



**CCNM**

Canadian College of  
Naturopathic Medicine

## COURSE OUTLINE

<b>Course:</b>	Chemistry II : Foundations of Chemistry
<b>Course Code:</b>	SGC102
<b>Times &amp; Location:</b>	Online Tutorial: Wednesdays 7:30 – 9:00 pm EST
<b>Course Coordinator:</b>	Dr. Melanie Facca, BSc, MS, ND
<b>Instructors/Teaching Assistants:</b>	
<b>E-mail:</b>	
<b>Office Hours:</b>	By appointment
<b>Office Location:</b>	Online

### Evaluation:

	<b>PERCENT</b>	<b>TEST DATE / DUE DATE</b>
<b>Tutorial Participation/ Attendance</b>	5%	Weekly tutorial
<b>Module Quizzes</b>	10%	10 Self-Scheduled Quizzes
<b>Assignments</b>	5%	2 Assignments - Assignment #1 deadline: <b>TBA</b> - Assignment #2 deadline: <b>TBA</b>
<b>Midterm Test</b>	30%	<b>TBA</b>
<b>Final Exam</b>	50%	<b>TBA</b>

Plagiarism and cheating are academic offenses and will be treated seriously by the College.

Students should refer to the college's policies in [Academic Calendar](#). Students may seek guidance from a number of style manuals located in the CCNM library.

### Required Texts:

Timberlake. *Chemistry: An Introduction to General, Organic and Biological Chemistry*. Pearson, 2017, 13<sup>th</sup> Edition.). Published by Pearson.

## **Course Description:**

Chemistry II (SGC102) is a three-credit, 8-week introductory course designed to build on knowledge acquired in Chemistry I. In Chemistry II, students will learn the fundamental concepts of organic chemistry and biochemistry. The course will emphasize the various families of organic compounds including hydrocarbons, alcohols, aldehydes, ketones, carboxylic acids, esters and amines with an emphasis on how they affect the physical and chemical behavior of biological molecules. The focus of the second half of the course is on the structure and function of carbohydrates, lipids, proteins and nucleic acids as well a basic introduction into metabolism.

The application of organic chemistry and biochemistry to naturopathic medicine is integrated throughout the course; providing students with a unique opportunity to learn chemistry within the context of naturopathic medicine. Incorporation of a virtual laboratory component enhances and re-enforces material covered in the course and allows the student to experience a practical application of chemistry while maintaining the convenience of an online chemistry course.

## **Prerequisites**

Chemistry I or an equivalent course from a recognized university is a prerequisite for Chemistry II.

## **Course Outcomes:**

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

- Demonstrate a basic understanding of organic and biochemistry.
- Demonstrate knowledge of the fundamental laws and vocabulary as they pertain to organic chemistry.
- Apply organic and biochemistry to Naturopathic principles.
- Demonstrate knowledge of organic chemistry nomenclature.
- Demonstrate knowledge of the chemical reactions of basic organic and biochemistry.
- Demonstrate knowledge of the 3 major biochemical macromolecules; carbohydrates, lipids and proteins.
- Demonstrate knowledge of the fundamental biochemical processes of the human body.
- Apply knowledge of organic and 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 - 9 p.m. EST (one evening per week) with the course instructor.

## **Evaluation:**

The passing grade is 60%, and evaluations/assessments will consist of tutorial attendance/participation (5%), one quiz per module (10%), two assignments (5%), one midterm test (30%), and a final exam (50%) which can be completed online and will be

proctored via remote invigilation.

## SGC102 Chemistry II: Foundations of Chemistry

### Lecture Schedule

Class	Date	Topic	Modules
1	TBA	Introduction to course	
2	TBA	Modules 1 & 2	Introduction to Organic Chemistry: Hydrocarbons & Alcohols, Thiols, Ethers, Aldehydes and Ketones
3	TBA	Modules 3 & 4	Carbohydrates & Carboxylic Acids, Esters, Amines and Amides
4	TBA	Module 5	Lipids
	TBA	Midterm Week	No Webinar (Includes Modules 1-4)
5	TBA	Module 6	Amino Acids, Proteins and Enzymes
6	TBA	Modules 7 & 8	Nucleic Acid and Protein Synthesis & Metabolic Pathways and Energy Production
7	TBA	Final Exam Week	Final Exam is cumulative

## SGC102 Chemistry II: Foundations of Chemistry Session Learning Outcomes

### Tutorial 1

Date: TBA

**Introduction to SGC102 Chemistry II: Foundations of Chemistry Course** By the end of this session, the student will be able to:

- Navigate Moodle SGC102 course shell and GoToWebinar programs
- Understand course requirement, including textbook readings, evaluations and deadlines
- Begin completion of Modules 1 and 2

