Chapter 9
Microbial Genetics
Chapter Outline

9.1. Introduction to Genetics and Genes: Unlocking the Secrets of Heredity
A. The nature of the genetic material
   1. Levels of structure and function of the genome
      a. Genome
      b. Chromosome
      c. Gene
   2. Size and packaging of genomes
B. The DNA code: A simple yet profound message
   1. Nucleotide
   2. Phosphate: Deoxyribose sugar and a nitrogenous base
   3. Purines and pyrimidines: Adenine, guanine, cytosine, and thymine
   4. Antiparallel arrangement in DNA
C. The significance of DNA structure
   1. Maintaining the code: Template
   2. Providing variety
D. DNA replication: Preserving the code and passing it on
   1. Overall replication process
      a. Templates and enzymes
      b. Semiconservative replication
   2. Refinements and details of replication
      a. Helicases
      b. DNA polymerase
      c. Replication fork
      d. Leading strand
      e. Lagging strand
      f. Okazaki fragments and DNA ligase
   3. Elongation and termination of the daughter molecules
   4. Replication in other biological systems

9.2. Applications of the DNA Code: Transcription and Translation
A. Gene-protein connection
   1. Structural genes
   2. Regulatory genes
   3. Genotype and phenotype
B. Major participants in transcription and translation
   1. RNAs: Tools in the cell's assembly line
   2. Messenger RNA: Carrying DNA's message
   3. Transfer RNA: The key to translation
   4. The ribosome: A mobile molecular factory for translation
C. Transcription: The first stage of gene expression
   1. RNA polymerase
   2. Template strand
   3. Coding strand
   4. Promoter region
   5. mRNA transcript
D. Translation: The second stage of gene expression
   1. The initiation of translation
2. The master genetic code: The message in messenger RNA
3. The beginning of protein synthesis
4. Continuation and completion of protein synthesis: Elongation and termination
   a. tRNA
   b. Translocation and post-translocation
   c. Polyribosomal complex
E. Eucaryotic transcription and translation: Similar yet different
   1. Introns
   2. Exons
   3. Split Gene
F. The genetics of animal viruses
   1. Replication, transcription, and translation of DNA viruses
   2. Replication, transcription, and translation of RNA viruses
      a. Positive-sense single-stranded RNA viruses
      b. RNA viruses with reverse transcriptase; Retroviruses: Significance to AIDS

9.3. Genetic Regulation of Protein Synthesis and Metabolism
A. Lactose operon: A model for inducible gene regulation in bacteria
   1. Regulator
   2. Repressor
   3. Control locus
   4. Promoter
   5. Operator
   6. Structural locus
   7. Inducer
B. A repressible operon
C. Antibiotics that affect transcription and translation
   1. Actinomycin D
   2. Erythromycin and spectinomycin
   3. Chloramphenicol
   4. Streptomycin

9.4. Mutations: Changes in the Genetic Code
A. Wild type strain
B. Mutant strain
C. Causes of mutations
   1. Spontaneous mutation
   2. Induced mutation
D. Categories of mutations
   1. Point mutations
   2. Missense mutation
   3. Nonsense mutation
   4. Silent mutation
   5. Back-mutation
E. Repair of mutations
   1. Photoactivation or light repair
   2. Excision repair
   3. Example: Xeroderma pigmentosa and enzyme photolyase
   4. Mismatched bases
F. The Ames Test: Salmonella typhimurium
G. Positive and negative effects of mutations
   1. Adaptation
   2. Natural selection
9.5. DNA Recombination Events
A. Transmission of genetic material in bacteria
   1. Conjugation: Bacterial “sex”
      a. Fertility or F factor
      b. Conjugative pilus
      c. Donor and recipient
      d. Resistance plasmids or R factors
   2. Transformation: Capturing DNA from solution
      a. *Streptococcus pneumoniae*
      b. Transformation
      c. Competent
      d. *Haemophilus and Neisseria*
      e. Transfection
   3. Transduction: The case of the piggyback DNA
   4. Transposons: "This Gene is Jumpin'"