

Session 5 - Microbial Genetics

Text:	Chapters 11, 12, 13, 14, 15
Anticipated time:	7 class periods
Thinking Questions:	Chap 11: 1 Chap 12: Chap 13: 2, 3, 5, 6 Chap 14: 6 Chap 15: 4
Basic Objectives:	You should be able to discuss the structure and function of genetic material in bacteria, especially noting the unique aspects of microbial genetics including mutations and detecting mutations in bacteria, mechanisms of genetic recombination in procaryotes, and the use of microorganisms in genetic engineering.

Chapter 11 – Microbial Genetics: Gene Structure, Replication and Expression

Overview	This chapter is a review of DNA and RNA structure, and DNA, RNA and protein synthesis. It covers gene structure and the molecular nature of information flow. This should be largely review material: You have already covered much of this in Cell Biology and Genetics. We will try, really!, to cover this quickly in class. But, as always, emphasize the important differences between eucaryotic and procaryotic cells as this is what we will study in class.
Introduction	<i>Read. Define:</i> Genotype and phenotype. <i>Read:</i> Box 11.1.
11.1 DNA as Genetic Material	<i>Read very carefully.</i> Understand the experimental significance of the experiments of Griffith (Fig 11.1) Avery et al (Fig 11.2) and Hershey & Chase (Fig 11.3). <i>Define:</i> Transformation. <i>Understand:</i> The Central Dogma of information flow.
11.2 The Flow of Genetic Information	<i>Read,</i> including Fig 11.4. Know the language.
11.3 Nucleic Acid Structure	
Introduction	<i>Review,</i> including Fig 11.5.
DNA Structure	<i>Review,</i> including Figs 11.6-11.8.
RNA Structure	<i>Review.</i>
Organization	<i>Review,</i> including Fig 11.9.
11.4 DNA Replication	
Introduction	<i>Review,</i> including Fig 11.10.
Patterns of DNA	<i>Review,</i> including Fig 11.11 11.12..
Replication	<i>Review,</i> including Figs 11.14 & 11.15. Read Fig 11.16.
Events	<i>Summarize</i> if you wish.
Termination	<i>Summarize</i> if you wish.
Replication	<i>Summarize</i> if you wish.
11.5 Gene Structure	
Introduction	<i>Review,</i> including Fig 11.21.
Genes...Proteins	<i>Summarize</i> if you wish..
Genes...RNA	<i>Summarize</i> if you wish.
11.6 Transcription	
Introduction	<i>Review,</i> including Fig 11.25.
Transcrip-Bacteria	<i>Review,</i> including Fig 11.26.
Transcrip-Eucarya	<i>Skip.</i>
Transcrip-Archea	<i>Skip.</i>

11.7 The Genetic Code

- Introduction *Read.*
- Establishment *Review.* What is the significance of the work of Nirenberg et al.?
- Organization *Review,* including Tab 11.4.

11.8 Translation

- Introduction *Read,* including Fig 11.39.
- Transfer RNA *Summarize.*
- The Ribosome *Read. Review* Fig 11.44.
- Initiation *Review,* including Fig 11.45.
- Elongation *Summarize*
- Termination *Summarize*
- Protein Folding *Read,* including Fig 11.51.

Chapter 12 – Microbial Genetics: Regulation of Gene Expression

Overview	This chapter is a review of the control of information flow (i.e. regulation of gene expression at the molecular level) from DNA to protein. As always, understand the concepts and mechanisms that relate primarily to procaryotes.
Introduction	<i>Read</i>
12.1 Levels of Regulation of Gene Expression	<i>Read</i> , including Fig 12.1.
12.2 Regulation of Transcription Initiation	
Introduction	<i>Read</i> , including Box 12.1.
Induction	<i>Read carefully</i> , including Fig 12.2 and understand concepts.
Control	<i>Read</i> , including Fig 12.3 and understand the mechanism.
The Lac Operon	<i>Read</i> , including Fig 12.4 & 12.7 and understand the mechanism. <i>Understand</i> Fig 12.5.
Tryptophan	<i>Read</i> , including Fig 12.8 and understand the mechanism.
Arabinose	<i>Skip</i> .
Two-Component	<i>Skip</i> .
12.3 Regulation of Transcription Elongation	<i>Skip</i> .
12.4 Regulation at the Level of Translation	<i>Skip</i> .
12.5 Global Regulatory Systems	
Introduction	<i>Review</i> for concepts.
Mechanisms	<i>Skip</i> .
Catabolite	<i>Read</i> , including Fig 12.15. <i>Define</i> : Diauxic Growth.
Quorum Sensing	<i>Read</i> , including Fig 12.19.
Sporulation	<i>Skip</i> .
12.6 Regulation of Gene Expression in <i>Eucarya</i> and <i>Archaea</i>	<i>Skip</i> .

