London South Bank University

Module Guide

Core Science for Forensic Scientists

EAC_4_134

Faculty of Engineering, Science and the Built Environment

2012-2013

Level 4, Year 1

Table of Contents

1. Module Details 3
2. Short Description 3
3. Aims of the Module 4
4. Learning Outcomes 4
   4.1 Knowledge and Understanding 4
   4.2 Intellectual Skills 4
   4.3 Practical Skills 4
   4.4 Transferable Skills 4
5. Assessment of the Module 5
6. Feedback 5
7. Introduction to Studying the Module 5
   7.1 Overview of the Main Content 5
   7.2 Overview of Types of Classes 5
   7.3 Importance of Student Self-Managed Learning Time 6
   7.4 Employability 6
8. The Programme of Teaching, Learning and Assessment 6
9. Student Evaluation 9
10. Learning Resources 9
   10.1 Core Materials 9
   10.2 Optional Materials 9

NOTES 10

1. MODULE DETAILS

Module Title:	Core Science for Forensic Scientists
Module Level:	Level 4, Year 1
Module Reference Number:	EAC_4_134
Credit Value:	2 Credits = 300 CATS points
Student Study Hours:	300 hours
Contact Hours:	96 Hours
Private Study Hours:	204 Hours
Pre-requisite Learning (If applicable):	None
Co-requisite Modules (If applicable):	Core Skills (practical skills
Course(s):	Forensic Science
Year and Semester	Year 1, semesters 1 and 2
Module Coordinator:	**Dr. Nicholas Power**
MC Contact Details (Tel, Email, Room)	Room BR 142 Tel: 7815-7956 Email: nicholas.power@lsbu.ac.uk
Teaching Team & Contact Details (If applicable):	Lecturers: **Dr. John Orrin** Room M306 Tel: 0207-815-7950 Email: orrinj@lsbu.ac.uk **Ms. Louise Powell-Cook** Room B136 Tel: 0207-815-7912 powellcl@lsbu.ac.uk **Dr Anne-Maria Brennan** Room B138 Tel: 0207-815-7929 Brennan@lsbu.ac.uk **Dr John Acord** Room B140 Tel: 0207-815-7992 acordj@lsbu.ac.uk **Dr Hongyu Li** Room B149 Tel: 0207-815-7988 li8@lsbu.ac.uk Tutors: **Dr. Chris Brock** Room E 243A Tel: 7815-7970 Email: Brockc@lsbu.ac.uk **Mr. Misbahu L. Mohammed** Room E Tel: 7815- Email: mohamm74@lsbu.ac.uk
Subject Area:	Forensic Science
Summary of Assessment Method:	Course work (Laboratory practical reports, Online MCQ tests, in class tests and a Seen Exam) (50%) and examination (50%)

2. SHORT DESCRIPTION

An introduction to the principles of chemistry and biochemistry required to underpin the Forensic Science degree course. Starting from a basic description of the atom, the course leads progressively to cover key aspects of fundamental physical, inorganic and organic chemistry. The unit also looks at various aspects of biochemistry; the structure of nucleic acids, proteins, lipids, carbohydrates and illicit drugs.

3. AIMS OF THE MODULE

The aims of this unit are:
• To equip students with the appropriate scientific background for the study of applied science.
• To encourage a confident, reasoning, disciplined, inquiring and investigative approach to the study of science.
• To provide a body of knowledge of chemical and biochemical science necessary for the study of forensic science.
• To illustrate some investigative and interdisciplinary approaches which explain chemical and biochemical structures and processes..

4. LEARNING OUTCOMES

4.1 Knowledge and Understanding

• Describe in qualitative terms the nature of the interactions between molecules in solids, liquids and gases,
• Carry out simple calculations using the relationships between molarity, relative molecular mass, %w/v, ppm, w/w,
• Describe the electronic structure of elements in the Periodic Table and explain the structure of the Table,
• Describe the different types of bonding found between atoms and predict the type of bonding to be expected in particular compounds,
• Explain what a radioactive isotope is and what is meant by its ‘half-life’,
• Predict the approximate equilibrium position of a reaction given the value of the Gibbs free energy change,
• Explain the difference between strong and weak acids and the significance and mechanism of buffering in biological systems and differentiate between oxygen addition and oxidation.
• Recognise the structure and relevance of a number of biologically important molecules such as carbohydrates, nucleic acids, amino acids, and fatty acids.
• Explain the importance of the cell as the basic unit of living organisms and describe the key differences between different types of cell.
• Outline the functions of the main compartments of eukaryotic cells and appreciate the relationships between them.
• Describe the principles of genetic inheritance.

