MOLECULAR BIOLOGY AND GENETICS: FROM GENES TO BIOLOGICAL FUNCTION - 2024/5

Module code: BMS2036

Module Overview

This Molecular biology/genetics module builds up on its first-year sister module BMS1047. The key difference from BMS1047 is that it focusses on eukaryotic molecular biology and techniques to evaluate various molecular biology processes, including more genome-wide aspects, and the significance of molecular biology mechanisms in the real world, for e.g., in cancer. Another key difference is that this module covers molecular biology in greater depth, in particular the regulatory aspects of molecular biology. Overall, you will develop oral and written communication skills in molecular biology and genetics and will be able to appreciate the differences between the eukaryotic and prokaryotic molecular systems.

Lectures are covered in a block of the following six themes.

1. Advanced human genetics/genomics à The lectures will cover the human genome, natural genetics variations, sequencing genes and genomes, the genotype-phenotype map to include Mendelian genetics/genetic diseases, the transmission of information, and the concept of recombination.

2. Eukaryotic DNA replication à Packaging of DNA, its organization on chromosomes and alignment with the cell cycle (telomeres, crossing over/recombinant). Enzymes needed for DNA replication with a reflection of BMS1047, key differences between Pro- and Eukaryotes, and techniques to study replication.

3. Eukaryotic DNA transcription à Eukaryotic Cis and trans elements in transcription, post-transcription modifications of transcripts and molecular biology methods to study/quantify transcripts, key differences between Pro- and Eukaryotes, enhancer/mediator complex, cDNA synthesis. control of transcription.

4. Post-transcriptional regulation à Molecular mechanisms of splicing, polyadenylation (mechanisms); Cytoplasmic events: RNA export, localization, regulation by lnc/miRNAs, RNA decay.

5. Eukaryotic mRNA translation à Eukaryotic regulation, global and specific regulation of transcription. Techniques to study Eukaryotic translation. regulation of translation by the proteasome.

6. Application of human genetic inheritance and gene expression in cancer, errors in DNA replication & their correction.

Practical componentà RNA extraction & quantification, reverse transcription and RT-PCR followed by electrophoresis.

Module provider

School of Biosciences

Module Leader

ASIM Mohammad (Biosciences)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 5

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 41

Lecture Hours: 22

Tutorial Hours: 15

Laboratory Hours: 6

Guided Learning: 44

Captured Content: 22

Module Availability

Semester 1

Prerequisites / Co-requisites

None

Module content

Indicative content includes:

The human genome

Natural genetic variation

Sequencing genes and genomics

Genotype-phenotype mapping

Processes in central dogma with emphasis on eukaryotes

DNA organization and packaging

Control and coordination of DNA replication and cell cycle

Post-transcriptional regulation

Eukaryotic transcription regulation

Eukaryotic translation regulation

Gene structure, cis- and trans-elements

Genes and mechanisms of cancer

DNA damage and repair

Through the use of online/virtual learning platforms such as Surreylearn, and active learning technologies such as Poll Everywhere, MS Teams (limited use in some tutorials), and by introducing you to molecular biology-specific online platforms such as GTex, Emsembl, you will develop digitally capabilities.

Through the attainment of molecular biology practical skills, coupled with scientific writing and communication skills, you will further develop essential employability skills. Through the use of problem-solving-based learning and self-directed flipped learning, supported by feedback tutorials you will develop resilience. You will learn to appreciate the quality of scientific literature and thus will develop critical thinking thus becoming more resourceful. Further independent research to complement in-class learning via lectures for exam preparation, self-evaluation via practice questions uploaded on Surreylearn and the provision of student feedback hours to discuss areas where improvements are needed will further complement student resilience and resourcefulness beyond their undergrad students.

Lecture content introducing a variety of human cancers, which are prevalent among different populations around the world, and access to medicines in different countries will allow students to develop global and cultural capabilities.

You will learn skills to analyze case studies/problem-based learning and thus develop the necessary skills to understand the molecular basis of cancer providing essential knowledge to combat real-world sustainability issues. Through gaining an in-depth understanding of molecular biology in relation to disease, the students develop critical knowledge and problem-solving skills making them highly competitive with potential employers in health services, the Pharma industry etc. thus further increasing student employability.

Assessment pattern

Assessment type	Unit of assessment	Weighting
Coursework	ONLINE SUBMISSION OF COURSEWORK BASED ON THE PRACTICAL	30
Examination	IN CLASS EXAM CONSISTING OF ESSAY (INCLUDING PROBLEM BASED LEARNING TYPE QUESTIONS) AND MCQ - 2 HOUR EXAM DURATION	70

Alternative Assessment

If practical components require re-assessment there will be a written exam to assess the underlying principles of the appropriate learning outcomes. This will reflect the material covered in the original assessment and will carry the same weighting.

