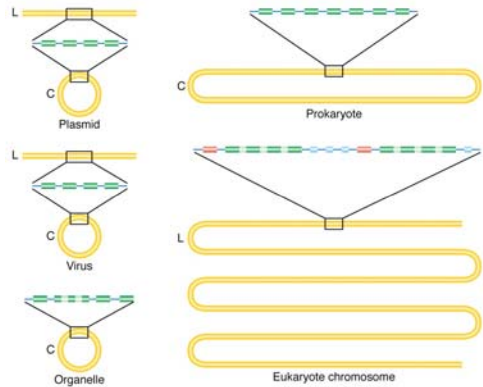


The nature of genomes

- Genomics: study of structure and function of genomes
- Genome size
 - variable, by orders of magnitude
 - number of genes roughly proportional to genome size
- Plasmids
 - symbiotic DNA molecules, not essential
 - mostly circular in prokaryotes
- Organellar DNA
 - chloroplast, mitochondrion
 - derived by endosymbiosis from bacterial ancestors

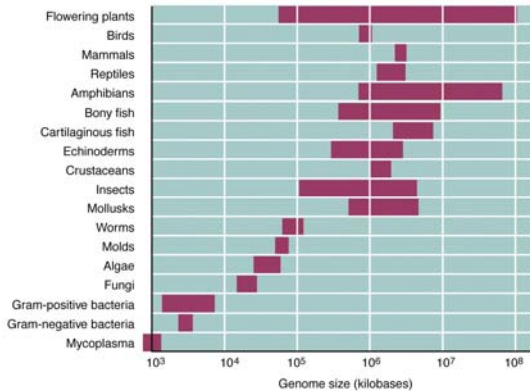
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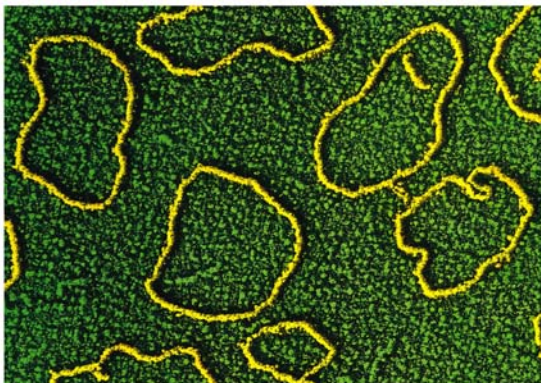
Viral genomes

- Nonliving particle
 - nucleic acid
 - protein
- DNA or RNA
 - single-stranded or double-stranded
 - linear or circular
- Compact genomes with little spacer DNA

In prokaryotes, viruses are sometimes referred to as bacteriophages.

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Prokaryotic genome

- Usually circular double helix
 - occupies nucleoid region of cell
 - attached to plasma membrane
- Genes are close together with little intergenic spacer
- Operon
 - tandem cluster of coordinately regulated genes
 - transcribed as single mRNA
- Introns very rare

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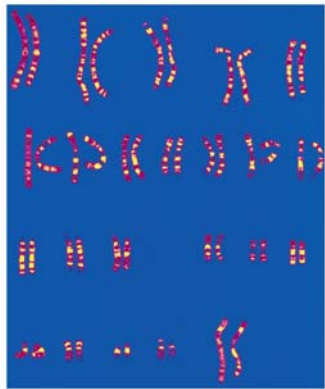
Eukaryotic nuclear genomes

- Each species has characteristic chromosome number
- Genes are segments of nuclear chromosomes
- Ploidy refers to number of complete sets of chromosomes
 - haploid ($1n$): one complete set of genes
 - diploid ($2n$)
 - polyploid ($\geq 3n$)
- In diploids, chromosomes come in homologous pairs (homologs)
 - structurally similar
 - same sequence of genes
 - may contain different alleles

In humans, somatic cells have $2n = 46$ chromosomes.