4.2 Intellectual Skills

• Learn how to interpret structural or molecular formulae to predict the approximate shapes of simple organic molecules from their formulae.
• Describe the relevant reactions that might be expected of substances of given molecular formulae.
• Describe the cellular basis of life and the complexity within cells that underpins multicellularity.
• Learning how to learn - there are a wide range of aspects to this skill which will be developed e.g. time management, finding and using information.
• Use of information and communication technology - the use of the textbooks and the internet to retrieve information.

4.3 Practical Skills

• Core scientific skills comes from skills unit, which this unit is designed to augment..

4.4 Transferable Skills

• Reasoning skills – through the knowledge of scientific concepts and reasoning.
• Communication skills - written and oral communication will be required during preparation for tutorials especially those involving presentations.
• Numeracy skills - analysis and interpretation of numerical information along with simple algebra.

5. ASSESSMENT OF THE MODULE

There will be a 2 hour examination containing up to fifty multiple choice questions along with some descriptive questions at the end of semester 2. The coursework component will be Laboratory sessions, a series of online MCQ throughout each of the semesters, three in class tests and a seen exam for the Biological Principles component (end of semester 1). The assessment will be based on 50% end-of-unit examination and 50% from course work.

6. FEEDBACK

MCQ test results will be returned immediately to students on submission of test. Laboratory reports should be marked and fee back given within two weeks after final submission date. In class test results should be posted by end of week of exam.

7. INTRODUCTION TO STUDYING THE MODULE

7.1 Overview of the Main Content

***The cell as the basic unit of living organisms*.** Common features of cells. Origin and structure of eukaryotic cells. Endosymbionts. Functional significance of compartmentalisation. Key biochemical functions associated with particular compartments and the trafficking of molecules within the cell. Intra- and inter-cellular signalling. Methods for studying cells.

***Chromosomes as carriers of genetic information*.** Cell division and its regulation. Mitosis and meiosis. Principles of heredity. Sex chromosomes and sex-linkage. Linkage and gene maps. Introduction to the molecular basis of information storage and expression and to methods for analyzing and manipulating genes. Genetically modified organisms.

The nature of matter. This examines the concepts of atoms and molecules, their structure, mass and chemical and physical properties: Electrons in pairs, orbitals and shells. Isotopes (stable and unstable). The formation of ions. The Periodic Table. Bonding; covalent and ionic. The structure of water and hydrogen bonding. Water as a solvent; hydrophobic and hydrophilic effects. ***Reactions.*** This examines chemical reactions, their direction, stoichiometry, catalysis, and energetics: Balancing equations and stoichiometry. Activation energy and the effect of temperature and reactant concentrations on the rates of reaction. Enthalpy, entropy and free energy. Equilibrium, Le Chatelier and the role of 'free energy'. Ionisation, water, strong and weak acids, bases, salts, pH, pK, titrations, buffers, indicators and the Henderson-Hasselbalch equation. ***Organic chemistry.*** This describes simple organic molecules and their reactions: The tetrahedral carbon atoms, double bonds and p electrons. Resonance and conjugation, delocalisation of electrons and aromatic compounds. Electrophilic and nucleophilic groups and reactions. Functional groups: - biologically relevant properties and reactions of alkyl, alkenyl, alcohols, aldehydes, ketones, carboxylic acids, anhydrides, amines, amides and esters. Conformational isomerism, stereoisomerism, optical isomerism and cis/trans isomerism. D-/L- and S-/R- nomenclature. ***Structural biochemistry***. This will investigate the structures and physical and chemical properties of representative members of the major groups of important biological molecules (polysaccharides, amino acids and proteins, nucleic acids and fatty acids) and relate these to their biological roles.

7.2 Overview of Types of Classes

This double credit (30 CATS points) credit unit contains lectures, tutorials and directed student-centred learning. It consists of over 300 hours made up of class contact time (96 hrs) and directed learning (216 hrs). Related practical classes form part of the Core Skills unit. The course will be presented in a series of 72 lectures with 24 one-hour tutorials in support. Four reinforcement/revision lectures are also given. Ten one-hour periods will be timetabled every other week starting in week two for the completion of multiple-choice tests. On the weeks following the tests, there will be a one-hour period for going over the answers to the previous week's test and for practising further examples. Practical work (about 18 hours) will support and reinforce the material in the theory sections and develop laboratory skills, safe practice and group participation. This practical work will form part of associated units. For the tutorials you will be divided into groups. Your tutor will concentrate on the needs of students who have done the least chemistry in the past. A program of guided student-centred activities is provided which includes guided reading, audio-visual aids, computer simulations, molecular modelling and problem solving. These times are NOT optional. You must invest your time if you are to benefit from University. If you do not use your opportunity then you let us and yourself down.

