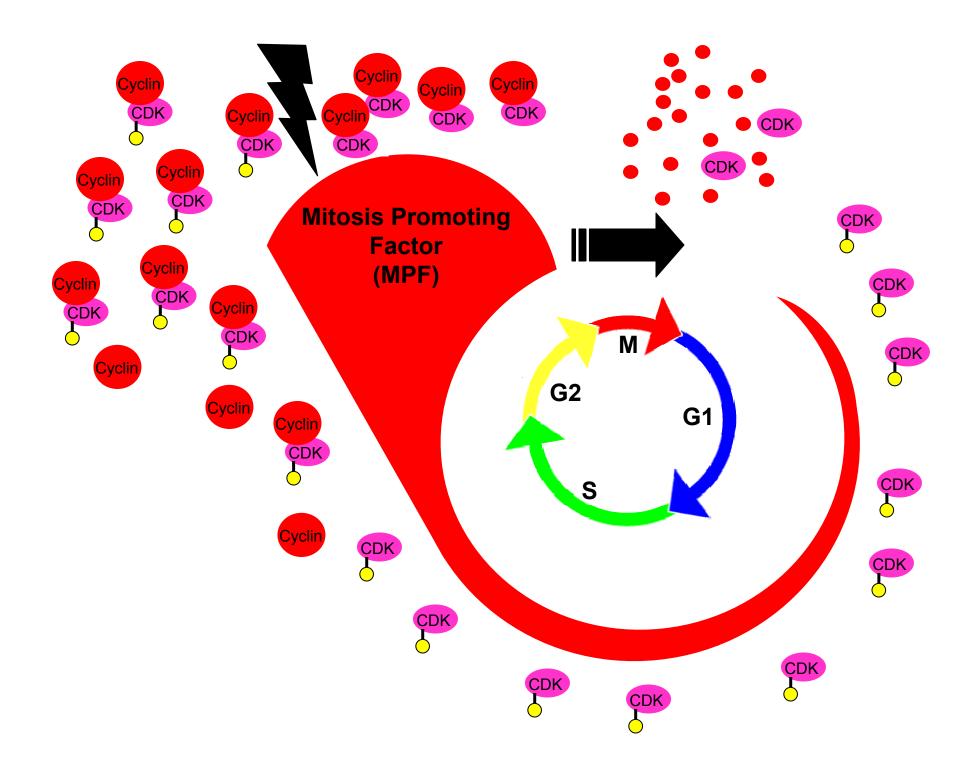


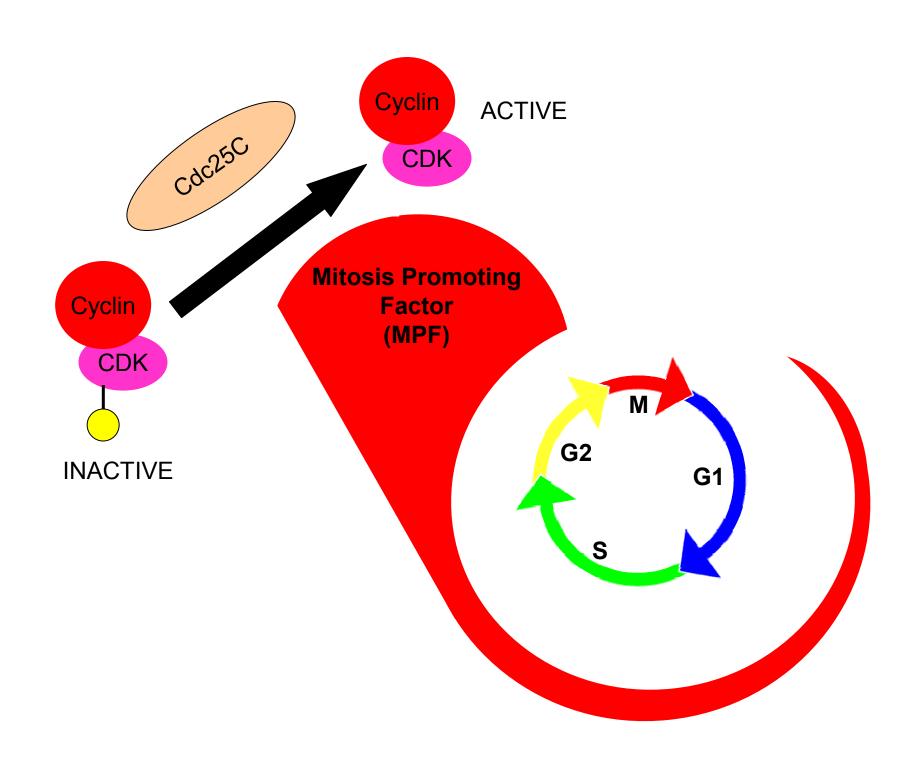
KINASES AND PHOSPHATASES

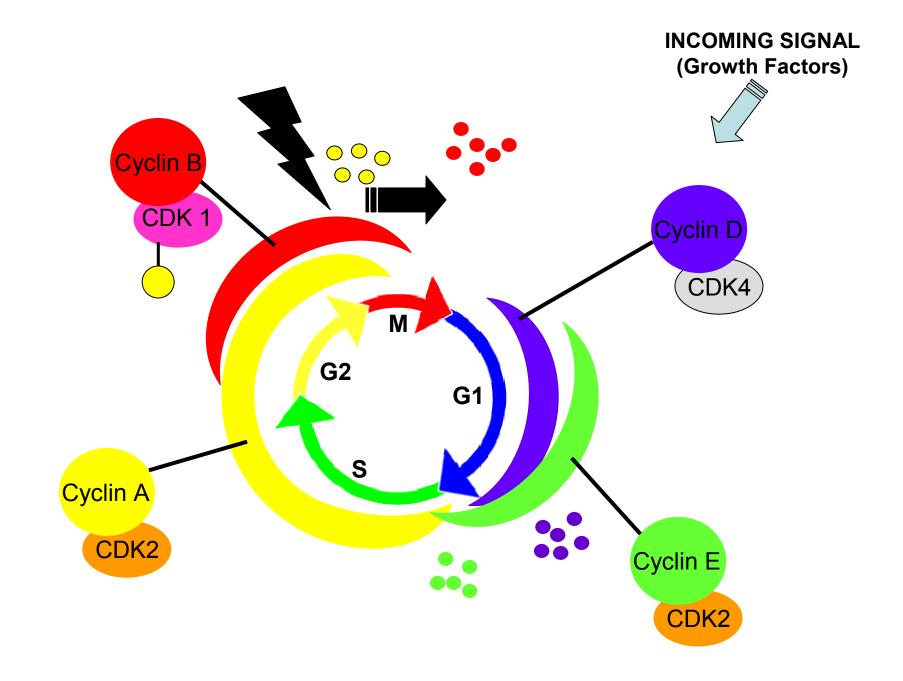






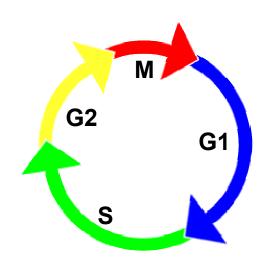






Why are there so many Cyclins and Kinases needed for cell division?

REGULATION!



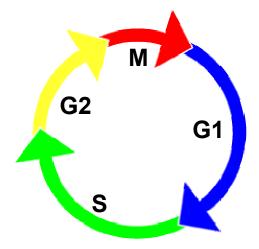
What can go wrong?

DNA is damaged

Sister chromatids do not separate

Cell enters cell cycle when it should not

Cell size is too small for cell division



The cell does not produce enough of the organelles or products needed for DNA synthesis and cell division

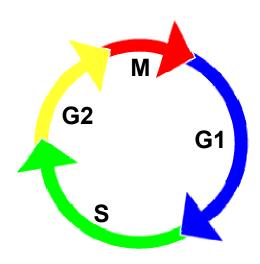
DNA is not completely synthesized

DNA is damaged but DNA synthesis proceeds

CELL CYCLE CHECKPOINTS

Critical points in the cell cycle that are tightly regulated.

Checkpoint failures lead to unregulated cell division or cancer.

