ccnm
CANADIAN COLLEGE OF NATUROPATHIC MEDICINE

COURSE OUTLINE 2021

Course:	Biochemistry
Course Code:	SBC100
Times & Location:	Online Tutorial: Wednesdays 7:30 – 9:00 pm EST
Course Coordinator:	Dr. Melanie Facca, BSc, MS, ND
Instructor:	Dr. Melanie Facca, BSc, MS, ND
Office Location:	Online

Evaluation:

	WEIGHTING	TEST DATE / DUE DATE
Module Quizzes	10%	8 Self-Scheduled Quizzes
Assignments	5%	2 Assignments (2.5% each)
Midterm Test	30%	
Course Participation	5%	
Final Exam	50%	

Plagiarism and cheating are academic offenses and will be treated seriously by the College. Students should refer to the College's policies on academic misconduct posted on in the Academic Calendar.

Required Text:
McMurray, Ballantine, Hoeger & Peterson. *Fundamentals of General, Organic and Biological Chemistry:* 2017, 8th Edition.). Published by Pearson.

Course Description:

SBC100 (Biochemistry) is a three-credit, 8-week introductory biochemistry course designed to build on knowledge acquired in SGC100. In SBC100, students will learn the fundamental concepts of biochemistry as it pertains to the human body. The focus of this course is on the structure and metabolism of macromolecules such as carbohydrates, lipids, proteins and nucleic acids. Essential biochemistry concepts including glycolysis, protein synthesis, enzymes, the citric acid cycle, the electron transport chain and ATP synthesis are thoroughly investigated.

The application of biochemistry to naturopathic principles is integrated throughout the course; providing students with a unique opportunity to learn biochemistry within the context of naturopathic medicine. Incorporation of a virtual laboratory component enhances and re-enforces course material and allows the student to experience a practical application of biochemistry while maintaining the convenience of online learning. SBC100 provides the necessary pre-requisite knowledge required for the ND program.

Prerequisites
General Chemistry (SGC100) or an equivalent course from a recognized university is a prerequisite for Biochemistry, SBC100.

Course Outcomes:

On completion of the course the student will be expect to:

- Demonstrate a basic understanding of biochemistry.
- Demonstrate knowledge of the fundamental laws and vocabulary as they pertain to biochemistry.
- Apply biochemistry to Naturopathic principles.
- Demonstrate knowledge of the fundamental biochemical processes of the human body.
- Demonstrate knowledge of the chemical reactions of biochemistry.
- Demonstrate knowledge of the 3 major biochemical macromolecules; carbohydrates, lipids and proteins.
- Demonstrate knowledge of the fundamental biochemical processes of the human body including, but not limited to, glycolysis, Kreb's cycle and the electron transport chain.
- Apply knowledge of biochemistry to a clinical setting.
- Demonstrate knowledge of the principles and process of the chemical experiment.

Pedagogy:

The course is delivered in a blended learning style which combines online self-study modules with weekly live interactive online tutorial sessions from 7:30 p.m. - 9 p.m. EST (one evening per week) with the course instructor.

Evaluation:

The passing grade is 60%, and evaluations/assessments will consist of, one quiz per module (10%), two assignments (5%), one midterm test (30%), class participation (5%) and a final exam (50%). The midterm and final exam are conducted online.

SBC100 Biochemistry

Course Schedule

Class	Date	Topic	Modules
1	Week 1	Introduction to course	
2	Week 2	Modules 1 & 2	• Amino Acids & Proteins (Ch 18) • Enzymes & Vitamins (Ch 19)
3	Week 3	Modules 3, 4 & 5	• Carbohydrates (Ch 20) • The Generation of Biochemical Energy (Ch 21) • Carbohydrate Metabolism (Ch 22)
	Week 4	**Midterm**	***No Webinar (Includes Modules 1-5)***
4	Week 5	Module 6 & 7	• Lipids (Ch 23) • Lipid Metabolism (Ch 24)
5	Week 6	Module 8 & 9	• Protein and Amino Acid Metabolism (Ch 25) • Nucleic Acids and Protein Synthesis (Ch 26)
6	Week 7	Module 10, 11 & 12	• Genomics (Ch 27) • Chemical Messengers: Hormones, Neurotransmitters & Drugs (Ch 28) • Body Fluids (Ch 29)
	Week 8	**Final Exam**	***Final Exam is cumulative***

The Academic Department reserves the right to make schedule changes.

