SCIAS7Z01: Molecular Bioscience

Full Title:	Molecular Bioscience
Module Code:	SCIAS7Z01
Credits:	15
Valid From:	Semester 1 - 2013/14 (September 2013)
Module Delivered in	6 programme(s)
Module Description:	•To introduce students to the nature, properties and biological roles of the main groups of biochemicals •To explain the overall organisation of metabolism as a series of interlinked pathways •To describe in some detail the driving forces behind metabolism (energy flows, enzyme catalysts and reaction equilibria) •To show how this complex network is controlled at various levels •To survey briefly the ways in which biochemicals and metabolism are studied. This module will also introduce students to the procedures by which the genetics and related processes of organisms can be altered in controlled ways, and the uses made of these modified organisms. Students will also consider other aspects of nucleic acid technology which are of modern importance, e.g. genetic fingerprinting and gene therapy.

Learning Outcomes:

On successful completion of this module the learner should be able to

1. Discuss the basic structures, and properties of biological relevance, of the common groups of biomolecules.
2. Distinguish the areas of primary, secondary, tertiary and quaternary structures in protein folding.
3. Explain the principles of enzyme catalysis, inhibition and regulation.
4. Analyse the cell's metabolic pathways, their inter-relationships and regulation.
5. Explain how the processes involved in the central dogma of molecular biology function.
6. Summarise the process of recombinant DNA technology and its benefit to the scientific community.
7. Communicate the biochemical and molecular procedures detailed/performed in the module using professional scientific reports or portfolios.
8. Apply practical competence in selected biochemical/molecular related techniques.

Module Content & Assessment

Indicative Content
CONTENT n/a
Introduction Cell structure and the cell cycle. Overview roles of the elements (with a focus on Carbon) and water in the cell. Overview of amino acids and nucleic acids as 'building blocks'. DNA structure and function. Principles of base-pairing and its importance in life. Thermodynamics and chemical reactions in the cell. Phylogeny, evolution and conservation. Telomeres as a counting mechanism and their role in cell ageing. Minerals and vitamins in the body and their function.
Protein structure Amino acids and their functional groups. Linking them together through peptide bonds. Structure/Function relationships. Primary, secondary, tertiary and quaternary protein structure in detail. Post-translational modifications, e.g. glycosylation.
Enzymes in action Enzyme catalysis, role of energy of activation. Chemical reactions in the cell, control through negative/positive feedback. Active site features and characteristics. Enzyme kinetics and enzyme inhibition principles (Michaelis-Menten and Lineweaver-Burk analysis). Competitive and non-competitive & uncompetitive inhibition. Mechanism of action of enzymes.
Metabolism Overview of interacting biochemical pathways in the cell and their regulation/cross-talk. Focus on ATP generation via carbohydrate metabolism through Glycolysis, Krebs cycle and oxidative phosphorylation. Others include Gluconeogenesis. Regulation of metabolic pathways, energy demands. Fatty acid metabolism, beta-oxidation. Compartmentation and tissue/organ variation of biochemicals and processes. Concept of control at organ, tissue, enzyme and genetic levels.
Central Dogma of information DNA replication, transcription and mRNA translation will be reviewed in detail building on the overview from year 1. Replication stages and order of events. Including details from SV40 replication research. Cell cycle phases and their role in cell structure/features/morphology. Intoduction to RNA, uracil, etc. Transcriptional overview including details on mRNA processing via 5'cap, 3' tail and splicing of introns. Transcriptional regulation through transcription factors, e.g. NFkB. Packaging of DNA and the role of histone proteins. The new era of epigenetics. Translation overview, details on the role of the wobble position/inosine presented. Importance of reading frame and the incorporation of bioinformatics analysis. The effect of mutations (or errors) in our DNA and mRNA on the protein produced. Genetic disorder due to mutated/over-produced proteins being present in the cell.
Recombinant DNA technology Principles presented. Details on plasmids, genes, coding sequences, restriction enzymes, ligations and transformations will be presented. The ability to generate genetically modified organisms and the importance of regulation/control. The importance of expression systems.
Methodology/Practical exercises will be performed to learn the principles of working with the following areas. The theory behind some more advanced methodologies will be covered in lectures. The use of pipettes and making up solutions (e.g. testing accuracy and repeatability, making up buffers and solutions, calculations). UV-Visible Absorption Spectrophotometry (e.g. absorption spectrum analysis, biuret method). Separation of Bioconstituents (e.g. Gel Filtration). Proteins (e.g. Protein Extraction, protein concentration estimation, SDS-PAGE). Enzymology (e.g. Alkaline phosphatase assay, determination of Km and Vmax). Carbohydrates (e.g. determination of glucose concentration). Lipids (e.g. thin layer chromatography of lipids). Genomic material (DNA extractions). Recombinant DNA technology (DNA restriction enzyme digestions, ligations). DNA quantification (UV spectrophotometry). DNA analysis (Agarose gel electrophoresis. Molecular Biology (Polymerase chain reaction (PCR), RT-PCR, Real time PCR), Southern and Northern blotting). Bioinformatics (sequence retrieval, translation to protein, reading frame identifier, sequence alignments). DNA Sequencing (Sanger dideoxy chain termination method).
LEARNING & TEACHING RESOURCES n/a
Format of Lecture Series Lecture delivery will engage with a variety of methods including on-line movie animations, visual demonstrations, large diagrams for illustration purposes as well as information from personal experience in the field and slide handouts. Novel methods using Classroom Response Systems (CRS) will also be utilised. Course material and revision quizzes will be made readily available on a virtual learning environment (VLE) for student access. The combination of these methods will facilitate in re-enforcing the student's understanding of some of the technical and mechanistic processes involved. Various aligned classroom assessment techniques will also be employed. These will include the background knowledge probe, the one minute paper, small group interaction and discussion, question & answer sessions, team presentations to class colleagues, pop-quizzes and open ended questioning. Access to course textbooks will be provided through the DkIT eBrary service (access to more than 50,000 multidisciplinary e-books), which will allow students 24/7 access to suitable reading material. A range of self-assessment, self-reflection and peer learning exercises will be built in to deliveries of both lectures and practical sessions.
Virtual Learning Environment (VLE) All lecture notes will be provided to the students through a VLE. This VLE will also be used for access to helpful YouTube video clips and peer reviewed publications of interest to the course. Students will have 24/7 access to the VLE allowing them to download and study at their own pace and in their own time. Screencast and Podcast tutorials will also be made available to the students to download and listen to in their own time. This will facilitate learning and understanding for all students, but in particular the international students who may not possess fluent English.