All lectures, tutorials and multiple-choice test classes must be attended unless you have an excuse acceptable to your course director. All sessions will have attendance monitored. Attendance is important and absence may cause you to fail. If multiple-choice test sessions are unavoidably missed, it
is not usually possible to do them at an alternative time. Exceptions may be possible if sufficient prior warning is given. The course has essential textbooks associated with it. One must be purchased to complete the background reading satisfactorily

7.3 Importance of Student Self-Managed Learning Time

Each one-hour lecture has associated with it two hours for reading your notes and the directed essential reading matter. This should be done on the same day as the lecture. The rest of the unit time is taken up with the problems. For maximum benefit these should also be done as close to their associated lectures as possible and before the following week. For these reasons you should set aside four hours each week on the same day as the Core Science for Forensic Scientists unit for this work. A further four hours should be set aside at the weekend for the problems and to prepare for the following week. Recognise that this is one of the more demanding Units and invest the time. The investment pays dividends.

7.4 Employability

The unit will develop written and verbal skills (including presentation skills) that are useful in future careers. These include: numeracy, literacy and the ability to reason, along with the ability to retrieve and process information

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

The unit comprises 3 hours of formal lectures per week along with a number of 1-hour long tutorials which students are assigned to take. An indicative weekly programme is given (in the next section) with the following headings:

Problems

Being able to answer these, or similar, problems proves many of the learning outcomes for the unit. The competence to answer them, or similar, will be tested in the fortnightly tests and final examination so practise these problems beforehand. They should be attempted each week. These are in a separate booklet.

Indicative weekly teaching and learning programme

The programme of classes below is intended only as a guide and is subject to modification according to rate of progress and unforeseen factors.

.

Semester 1, Biological Principles: Cells & Genes

Week No.	**Lecture Title**	**Lecturer**
Week 1	Introduction to module	Ms. Louise Powell-Cook
	What is life?	Ms. Louise Powell-Cook
	The domains of life	Dr. Anne-Maria Brennan
Week 2	Origin of Life	Dr. Anne-Maria Brennan
	Endosymbiont Theory	Dr. Anne-Maria Brennan
Week 3	Introduction to cells	Ms. Louise Powell-Cook
	Cell organelles	Ms. Louise Powell-Cook
Week 4	Mitochondria	Ms.Louise Powell-Cook
	Chloroplasts, peroxisomes	Ms.Louise Powell-Cook
Week 5	Endomembrane Systems	Dr. Hongyu Li
	Organelles of intracellular traffic	Dr. Hongyu Li
Week 6	Chromosomes and DNA	Dr. John Acord
	Transcription and Translation	Dr. John Acord
Week 7	Nucleus and cytosol	Dr. Anne-Maria Brennan
	Sex and gametes	Dr. Anne-Maria Brennan
Week 8	Mitosis	Dr. Anne-Maria Brennan
	Meiosis	Dr. Anne-Maria Brennan
Weeks 9 & 10	Guided assessment preparation	Dr. Anne-Maria Brennan Ms. Louise Powell-Cook

Semester 2
These series of three hour lectures are given by Dr. J. Orrin and Dr. N Power

Tutorial programme: Student led tutorial system, based on online MCQ and in-class test performance.

Week 19:
Lecture 2-3 pm (NPP) Introduction to unit; Atomic structure, Periodic table.

Lecture 3-4 pm (NPP) Molarity, Molecular & Empirical formulae.

Lecture 4-5 pm (JO) Lewis Structures, Ionic & covalent bonding, electronegativity.
.
Week 20
Lecture 2-3 pm (JO) The gas laws; Dalton's law of partial pressures; states of matter, solids, liquids and gases.

Lecture 3-4 pm (NPP) Isotopes, stable and unstable; mass spectra, radioactivity, half life.

Lecture 4-5 pm (NPP) Molecular orbitals, shapes of molecules.

Week 21:
Lecture 2-3 pm (JO) Liquids, solids and solutions; intermolecular forces in molecules; solubility of ionic and covalent compounds; osmosis, colloids.

Lecture 3-5 pm (NPP) The tetrahedral carbon atom and the projection of 3-dimensional structures; alkanes, alkenes and alkynes; double bonds, π electrons, aromaticity and resonance.

Week 22:
Lecture 2-3 pm (JO) Chemical reactions, activation energy, effect of temperature, catalysis; Chemical equilibrium, Le Chatelier's principle, effect of temperature and pressure on equilibria.

Lecture 3-5 pm (NPP) Isomers, stereo cis/trans, optical and conformational, chirality.

Week 23:
Lecture 2-3 pm (JO) Water, ionisation, acids (strong and weak), bases, salts and pH.

Lecture 3-5 pm (NPP) Organic reactions, introduction to nucleophilic groups, nucleophilic substitution reactions, addition and polymerisation of alkenes.