SBC100 Biochemistry
Session Learning Outcomes

Tutorial 1

Course Introduction: SBC100 Biochemistry

By the end of this session, the student will be able to:

- Navigate Moodle SBC100 course shell and Zoom programs
- Understand course requirements, including textbook readings, evaluations and deadlines
- General overview of Modules 1 and 2

Deadline: Post a brief introduction on "Please introduce yourself" forum before the start of the tutorial.

Tutorial 2

Introduction to Biochemistry: Amino Acids, Proteins, Enzymes & Vitamins

By the end of this session, the student will be able to:

- classify proteins by their function
- give the name and abbreviation for an amino acid
- draw the ionized and zwitterion structure of an amino acid
- draw the condensed structural formula for an amino acid at pH values above or below its isoelectric point
- draw the condensed structural formula for a peptide
- name a peptide in its primary structure
- describe the primary structure of a protein
- describe the secondary, tertiary and quaternary structures of a protein
- describe the denaturation of a protein
- describe enzymes and their role in enzyme-catalyzed reactions
- describe the effect of temperature, pH, and inhibitors on enzyme activity
- describe the two classes of vitamins
- describe the reasons vitamins are necessary in the diet, and the results of vitamin excesses or deficiencies
- identify antioxidants and explain their function
- identify essential minerals, explain why minerals are necessary in the diet
- explain the results of mineral deficiencies

Deadline: Complete Modules 1 and 2 before the start of the tutorial.

Tutorial 3

Carbohydrates, the Generation of Biochemical Energy and Carbohydrate Metabolism

By the end of this session, the student will be able to:

- Classify carbohydrates by functional group and number of carbon atoms and label them accordingly.
- Identify D and L enantiomers and any diastereomers of a monosaccharide from the Fischer projection.
- Draw the Fischer projection for a monosaccharide.
- Convert five-and six-carbon monosaccharides from the Fischer projection to the Haworth projection.
- Identify the anomeric carbon and the alpha (α) or beta (β) form of the monosaccharide and describe the role of mutarotation in cyclic structure.
- Identify by name and structure the common monosaccharides, their sources and uses.
- Predict the products of oxidation and reduction reactions on monosaccharides.
- Predict the products of reactions between monosaccharides and alcohols.

- Recognize and predict the products of hydrolysis reactions of polysaccharides and phosphorylation reactions of monosaccharides.
- Identify by name and structure the common disaccharides, the subunits and the bond between them, their sources and uses.
- Recognize common polysaccharides and identify where each polysaccharide is found in nature and its function.
- Identify the monomers and type of bond present in each polysaccharide.
- Identify the modified monosaccharides found in naturally occurring polysaccharides and identify the functions of these polysaccharides
- Identify energy sources and our specific requirements for energy regulation.
- Explain the significance of exergonic and endergonic reactions in metabolism.
- Describe the eukaryotic cell and explain the function of each structure.
- List the stages in catabolism of food and describe the role of each stage.
- Describe the role of ATP in energy transfer.
- Explain why some reactions are coupled and give an example of a coupled reaction.
- Give an example of a coenzyme changing from oxidized to reduced form in a reaction and explain the purpose of the change.
- Describe the reactions in the citric acid cycle and explain its role in energy production.
- Describe the electron-transport chain, oxidative phosphorylation, and how the two processes are coupled.
- Describe carbohydrate digestion, where it takes place in the body, the enzymes involved, and name the major products of the process.
- Identify the pathways by which glucose is first synthesized and then broken down and describe their interrelationships.
- Describe the glycolysis pathway and its products.
- Identify where the major monosaccharides enter glycolysis.
- Describe the pathways involving pyruvate and their respective outcomes.
- Calculate the energy produced by partial or total oxidation of glucose.
- Identify the hormones that influence glucose metabolism and describe the changes in metabolism during stress conditions.
- Explain the pathways for glycogen metabolism and their purpose.
- Explain the pathways for synthesis of glucose from noncarbohydrate molecules.

Deadline: Complete Modules 3, 4 and 5 before the start of the tutorial.

