

Session 4 - Microbial Metabolism

Text:	Chapters 8, 9, 10
Anticipated time:	5 class periods
Thinking Questions:	Chap 8: 2, 5 Chap 9: 1, 2, 5 Chap 10: 1
Basic Objectives:	You should be able to discuss the diversity of metabolic energy trapping and utilizing patterns in bacteria, emphasizing the unique metabolic schemes employed by procaryotes. This is a lot to cover in 5 class periods. We will emphasize important aspects of procaryotic metabolism. You should already understand the basics of metabolism in eucaryotic systems.

Chapter 8 - Metabolism: Energy, Enzymes and Regulation

This is a review chapter on thermodynamics and enzyme activity. We will not cover this section in class in great detail. Follow the Reading Guidelines. However, if you have completed Biochemistry I recommend you at least *Review* the entire chapter and the Summary at the end of the chapter so that you have a good understanding of the following concepts: Energy, use of ATP in biological systems, the nature of re-dox reactions, and the function of enzymes. If you have questions about any of these concepts or any details in the chapter, bring them up in class!

Introduction	<i>Review</i>
8.1 An Overview of Metabolism	<i>Read</i> , including Fig 8.1.
8.2 Energy and Work	<i>Review.</i>
8.3 The Laws of Thermodynamics	<i>Review.</i>
8.4 Free Energy Reactions	<i>Read</i> , including Fig 8.4. <i>Understand</i> : Free energy.
8.5 The Role of ATP in Metabolism	<i>Read</i> , including Figs 8.5, 8.6 & 8.7
8.6 Oxidation Reduction Reactions	<i>Read carefully.</i> Read Figs 8.8 & 8.9. <i>Understand</i> : Reduction potential, and its relation to free energy changes.
8.7 Enzymes	
Introduction	<i>Read.</i>
Classification	<i>Review.</i>
Mechanisms	<i>Read</i> , including Fig 8.16.
Environment	<i>Review.</i>
Inhibition	<i>Review.</i>
8.8 The Nature and Significance of Metabolic Regulation	<i>Review.</i>
8.9 Control of Enzyme Activity	
Introduction	<i>Read.</i>
Allosteric	<i>Review</i> , including Fig 8.22.
Covalent	<i>Review</i> , including Fig 8.25.
Feedback	<i>Review</i> , including Fig 8.27.
Chemotaxis	<i>Read</i> , including Fig 8.28.

Chapter 9 - Metabolism: Energy Release and Conservation

This chapter is devoted to energy trapping metabolism. There is tremendous overlap of procaryotic and eucaryotic metabolism: we will emphasize procaryotes, especially the unique aspects of energy trapping in bacteria.

Introduction

Review. Read the quotation carefully!

9.1 Chemoorganotrophic Fueling Processes

Read, including Figs 9.1 & 9.2. *Define*: Catabolism and Anabolism, Fermentation and Aerobic and Anaerobic Respiration. And what is lithotrophy?

9.2 Aerobic Respiration

Read. Understand: Figs 9.3 & 9.4.

9.3 The Breakdown of Glucose to Pyruvate

Introduction

Read.

Embden-Meyerhof *Read*, including Fig 9.5. What goes into, what leaves, and what is recycled in glycolysis? What are the functions of glycolysis?

Pentose Pathway *Read*, including Fig 9.6. What are the functions of this pathway?

Entner-Duodoroff *Read*, including Fig 9.8. What is going on here?

9.4 The Tricarboxylic Acid Cycle

Read for concepts, including Fig 9.9. What goes into, what leaves, and what is recycled? What are the functions of the TCA cycle?

9.5 Electron Transport and Oxidative Phosphorylation

Introduction *Read*, Including Fig 9.10.

Electron Transport *Read* for concepts. Contrast Figs 9.11 & 9.12.

Oxidative Phos... *Read* for concepts, including Fig 9.13. *Review* Fig 9.14.

ATP Yield *Review*, including Fig 9.15. Do you believe the numbers? Why not?

9.6 Anaerobic Respiration

Read carefully. Understand the use of terminal electron acceptors (other than oxygen) and how they are used in respiratory metabolism (Tab 9.1).

Define: Anaerobic respiration and Dissimilatory metabolism.

Differentiate: Aerobic vs anaerobic respiration as shown in Fig 9.16.

9.7 Fermentations

Read carefully, including Figs 9.17 & 9.18. *Review* Tab 9.2. Why do mo's do fermentations? What are the physiologic consequences (products) of these reactions? How have we exploited these reactions? *Read* Box 9.1.

9.8 Catabolism of Carbohydrates and Intracellular Reserve Polymers

Summarize, only if you have time.

9.9 Lipid Catabolism

Summarize, only if you have time.

9.10 Protein and Amino Acid Catabolism

Summarize, only if you have time.

9.11 Chemolithotrophy

Read carefully, including Fig 9.24 and Tabs 9.3 & 9.4. Understand how chemolithotrophs trap energy from inorganic nutrients. *Read* Box 9.2.

9.12 Phototrophy

Introduction *Read*, including Tabs 9.5 & 9.6 and Fig 9.27.

Oxygenic Photo *Review*, including Figs 9.30 & 9.31.

Anoxygenic Photo *Review*. Including Fig 9.33 or 9.34

Rhodopsin- Photo *Review*.

Overall, *Contrast*: Oxygenic vs anoxygenic vs rhodopsin-based photosynthesis as it occurs in procaryotes and eucaryotes, but don't memorize details.

Chapter 10 - Metabolism: The Use of Energy in Biosynthesis

- Overview This chapter is devoted to biosynthesis. Emphasize the unique aspects of anabolism in procaryotic organisms.
- Introduction *Read*, including Fig 10.1.
- 10.1 Principles Governing Biosynthesis
Review, including Tab 10.1 and *Be Amazed*.
- 10.2 The Precursor Metabolites
Review, including Fig 10.3.
- 10.3 The Fixation of Carbon Dioxide by Autotrophs
Introduction *Read*.
The Calvin Cycle *Review*, including Fig 10.4.
Other Pathways *Review*, including Fig 10.6.
- 10.4 Synthesis of Sugars and Polysaccharides
Introduction *Read*
Monosaccharides *Summarize*, including Fig 10.9, only if you have time.
Polysaccharides *Summarize*, only if you have time.
Peptidoglycan *Review*, including Fig 10.12. I hope we have time to discuss this.
- 10.5 Synthesis of Amino Acids
Introduction *Read*.
Nitrogen *Read carefully*, including Figs 10.16, 10.18, 10.19 & 10.20, but try to not get bogged down in all the details. Understand the various forms of nitrogen that can serve as sources of nitrogen. Understand nitrogen reduction and assimilation.
Sulfur *Read carefully*, including Fig 10.24. Differentiate: Assimilatory from Dissimilatory metabolism.
Biosynthetic *Review*.
Anapleurotic *Read*, including Fig 10.27.
- 10.6 Synthesis of Purines, Pyrimidines and Nucleotides
Introduction *Read*.
Phosphorous *Read*.
Purine *Skip*.
Pyrimidine *Skip*.
- 10.7 Lipid Synthesis
Summarize, only if you have time.