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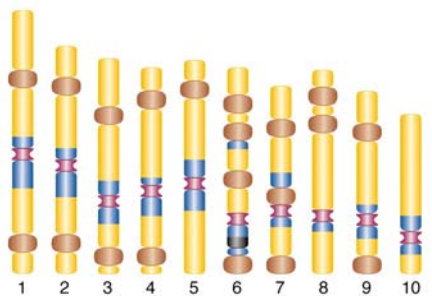
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Eukaryotic chromosomes (1)

- Cytogenetics: microscopic study of chromosomes
- Considerable difference in size and number of genes
- Variable centromere position
 - telocentric: centromere at end
 - acrocentric: centromere close to end
 - metacentric: centromere in middle
 - p arm is shortest, q arm is longest
- Telomere: end of chromosome
- Nucleolar organizer (rRNA)
- Chromomere

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- Euchromatin
- Knobs (thickenings)
- Heterochromatin
- Centromere
- Nucleolar organizer

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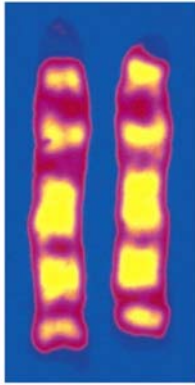
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Eukaryotic chromosomes (2)

- Heterochromatin
 - densely stained regions of highly compact DNA
 - mostly repetitive sequences
- Euchromatin: poorly stained, less compact, contains transcribed genes
- Banding patterns (metaphase chromosomes)
 - differential uptake of dyes
 - G bands, Giemsa stain (A/T rich)
 - R bands, reverse of Giemsa (G/C rich)
- Polytene chromosomes
 - replicated, unseparated chromosomes
 - present in certain tissues of dipteran insects

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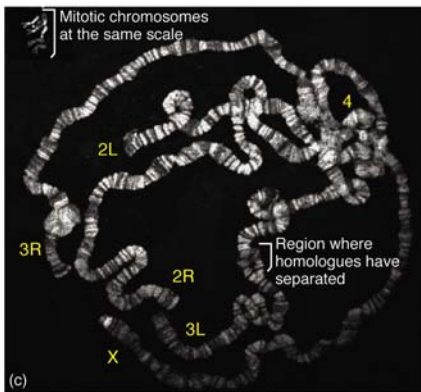
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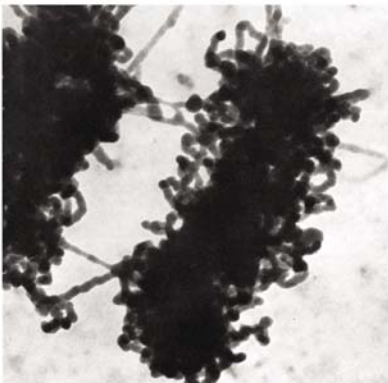
Nuclear DNA

- 10 nm fiber
- Highly organized, various degrees of coiling
- Nucleosome
 - fundamental unit of chromatin
 - DNA wound around histone core (octamer)
 - histones are highly conserved proteins
 - H2A, H2B, H3, H4
 - solenoid, 30 nm fiber
- Higher order coiling
 - solenoid loops attach to scaffold
 - scaffold attachments contain topoisomerase II
 - form larger diameter fibers

A haploid set of human chromosomes consists of about 1 meter of DNA.