Tutorial 4

Lipids & Lipid Metabolism

By the end of this session, the student will be able to:

- Describe the chemical structures and general properties of fatty acids, waxes, sterols, fats, and oils.
- Describe the characteristics of fatty acids and fatty acid esters.
- List the physical properties of fats and oils and explain why they are different.
- Describe hydrogenation and hydrolysis reactions of triacylglycerols, and given the reactants, predict the products.
- Recognize phospholipids and glycolipids and describe their functions.
- Identify sterols and their derivatives and describe their structures and roles.
- Identify the membrane lipids and describe their structures and roles.
- Describe the general structure of a cell membrane and its chemical composition.
- Distinguish between passive transport and active transport and between simple diffusion and facilitated diffusion.
- List the steps in the digestion of dietary triacylglycerols and their transport into the bloodstream.
- Name the major classes of lipoproteins, specify the nature and function of the lipids they transport, and identify their destinations.
- Name the major pathways for the synthesis and breakdown of triacylglycerols and fatty acids, and identify their connections to other metabolic pathways.
- Explain the reactions by which triacylglycerols are stored and mobilized, and how these reactions are regulated.
- Describe fatty acid oxidation.
- Calculate the energy yield from fatty acid oxidation.
- Identify ketone bodies, describe their properties and synthesis, and explain their role in metabolism.
- Compare the pathways for fatty acid synthesis and oxidation, and describe the reactions of the synthesis pathway

Deadline: Complete Module 6 and 7 before the start of the tutorial.

Tutorial 5

Protein and Amino Acid Metabolism and Nucleic Acids and Protein Synthesis

By the end of this session, the student will be able to:

- List the steps of protein digestion.
- Define the amino acid pool and its metabolic role.
- Explain how amino acids are catabolized.
- Discuss the fate of the nitrogen of an amino acid.
- Identify the major reactants and products of the urea cycle.
- Describe the metabolic fate of the carbon atoms in an amino acid.
- Define essential and nonessential amino acids, and describe the general scheme of amino acid biosynthesis.
- Explain the role of chromosomes, genes, and DNA, and describe their basic function in the human body.
- Describe, identify, and draw the components of nucleosides and nucleotides.
- Describe and identify nucleic acid chains in DNA and RNA.
- Interpret the structure of DNA, and write complementary sequences.
- Describe how genetic information is duplicated, transferred, and expressed.
- Explain the process of DNA replication.
- List the types of RNA, their locations in the cell, and their functions.
- Explain the process of transcription, and write complementary strands through mRNA.
- Interpret mRNA codons from the genetic code, and write the primary sequence of a protein.
- Identify the initiation, elongation, and termination steps in translation for protein synthesis.

Deadline: Complete Module 8 and 9 before the start of the tutorial.

Tutorial 6

Genomics, Chemical Messengers: Hormones, Neurotransmitters & Drugs and Body Fluids

By the end of this session, the student will be able to:

- Describe how a genome is mapped.
- Identify the genetic roles of telomeres, centromeres, exons and introns, and noncoding DNA.
- Describe a mutation and what can result from one.
- Define polymorphisms and SNPs, and explain the significance of the locations of SNPs.
- Describe recombinant DNA and its uses.
- Identify the possible applications of genomic mapping.
- Describe the origins, pathways, and actions of hormones.
- Distinguish between the different types of hormonal control.
- List the different chemical types of hormones and give examples of each.
- Explain the sequence of events in epinephrine's action as a hormone.
- Explain the functions of the three major types of hormones: amino acid derivatives, polypeptides, and steroids.
- Describe the origins, pathways, and actions of neurotransmitters.
- Outline the sequence of events in acetylcholine's action as a neurotransmitter and give examples of its agonists and antagonists.
- Describe the neurotransmitters and types of drugs that play roles in allergies, mental depression, and drug addiction.
- Describe the major categories of body fluids, their composition, and the exchange of solutes between them.
- Discuss how fluid balance is maintained.
- Describe the composition and functions of blood.
- Explain the roles of the blood components that participate in inflammation and the immune response.
- List the steps involved in blood clotting.
- Explain the relationships among O_2 and CO_2 transport and acid-base balance.
- Describe the transfer of water and solutes during urine formation.
- Describe the composition of urine.

Deadline: Complete Module 10, 11 and, 12 before the start of the tutorial.