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

### Tutorial 2

Date: TBA

### Introduction to Organic Chemistry: Hydrocarbons & Alcohols, Thiols, Ethers, Aldehydes and Ketones

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

- identify properties characteristic of organic and inorganic substances
- write the IUPAC names for alkanes and cycloalkanes
- draw the condensed and skeletal formulas for alkanes and cycloalkanes
- write the IUPAC names for alkanes with substituents
- draw the condensed and skeletal formulas for alkanes with substituents
- identify the properties of alkanes

- write balanced chemical equations for the combustion of alkanes
- identify structural formulas as alkenes, cycloalkenes and alkynes
- write the IUPAC names for alkenes, cycloalkenes and alkynes
- draw the condensed structural formulas for cis-trans isomers of alkenes
- give the names for cis-trans isomers of alkenes
- draw the condensed structural formulas and give the names for the organic products of addition reactions of hydrogenation and hydration reactions
- describe the bonding in benzene
- name aromatic compounds and draw their skeletal formulas
- give the IUPAC and common names for aldehydes and ketones
- give the common names for thiols and ethers
- draw condensed or skeletal formulas for aldehydes, ketones, thiols and ethers
- describe the classification of alcohols
- describe the solubility of alcohols in water
- write the IUPAC names and common names of aldehydes and ketones
- draw the condensed formula for aldehydes and ketones
- describe the solubility of aldehydes and ketones in water
- write balanced chemical equations for the combustion, dehydration and oxidation of alcohols
- write balanced chemical equations for the combustion, dehydration and oxidation of thiols, aldehydes and ketones

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

### **Tutorial 3**

**Date: TBA**

#### **Carbohydrates & Carboxylic Acids, Esters, Amines and Amides**

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

- classify a monosaccharide as an aldose or ketose
- identify the number of carbon atoms in a monosaccharide
- identify chiral and achiral carbon atoms in an organic molecule
- use Fischer projections to draw the D or L stereoisomers for glucose, galactose and fructose
- draw and identify Haworth structures for monosaccharides
- identify the products of the oxidation or reduction of monosaccharides
- determine whether a carbohydrate is a reducing sugar
- describe the monosaccharide units and linkages in disaccharides
- describe the structural features of amylose, amylopectin, glycogen and cellulose
- write the IUPAC names and common names of carboxylic acids
- draw the condensed and skeletal formula for carboxylic acids
- describe the solubility, ionization and neutralization of carboxylic acids
- give the IUPAC and common names for esters
- write the balanced chemical equation for the formation of an ester
- draw the condensed structural formulas for the products from acid and base hydrolysis of esters
- give the common names for amines
- draw the condensed chemical formulas for amines when given their names
- classify amines as primary, secondary or tertiary
- describe the solubility, ionization and neutralization of amines in water
- give the IUPAC and common names of amides
- draw the condensed structural formulas for the products of formation and hydrolysis

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

#### **Tutorial 4**

**Date: TBA**

##### **Lipids**

- describe the classes of lipids
- draw the condensed formula of a fatty acid
- identify a fatty acid as saturated or unsaturated
- draw the condensed structural formula for a wax or triacylglycerol produced by the reaction of a fatty acid and an alcohol
- draw the condensed structural formula of a triacylglycerol that undergoes hydrogenation, hydrolysis, or saponification
- describe the structure of a phospholipid containing glycerol or sphingosine
- describe the structure of steroids
- describe the composition and function of the lipid bilayer in cell membranes

*Deadline: Complete Module 5 before the start of the tutorial.*

#### **Tutorial 5**

**Date: TBA**

##### **Amino Acids, Proteins and Enzymes**

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 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 for 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
- classify proteins by their function
- give the name and abbreviation for an amino acid
- draw the ionized 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 for 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

*Deadline: Complete Module 6 before the start of the tutorial.*

## Tutorial 6

Date: TBA

### Nucleic Acid and Protein Synthesis & Metabolic Pathways and Energy Production

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

- describe the bases and ribose sugars that make up the nucleic acids RNA and DNA
- describe the primary structures of DNA and RNA
- describe the double helix of DNA
- describe the process of DNA replication
- identify the different types of RNA
- describe the synthesis of mRNA
- describe the process of protein synthesis from mRNA
- describe some ways in which DNA is altered to cause mutations
- describe the methods by which a virus infects a cell
- describe the 3 stages of catabolism and the role of ATP
- give the sites and products for digestion for carbohydrates, triacylglycerol and proteins
- describe the components and function of NAD<sup>+</sup>, FAD and coenzyme A
- describe the conversion of glucose to pyruvate in glycolysis and the subsequent conversion of acetyl CoA or lactate
- describe the oxidation of acetyl CoA in the citric acid cycle
- describe the electron transport and the process of oxidative phosphorylation
- calculate the ATP from the complete oxidation of glucose
- describe the metabolic pathway of  $\beta$ -oxidation
- calculate the ATP from the complete oxidation of a fatty acid
- describe the reactions of transamination, oxidative deamination
- describe the entry of amino acid carbons into the citric acid cycle

*Deadline: Complete Module 7 and 8 before the start of the tutorial.*