

- 1 **Principles of Bacterial Genetics**
Chapter 11
- 2 **11.1 Genetic Map of the *Escherichia coli* Chromosome**
 - *Escherichia coli*
 - model organism
 - biochemistry, genetics, & bacterial physiology
- 3 **11.2 Plasmids: General Principles**
 - Plasmids:
 - replicate independently
 - Small circular or linear DNA molecules
 - Carry nonessential, but helpful, genes
 - Abundance (copy number) is variable
- 4 **11.2 Plasmids: General Principles**
 - Some plasmids (*episomes*) can integrate into cell chromosome
 - Conjugative plasmids transferred via cell-to-cell contact
- 5 **11.3 Types of Plasmids and Their Biological Significance**
 - R plasmids
 - resistance to antibiotics & growth inhibitors
 - Many are conjugative
 - R100
 - Sulfonamides, streptomycin, spectinomycin, fusidic acid, chloramphenicol, tetracycline & mercury
 - Enteric bacteria
 - *Escherichia*, *Klebsiella*, *Proteus*, *Salmonella* & *Shigella*
- 6 **11.4 Mutations and Mutants**
 - Mutation
 - Heritable change in DNA sequence
 - Mutant
 - any cell or virus differing from parental strain
 - Wild-type strain
 - strain isolated from nature
- 7 **11.4 Mutations and Mutants**
 - Selectable mutations
 - give mutant advantage under certain environmental conditions
 - Useful in genetic research
 - Nonselectable mutations
 - neither an advantage or disadvantage
- 8 **11.4 Mutations and Mutants**
 - Screening is more tedious than selection
 - Screening methods
 - replica plating
 - identify cells with a nutritional requirement (auxotroph)
- 9 **11.5 Molecular Basis of Mutation**
 - Induced mutations
 - made deliberately
 - Spontaneous mutations
 - No human intervention
 - natural radiation or oxygen radicals
 - Point mutations
 - change only one base pair

- single amino acid change in a protein or no change at all
 - Transitions = purine for purine (A for G) or pyrimidine for pyrimidine (C for T)
 - Transversions = purine for pyrimidine & vice versa (A or G for C or T)
- 10 **11.5 Molecular Basis of Mutation**
 - Silent mutation
 - Does not affect amino acid sequence
 - Missense mutation
 - Amino acid changed
 - Nonsense mutation
 - Codon becomes stop codon
- 11 **11.5 Molecular Basis of Mutation**
 - more dramatic changes in DNA
 - Frameshift mutations
 - Deletions or insertions
 - shift in the reading frame
 - complete loss of gene function
- 12 **11.5 Molecular Basis of Mutation**
 - Specific mutations (site-directed mutagenesis)
 - Point mutations typically reversible
 - Reversion
 - reverses the effects of a prior mutation
 - Same-site revertant:
 - 2nd mutation at original site
 - Second-site revertant:
 - 2nd mutation at different site
 - suppressor mutation compensates for effect of original mutation
- 13 **11.7 Mutagenesis**
 - Mutagens:
 - chemical, physical, or biological agents
 - chemical mutagens
 - Nucleotide base analogs:
 - resemble nucleotides
 - chemical modifications
 - alkylating agents like nitrosoguanidine
 - Acridines:
 - intercalating agents
 - typically cause frameshift mutations
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- 15 **11.7 Mutagenesis**
 - Several forms of radiation are highly mutagenic
 - mutagenic radiation
 - Non-ionizing (UV radiation)
 - Purines and pyrimidines strongly absorb UV
 - Pyrimidine dimers is one effect of UV radiation
 - Ionizing (X-rays, cosmic rays, and gamma rays)
 - Ionize water and produce free radicals
 - Free radicals damage macromolecules in the cell
- 16 **11.7 Mutagenesis**
 - Three Types of DNA Repair Systems
 - Direct reversal:

- repaired without referring to other strand
 - Repair of single strand damage
 - using opposite strand as template
 - Repair of double strand damage:
 - break in the DNA
 - error-prone repair mechanisms
- 17 **11.8 Mutagenesis and Carcinogenesis: The Ames Test**
- Ames test
 - detect potentially hazardous chemicals
 - increase in mutation of bacteria
 - carcinogenicity
- 18 **11.9 Genetic Recombination**
- Recombination
 - Physical exchange of DNA between genetic elements
 - Homologous recombination
 - genetic exchange between homologous DNA from two different sources
 - Selective medium can be used to detect rare genetic recombinants
- 19
- 20 **11.10 Transformation**
- Transformation
 - Fredrick Griffith in the late 1920s
 - *Streptococcus pneumoniae*
 - Lead to discovery of DNA
- 21 **11.11 Transduction**
- Transduction
 - DNA transfer mediated by bacteriophage
 - Two modes
 - Generalized transduction: DNA from any portion of host genome
 - Specialized transduction: DNA from specific region of host genome
- 22 **11.12 Conjugation: Essential Features**
- Bacterial conjugation (mating):
 - cell-to-cell contact
 - Plasmid encoded mechanism
 - Donor cell: contains conjugative plasmid
 - Recipient cell: does not contain plasmid
- 23 **11.12 Conjugation: Essential Features**
- F (fertility) plasmid
 - Circular DNA molecule; ~ 100 kbp
 - Contains genes that regulate DNA replication & transposable elements that allow integration
- 24 **11.13 The Formation of Hfr Strains and Chromosome Mobilization**
- F plasmid is an episome can integrate into host
 - F+
 - non-integrated F plasmid
 - Hfr (high frequency of recombination)
 - integrated F plasmid
 - Recipient cell does not become Hfr
 - F'
 - Previously integrated F plasmids
 - excised and captured some chromosomal genes

25 **11.16 Mobile DNA: Transposable Elements**

- transposable elements
 - segments of DNA that move
 - First observed by Barbara McClintock
- Two Types
 - Conservative:
 - Change in location
 - Number of transposons stays constant
 - Replicative:
 - new copy at a second location
 - Number of transposons increases