Indicative Content
Formative Assessments Throughout the semester, students will be provided with formative assessments both in lectures and in laboratory environments. These are designed to facilitate group work in problem solving situations. These assessments are built in to the lecture and practical components.
ePortfolio (Technology enhanced learning) Over the Christmas break, students in groups of two will prepare a report/summary of a particular technical approach. They will engage with technology to present this in an ePortfolio format (training will be provided during the course on the Mahara platform adopted by Dundalk IT). The incorportation of video clips and images in to the portfolio will be encouraged.
Keeping up-to-date with the life science industry Breakthroughs in the life science will be sent to the students on a regular basis. This will involve novel developments in the field in addition to postings on jobs/careers in the industry. This concept facilitates the students in preparing for life after college in the life science industry.
ASSESSMENT STRATEGY n/a
Practical labs/sessions Practical / Skill set tests / Lab write-up reports. In the practical sessions, students will focus on improving their practical skill set, while also dealing with obtaining and analysing data in addition to drawing conclusions from the data. Students will also perform formative skill set tests (e.g. pipette tests, graph tests, data handling test, data interpretation tests etc.) all generated to assist understanding and improve technique. Students will work on an interactive lab manual which will contain in-class exercises for review. Group (Peer-assisted learning) work will be encouraged. Technology use will also be encouraged throughout (for example using excel for graphing / trend line generation etc.). The requirement to submit regular laboratory reports is intended to act as serious encouragement for students to focus on the laboratory work. Marks for these reports will be based on students' ability to record primary data, calculate derivatives from these, display these data, comment on their meaning in the context of the actual experiment and associated theory, and discuss limitations to the experiment and the results obtained.
Short answer / diagram / MCQ exams Two continuous assessment exams will take place in the module. The first will primarily be MCQ based, while the second will require the students to answer selected short answer questions in addition to drawing diagrams of cellular processes. Formative quizzes will be performed throughout the module to facilitate learning and understanding of topics covered in addition to preparing the students to the style of these summative exams.
Scientific Breakthrough Report A brief summary of a recent scientific development will be provided by the student (the student will have access to a VLE containing numerous articles for them to study). This assessment will ensure students engage with literature, learn about referencing, write concisely and keep up-to-date.
Mahara ePortolio This represents an e-Portfolio based assessment on a practical technique studied in the laboratory practical sessions. This assessment engages the students with technology enhanced learning in a team environment while also ensuring a thorough understanding of particular lab techniques is gained.

Assessment Breakdown	%
Course Work	60.00%
End of Module Formal Examination	40.00%

Full Time

Course Work							
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Marks Out Of*	*Pass Marks*	*Assessment Date*	*Duration*
Written Report	Students will survey recent published scientific breakthroughs provided to them via a virtual learning environment (VLE). Students will select an article of interest to them and write a summary report.	7	2.50	0	0	Week 3	0
Multiple Choice Questions	A multiple choice exam will be carried out to assess the student's knowledge and understanding of topics covered in the first 9 weeks of the module.	1,2,3,4	10.00	0	0	Week 9	0
Portfolio	In groups of two, students will develop an ePortfolio using the DkIT mahara system to provide a visual overview of a laboratory technique of choice (a list will be provided). The incorporation of video clips and images in the ePortfolio will be encouraged.	7	7.50	0	0	Week 14	0
Short Answer Questions	A short answer / sketch / fill in the blanks exam will be performed to examine the knowledge and understanding the students have gained of the material covered between weeks 1 and 9 of the second term.	1,5,6	10.00	0	0	Week 29	0
Practical/Skills Evaluation	Students will participate in weekly laboratory-based practical sessions in which formative assessments will be performed in interactive group settings (e.g. problem based learning, quizzes, protocol review exercises, worksheet completion etc.). Summative practical laboratory reports will be submitted during the module for grading. Further details are presented in the indicative content section of this document.	1,3,4,6,7,8	30.00	0	0	Every Week	0