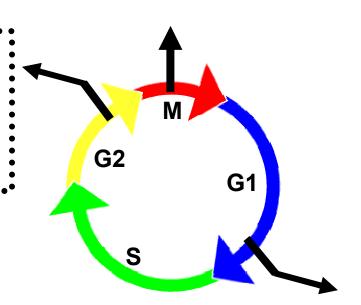


Metaphase Checkpoint

chromosome attachment to mitotic spindles

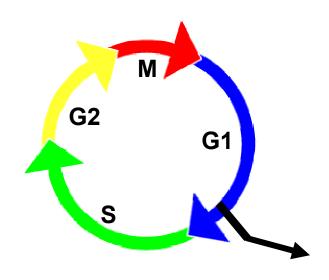
G2 Checkpoint

cell size chromosome replication DNA damage



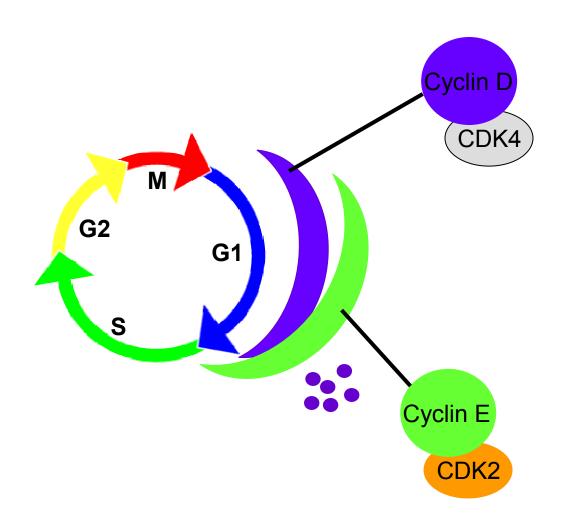
G1 Checkpoint

