

## General Cell Division

- Varying life-spans – can be very short
  - Taste Cells = 10 days vs. Muscle Cells = 15 years
  - Most cells in body are NOT dividing
- Highly regulated by signals which prevent over-growth
  - Unregulated growth leads to tumors/cancer
  - The Cell Cycle = Series of events/checkpoints that must occur before a cell divides
    - Regulated by proteins
      - Mutations/deficiencies lead to uncontrolled growth
    - G0 – Non-dividing cells exit the cycle and enter G0
  - G1 – Growth, Preparation for DNA Synthesis
    - Non-DNA contents replicate, cell size increases
    - Production of proteins/enzymes needed for replication
    - Checkpoint at the end of the phase (before S Phase) – checks for DNA damage, proper growth, nutrients and energy
  - S – DNA Replication (Synthesis)
    - In eukaryotic cells DNA is organized to chromosomes
      - Number/length varies by species
      - Each chromosome is made of one double-stranded DNA piece
      - After duplication there are two pieces – sister chromatids
        - Attached at the centromere

- Still mostly uncondensed during S-Phase
  - Intra S-Phase checkpoint → Proofreading of DNA
    - Errors are identified and corrected
- o G2 - Preparation for Mitosis, Growth
  - G1/G2 Checkpoint → Completes growth, chromosomes start to condense, checks that all organelles are ready for division
  - Cycle is halted if there is any minor DNA damage
  - Apoptosis occurs if there is major damage
- o Collectively, G0, G1 and G2 are the Interphase
- o M - Prophase, Metaphase, Anaphase, Telophase
  - Duplicated chromosomes are separated into two genetically identical sets of chromosomes
  - Cell has not divided into two cells at the end of mitosis
- o Cytokinesis → Division of cellular content
- o Proto-Oncogenes (Gas Pedal) → Proteins that send signals to stimulate cell division
  - Mutations can cause continual signal (problem)
- o Tumor Suppressors (Brakes) → Proteins that send signals to stop cell division
  - Mutations can allow cells to divide when they shouldn't
- o In proto-oncogenes and tumor suppressors (two copies - 1 mom and 1 dad) a mutation in a one dominant trait is sufficient enough to supercede normal protein
  - In a recessive trait both copies need mutation for supercession

#### Human Chromosomes

- Come in pairs - diploid
  - o 1 from mom, 1 from dad

- o 23 unique chromosomes
  - # of unique chromosomes designated by "n"
  - $n = 23$ , but diploid so  $2n = 46$
  - Paired chromosomes = homologous chromosomes
- Centrioles → Star-shaped cylindrical microtubule structure
  - o Only in animal cells
- Pericentriolar Material → Shapeless, dense mass of proteins
  - o Anchor microtubules that radiate out from centrosome
  - o Helps form mitotic spindle
- Centrosomes → Pair of perpendicular centrioles and pericentriolar material

#### Stages of Mitosis

- Prophase → Chromosomes super-coil/condense
  - o Become visible to microscope
    - DNA wraps around histone proteins/supercoil
    - Nucleosome = Histone with DNA wrapped around it
  - o Nucleolus/nucleoli disappear
  - o Centrosomes move to opposite ends of cell (animals)
    - Microtubules radiate out from centrosomes
    - Start to extend/form mitotic spindle
- Prometaphase → Nuclear envelope breaks apart
  - o Mitotic spindle microtubules enter nuclear space