

1 **Chapter 4:**

DNA, Chromosomes, and Genomes

2 **Major questions???**

- What molecule is capable of accurate & almost unlimited replication?
- How is it also able to direct development of an organism and the daily life of a cell?
- What kind of instructions does genetic information contain?
- How can the enormous amount of information for development & Maintenance fit within the tiny space of a cell?

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- Late 19th century
 - Chromosomes carry genetic information
 - Made of deoxyribonucleic acid & protein
 - Which part of the molecule carries the info???
- 1940's
 - DNA is the likely location of the info
 - Genetic instructions make proteins

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- DNA is genetic material (1940's)

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- 1953 "James Watson & Francis Crick"
 - Double helix
 - Replication
 - Information (sequence)
 -
 - Photo 51 Video

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The Structure & Function of DNA
197-201

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- Deoxyribonucleic acid (DNA)
 - Pyrimidine
 - Cytosine
 - Thymine
 - Purine
 - Adenine
 - Guanine
- Sugar phosphate backbone
 - 5' phosphate & 3' hydroxyl
- Turn = 10bp
- Antiparallel & complementary

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- [Genome](#)
 - All DNA in an organism
- [gene](#)
 - piece of DNA that directs production of a protein

- Template for replication
 - Semi-conservative replication

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Chromosomal DNA & its Packaging in the Chromatin Fiber

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- Perspective
 - Human cell 46 chromosomes ~ 2m
 - Nucleus 6 μ m
 - 24 miles fine thread into tennis ball

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- Chromatin
- Comparison to bacteria
- Homologs
 - Autosomes
 - Sex chromosomes
- karyotype

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- Number of & density of genes
 - Bacteria 500
 - Humans ~ 25,000
- Amount of DNA
 - Human
 - 200x larger than *S. cerevisiae*
 - 30x smaller than some plants & amphibians
 - 200x smaller than certain amoeba
- Chromosome #
 - Deer 6
 - Carp >100

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- Human genome project
 - Draft 2001 complete in 2004
- Transposable elements
- Exons & introns
- Regulatory sequences

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- Conserved regions

- 5% human genome
 - 1/3 protein
 - Protein binding sites (regulation)
 - RNA
 - Majority unknown function
- Conserved synteny

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- Cell cycle
 - Interphase chromosomes
 - Mitotic chromosomes

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- Origins of replication
- Centromere
 - Kinetochore
- telomeres

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- Chromatin
 - DNA, Histone & nonhistone proteins
 - Nucleosome
 - Protein-DNA
 - Histones two of each
 - H2A, H2B, H3, H4
 - 147 bp DNA (1.7 times)
 - Linker DNA 80bp

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- Bonds
 - 142 hydrogen bonds
 - Half backbone & histones
 - Hydrophobic interactions
 - Salt linkages
- Compression of minor groove
- Some sequence forms tighter bonds
 - Precise positioning of nucleosomes
- Highly conserved
 - Pea & cow 2 out of 102 different
 -
-

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- Chromatin remodeling complexes
 - spontaneous
 - ATP dependent
 - Nucleosome sliding
 - Chaperone interactions
 - Dynamic arrangement

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- 30nm fiber arrangement
 - Unknown
 - Zigzag model
 - Solenoidal structure
- Histone tails
- Histone H1