Chapter 13 - Microbial Genetics: Mechanisms of Genetic Variation

- Overview This very important chapter is an introduction to microbial plasmids, mutations and recombination. We would not have made the advances in contemporary eucaryotic molecular genetics without having first understood these mechanisms in procaryotes. We will discuss mechanisms of microbial recombination by studying the experiments that led to our understanding these fundamental principles.
- Introduction *Read.*
- 13.1 Mutations and Their Chemical Basis
- Introduction *Read carefully. Define: Mutation.*
 - Spontaneous *Review, including Figs 13.1 & 13.2. Define: Directed/Adaptive Mutation*
 - Induced *Review for background only.*
 - Effects *Review for background only.*
- 13.2 Detection and Isolation of Mutants
- Introduction *Read.*
 - Mutant Detection *Read, and understand Replica Plating, Fig 13.7, very well.*
 - Mutant Selection *Read, and understand Fig 13.8.*
 - Carcinogenicity... *Read carefully and understand Ames Testing, Fig 11.33.*
- 13.3 DNA Repair
- Introduction *Read.*
 - Excision Repair *Read and understand Figs 13.10 & 13.11.*
 - Direct *Read and understand Photoreactivation, Fig 13.12.*
 - Mismatch *Read and understand mechanisms, Fig 13.13.*
 - Recombinational *Read and understand Fig 11.14.*
 - SOS Response *Read and understand mechanisms.*
- 13.4 Creating Genetic Variability
- Introduction *Read. Define: Genetic Recombination.*
 - Recombination *Review for concepts, including Fig 13.15. How do eucaryotes do recombination?*
 - Horizontal Gene *Read.*
 - Recombination *Read, including Fig 13.18.*
- 13.5 Transposable Elements
- Review and understand only paragraph one. Define: Transposons.*
- 13.6 Bacterial Plasmids
- Read carefully. Understand: Plasmids. Review Tab 3.3 to appreciate the functional diversity of plasmids.*
- 13.7 Bacterial Conjugation
- Introduction *Read very carefully and understand the experiments by Lederberg and Tatum (Fig 13.26), and Davis (Fig 13.27).*
 - F+ x F- Mating *Read carefully and understand the mechanism (Fig 13.28a).*
 - Hfr Conjugation *Read and understand the mechanism (Fig 13.28b).*
 - F' Conjugation *Review.*
 - Others *Review.*
- 13.8 DNA Transformation
- Read very carefully and understand the mechanisms (Figs 13.31-13.33).*
- 13.9 Transduction
- Introduction *Read very carefully, and try to understand the nature of the Lytic vs the Lysogenic life cycle (Fig 13.34) . We will do this again. What is a Prophage?*
 - Generalized *Read carefully, including Fig 13.35. Be able to discuss the design and interpretation of the experiments of Lederberg and Zinder.*
 - Specialized *Read carefully, including Fig 13.36. Contrast with Generalized Transduction.*
- 13.10 Mapping the Genome
- Skip.*
- 13.11 Recombination and Genome Mapping in Viruses
- Skip.*

Chapter 14 - Recombinant DNA Technology

- Overview This is a chapter that discusses the historical roots of recombinant DNA technology (often in microbiology) and the applied uses of microorganisms in contemporary biotechnology. We will cover this to the extent that time permits. Remember what *Summarize* means.
- Introduction *Read carefully* and understand the language.
- 14.1 Historical Perspectives
Read, including Tab 14.1 and Fig 14.1. Know how Restriction Enzymes and Vectors are used.
- 14.2 Synthetic DNA
Summarize if time permits.
- 14.3 Polymerase Chain Reaction
Summarize if time permits.
- 14.4 Gel Electrophoresis
Summarize if time permits.
- 14.5 Cloning Vectors and Creating Recombinant DNA
Summarize if time permits.
- 14.6 Construction of Genomic Libraries
Summarize if time permits..
- 14.7 Inserting Recombinant DNA into Host Cells
Summarize if time permits.
- 14.8 Expression of Foreign Genes in Host Cells
Summarize if time permits.
- 14.9 Applications of Genetic Engineering
- Introduction *Read*.
 - Medical *Read carefully. Review* Tab 14.4.
 - Agricultural *Read carefully*
- 14.10 Social Impact of Recombinant DNA Technology

Chapter 15 - Microbial Genomics

Overview	This is a relatively new chapter in this textbook, and as such it relates to the newest information on microbial genetics (or genomics), including applications of knowledge. We will not have the time to cover much of this chapter in our course. We will discuss some of the important concepts involved in this very important area of modern science.
Introduction	<i>Read.</i>
15.1 Introduction	<i>Read carefully. Define: Genomics.</i>
15.2 Determining DNA Sequences	<i>Summarize if time permits..</i>
15.3 Whole-Genome Shotgun Sequencing	<i>Read only paragraph 1. Review Tab 15.1.</i>
15.4 Bioinformatics	<i>Read. Define: Bioinformatics. Review Tab 15.2.</i>
15.5 Functional Genomics	<i>Summarize if time permits.</i>
15.6 Comparative Genomics	<i>Summarize if time permits.</i>
15.7 Proteomics	<i>Read only paragraph 1.</i>
15.8 Insights from Microbial Genomes	
Introduction	<i>Read.</i>
Identification	<i>Read only paragraph 1.</i>
Genomic Analysis	<i>Review, including Figs 15.14, 15.15 & 15.17.</i>
Extremophiles	<i>Review.</i>
15.9 Environmental Genomics	<i>Review.</i>