- Chapter 1 From Sequence to Structure
- 1-0 Overview: Protein Function and Architecture (p. 2)
- **1-1 Amino Acids** (p. 4)
- 1-2 Genes and Proteins (p. 6)
- 1-3 The Peptide Bond (p. 8)
- 1-4 Bonds that Stabilize Folded Proteins (p. 10)
- 1-5 Importance and Determinants of Secondary Structure (p. 12)
- 1-6 Properties of the Alpha Helix (p. 14)
- 1-7 Properties of the Beta Sheet (p. 16)
- 1-8 Prediction of Secondary Structure (p. 18)
- **1-9 Folding** (p. 20)
- 1-10 Tertiary Structure (p. 22)
- 1-11 Membrane Protein Structure (p. 24)
- 1-12 Protein Stability: Weak Interactions and Flexibility (p. 26)
- 1-13 Protein Stability: Post-Translational Modifications (p. 28)
- **1-14 The Protein Domain** (p. 30)
- 1-15 The Universe of Protein Structures (p. 32)
- **1-16 Protein Motifs** (p. 34)
- 1-17 Alpha Domains and Beta Domains (p. 36)
- 1-18 Alpha/Beta, Alpha+Beta and Cross-Linked Domains (p. 38)
- 1-19 Quaternary Structure: General Principles (p. 40)
- 1-20 Quaternary Structure: Intermolecular Interfaces (p. 42)
- 1-21 Quaternary Structure: Geometry (p. 44)
- 1-22 Protein Flexibility (p. 46)
- Chapter 2 From Structure to Function
- 2-0 Overview: The Structural Basis of Protein Function (p. 50)
- 2-1 Recognition, Complementarity and Active Sites (p. 52)
- 2-2 Flexibility and Protein Function (p. 54)
- 2-3 Location of Binding Sites (p. 56)
- 2-4 Nature of Binding Sites (p. 58)
- 2-5 Functional Properties of Structural Proteins (p. 60)
- **2-6 Catalysis: Overview** (p. 62)
- 2-7 Active-Site Geometry (p. 64)
- 2-8 Proximity and Ground-State Destabilization (p. 66)
- 2-9 Stabilization of Transition States and Exclusion of Water (p. 68)
- **2-10 Redox Reactions** (p. 70)
- 2-11 Addition/Elimination, Hydrolysis and Decarboxylation (p. 72)
- 2-12 Active-Site Chemistry (p. 74)
- **2-13 Cofactors** (p. 76)
- 2-14 Multi-Step Reactions (p. 78)
- 2-15 Multifunctional Enzymes (p. 80)
- 2-16 Multifunctional Enzymes with Tunnels (p. 82)
- Chapter 3 Control of Protein Function
- 3-0 Overview: Mechanisms of Regulation (p. 86)
- 3-1 Protein Interaction Domains (p. 88)
- **3-2 Regulation by Location** (p. 90)

- 3-3 Control by pH and Redox Environment (p. 92)
- 3-4 Effector Ligands: Competitive Binding and Cooperativity (p. 94)
- 3-5 Effector Ligands: Conformational Change and Allostery (p. 96)
- 3-6 Protein Switches Based on Nucleotide Hydrolysis (p. 98)
- 3-7 GTPase Switches: Small Signaling G proteins (p. 100)
- 3-8 GTPase Switches: Signal Relay by Heterotrimeric GTPases (p. 102)
- **3-9 GTPase Switches: Protein Synthesis** (p. 104)
- **3-10 Motor Protein Switches** (p. 106)
- **3-11 Regulation by Degradation** (p. 108)
- 3-12 Control of Protein Function by Phosphorylation (p. 110)
- 3-13 Regulation of Signaling Protein Kinases: Activation Mechanism (p. 112)
- 3-14 Regulation of Signaling Protein Kinases: Cdk Activation (p. 114)
- 3-15 Two-Component Signaling Systems in Bacteria (p. 116)
- 3-16 Control by Proteolysis: Activation of Precursors (p. 118)
- 3-17 Protein Splicing: Autoproteolysis by Inteins (p. 120)
- **3-18 Glycosylation** (p. 122)
- 3-19 Protein Targeting by Lipid Modifications (p. 124)
- 3-20 Methylation, N-acetylation, Sumoylation and Nitrosylation (p. 126)
- Chapter 4 From Sequence to Function: Case Studies in Structural and Functional Genomics
- 4-0 Overview: From Sequence to Function in the Age of Genomics (p. 130)
- 4-1 Sequence Alignment and Comparison (p. 132)
- **4-2 Protein Profiling** (p. 134)
- **4-3 Deriving Function from Sequence** (p. 136)
- 4-4 Experimental Tools for Probing Protein Function (p. 138)
- 4-5 Divergent and Convergent Evolution (p. 140)
- 4-6 Structure from Sequence: Homology Modeling (p. 142)
- 4-7 Structure From Sequence: Profile-Based Threading and "Rosetta" (p. 144)
- 4-8 Deducing Function from Structure: Protein Superfamilies (p. 146)
- 4-9 Strategies for Identifying Binding Sites (p. 148)
- 4-10 Strategies for Identifying Catalytic Residues (p. 150)
- 4-11 TIM Barrels: One Structure with Diverse Functions (p. 152)
- 4-12 PLP Enzymes: Diverse Structures with One Function (p. 154)
- 4-13 Moonlighting: Proteins With More Than One Function (p. 156)
- 4-14 Chameleon Sequences: One Sequence with More than One Fold (p. 158)
- Chapter 5 Structure Determination
- 4-15 Prions, Amyloids and Serpins: Metastable Protein Folds (p. 160)
- 4-16 Functions for Uncharacterized Genes: Galactonate Dehydratase (p. 162)
- 4-17 Starting From Scratch: A Gene Product of Unknown Function (p. 164)
- 5-1 The Interpretation of Structural Information (p. 168)
- 5-2 Structure Determination by X-Ray Crystallography and NMR (p. 170)
- 5-3 Quality and Representation of Crystal and NMR Structures (p. 172)
- **Glossary** (p. 175)
- **References** (p. 181)
- **Index** (p. 189)