LONDON SOUTH BANK UNIVERSITY

unit guide

Metabolism & Molecular Biology

SFB-5-204

Please see associated blackboard site

Faculty of Engineering, Science and the Built Environment

2010/2011

become what you want to be

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1. UNIT DETAILS

Unit Title:	Metabolism & Molecular Biology
Unit Level:	Level 5
Unit Reference Number:	SFB 5 204
Credit Value:	30 CATS points
Student Study Hours:	300 hrs
Contact Hours:	90
Private Study Hours:	210
Pre-requisite Learning (If applicable):	(Bio)molecules
Co-requisite Units (If applicable):	None
Course(s):	BSc Bioscience options Compulsory for Biochemistry, Biochemistry (Clinical) and Microbiology students
Year and Semester	2010-11 Semesters 1 & 2
Unit Coordinators:	Dr. Michael Byford (Metabolism) B150 byfordmf@lsbu.ac.uk EX 7994 Dr. John Acord (Molecular Biology) B140 acordj@lsbu.ac.uk EX 7992
Subject Area:	Bioscience and Food
Summary of Assessment Method:	35% of the marks will be derived from an assessment at the end of semester 1 and the remaining 35% of the mark will be derived from an assessment at the end of the course. The remaining 30% of the mark will be derived from the practical classes.

2. SHORT DESCRIPTION

This guide is designed to help you structure your learning by providing an indicative structure and content for the unit. It is a guide and not a definitive statement of what you will be taught. We will try to follow this published schedule as far as possible, but there may be some variation as the unit develops and as we try to match the pace and content of our teaching to student needs. Please see the associated Blackboard site for the most up-to-date material for this unit.

This unit studies in detail the processes involved in the key metabolic pathways involved in the metabolism of carbohydrates, fats and proteins along with their regulation at both the molecular and cellular level. The unit will also cover the central dogma of molecular biology and will introduce the student to the molecular biology of microbial genetics, recombinant DNA technology and gene regulation.

3. AIMS OF THE UNIT

- To provide students with a broad understanding of the topics which constitute the recognized 'core' of molecular biological knowledge and principles of intermediary metabolism, its energetics and regulation.

- To provide the intellectual framework whereby the student develops the ability to execute his/her own experiments, to analyze experimental data, to draw qualitative and quantitative conclusions from available data and to discern whether such conclusions are justified.

- To provide students with an appropriate range of transferrable skills.

4. LEARNING OUTCOMES

By the end of this unit students should be able to:

Knowledge and Understanding:

- Describe in detail the processes involved in the key pathways of intermediary metabolism.

- Explain the interrelationships of these pathways with special reference to their regulation in satisfying the requirements of the cell and organism as a whole.

- Develop, at the level presented in standard undergraduate textbooks, knowledge and understanding of the major areas of molecular biology, namely: structure of nucleic acids, recombinant DNA technology, plasmids, microbial genetics, prokaryotic transcription and its control, DNA replication, mutagenesis, protein synthesis, eukaryotic gene control and application of recombinant DNA techniques.

Intellectual Skills:

- Have the ability to integrate knowledge and understanding of numerous diverse processes into a comprehensive understanding of the interrelationships between them and their bearing on a complete system.

Practical Skills:

- Basic laboratory skills from level 1 will be reinforced. New skills more specifically relating to the means by which basic metabolic and molecular processes can be easily studied will be developed. Ability to produce a coherent and succinct practical report enhanced. A range of methodologies will be presented in both lectures and the practical classes in order to encourage an understanding of the experimental basis of metabolic biochemistry and molecular biology.

Transferable Skills:

- Numeracy, presentation skills, teamwork, individual study skills, time management and word processing skills.

5. ASSESSMENT OF THE UNIT

35% of the marks will be derived from an assessment at the end of semester 1 and the remaining 35% of the mark will be derived from an assessment at the end of the course. The remaining 30% of the mark will be derived from the practical classes. In addition, *there is an attendance requirement for the practicals*, and students must maintain appropriate records of their experimental and tutorial work.

6. FEEDBACK

Feedback will normally be given to students 15 working days after the submission of an assignment.

7. INTRODUCTION TO STUDYING THE UNIT

Overview of the Main Content

Semester 1 will concentrate on metabolism and metabolic pathways in both eukaryotes and prokaryotes.

Semester 2 will focus on molecular biology.

Overview of Types of Classes

The unit comprises 2 hours of formal lectures per week along with a 1-hour long tutorial.

There are laboratory classes associated with both sections of this unit; these are an integral part of the unit. The laboratory sessions will enable you to conduct experimental work that relates directly to the topics covered in lectures. Your experience and results from the laboratory work provide the basis for the coursework component of the unit assessment. Attendance at all laboratory sessions is a requirement for passing this unit. If you miss one because of illness or other exceptional circumstances, you must see the unit leader.

Importance of Student Self-Managed Learning Time

This unit builds on your previous studies (i.e., your first-year (Bio)molecules unit): it will not simply repeat them. Since you will have passed a unit that covered the basis of

carbohydrate, fatty acid, polynucleotide and amino acid structures, your lecturers will assume that you already have this knowledge when you go into a class. *Your private study in the first few weeks should therefore be devoted to revising this knowledge.*

It is vitally important to maintain a rolling programme of private study. There is a great deal of detailed biochemistry and molecular biology that you must assimilate.