cell size nutrient levels DNA damage

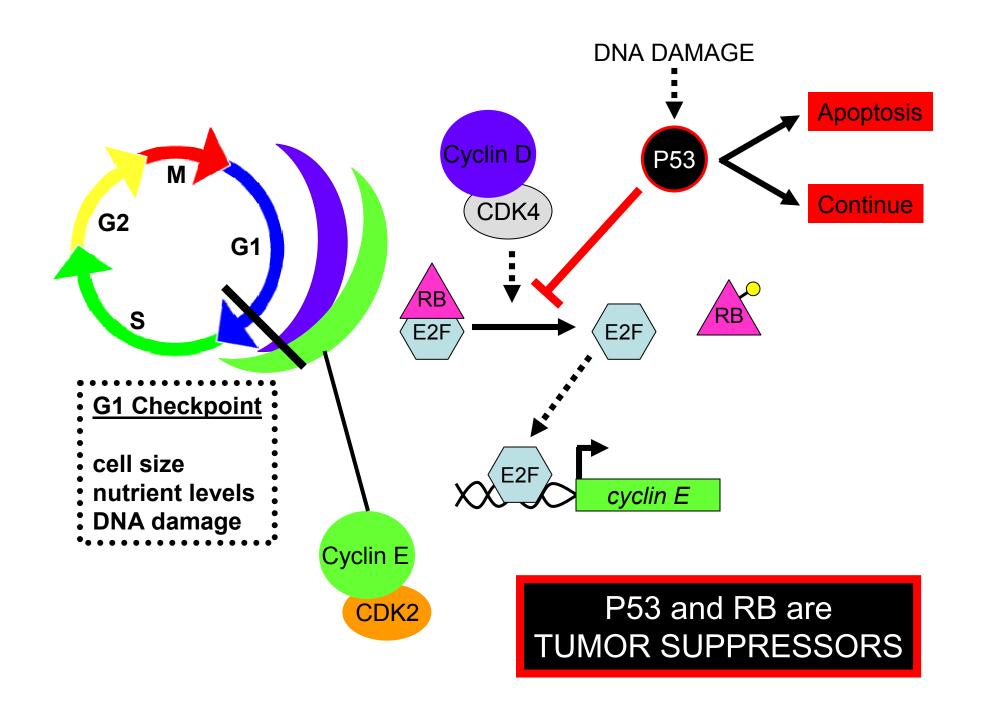


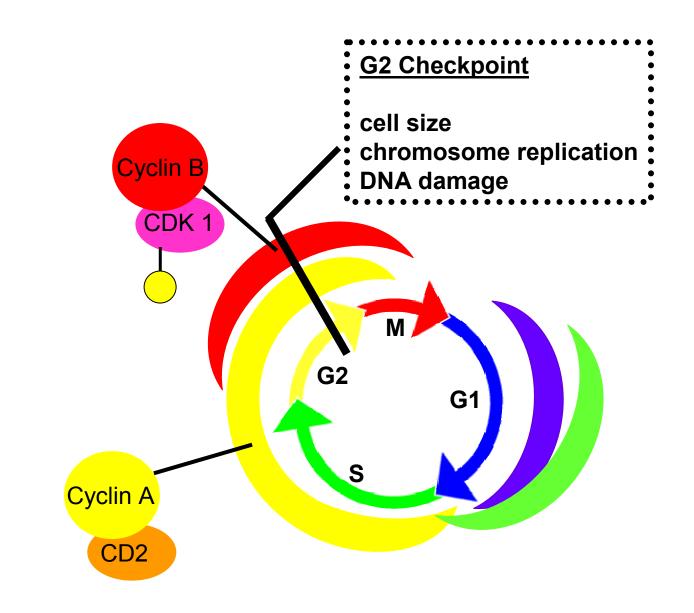
G1 Checkpoint

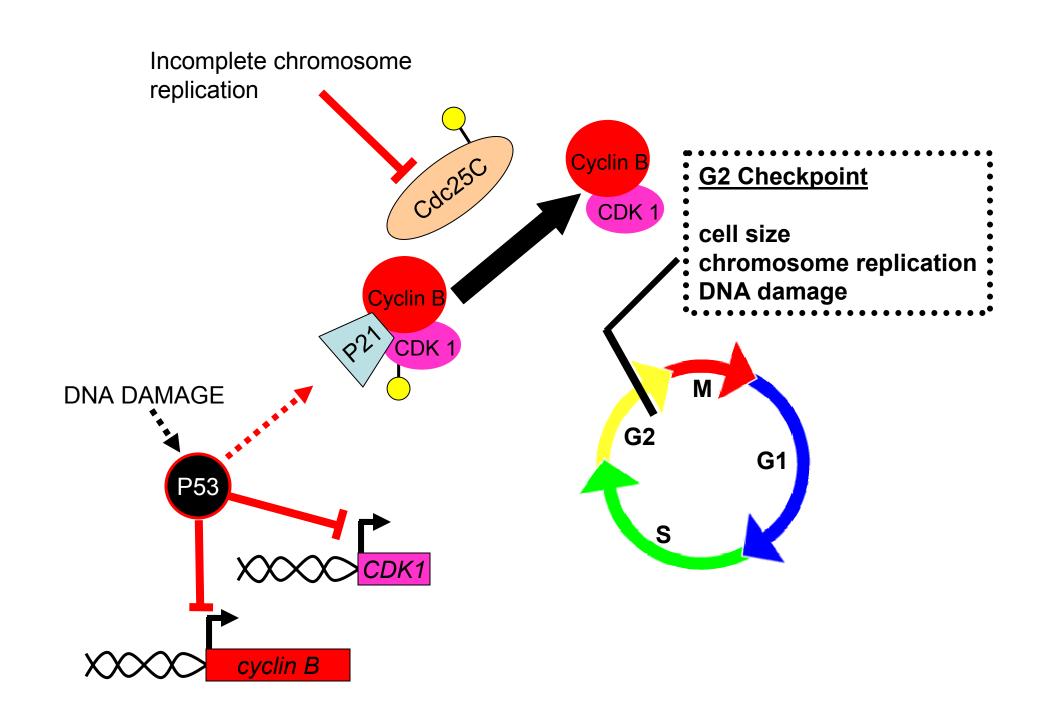
cell size nutrient levels DNA damage

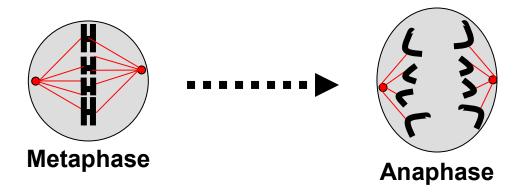


INCOMING SIGNAL (Growth Factors)