No Project

No Practical

End of Module Formal Examination							
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Marks Out Of*	*Pass Marks*	*Assessment Date*	*Duration*
Formal Exam	End-of-Semester Final Examination	1,2,3,4,5,6,7	40.00	0	0	End-of-Semester	0

DKIT reserves the right to alter the nature and timings of assessment

Module Workload & Resources

Workload: Full Time

Workload Type	Workload Description	Hours	Frequency	Average Weekly Learner Workload
Lecture	3 x 1 hour interactive lectures per week.	3.00	Every Week	3.00
Practical	1 x 3 hour laboratory session	3.00	Every Week	3.00
Directed Reading	Notes / Paper / Textbook reading	2.00	Every Week	2.00
Independent Study	Self / group study	5.00	Every Week	5.00
			Total Weekly Learner Workload	13.00
			Total Weekly Contact Hours	6.00

This course has no Part Time workload.

Resources

Recommended Book Resources

Berg, Tymoczko and Stryer. 2012, *Biochemistry*, 6th and 7th editions, Ed., WH Freeman

Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaira. 2012, *Molecular Cell Biology*, 6th and 7th editions, Ed., WH Freeman

David P. Clark 2010, *Molecular Biology*, Update edition Ed., Elsevier Available on DkIT dawsonera online collection.

William H. Elliott, Daphne C. Elliott 2005, *Biochemistry and molecular biology*, 3 Ed., Oxford ; New York : Oxford University Press

David Sheehan 2009, *Physical Biochemistry*, 2nd Ed., Wiley available on the Dkit dawsonera online collection

Keith Wilson and John Walker 2005, *Principles and techniques of biochemistry and molecular biology*, 6th Ed., Cambridge University Press

David Nelson and Michael Cox 2012, *Lehninger Principles of Biochemsitry*, 4th (2005) and 6th (2012) Ed., WH Freeman

H. John Smith and Claire Simons 2005, *Enzymes and their inhibition : drug development*, CRC Press

Supplementary Book Resources

Resources

Recommended Book Resources

Robert K. Murray et al. 2009, *Harper's illustrated biochemistry*, 28th Ed., McGraw-Hill Medical Available on the DkIT dawsonera online collection

Mary K. Campbell, Shawn O'Farrell 2006, *Biochemistry*, 5th Ed., Brooks Cole

Robert A. Copeland 2004, *Enzymes: a practical introduction to structure, mechanism, and data analysis*, 2 Ed., Interscience Available through the DkIT dawsonera online collection

Colleen Smith, Allan Marks, Michael Lieberman 2013, *Basic Medical Biochemistry'*, 2nd (2005) & 4th (2013) Ed., Lippincott, Williams and Wilkins

David Hames, Nigel Hooper 2011, *BIOS Instant notes in Biochemistry*, 4th Ed., Garland Science Available on the DkIT dawsonera online collection

This module does not have any article/paper resources

Other Resources

Textbook collection online with DkIT: *Access online textbooks through DkIT's dawsonera and eBrary collection (go to DkiT library site to begin)*

Up to date science breakthrough website: *www.breebio.com*

Website: *Wiley interactive animations: http://www.wiley.com//legacy/college/boy er/0470003790/animations/animations.htm*

Website: *Online Bioinformatics Tools: www.expasy.org*

Online publication database: *www.sciencedirect.com*, (log in through DkIT library webpage for access to subscribed journals)

Online publication database: *www.pubmed.com*

Website: *www.biotechnologyireland.com*

Website accompanying textbook: *http://whfreeman.com/Catalog/product/bio chemistry-seventhedition-berg*

Website accompanying textbook: *http://whfreeman.com/Catalog/product/mol ecularcellbiology-seventhedition-lodish*

Link: *Library Catalogue*
http://tinyurl.com/pw7fmd2

Link: *Library Catalogue*
http://tinyurl.com/l4oej46

Link: *Library Catalogue*
http://tinyurl.com/njwvpgg

Module Delivered in

Programme Code	Programme	Semester	Delivery
DK_SENVI_8	Bachelor of Science (Honours) in Environmental Bioscience	3	Mandatory
DK_SAPBI_7	Bachelor of Science in Applied Bioscience	3	Mandatory
659	Bachelor of Science in Environmental Bioscience	3	Mandatory
DK_SPHAR_7	Bachelor of Science in Pharmaceutical Science	3	Mandatory
Dk_SPHAR_6	Higher Certificate in Science	4	Mandatory
Dk_SAPBI_6	Higher Certificate in Science	4	Mandatory