Employability

Employability is enhanced by the key transferable skills imparted by the practical component. Metabolism also impacts heavily on nutrition and microbiology disciplines. An understanding of the basics of the central dogma of molecular biology is crucial across the whole of biology and underpins the burgeoning biotechnology sector.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Semester 1 - Metabolism.

Week 1: Introduction to intermediary metabolism.
Glycolysis.

Week 2: Gluconeogenesis and glycogen metabolism.
Alternative fates for pyruvate. Regulation of glycolysis and gluconeogenesis.

Week 3: Synthesis of non-essential amino acids.
Consideration of essential amino acids. Breakdown of amino acids (glycogenic and ketogenic amino acids). The urea cycle.

Week 4: Krebs' (citric acid) cycle.
Regulation of Krebs cycle and intermediary metabolism. Pentose phosphate pathway.

Week 5: Introduction to lipid metabolism.
Structure of lipids. β-Oxidation of fatty acids.

Week 6: Fatty acid-synthesis.
Similarities and contrasts with oxidation. Synthesis of physiologically significant lipids using cholesterol as a precursor.

Week 7: Introduction to energy metabolism.
NADH linked dehydrogenases and electron transfer reactions in mitochondria. Mitochondrial electron transport and oxidative phosphorylation. Malate-aspartate shuttle and glycerol-3-phosphate shuttle.

Week 8: Aerobic and anaerobic respiration. Microbial fermentations (alcoholic, lactic acid, propionic acid, etc.).

Week 9: Chemolithotrophy and biogeochemical cycles. Nitrogen fixation.

Week 10: Secondary metabolism especially with regard to production of pharmaceutically useful products

Week 11: Photosynthesis. The light reactions.
Comparison with mitochondrial electron transport/oxidative phosphorylation. The dark reactions compared with the pentose phosphate pathway. Oxygenic and anoxygenic photosynthesis in bacteria

Week 12: Revision class

Semester 2 – Molecular Biology.

Week 1: Introduction to molecular biology.
The nature of genetic material, revision of DNA structure and function.

Week 2: DNA topology, histones & chromatin structure.
Supercoiling, nucleosomes and higher order structure of chromosomes.

Week 3: Replication of DNA & PCR.
Events at the replication fork and the polymerase chain reaction.

Week 4: DNA repair & the restriction/modification system.
The nature of mutations, the repair systems and the prokaryotic restriction/modification system.

Week 5: Transcription.
RNA polymerase structure and function, elongation and termination. Promoters.

Week 6: RNA splicing.
Eukaryotic RNA splicing, introns and exons.

Week 7: Translation I.
Shine-Dalgarno sequence, tRNA and ribosomes.

Week 8: Translation II.
Termination of translation, chaperones and protein degradation.

Week 9: Prokaryotic regulation of gene expression.
The *lac* operon, the *trp* operon.

Week 10: Plasmids, libraries, cloning and screening.
An introduction to the basic techniques of a molecular biology laboratory.

Week 11: Protein techniques.
Acrylamide gel electrophoresis, 2-D gels, Western blotting.

Week 12: Revision week.

9. LEARNING RESOURCES

Core Texts:

- Nelson, D. L. & Cox, M. M. (2009) *Lehninger Principles of Biochemistry.* 5th Edition. W. H. Freeman.
- Madigan, M. T., Martinko, and Parker, J**. *Brock: Biology of Microorganisms***, 10th edition, Prentice Hall (2002)
  This is an excellent textbook but contains much that is superfluous to the requirements of the unit
- Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. ***Industrial Microbiology: an introduction***. Blackwell Science (2001). Chapters 1 - 3.
- Watson, J. D. *Et al* (2008) *Molecular Biology of the Gene.* 6th Edition. Pearson.

Other Recommended Material:

- Horton, H. R. *Et al* (2006) *Principles of Biochemistry*. 4th Edition. Pearson.
- Dale, J. W. & Park S. F. (2004) *Molecular Genetics of Bacteria.* 4th Edition. Wiley.
- Alberts, B. *Et al* (2008) *Molecular Biology of the Cell*. 5th Edition. Garland Science
- Weaver, R. F. (2007) *Molecular Biology.* 4th Edition. McGraw-Hill.

  Reed, R. *Et al* (2007) *Practical Skills in Biomolecular Sciences.* 3rd Edition. Benjamin Cummings.

  NIH Pub Med enables access to a number of useful texts !free! of charge:

  http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed

  Click the extreme right hand link at the top labelled “Books”. The virtual bookshelf is fully searchable, and many of the individual texts are also searchable.

  The Cell - A Molecular Approach Cooper, Geoffrey M.
  Sunderland (MA): Sinauer Associates, Inc. (2000)
  http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=cooper.TOC&depth=2

  Molecular Biology of the Cell Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter
  New York and London: Garland Science (2002)
  http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mboc4.TOC&depth=2

  Molecular Cell Biology Lodish, Harvey; Berk, Arnold; Zipursky, S. Lawrence; Matsudaira, Paul; Baltimore, David; Darnell, James E.
  New York: W. H. Freeman & Co. (1999)
  http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mcb.TOC

Other learning resources:

Please see the blackboard site for links to other relevant material.