Chapter 12

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- Reasons for Cells to Divide:
    1. Growth and Development
    2. Asexual Reproduction
    3. Tissue Renewal
- The Cell Cycle:
    1. Interphase (G_1 phase, S phase, and G_2 phase)
    2. Mitotic Phase (Mitosis, Cytokinesis)
- G_1 Phase − Growth phase, as the cell prepares to divide
- S Phase − Synthesis phase, DNA is duplicated so that cells remain the same
- G_2 Phase − Prepares the cell for cell division
- Chromosome Organization:
    1. Each cell has about 2 meters of DNA in the nucleus, made up of thin threads called chromatin
    2. Before division, chromatin is condensed to chromosomes
    3. DNA replicates before cell division to produce paired chromatids
- In G_2 of interphase, chromatin is duplicated
- In metaphase, spindle fibers attach to chromosomes
- In anaphase, spindles pull sister chromatids, splitting the chromosomes in two
- Bacterial Binary Fission − Bacteria do not have a nucleus, and contain a single chromosome, which is replicated. The bacteria then splits in two.

- When cells are not actively dividing, they are in G_0 phase
- Cells enter the cell division cycle if they activate the genes for cyclin proteins
    1. Activated by growth factors and other signals
    2. Inhibited by cell density and/or lack of ECM anchorage
- 3 Major Cell Checkpoints:
    1. Between G_1 and S Phase − Can DNA synthesis begin?
    2. Between G_2 and M Phase − Has DNA synthesis been completed correctly, and can the cell commit to mitosis?
    3. Spindle Checkpoint − Are all chromosomes attached to spindles, and are sister chromatids split correctly?
- Protein Signals promote cell growth and division:
    1. Internal signals are called "promoting factors"
    2. External signals are called "growth factors"
- Primary Mechanism of Control done by Phosphorylation by kinase enzyme:
    1. Kinases must be attached to a cyclin to be activated
    2. Cyclin concentration fluctuates in a cell and is high in M phase
- Growth Factors − Protein signals released by body cells that stimulate other cells to divide
    1. Density-Dependent Inhibition − When cells crowd, they stop dividing. Each cell binds to a bit of growth factor, until none is left
    2. Anchorage Dependence − Must attach to substrate, too many cells, nowhere to attach
    3. Cancer cells have neither of the above
- Cancer is essentially uncontrolled cell growth
- What control is lost? Lose checkpoint stops. Gene p53 plays a key role in G_1/S restriction point. p53 usually halts cell division if it detects a damaged DNA. All cancers do not have p53.