Genetics and Molecular Biology: Lecture 3

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- Genome and Chromosome Structure
  - Genomes consist of one or more chromosomes - a large continuous DNA molecule
  - Classes of Cells
    - Prokaryotic cells "before nucleus":
      1. Archaea, Eubacteria (domains)
      2. 1-5 μm in diameter
      3. DNA stored in cytoplasm
      4. Only single-celled organisms
    - Eukaryotic cells "true nucleus":
      1. Eukarya (domain)
      2. DNA stored in nucleus (membrane-bound)
      3. Organelles with specialized tasks
      4. 10-100 μm in diameter
      5. Single-celled and multicellular organisms
  - Genome Architecture
    - Prokaryotes:
      1. Very diverse
      2. One or more chromosomes (linear or circular)
      3. Can also have circular pplasmids not needed to survive: smaller than chromosomes, gained or lost due to environmental conditions
    - Eukaryotes:
      1. Multiple linear chromosomes
      2. Chromosomes do not loop
  - Genome Size: *E. coli*: 4639 kilobases (kb) (0.006 ft); Human: 3200000 kb (6 ft)
  - Chromosome rearrangement causes chromosome number to vary between species
- Eukaryotic Chromosomes
  - Made of Chromatin - DNA wrapped around histone proteins
  - Nucleosome - DNA strans wrap as unit around histone "bead on a string"
    1. 8 histones per nucleosome
    2. Arrange into higher order packing patters: 30nm filament from nucleosomes $/rightarrow$ extended form of chromosome $/rightarrow$ condensed section of chromosome $/rightarrow$ mitotic chromosome

  - Cohesin proteins help pack DNA: bring sister chromatids together during mitosis, repair DNA

- Chromosome Condensation
  - More tightly packed DNA: genes less likely to be read to make proteins
  - Euchromatin: loosely packed, DNA actively being used to produce proteins
  - Heterochromatin: tightly packed, DNA not being read to produce proteins

- Covalent Modifications to Histine Proteins and DNA Changes DNA Packing Density
  - Acetylation of histone proetins loosens DNA packing (acetyl groups are polar) - acetylated histones are more likely to be Euchromatin
  - Methylation of histone proteins and DNA tightens DNA packing (methyl groups are nonpolar)

- RNA Structure
  - RNA vs. DNA
    * RNA is single-stranded (usually)
    * RNA has uracil instead of thymine
    * RNA uses ribose instead of deoxyribose (sugar backbone)
    * RNA can also make base pairs either on hte same RNA molecule, on different RNA molecules, or with DNA (with a single strand)
    * RNA folds into 3D strcutures based on base pairing

- DNA Replication
  - DNA: Double Helix of Anti-Parallel Strands
    * One strand: 5' to 3'
    * Other strand: 3' to 5'
    * Sugar phosphate backbones
    * Base pairs: A = T, G $\equiv$ C
  - Cell Division
    * Prior: DNA must be replicated to make two identical copies for daughter cells
    * Chromosome duplication and Condensation
    * Separation of sister chromatids into two chromosomes
  - Complementary strands allow for sinple replication of DNA
  - Definitions:
    * Origin of Replication: specific sites (sequences) where replication starts
    * Replication Bubble: expanded area of replicated DNA
    * Replication Fork: site of active replication, two per Bubble