Table of Contents

Dr. Kevin Ahern and Dr. Indira Rajagopal's electronic book is aimed at helping students learn the basics of biochemistry in a fun and engaging format.

• **1: Cells, Water, and Buffers**
  - 1.1: Introduction
  - 1.2: Cells: The Bio of Biochemistry
  - 1.3: Water, Water Everywhere
  - 1.4: Buffers Keep the Cellular Environment Stable
  - 1.5: Henderson-Hasselbalch Approximation

• **2: Energy**
  - 2.2: Oxidative Energy
  - 2.3: Oxidation vs Reduction in Metabolism
  - 2.4: Energy Coupling
  - 2.5: Entropy and Energy
  - 2.6: Gibbs Free Energy
  - 2.7: Cellular Phosphorylations
  - 2.8: Energy Efficiency
  - 2.9: Metabolic Controls of Energy
3: Structure & Function

Function flows from structure. In order to understand the function of biomolecules, we must first understand their structures.

- 3.0: Introduction to Structure & Function
- 3.1: Building Blocks
- 3.2: Proteins
- 3.3: Nucleic Acids
- 3.4: Carbohydrates
- 3.5: Lipids and Membranes

4: Catalysis

- 4.0: Introduction to Catalysis
- 4.1: Activation Energy
- 4.2: General Mechanisms of Action
- 4.3: Substrate Binding
- 4.4: Enzyme Flexibility
- 4.5: Active Site
- 4.6: Chymotrypsin
- 4.7: Enzyme Parameters
- 4.8: Perfect Enzymes
- 4.9: Lineweaver-Burk Plots
- 4.10: Enzyme Inhibition
- 4.11: Control of Enzymes
- 4.12: Ribozymes

5: Flow of Genetic Information

As the cell’s so-called blueprint, DNA must be copied to pass on to new cells and its integrity safeguarded. The information in the DNA must also be accessed and transcribed to make the RNA instructions that direct the synthesis of proteins.

- 5.1: DNA Replication
- 5.2: DNA Repair
- 5.3: Transcription
- 5.4: Regulation of Transcription
6: Metabolism I - Oxidative/Reductive Processes

Depending on your mathematical perspective, life is the sum of the product of the biochemical reactions that occur in cells. The collection of these reactions is known as metabolism. We break the subject into two broad areas: 1) oxidative/reductive metabolism and 2) pathways that involve little oxidation/reduction.

- 6.1: Definitions
- 6.2: Perspectives
- 6.3: Glycolysis
- 6.4: Gluconeogenesis
- 6.5: Citric Acid Cycle
- 6.6: Glyoxylate Pathway
- 6.7: Acetyl-CoA Metabolism
- 6.8: Cholesterol Metabolism
- 6.9: Ketone Body Synthesis
- 6.10: Prostaglandin Synthesis
- 6.11: Fatty Acid Oxidation
- 6.12: Fatty Acid Synthesis
- 6.13: Metabolism of Fat
- 6.14: Connections to Other Pathways

7: Metabolism II

In this second section of metabolism, we cover metabolic pathways that do not have a strong emphasis on oxidation/reduction.

- 7.1: Carbohydrate Storage and Breakdown
- 7.2: Pentose Phosphatate Pathway
- 7.3: Calvin Cycle
- 7.4: C4 Plants
- 7.5: Urea Cycle
- 7.6: Nitrogen Fixation
- 7.7: Amino Acid Metabolism
- 7.8: Amino Acid Catabolism
- 7.9: Nucleotide Metabolism
- 7.10: Pyrimidine de novo Biosynthesis
- 7.11: Purine de novo Biosynthesis
8: Signaling

Cells must receive and respond to signals from their surroundings. Cellular signals and the pathways through which they are passed on and amplified to produce the desired effects on their targets are the focus of this section.

- 8.1: Cell Signaling
- 8.2: Ligand-gated Ion Channel Receptors
- 8.3: Nuclear Hormone Receptors
- 8.4: G-protein Coupled Receptors (GPCRs)
- 8.5: Receptor Tyrosine Kinases (RTKs)

9: Techniques

In this section, we describe some of the methods biochemists use to do their work.

- 9.1: Cell Disruption
- 9.2: Fractionation
- 9.3: Ion Exchange Chromatography
- 9.4: Gel Exclusion Chromatography
- 9.5: Affinity Chromatography
- 9.6: High Performance Liquid Chromatography (HPLC)
- 9.7: Histidine Tagging
- 9.8: Electrophoresis
- 9.9: Protein Cleavage
- 9.10: Microarrays
- 9.11: Blotting
- 9.12: Making Recombinant DNAs
- 9.13: Polymerase Chain Reaction
- 9.14: Lac Z Blue-White Screening
- 9.15: Reverse Transcription

10: Putting It All Together

With this chapter, we tie up a bunch of loose ends and ponder what lies in the future of biochemistry.

- 10.1: Looking Back
- 10.2: Looking Forward
Back Matter

- 11.2: Appendix 2 - Key Points

Front Matter

- TitlePage
- InfoPage
- Table of Contents