MD1A4-45 Integrated Science Organelles and Cells

26/27

Department
Warwick Medical School
Level
Undergraduate Level 1
Module leader
Masanori Mishima
Credit value
45
Module duration
10 weeks
Assessment
80% coursework, 20% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The module aims to equip students with the conceptual, theoretical and computational skills required for the analysis and engineering of prokaryotic and eukaryotic organelles and cells.

Module web page

Module aims

Students will learn to solve scientific problems in this area by integrating concepts and approaches from different scientific disciplines, including biology, physics, chemistry, mathematics and computing.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Mathematical Skills Block:

In this block, you will develop essential mathematical skills crucial for data analysis and theoretical simulations. Biological questions will be solved through both mathematical theories and computing exercises using Python.

Bioelectricity Block:
In this block, we will explore how cells harness electricity to transmit information. You'll learn how cells generate electro-chemical gradients, use protein ion channels to regulate ion flow, and how this electrical activity controls vital processes like heartbeat, muscle movement, and thought. Through hands-on experiments and computer models, you'll investigate how these processes are essential for life and medical innovation.

Synthetic Biology Block:
In this block, you'll explore the natural process of protein synthesis and investigate how synthetic biology can modify this process to create proteins with novel amino acids, codons, and translation machinery. Through this exploration, you'll uncover how synthetic reconstruction not only expands our understanding of biology but also drives innovation in research, industry, and medicine.

Light Block:
Light microscopy is key for observation at cell and tissue levels. In this block, you'll explore the principles of light microscopy and gain hands-on experience by dissecting the eduWOSM, an open-source light microscope. You'll learn how to adapt this tool to tackle an unanswered biological question.

Chemical Biology Block:
This block introduces the fundamental concepts of organic chemistry as they apply to biomolecules like proteins, nucleic acids, and carbohydrates. You'll explore their supramolecular interactions and discover how these principles drive biological processes.

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate the ability to apply creative analytical thinking in order to frame and answer scientific questions, especially about the structures, functions and mechanisms of cells and cellular organelles.
- Demonstrate a grasp of physical law as it applies to the structures and behaviours of living cells and their organelles, especially nuclei.
- Use mathematical approaches to solve problems relating to the structure and behaviours of living cells and their organelles.
- Describe and interpret quantitatively the mechanisms by which life harnesses electrical forces
- Access and use the scientific literature effectively
- Demonstrate the writing skills required to report experimental results in the format of a scientific paper, including the ability to write an abstract, to write a short critical review of the relevant literature, present results in an appropriate format and detail with appropriate statistics, discuss the results and frame a clear conclusion.
- Harness computation to analyse scientific data
- Demonstrate the hands-on practical skills required to perform experimental tests of tractable scientific questions, especially about the structure and dynamics of cells and their

organelles.
- Describe and interpret quantitatively how synthetic biology can be used to interrogate the mechanisms of life.
- Demonstrate a grasp of the properties of light and the principles of optical image formation
- Describe and interpret quantitatively how chemical biology can be used to interrogate the mechanisms of life.
- Demonstrate the ability to accurately record experimental procedures and results in appropriate detail.
- Operate safely within a laboratory environment.

Indicative reading list

Reading lists can be found in Talis

Interdisciplinary

Combines the methods of Biology, Chemistry, Physics and computing to interrogate the mechanisms of living systems.

Subject specific skills

The ability to apply creative analytical thinking in order to frame incisive, tractable scientific questions, especially about the structures, functions and mechanisms of cells and cellular organelles.

The ability to demonstrate a grasp of physical law as it applies to the structures and behaviours of living cells and their organelles, especially nuclei.

The ability to solve problems relating to the structure and behaviours of living cells and their organelles.

Be able to describe and discuss how chemical biology and synthetic biology can be used to interrogate the mechanisms of life.

The ability to use mathematical and computational approaches to solve problems relating to biomolecular structures, functions and reactivities The ability to explain the organisation and behaviour of biomolecules, including the mechanisms by which biomolecules self-organise. The ability to design and describe simple optical circuits and to use focussed light to interrogate systems of biologically-relevant molecules.

Transferable skills

Usage of mathematical and computational approaches to solve problems.

A grasp of safety rules and an ability to work safely in the laboratory environment.

The skills to accurately record experimental procedures and results, in appropriate detail.

The skills to use computational and statistical approaches to analyse data.

The skills to access and use the scientific literature effectively.

The writing skills required to report experimental results in the format of a scientific paper.

Study

Study time

Type	Required	Optional
Lectures	30 sessions of 1 hour (7%)	
Tutorials	30 sessions of 1 hour (7%)	10 sessions of 2 hours
Practical classes	30 sessions of 3 hours (20%)	
Private study	150 hours (33%)	
Assessment	150 hours (33%)	
Total	450 hours	

Private study description

Background reading in relation to each block (set of experiments), including reading scientific papers that are then referenced in the write ups.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D2

	Weighting	Study time	Eligible for self-certification
Assessment component			
3 x laboratory reports	40%	60 hours	Yes (extension)

Students work in pairs to carry out laboratory experiments that address unsolved scientific questions. At the end of each 2-week Block of the module, the results obtained are written up as

	Weighting	Study time	Eligible for self-certification

a report in the format of a scientific paper. Each report will be 1500 words.

Reassessment component is the same

Assessment component

Mathematical Skills	20%	9 hours	No

Students will be tested on their mathematical skills from Block 6 with an in-class, short-answer test based on problem sets that they have been set during this block.

Reassessment component is the same

Assessment component

Assessment of laboratory skills	20%	72 hours	No

Assessing the proficiency in laboratory techniques, observing good laboratory practice, engagement and contribution to group experiments.

Reassessment component

Laboratory Skills			No

A written examination testing knowledge of practical laboratory skills, use of laboratory equipment, basic calculations, experimental procedures and good laboratory practice. Examination questions are reflective of what a student would have learnt during the laboratory practicals, with the theoretical knowledge being present in Laboratory Handbook and the Lab Protocol.

Assessment component

Written examination	20%	9 hours	No

Reassessment component is the same

Feedback on assessment

Laboratory reports - submission annotated and returned, general comments/'what was good'/'what could be improved' alongside marking rubric.

Assessment of laboratory skills - at the end of each two-week laboratory session, block leads will provide comments on proficiency, Good Laboratory Practice (GLP) and engagement/group contribution that arise. Due to the volume of feedback, stock phrases will be provided to the block leads, which may be amended or expanded at the lead's discretion. Further verbal feedback will be given to students on request.
In terms of practicalities, following GLP, executing the laboratory protocol, attaining proficiency in techniques taught and engaging/contributing to group activities (where required) will be based at 62 on the 20-point University scale. Exceptional attainment/contributions will grade higher, whereas disengagement, not observing GLP, and an unwillingness to acquire lab proficiency will score lower. Marks will not take into account whether a student achieved a desired experimental result or not. The block lead will work with the laboratory technician in observing and recording these across the cohort. Feedback will be provided biweekly at the end of each block.

Past exam papers for MD1A4

Availability

Courses

This module is Core for:

- Year 1 of UMDA-CF10 Undergraduate Integrated Natural Sciences (MSci)