Microbial Genetics

Lecture 26

BT 206

Definitions

- Genetics
  - the study of heredity, genes and the mechanisms that they carry this information
    - Replication
    - Expression
- Genome
  - Complete genetic information of the cell

Definitions

- Chromosome
  - The structures that are composed of DNA that carry the hereditary information
- Gene
  - Segments of the chromosome that code for a specific product (usually a protein)
- Genomics
  - Sequencing and molecular characterization of genomes

Definitions

- DNA (deoxyribose nucleic acid)
  - Nucleotides
  - 3 components
    - Phosphate
    - Deoxyribose sugar
    - Nitrogenous base
      - Adenine, thiamine, cytosine or guanine
  - Double helix (complementary strands)
    - Base pairs
      - A-T
      - C-G
      - A-U (RNA)
    - Hydrogen bonds

DNA

- Base sequence codes for protein
- 4 letter alphabet (A, T, G and C)
- Genetic code
  - Determines how nucleotide sequence is converted into amino acid sequences
- Complementary strand allow precise duplication

DNA to proteins

- Gene on DNA
- Converted to mRNA
- mRNA on ribosome
- tRNA brings amino acids to ribosome for protein synthesis

Definitions

- Genotype
  - Genetic information of the organism
  - Information that codes for characteristics of the organism
- Phenotype
  - The expressed or physical characteristics of the organism
  - The expression of the genotype

Bacterial Chromosome (DNA)

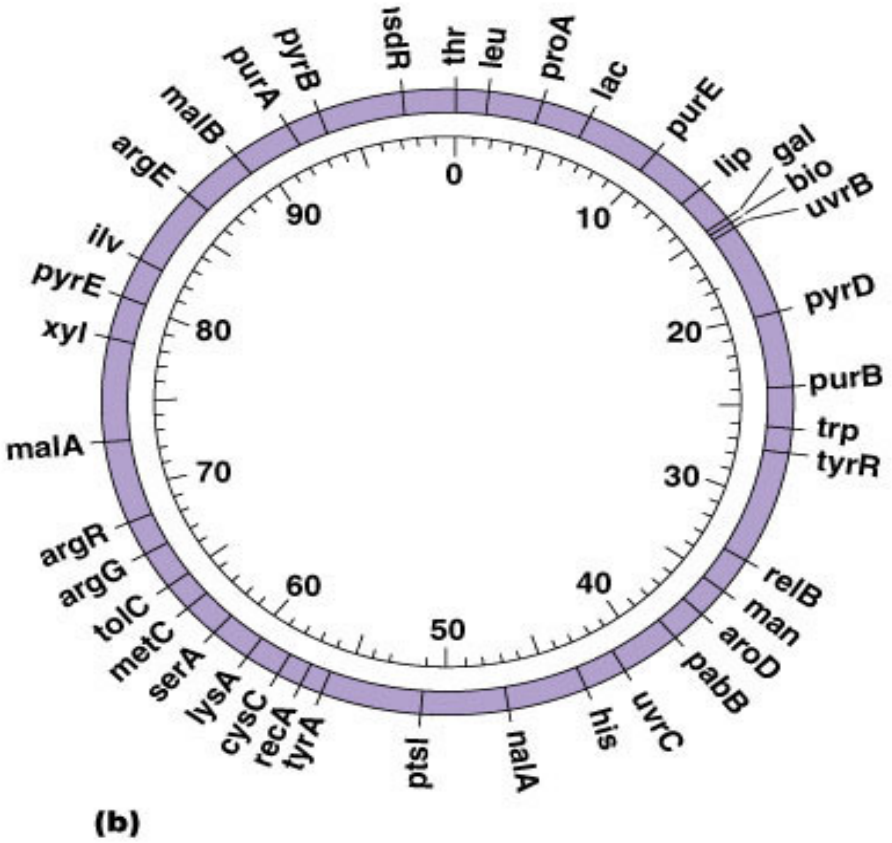
- Bacterial chromosome
  - Single
  - Circular
  - Attached one or many sites to plasma membrane

Bacteria chromosome

- *Escherichia coli*
  - 4.6 million base pairs
  - 4300 genes
  - 1mm long
  - 1,000 X length of cell
  - Supercoiled
    - Topoisomerase II
    - DNA gyrase

