CELLULAR

Section I - Cell Cycle

I. Cell cycle phases
   A. Interphase
      1. G_0 - a non-dividing resting state
      2. G_1 - first growth phase (synthesis of carbohydrates, proteins, lipids, and RNA)
      3. S - DNA synthesized
      4. G_2 - second growth phase (synthesis of ATP)
   B. Mitosis (M)
      1. Prophase: chromosomes condense and spindle fibers form.
      2. Metaphase: chromosomes line up in the middle of cell.
      3. Anaphase: chromosomes separate to opposite sides of the cell.
      4. Telophase: the cell divides and replicated chromosomes are equally split among daughter cells.

II. Cell types
   A. Permanent - always in G_0
      1. Muscle cells, neurons, and RBCs
   B. Stable (quiescent) - alternate between G_0 and G_1
      1. Hepatocytes and lymphocytes
   C. Labile - rapidly dividing and rarely in G_0

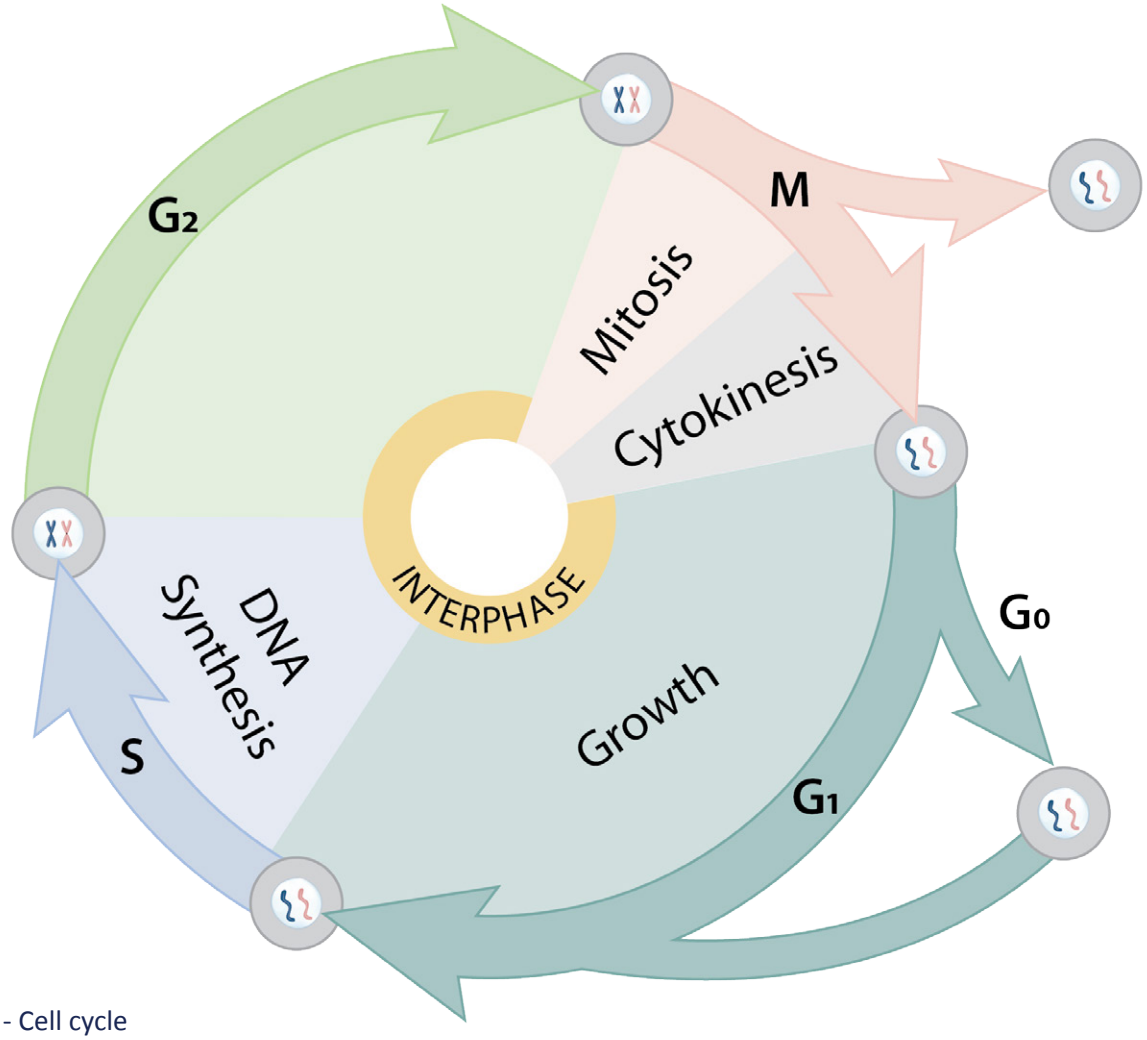


Figure 2.2.1 - Cell cycle

1. Bone marrow cells, skin, hair follicles, and gut epithelial cells

III. Cell cycle regulation (Figure 2.2.2)

A. Cyclins bind cyclin dependent kinases (CDKs) → cyclin-CDK complex → phosphorylation (inactivation) of retinoblastoma protein (Rb) → release of E2F (transcription factor) → cellular division

B. Cyclin D1 promotes cell cycle progression (G_1 → S) and dysregulation is implicated in mantle cell lymphoma

C. Abnormal Rb protein is implicated in retinoblastoma

D. Li-Fraumeni syndrome is caused by mutations in p53

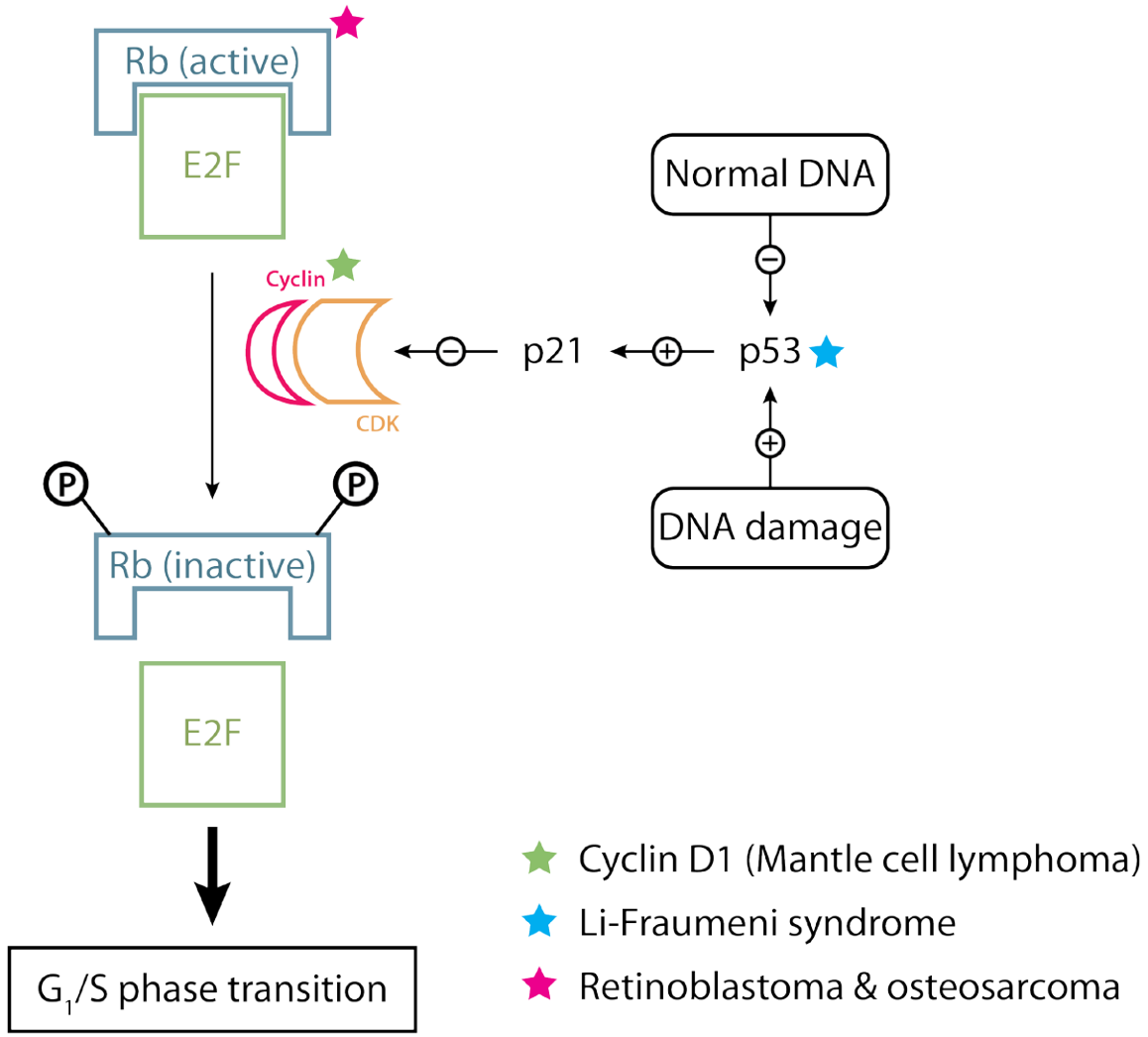
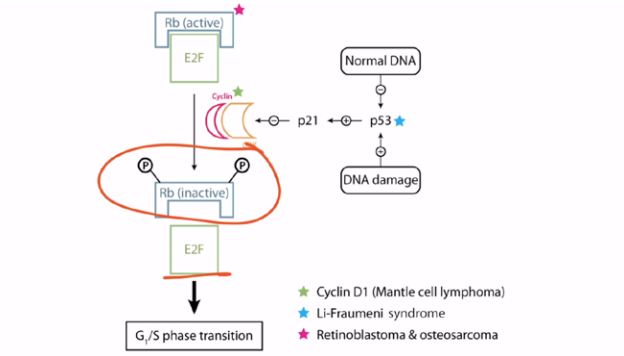


