

## CHEM450 | Biochemistry

### Course Texts

No need to track down a textbook; these texts are provided digitally as part of the course enrollment:

Nelson, David L., et al. *Lehninger Principles of Biochemistry*. 8th ed., Macmillan Learning, 2021.

### Course Description

Biochemistry provides a comprehensive overview of the fundamental principles of biochemistry, from the structure and function of biomolecules to the regulation of cellular metabolism. The course starts with an introduction to the foundations of biochemistry, including the chemistry of life and the properties of water as the solvent of life. The structure, function, and regulation of amino acids, peptides, and proteins are then explored, including protein folding and enzyme catalysis. The course also covers the metabolism of carbohydrates, lipids, and nucleic acids, including glycolysis, the citric acid cycle, fatty acid catabolism, oxidative phosphorylation, and lipid biosynthesis. The biosynthesis of amino acids, nucleotides, and related molecules is also examined, as well as hormonal regulation and the integration of mammalian metabolism. Additionally, the course explores the structure and function of biological membranes, transport mechanisms, and biochemical signaling pathways. Finally, the course also covers the regulation of gene expression, including the structure and function of genes and chromosomes, DNA metabolism, RNA metabolism, and protein metabolism.

### Learning Outcomes

After completing this course, students will be able to:

1. Identify weak interactions in aqueous systems, ionizations of water, and buffers against pH changes in biological systems.
2. Contrast primary, secondary, tertiary, and quaternary structures of proteins and their effects on binding and interactions.
3. Sort monosaccharides, disaccharides, polysaccharides, and glycoconjugates.
4. Understand nucleic acid structure and chemistry.
5. Contrast the functions and features of lipids when acting as signals, cofactors, and pigments.
6. Understand the relationship of membrane dynamics with their composition and architecture.
7. Explain how the G Protein, gated ion channels, regulation of transcription and cell cycle achieve biochemical signaling.
8. Identify the effects of bioenergetics and thermodynamics on metabolism.
9. Explain the role of glycogen and glycolysis in metabolic pathways.
10. Articulate the citric acid cycle.
11. Understand the digestion, mobilization, and transport of fats.
12. Articulate the role of ATP in oxidative phosphorylation.
13. Explain the biosynthesis of fatty acids, triacylglycerols and membrane phospholipids.

14. Understand the role of hormone regulation on metabolism.
15. Articulate how genes, chromosomes, DNA, RNA, and other proteins are used as information pathways.

## Course Prerequisites

Completion of Organic Chemistry I & II, or their equivalent, is strongly encouraged, though not required.

## Academic Integrity Statement

Academic integrity is the pursuit of scholarly activity in an honest, truthful and responsible manner. Violations of academic integrity include, but are not limited to, plagiarism, cheating, fabrication and academic misconduct. Failure to comply with the Academic Integrity Policy can result in a failure and/or zero on the attempted assignment/examination, a removal from the course, disqualification to enroll in future courses, and/or revocation of an academic transcript.

## Course Completion Policy

In order for a course to be considered complete, **all required coursework must be attempted, submitted, and graded.** Required coursework consists of graded assignments. Any Academic Integrity Policy violations may prevent a course from being considered complete.

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## Assessment Types

StraighterLine courses may include any combination of the assessment types described below. Review the descriptions to learn about each type, then review the Course Evaluation Criteria to understand how your learning will be measured in this course.

### Benchmarks

Benchmarks test your mastery of course concepts. You have 3 attempts, and your highest score counts.

**Note:** Cumulative Benchmarks (final exams) only allow 1 attempt.

### Capstones

Capstones are project-based assessments that help you apply concepts to real-world scenarios. You have 2 attempts, and your highest score counts.

### Checkpoints

Checkpoints are quick knowledge checks on important course concepts. All are open-book, and most have 1-3 attempts.

## AI Use-Case Policies

StraighterLine Capstone assessments operate under one of three AI Use-Case Policies. These designations are selected intentionally to support learners in developing digital literacy, ethical reasoning, and authentic communication skills. Each model requires students to engage meaningfully with the course outcomes while adhering to academic standards.

**Independent Work Requirement:** Capstones with this designation must be completed independently without using AI tools. The goal is for learners to showcase their own understanding and skills without AI assistance. Students are expected to generate and submit original work developed solely through their own reasoning and effort.

**AI-Assisted Planning Option:** Capstones with this designation may allow AI tools to support brainstorming and assessment planning. If allowed, students will be asked to document any AI assistance by noting how it informed their work. Documentation must be included within the assignment or in a designated reflection field. Examples include describing how an AI tool helped organize an outline, generate ideas, or surface sources for further exploration.

**AI-Integration Requirement:** Capstones with this designation require AI tools as part of the learning process. Students will be asked to reflect upon their AI interactions and AI contributions to the assessment. Reflections must include which tools were used, how they were used, and what insights students gained from the process. This promotes transparency, ethical use, and metacognitive skill-building.