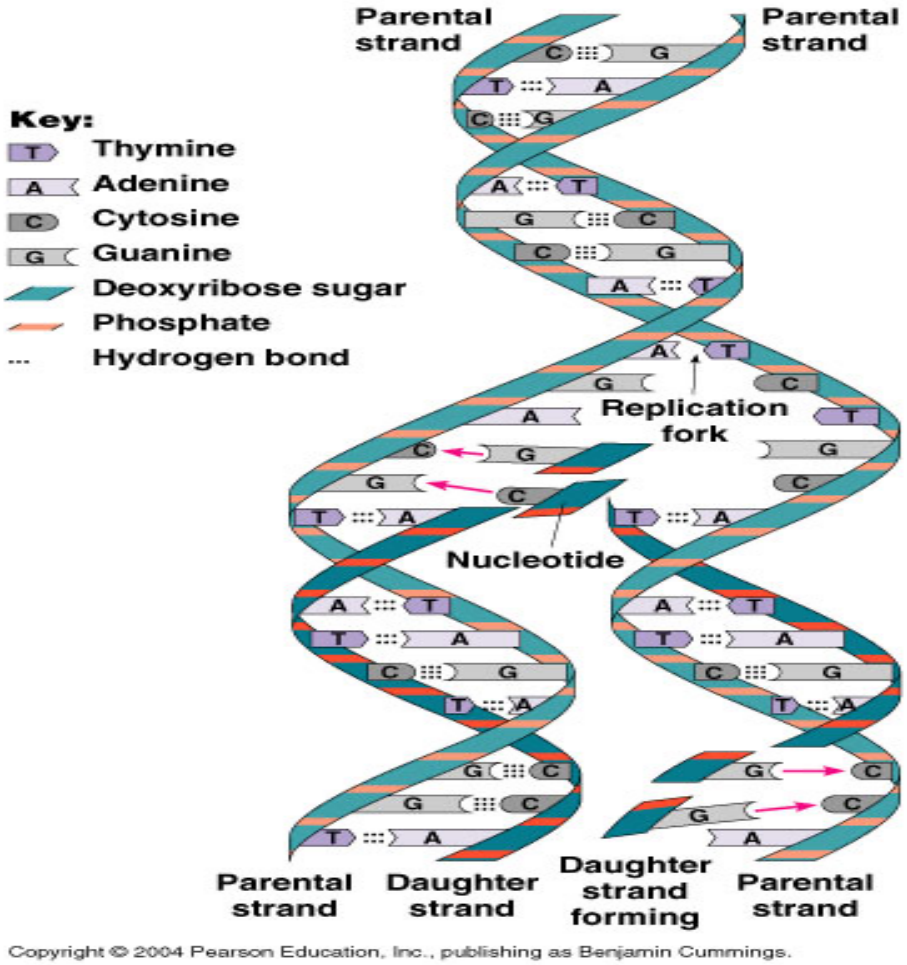
Bacterial chromosome

- Genetic map
  - Mapped in minutes
  - Based on time for chromosome exchanged between two cells