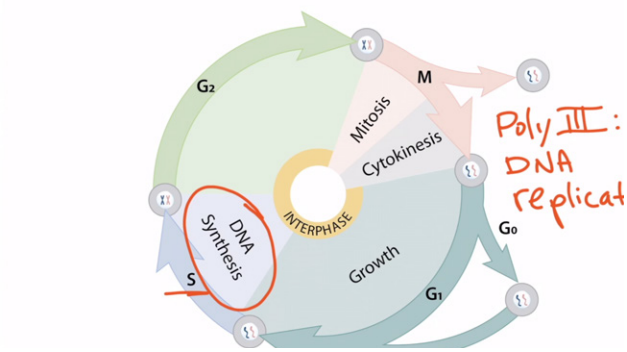
Figure 2.2.2 - Regulation of G1/S phase transition

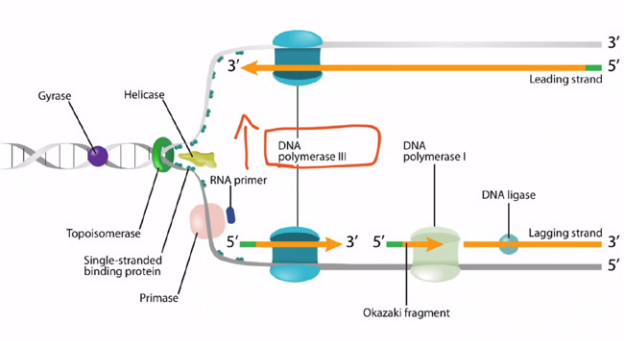
REVIEW QUESTIONS

1. Researchers are studying the effects of a new drug on the cell cycle in mice. The mice are exposed to the new drug and then several proteins are isolated. One protein of interest is found to be heavily phosphorylated by the new drug, resulting in an altered interaction with the transcription factor E2F. How would the activity of DNA polymerase III likely be altered as a result of exposure to the new drug?

   - **The new drug increases the phosphorylation of a protein (Rb) → release of E2F → G_1/S phase transition → ↑ DNA synthesis → ↑ DNA polymerase III**







2. A 12-year-old girl presents to the office for a follow up visit. She has a history of xeroderma pigmentosum and requires frequent visits to screen for skin cancer. How will the activity of p53 likely be altered in this patient?

   - **Xeroderma pigmentosum → ↓ nucleotide excision repair → ↑ DNA damage → ↑ p53**