**Chapter 7**

**The Structure of Prokaryotic Genomes**

* Prokaryotic chromosomes
  + Main portion of DNA, along with associated proteins and RNA, packaged in 1-2 distinct chromosomes
  + Prokaryotic cells have a single copy of each chromosome (haploid)
  + Typical chromosome – circular molecule of DNA in nucleoid
  + Plasmids
    - Small molecules of DNA that replicate independently
    - Carry information required for their own replication, and often for one or more cellular traits
    - Not essential for normal metabolism, growth, or reproduction
    - Can confer survival advantages
    - Many types of plasmids
      * Fertility factors
      * Resistance factors
      * Bacteriocin factors
      * Virulence plasmids
      * Cryptic plasmids
  + Nuclear chromosomes
    - Typically have more than one chromosome per cell
    - Chromosomes are linear and sequestered within membrane-bound nucleus
    - Eukaryotic cells often have two copies of each chromosome (diploid)

**Regulation of Genetic Expression**

* Nature of prokaryotic operons
  + An operon consists of a promoter and a series of genes
  + Some operons are controlled by a regulatory element called an operator
    - activated by inducers
      * Lactose operon
    - Repressible operons are transcribed continually until deactivated by repressors
      * Tryptophan operon

**Mutations of Genes**

* Mutation – change in the nucleotide base sequence of a genome
* Rare event
* Almost always deleterious
* Rarely leads to a protein having a novel property that improves ability of organism and its descendents to survive and reproduce
* Mutagens
  + Radiation
    - Ionizing radiation – induces breaks in chromosomes
    - Nonionizing radiation – induces pyrimidine dimers
  + Chemical Mutagens
    - Nucleotide analogs – disrupt DNA and RNA replication and cause point mutations
    - Nucleotide-altering chemicals – result in base-pair substitution mutations and missense mutations
    - Frameshift mutagens – result in nonsense mutations

**Genetic Recombination and Transfer**

* Exchange of nucleotide sequences often mediated by DNA segments composed of homologous sequences
* Recombinants – cells with DNA molecules that contain new nucleotide sequences
* Vertical gene transfer – organisms replicate their genomes and provide copies to descendants
* Horizontal Gene Transfer Among Prokaryotes
  + Horizontal gene transfer – donor cell contributes part of genome to recipient cell
  + Three types
    - Transformation
    - Transduction
    - Bacterial conjugation
  + Transformation
    - Transforming agent was DNA; one of conclusive pieces of proof that DNA is genetic material
    - Cells that take up DNA are competent; results from alterations in cell wall and cytoplasmic membrane that allow DNA to enter cell
  + Transduction
    - Generalized transduction – transducing phage carries random DNA segment from donor to recipient
    - Specialized transduction – only certain donor DNA sequences are transferred