

**CHAPTER 11**  
**MICROBIAL GENETICS AND**  
**INFECTIOUS DISEASE**

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**DNA**

- ◆ DNA stands for deoxyribonucleic acid
- ◆ DNA is the informational molecule of the cell and is a double-stranded molecule made up of nucleotides
- ◆ A DNA nucleotide is composed of a phosphate, a deoxyribose sugar, and one of the four nucleotide bases (adenine, thymine, guanine, or cytosine)

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**RNA**

- ◆ RNA stands for ribonucleic acid
- ◆ In RNA, thymine is replaced by uracil and the sugar is ribose instead of deoxyribose
- ◆ There are three types of RNA: messenger, transfer, and ribosomal

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## DNA REPLICATION

- ◆ DNA is faithfully replicated so that the same genetic information is passed on from generation to generation
- ◆ The enzymes topoisomerase and helicase unwind and separate the strands of DNA to be replicated

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## DNA POLYMERASE

- ◆ DNA polymerase copies both DNA strands so that each daughter cell will contain a chromosome made up of an original strand and a daughter strand
- ◆ DNA polymerase has a proofreading capability to prevent mistakes during replication, and it replicates in only one direction (from the 3' end of the new strand)

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## REPLICATION FORK

- ◆ The replication fork is the site at which replication is occurring
- ◆ At the replication fork there is a leading strand, which is replicated continuously, and a lagging strand, which is replicated in pieces known as Okazaki fragments
- ◆ Replication is initiated at a site on the DNA called the origin of replication and proceeds until the entire chromosome has been copied

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## GENETIC CODE

- ◆ The genetic code is based on combinations of three letters called codons
- ◆ Each codon codes for a specific amino acid except for the three stop codons
- ◆ There are three stop codons and one start codon in the code

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## GENE EXPRESSION

- ◆ Gene expression is the process of making a functional product based on the genetic information contained in the DNA and consists of transcription and translation
- ◆ Transcription proceeds through three steps: initiation, elongation, and termination
- ◆ Translation uses messenger RNA, transfer RNA, and ribosomal RNA and occurs at the ribosome of the cell

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## RIBOSOME

- ◆ The ribosome is made up of two subunits that contain RNA and protein
- ◆ Amino acids are brought to the ribosome by transfer RNA molecules, which are specific for certain amino acids
- ◆ While at the ribosome, peptide bonds form between adjacent amino acids
- ◆ Translation stops when a stop codon enters the ribosome

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### REGULATION OF GENE EXPRESSION

- ◆ The expression of a gene is carefully regulated
- ◆ Genes can be constitutive (always on), inducible (off and can be turned on), or repressible (on but can be turned off)
- ◆ An operon is a set of structural genes that share a common promoter and operator and are regulated together by a control gene

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### REGULATION OF GENE EXPRESSION

- ◆ Regulatory proteins control induction and repression through binding on the DNA at the site known as the operator site
- ◆ Gene expression is regulated at the level of mRNA production. When induced, message is made; when repressed, message is not made

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### MUTATION AND REPAIR OF DNA

- ◆ Mutations have an important role in the infection process because pathogens can become resistant to antibiotics or generally more virulent through mutation
- ◆ Bacteria depend on a balance between mutation and repair
- ◆ Mutations can result from transposition of genes in the chromosome, point mutations, or frameshift mutations

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### MUTATION AND REPAIR OF DNA

- ◆ Suppressor mutations can reverse the primary mutation
- ◆ DNA can be damaged by chemicals called mutagens, chemical reactions, or by radiation
- ◆ Repair of damaged DNA can be accomplished by excision repair or nucleotide excision systems in the cell

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### TRANSFER OF GENETIC INFORMATION

- ◆ Genetic recombination occurs in bacteria through transposition, transformation, transduction, or conjugation
- ◆ Transposition is a specific form of recombination in which genetic elements called transposons move from one place in the chromosome to another in the same cell
- ◆ Transformation involves the uptake of naked DNA by a cell

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### TRANSFER OF GENETIC INFORMATION

- ◆ Transduction is caused by a virus transferring pieces of DNA from one cell to another
- ◆ Conjugation occurs when DNA is moved from a donor cell (designated F<sup>+</sup>) to a recipient cell (designated F<sup>-</sup>)
- ◆ Each of the transfer mechanisms causes genetic recombination in the recipient cell and thus can be important in making a pathogen more dangerous

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