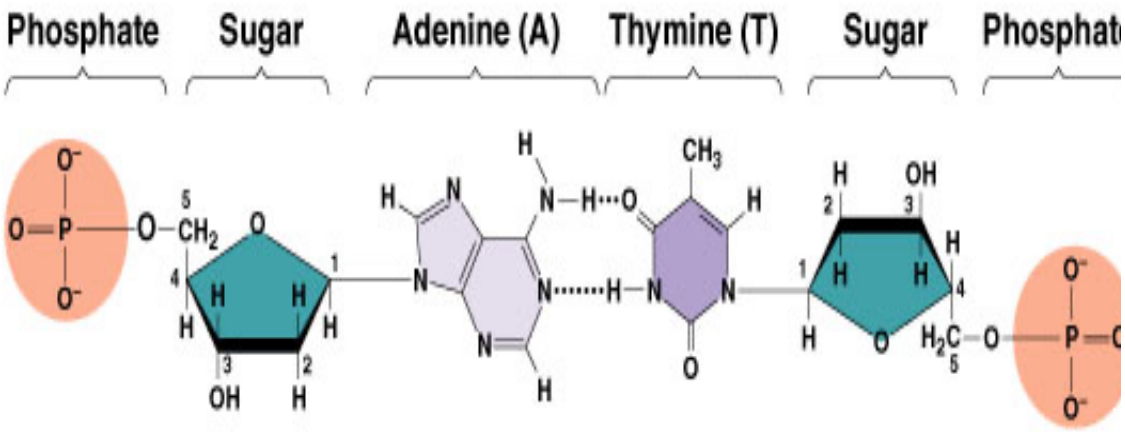


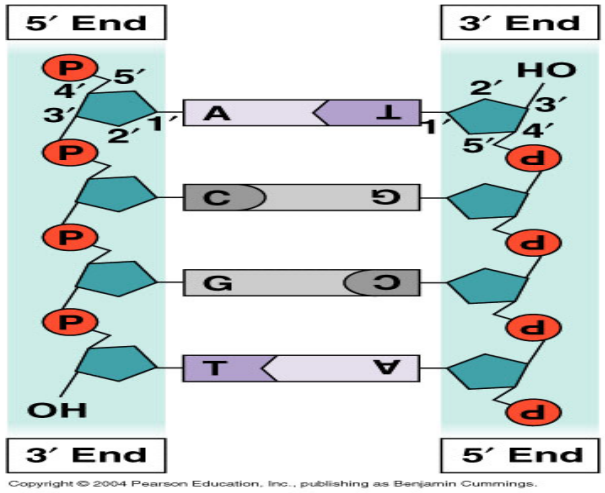
DNA replication

- Parental strand
  - Two new “daughter strands”
  - Each strand acts as template for new strands
  - Semiconservative replication