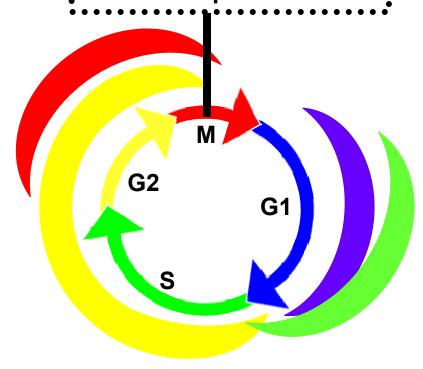


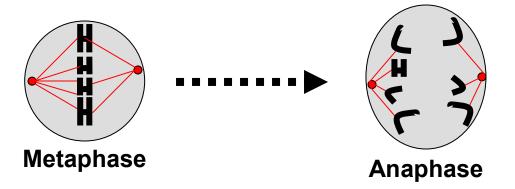


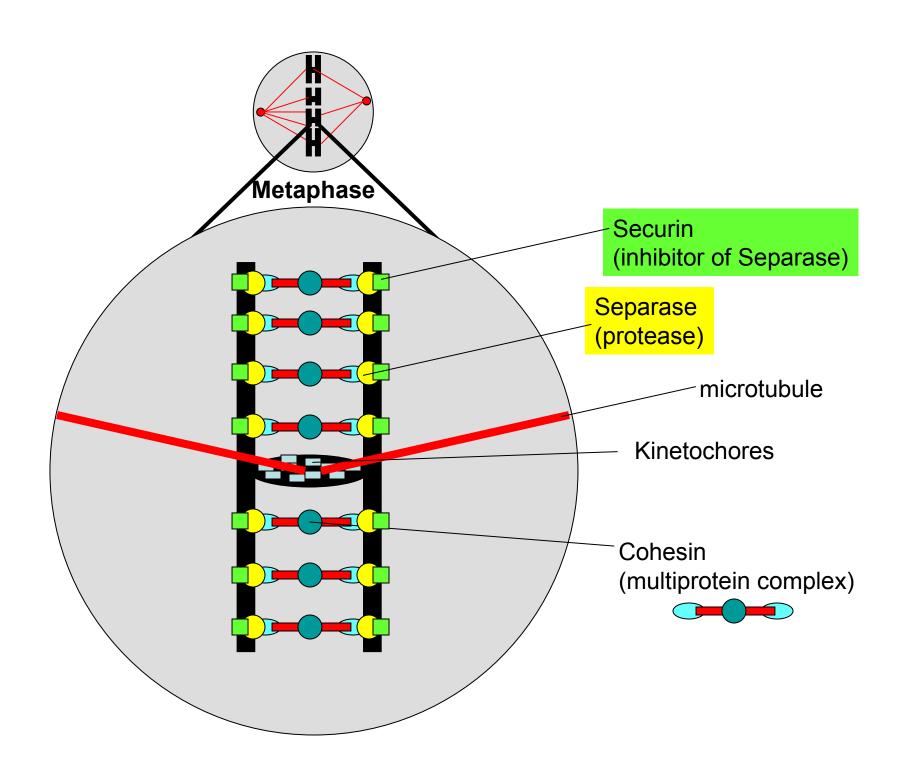


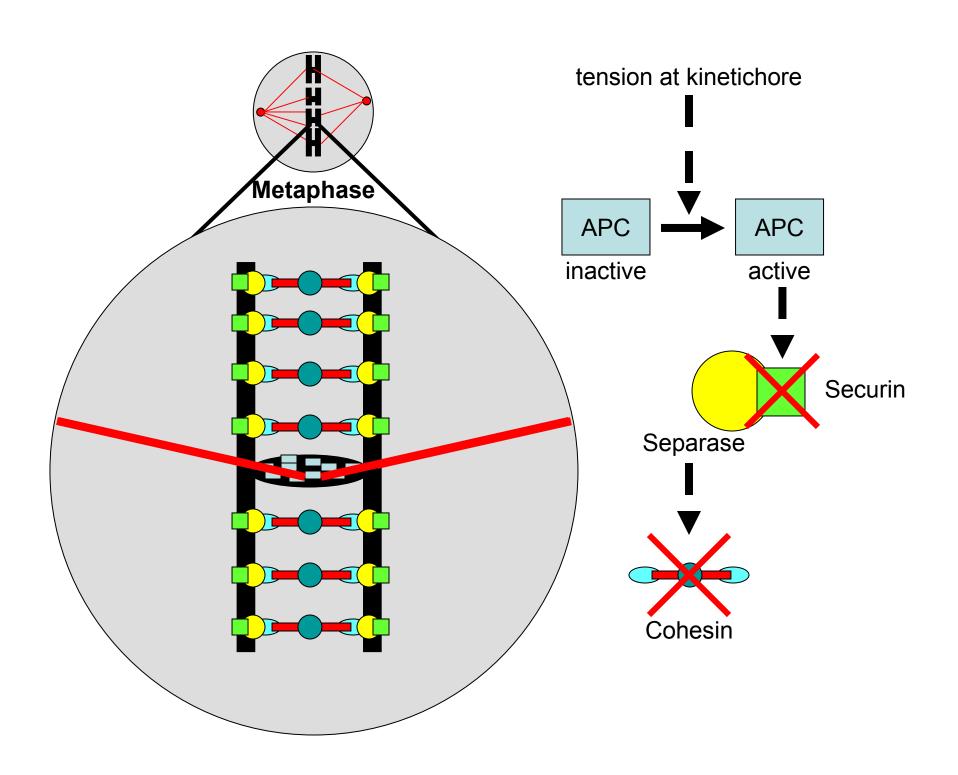
Metaphase Checkpoint

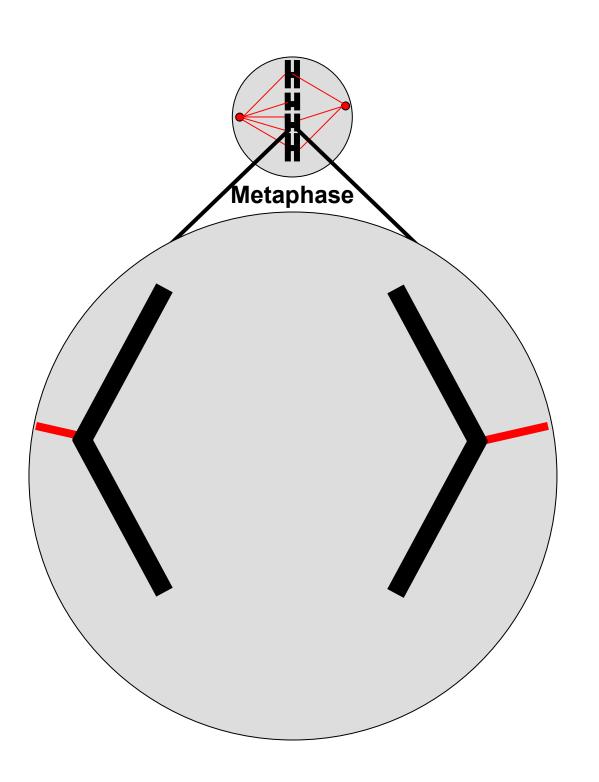
chromosome attachment to mitotic spindles











Metaphase Checkpoint

chromosome attachment to mitotic spindles

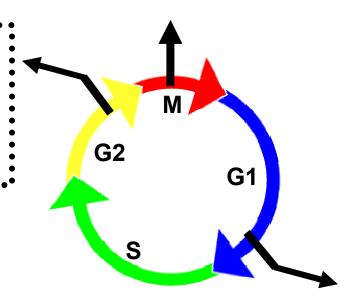
APC

G2 Checkpoint

cell size chromosome replication DNA damage



Cdc25C





P53

G1 Checkpoint

cell size nutrient levels DNA damage

Leland Hartwell

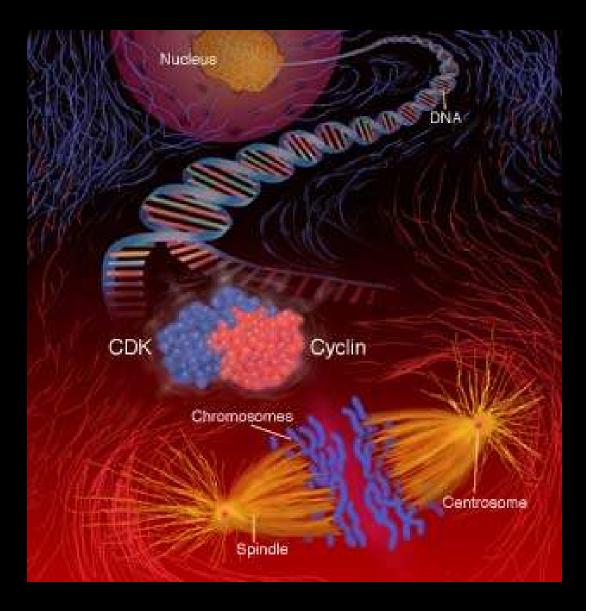


Paul Nurse



Tim Hunt

The Nobel Prize in Physiology or Medicine 2001



SUMMARY

- Activities that occur during different stages of the cell cycle
 - ■G1: cell growth, preparation for DNA synthesis
 - S: DNA synthesis
 - ■G2: cell growth, preparation for cell division
 - ■M: Cell divides
- Regulatory factors that control the cell cycle
 - Cyclins, kinases, phosphatases, and tumor suppressors
- Communication within cells Phosphorylation and de-phosphorylation
- Cell cycle checkpoints G1, G2, and Metaphase checkpoints
- Tumor suppressors P53, and RB
- Cancer Occurs when checkpoints fail or an oncogene is expressed