## Course Evaluation Criteria

Your score provides a percentage score and letter grade for each course. A passing percentage is 70% or higher.

There are a total of 1000 points in the course:

| Assessment                                                                    | Points | Learning Outcomes |
|-------------------------------------------------------------------------------|--------|-------------------|
| Checkpoint 1: The Foundations of Biochemistry                                 | 0      | N/a               |
| Checkpoint 2: Water, the Solvent of Life                                      | 0      | N/a               |
| Checkpoint 3: Amino Acids, Peptides, and Proteins                             | 0      | N/a               |
| Checkpoint 4: The Three-Dimensional Structure of Proteins                     | 0      | N/a               |
| Checkpoint 5: Protein Function                                                | 0      | N/a               |
| Checkpoint 6: Enzymes                                                         | 0      | N/a               |
| Benchmark 1: Checkpoints 1-6                                                  | 125    | 1, 2              |
| Checkpoint 7: Carbohydrates and Glycobiology                                  | 0      | N/a               |
| Checkpoint 8: Nucleotides and Nucleic Acids                                   | 0      | N/a               |
| Checkpoint 9: Lipids                                                          | 0      | N/a               |
| Checkpoint 10: Biological Membranes and Transport                             | 0      | N/a               |
| Checkpoint 11: Biochemical Signaling                                          | 0      | N/a               |
| Checkpoint 12: Introduction to Metabolism                                     | 0      | N/a               |
| Benchmark 2: Checkpoints 7-12                                                 | 125    | 3-8               |
| Benchmark 3: Checkpoints 1-12                                                 | 200    | 1-8               |
| Checkpoint 13: Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway | 0      | N/a               |
| Checkpoint 14: The Metabolism of Glycogen in Animals                          | 0      | N/a               |
| Checkpoint 15: The Citric Acid Cycle                                          | 0      | N/a               |

| Assessment                                                                     | Points | Learning Outcomes |
|--------------------------------------------------------------------------------|--------|-------------------|
| Checkpoint 16: Fatty Acid Catabolism                                           | 0      | N/a               |
| Checkpoint 17: Oxidative Phosphorylation                                       | 0      | N/a               |
| Checkpoint 18: Lipid Biosynthesis                                              | 0      | N/a               |
| Benchmark 4: Checkpoints 13-18                                                 | 125    | 9-13              |
| Checkpoint 19: Biosynthesis of Amino Acids, Nucleotides, and Related Molecules | 0      | N/a               |
| Checkpoint 20: Hormonal Regulation and Integration of Mammalian Metabolism     | 0      | N/a               |
| Checkpoint 21: Genes and Chromosomes                                           | 0      | N/a               |
| Checkpoint 22: DNA Metabolism                                                  | 0      | N/a               |
| Checkpoint 23: RNA Metabolism                                                  | 0      | N/a               |
| Checkpoint 24: Protein Metabolism                                              | 0      | N/a               |
| Checkpoint 25: Regulation of Gene Expression                                   | 0      | N/a               |
| Benchmark 5: Checkpoints 19-25                                                 | 125    | 14, 15            |
| Benchmark 6: Checkpoints 1-25                                                  | 300    | 1-15              |
| Total                                                                          | 1000   |                   |

## Course Roadmap

This roadmap provides an overview of the checkpoints and lessons covered in this course.

### Checkpoint 1: The Foundations of Biochemistry

- Textbook: Checkpoint 1 Reading Assignment: Chapter 1
- The Foundations of Biochemistry
- Checkpoint 1: Chapter 1: Concept Map Activity

### Checkpoint 2: Water, the Solvent of Life

- Textbook: Checkpoint 2 Reading Assignment: Chapter 2
- Water: The Solvent of Life
- Checkpoint 2: Chapter 2: Concept Map Activity

### Checkpoint 3: Amino Acids, Peptides, and Proteins

- Textbook: Checkpoint 3 Reading Assignment: Chapter 3
- Amino Acids, Peptides, and Proteins
- Checkpoint 3: Chapter 3: Video Playlist
- Checkpoint 3: Chapter 3: Concept Map Activity

#### **Checkpoint 4: The Three-Dimensional Structure of Proteins**

- Textbook: Checkpoint 4 Reading Assignment: Chapter 4
- The Three Dimensional Structure of Proteins
- Checkpoint 4: Chapter 4: Video Playlist
- Checkpoint 4: Chapter 4: Concept Map Activity

#### **Checkpoint 5: Protein Function**

- Textbook: Checkpoint 5 Reading Assignment: Chapter 5
- Protein Function
- Checkpoint 5: Chapter 5: Video Playlist
- Checkpoint 5: Chapter 5: Concept Map Activity

#### **Checkpoint 6: Enzymes**

- Textbook: Checkpoint 6 Reading Assignment: Chapter 6
- Enzymes
- Checkpoint 6: Chapter 6: Video Playlist
- Checkpoint 6: Chapter 6: Concept Map Activity