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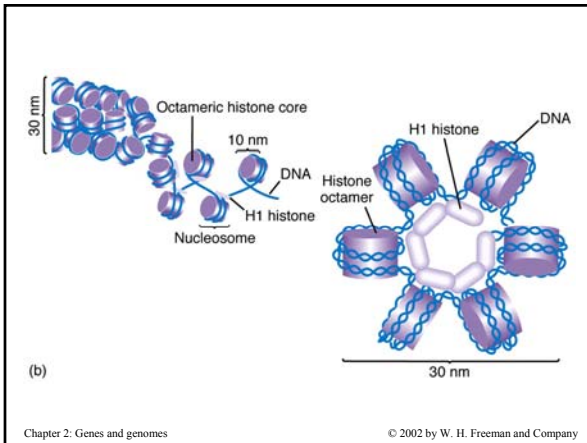
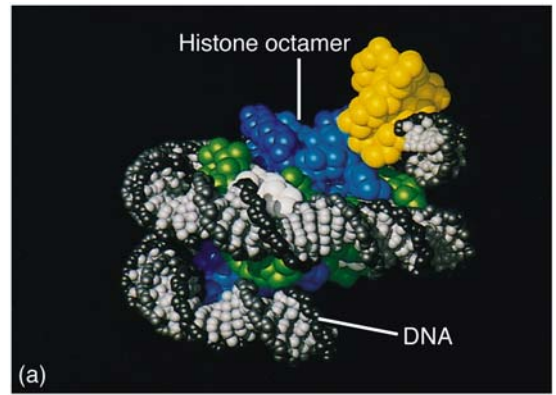
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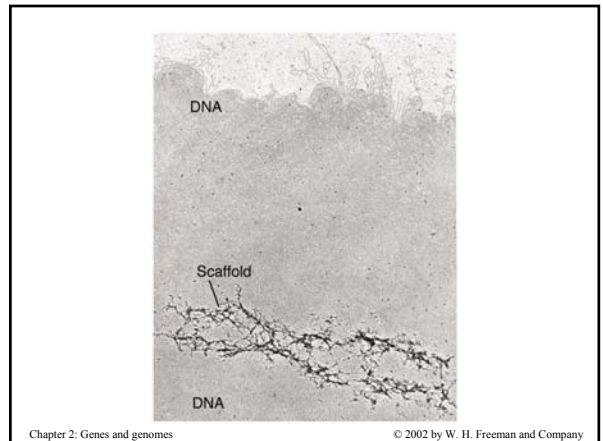
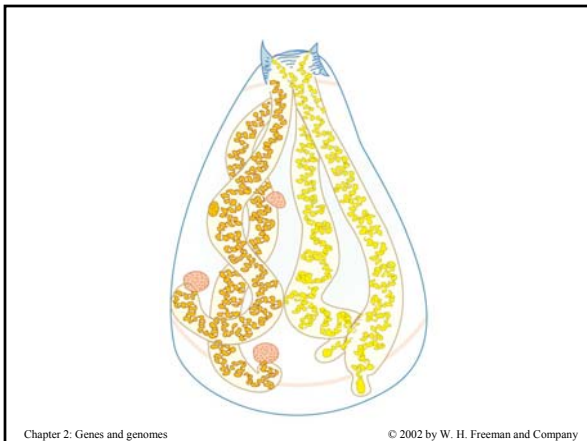
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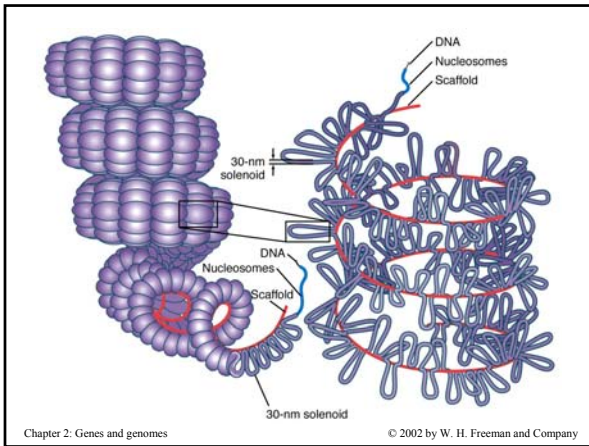


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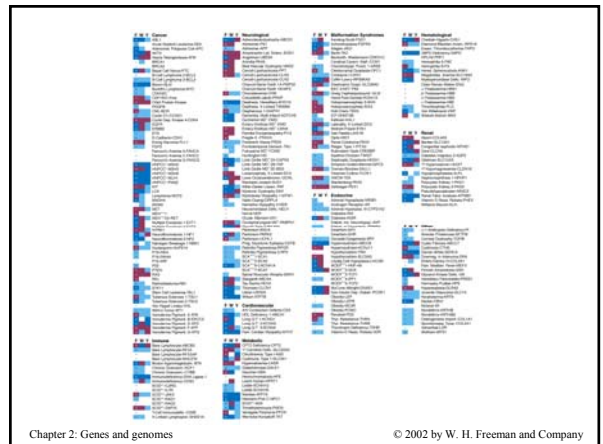
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Comparative genomics

- Study of similarities and differences among genomes
- Many genes are shared among all living things or between related groups
- Study of genes in model organisms provides useful information regarding genes in other organisms
- Large genome projects produce considerable information
 - computer analysis

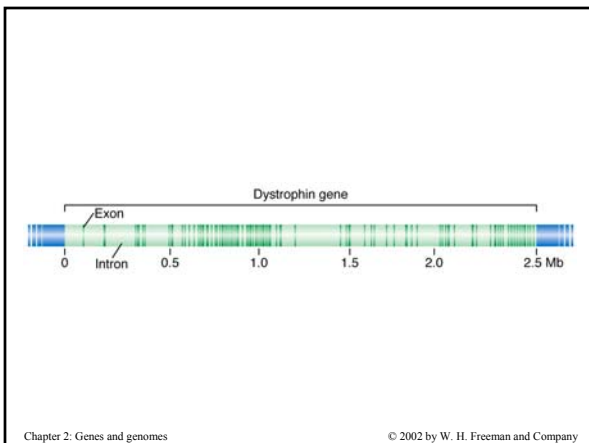
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