Week 24:
Lecture 2-3 pm(JO) Weak acids, pK_a, the Henderson-Hasselbach equation and buffers, acid-base titrations and indicators.

Lecture 3-5 pm (NPP) Alcohols, dehydration; ethers, phenols, carboxylic acids, pK_a's; anhydrides and esters formation and hydrolysis.

Week 25:
Lecture 2-3 pm (JO) Chemical kinetics; rates of reaction, zero, first and second order rate equations.

Lecture 3-5 pm (NPP) Aldehydes and ketones, oxidation and reduction, reaction with alcohols and amines.

Week 26:
Lecture 2-3 pm (JO) Laws of thermodynamics, the first law, systems, states and energies, enthalpy.

Lecture 3-5 pm (NPP) Amines, primary, secondary, tertiary and quaternary, imidazoles, redox properties; amides, formation and hydrolysis.

Week 30:
Lecture 2-3 pm (JO) Second and third laws of thermodynamics, spontaneity, entropy, relationship to equilibrium constant, free energy.

Lecture 3-5 pm (NPP) Amino acids and the structure of proteins.

Week 31:
Lecture 2-3 pm (JO). Forensic examination of hairs, fibres and paints.

Lecture 2-5 pm (NPP) Carbohydrates, Nucleic acids and the structure of DNA and RNA.
.
Week 32: .
Lecture 2-3 pm (JO) Introduction to polymer chemistry, structure, synthesis, physical properties and applications of some common and synthetic polymers.

Lecture 2-5 pm (NPP) Drugs.

Week 33 :
Revision lecture JO
Revision lecture NPP

ASSESSMENT

The assessment will be based on 50% end-of-unit multiple-choice and descriptive question examinations and 50% from the Laboratory sessions and in-course multiple-choice tests and seen exam for Biological Principles. A number of in course tests and online MCQ's will be given. A selection of the highest scoring marks may be weighted in forming the in-course test mark. This is to allow for, and encourage, students to improve throughout the unit and should not be used as an excuse for not trying to pass all tests. These tests will be addressed to the learning outcomes of current aspects of the course, as presented in the lectures, guided reading, and tutorial problems. To encourage note-taking, you *may be* allowed to bring your hand-written notes to some of the class tests, but not to the end-of-unit examination. You will need a simple calculator for these tests. They will concentrate on the specified lectures but may contain material

tested previously. The overall pass mark for this Unit is 40% with a minimum mark in the final examination of 30%.

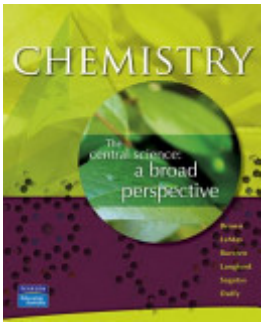
9. STUDENT EVALUATION

In 2011-12, 49 students completed the unit, 38 passed in June and 5 further students passed on referral.

10. LEARNING RESOURCES

10.1 Core Materials

- Chemistry: the central science: with Mastering Chemistry, Brown, Lemay, Bursten, Langford, Sagatys, Duffy. Pearson Education Australia, 2009, ISBN13: 9781442511477, ISBN10: 1442511478. http://www.pearsonhighered.co.uk



Note: The purchase of one of these books should be considered essential for this unit. They contain all of the directed reading. You will find them to be useful for other units in your course and as a reference book in your later careers.

The Unit Web site: http://www.lsbu.ac.uk/biology/biolchem/ contains much extra information concerning this unit including: Problems and their worked answers, exam-type questions and their worked answers, the pH/titrations computer program, information sheets and any notices concerning the Unit

10.2 Optional Materials

- General, Organic & Biological Chemistry Structures of Life, Karen C. Timberlake, Pearson Education, Inc., 2004, ISBN 0-8053-8914-8. It includes an excellent and useful CD-ROM for PCs and links to its Web site, http://www.chemplace.com/college.
- Chemistry, Molecules, Matter, and Change, Loretta Jones and Peter Atkins, 4th edition, W. H. Freeman, 1999, ISBN 0-7167-3254-8. It includes two excellent and useful CD-ROMs for PCs and links to its Web site, http://www.whfreeman.com/chemistry/.
- Chemistry, 2nd edition, by Catherine E Housecroft and Edwin C Constable, Prentice Hall, 2002, ISBN 0-130-86924-4. This is a comprehensive and more advanced textbook. Students with an 'A' or 'AS' level chemistry background are recommended this. It includes a useful Web site, http://www.booksites.net/housecroft.
- White P. (ed.), From Crime Scene to Court, Royal Soc. of Chemistry,1998.

NOTES

[Click and replace]