#### **Checkpoint 7: Carbohydrates and Glycobiology**

- Textbook: Checkpoint 7 Reading Assignment: Chapter 7
- Carbohydrates and Glycobiology
- Checkpoint 7: Chapter 7: Concept Map

#### **Checkpoint 8: Nucleotides and Nucleic Acids**

- Textbook: Checkpoint 8 Reading Assignment: Chapter 8
- Nucleotides and Nucleic Acids
- Checkpoint 8: Chapter 8: Video Playlist
- Checkpoint 8: Chapter 8: Concept Map

#### **Checkpoint 9: Lipids**

- Textbook: Checkpoint 9 Reading Assignment: Chapter 10
- Lipids
- Checkpoint 0: Chapter 10: Concept Map Activity

#### **Checkpoint 10: Biological Membranes and Transport**

- Textbook: Checkpoint 10 Reading Assignment: Chapter 11
- Biological Membranes and Transport
- Checkpoint 10: Chapter 11: Video Playlist
- Checkpoint 10: Chapter 11: Concept Map Activity

#### **Checkpoint 11: Biochemical Signaling**

- Textbook: Checkpoint 11 Reading Assignment: Chapter 12
- Biochemical Signaling
- Checkpoint 11: Chapter 12: Concept Map Activity

### Checkpoint 12: Introduction to Metabolism

- Textbook: Checkpoint 12 Reading Assignment: Chapter 13
- Introduction to Metabolism
- Checkpoint 12: Chapter 13: Video Playlist
- Checkpoint 12: Chapter 13: Concept Map Activity

### Checkpoint 13: Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway

- Textbook: Checkpoint 13 Reading Assignment: Chapter 14
- Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway
- Checkpoint 13: Chapter 14: Video Playlist
- Checkpoint 13: Chapter 14: Concept Map Activity

### Checkpoint 14: The Metabolism of Glycogen in Animals

- Textbook: Checkpoint 14 Reading Assignment: Chapter 15
- The Metabolism of Glycogen in Animals
- Checkpoint 14: Chapter 15: Video Playlist
- Checkpoint 14: Chapter 15: Concept Map Activity

### Checkpoint 15: The Citric Acid Cycle

- Textbook: Checkpoint 15 Reading Assignment: Chapter 16
- The Citric Acid Cycle
- Checkpoint 15: Chapter 16: Video Playlist
- Checkpoint 15: Chapter 16: Concept Map Activity

### Checkpoint 16: Fatty Acid Catabolism

- Textbook: Checkpoint 16 Reading Assignment: Chapter 17
- Fatty Acid Catabolism
- Checkpoint 16: Chapter 17: Video Playlist
- Checkpoint 16: Chapter 17: Concept Map Activity

### Checkpoint 17: Oxidative Phosphorylation

- Textbook: Checkpoint 17 Reading Assignment: Chapter 19
- Oxidative Phosphorylation
- Checkpoint 17: Chapter 19: Concept Map Activity

### Checkpoint 18: Lipid Biosynthesis

- Textbook: Checkpoint 18 Reading Assignment: Chapter 21
- Lipid Biosynthesis
- Checkpoint 18: Chapter 21: Concept Map Activity

### Checkpoint 19: Biosynthesis of Amino Acids, Nucleotides, and Related Molecules

- Textbook: Checkpoint 19 Reading Assignment: Chapter 22
- Biosynthesis of Amino Acids, Nucleotides, and Related Molecules
- Checkpoint 19: Chapter 22: Video Playlist

- Checkpoint 19: Chapter 22: Concept Map Activity

### **Checkpoint 20: Hormonal Regulation and Integration of Mammalian Metabolism**

- Textbook: Checkpoint 20 Reading Assignment: Chapter 23
- Hormonal Regulation and Integration of Mammalian Metabolism
- Checkpoint 20: Chapter 23: Concept Map Activity

### **Checkpoint 21: Genes and Chromosomes**

- Textbook: Checkpoint 21 Reading Assignment: Chapter 24
- Genes and Chromosomes
- Checkpoint 21: Chapter 24: Concept Map Activity

### **Checkpoint 22: DNA Metabolism**

- Textbook: Checkpoint 22 Reading Assignment: Chapter 25
- DNA Metabolism
- Checkpoint 22: Chapter 25: Concept Map Activity

### **Checkpoint 23: RNA Metabolism**

- Textbook: Checkpoint 23: Reading Assignment: Chapter 26
- RNA Metabolism
- Checkpoint 23: Chapter 26: Concept Map Activity

### **Checkpoint 24: Protein Metabolism**

- Textbook: Checkpoint 24 Reading Assignment: Chapter 27
- Protein Metabolism
- Checkpoint 24: Chapter 27: Concept Map Activity

### **Checkpoint 25: Regulation of Gene Expression**

- Textbook: Checkpoint 25 Reading Assignment: Chapter 28
- Regulation of Gene Expression
- Checkpoint 25: Chapter 28: Concept Map Activity

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## **Related Courses**

**CHEM450L**

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