DNA Replication

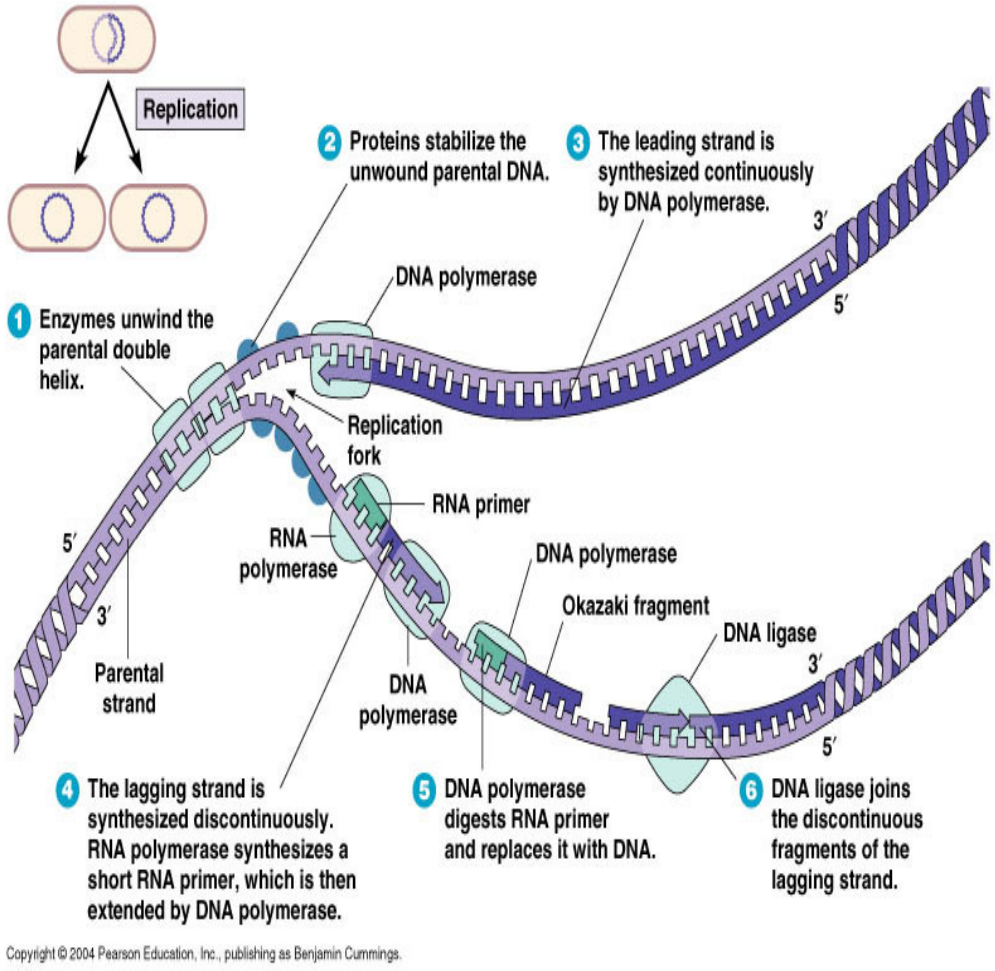




- Carbons in nucleotide numbered 1`-5`
- Complementary sugars are upside down to one another
- Strands run 5`→3` on each side

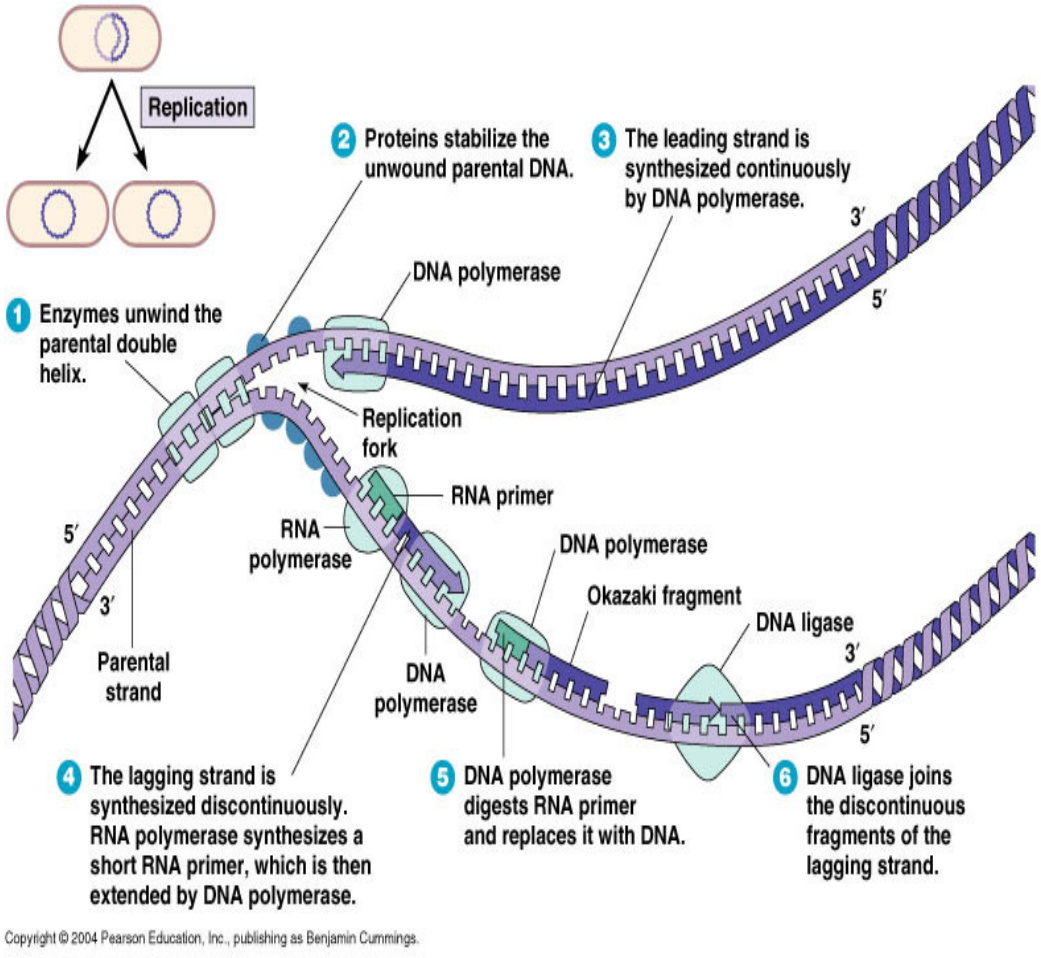
DNA Replication

- Steps in replication
  - DNA unwinds
  - DNA polymerase
    - Adds nucleotides to 3` end
  - Replication fork forms
  - Leading strand forms towards the fork
    - 5`→3`