Assessment Strategy

The assessment strategy is designed to evaluate and demonstrate the knowledge of the basic principles and practice of molecular biology and genetics. It includes:

The summative assessment for this module consists of:

- One practical coursework report is to be submitted for assessment approximately 2 weeks after practical completion.
- A 2-hour in-class, invigilated exam comprising of 1 essay question (out of a choice of 5 questions which can be a mix of essay PLUS problem based learning questions) and an MCQ (fifty) exam comprised of 50 questions (Only 1 correct option out of 5 possible answers) covering material across the entire module. There will be no restrictions around the page length, but most questions can be effectively answered within 800-1000 words inclusive of references (not mandatory) if used.

Formative assessment You will be provided with exam-style questions during or following lectures in order to prepare you for the summative assessment. Verbal or written feedback will be provided for these questions.

Module aims

- Learn details of the principles of the central dogma of Molecular Biology, supported by diverse methodologies applied to their study.
- Develop an understanding of the origins and nature of genetic variation.
- Appreciation of the high-throughput methods for studying genes and genomes.
- Understand the origin and genetic basis of cancer, introducing some key genes and pathways involved in cancer, and its treatment.
- Comparison of prokaryotic and eukaryotic mechanisms of replication, transcriptional and translational control.
- Develop practical and analytical skills in the evaluation of gene expression.

Learning outcomes

		Attributes Developed
001	Describe gene structure, principles of genome changes and technologies to study them	KCT
002	Describe natural genetic variation, genotype-phenotype maps, and Genome-wide association studies	KT
003	Describe Eukaryotic processes in replication, transcription and translation, the enzymes involved and their inhibitors	KCT
004	Describe the processes/mechanisms of gene expression control	KCP
005	Plan and undertake quantitative experiments investigating transcript expression in eukaryotes	KCP
006	Communicate scientific information effectively	KCPT
007	Apply principles of molecular biology to explain cancer development	KT

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategies are designed to:

Provide the basic information to understand the principles and concepts of the Eukaryotic gene and genome organisation, control of gene expression, and methods and approaches employed in studying their structure, organisation, expression and their regulation. The module aims to provide the students with hands-on experimental skills in molecular biology.

The learning and teaching methods include:

- Lectures à Lecture slides will be posted on surreylearn and will be available to you at least one week in advance. Further reading material will be provided to help develop resourcefulness. Lectures will be interactive and appropriate digital tools such as Kahoot and Poll everyone will be used where necessary to support your active engagement.

- Feedback tutorials à These include both covering the subject-related queries/clear misconceptions, applications, and new dimensions emerging from the content, as well as exam revision tutorials, and a tutorial to cover special skills in a subject-specific manner.

- Exam tutorials à To help you develop skills to appropriately cover the content in exams esp. compose a good essay, and clear any misunderstandings around the content.

- Lab practical sessions à small work in small groups on molecular biology techniques and based on their results submit their coursework. Practicals will be complemented by pre-and post-tutorials, covering the techniques to be employed and the interpretation/writing part respectively.

- Independent study à You will refine your knowledge of the content by studying textbooks and research papers beyond the course content. Completion of pre-reading will help students identify topics to revise or seek help from the lecturers (on discussion boards or in person) to improve summative assessment performance.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: BMS2036

Other information

Resourcefulness and resilience: Problem-solving-based learning and self-directed flipped learning supported by in-class tutorials/writing skill development workshops. Further independent research to complement in-class learning via lectures for exam preparation. Self-evaluation via practice questions uploaded on Surreylearn. Provision of student feedback hours to discuss areas where improvements are needed.

Global and cultural capabilities: Lecture content introduces a variety of human cancers, which are prevalent among different populations around the world. Access to medicines in different countries.

Sustainability: Analyse case studies and develop the necessary skills to understand the molecular biological basis of cancer thus developing essential knowledge to combat real-world sustainability issues. In line with OneHealth approach the module works towards relevant SDGs such as SDG4-good health and well-being.

Digital capabilities: Introduction to online genetic platforms such as GTex, Ensembl. The use of video communication tools such as Zoom/Teams to facilitate discussion for online/hybrid communication. Creation of digital reports for submission to Surreylearn as a further means for discussion.

Employability: Through gaining an in-depth understanding of molecular biology in relation to disease, the students develop critical knowledge and problem-solving skills making them highly competitive with potential employers in health services, the pharma industry etc.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Biochemistry BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biochemistry MSci (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biological Sciences (Animal Biology and Ecology) BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biological Sciences (Cellular and Molecular Sciences) BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biological Sciences (Infection and Immunity) BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biological Sciences BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biomedical Science BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biomedical Science MSci (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Microbiology BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Veterinary Biosciences BSc (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module

Please note that the information detailed within this record is accurate at the time of publishing and may be subject to change. This record contains information for the most up to date version of the programme / module for the 2024/5 academic year.