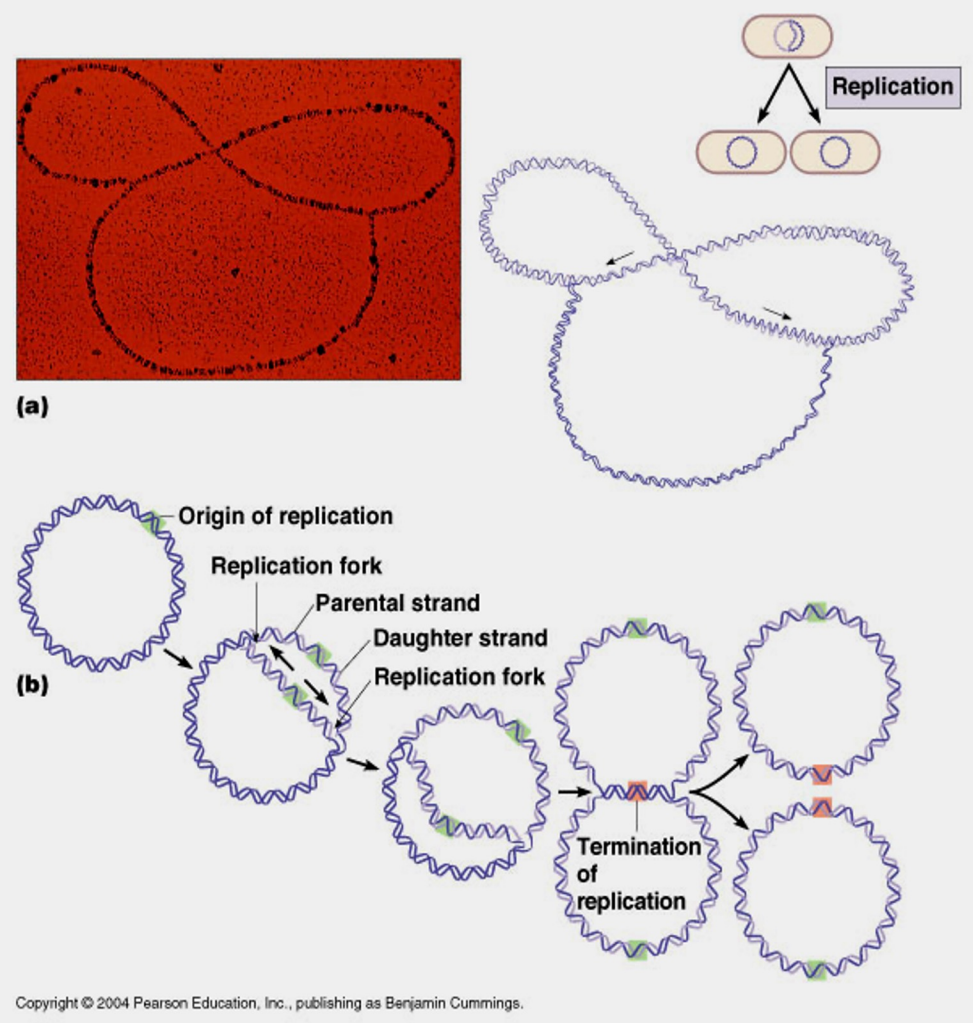
DNA Replication

- DNA replication
  - Lagging strand
    - Needs RNA primer
      - Removed by DNA polymerase
    - Synthesized discontinuously
    - Moves away from fork
    - Okazaki fragments
      - 1000 nucleotides
      - DNA ligase fuses segments



Bacterial DNA Replication

- Bacterial DNA replication
  - *E. coli*
    - Occurs bidirectionally
    - Two replication forks
    - Continues until forks meet



RNA Synthesis

- Transcription
  - Process of taking DNA code and converting to RNA code
- Translation
  - Converting RNA (mRNA) with tRNA to form amino acid sequences and proteins
  - Occurs at ribosome

Protein Synthesis

- Three types of RNA
  - mRNA - messenger
  - tRNA - transfer
  - rRNA – ribosomal
- DNA unzips at gene