MD1A6-30 Integrated Science Embryos and Organisms (MD1A6-30)

22/23

Department
Warwick Medical School
Level
Undergraduate Level 1
Module leader
John R James
Credit value
30
Module duration
6 weeks
Assessment
60% coursework, 40% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

MD1A6-30 - Integrated Science Embryos and Organisms
The module aims to equip students with the conceptual, computational and practical skills required for the analysis and engineering of prokaryotic and eukaryotic organisms and their development.

Module web page

Module aims

Students will learn to solve scientific problems and perform lab practicals in this area by integrating concepts and approaches from different scientific disciplines, including biology, physics, chemistry and computing, with the underlying mathematics serving as a common language.

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.

With indicative outcomes, including material explored in more detail during lab practicals in each block.

B11 Development | Aparna Ratheesh
Spatial control of gene expression, mechanical forces, cell motility
How are embryos organized?

B11-Lec1 | Biological patterns – development: Discerning differences between cells - methods for detecting differences in gene expression between cells, epigenesis vs. predeterminism, overview of metazoan embryology

- Sketch the main large scale organisational events in early metazoan development
  B11-Lec2 | Worm fate map: Lineage, fate decisions, and noise in C. elegans vulval development
- Access and harness wormbase.org
  B11-Lec3 | A-P axis in Drosophila embryo: Maternal effect/gap/segment polarity genes, morphogens, useful transgenic techniques
- Describe the major large scale events in Drosophila melanogaster development
  B11-Lec4 | Worms II: Connectome, EM reconstruction, network properties
- Describe the major large scale events in C. Elegans development
  B11-Lec5 | Classical genetics: Genes, alleles, sex, meiosis, mapping, screens
- Explain the difference between a gene and an allele
- Explain the practicalities of a genetic screen
  B11-Lec6 | Molecular genetics I: Mutant selection, epistasis, chromosome elements, manipulation
- Design a genetic screen in C. Elegans
  B11-Lec7 | Molecular genetics II: Diploids, transgenesis, CRISPR
- Describe the design logic of a CRISPR experiment
- Use open source software to design CRISPR guides RNAs
  B11-Lec8 | Genomics: Sequencing, assembly, homology, BLAST
- Demonstrate an ability to run BLAST searches

B12 | Immunity | John James
Mechanisms and mathematics of the immune response
How do organisms recognise non-self?

B12-Lec1 | Overview of Immune System

- Overview of mammalian immune system and its role in maintaining our dynamic relationship with our environment
  B12-Lec2 | Innate Immune Response
- Discuss the importance of inheritance for immunity
  B12-Lec3 | Adaptive Immune Response
- Discuss why we need an adaptive (learned) response for life-long immune memory and the parallels with evolutionary selection
  B12-Lec4 | Generating Receptor Diversity
- Outline of how receptor diversity is generated for the BCR and TCR, along with the selection mechanisms used to filter it
  B12-Lec5 | Immune Cell Signalling

- Overview of the signalling pathways used by T and B cells, including what signals “1, 2 and 3” and why they are important
  B12-Lec6 | Co-evolution of the Immune System
- Describe mechanisms by which pathogens avoid detection by the immune system, along with a discussion of acute vs chronic infections
  B12-Lec7 | Autoimmunity and the Cancer Immune Response
- Discuss how the immune system can be the “enemy within”. What drives auto-immunity, genetic disposition, treatments for it
  B12-Lec8 | Therapeutic manipulation of the immune system
- Overview of how new drugs and cell-based therapies are being used to retarget our immune system to treat normally intractable diseases including cancer

B13 | Pathogens and Parasites| Sam Dean
How have parasites evolved to invade our bodies?

B13-Lec1 | Flagellar-driven motility

- Overview of eukaryotic flagella: their structure, how they are assembled and their varied functions
  B13-Lec2 | African Sleeping Sickness and trypanosomes
- Overview of Trypanosoma brucei: their lifecycle and how, despite being continuously exposed to host antibodies, they thrive in the host blood
  B13-Lec3 | Intracellular parasites
- Overview of Leishmania and Trypanosoma cruzi, hugely successful kinetoplastid parasites that actually invade the cells that are supposed to kill them
  B13-Lec4 | Gliding motility in apicomplexans
- How parasites move WITHOUT a flagellum and how is this machinery used to move through host cells and invade them
  B13-Lec5 | Plasmodium and Malaria
  Plasmodium parasites that cause malaria, the big killer. How they resist the drugs that are supposed to kill them, and how humans have evolved to combat them
  B13-Lec6 | Toxoplasma and toxoplasmosis
- Toxoplasma: “Why cats?” and how the parasite modifies the host behaviour (or not…)
  B13-Lec7 | Co-evolution of parasites and the immune system
- How the evolution of pathogens and parasites has also driven the devlopment of our immune system and other host defences

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 incisive, tractable scientific questions, especially about the structure, organisation and dynamics of embryos and organisms.
- Demonstrate a grasp of physical law as it applies to the properties and behaviours of living embryos and organisms.
- Use mathematical approaches to solve problems relating to the behaviours and interactions

of embryos and organisms.
- Describe and discuss how embryos are organised and the forces that drive these processes.
- Describe and discuss how organisms use an immune system to recognise non-self.
- Describe and discuss how pathogens and parasites have evolved to invade their hosts.
- Demonstrate the hands-on practical skills required to perform experimental tests of tractable scientific questions, especially about the structure and dynamics of embryos and organisms
- Harness computational data analysis techniques and statistical approaches to analyse data.
- Access and use the scientific literature effectively.
- Interpret and explain experimental data relating to the organisation and development of embryos, the migration of immune cells, and flagellum function and parasite motility.
- 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.

Indicative reading list

Physical biology of the cell / Rob Phillips, Jane Kondev, Julie Theriot, Hernan G. Garcia
Gastrulation : from cells to embryo / edited by Claudio D. Stern
Biological Physics of the Developing Embryo / Gabor Forgacs, Stuart A. Newman
Janeway's Immunobiology (Ninth Edition) / Kenneth Murphy & Casey Weaver
Basic Immunology: Functions and Disorders of the Immune System / Abul K. Abbas

View reading list on Talis Aspire

Interdisciplinary

Students will learn to solve scientific problems about embryos and organisms by integrating concepts and approaches from different scientific disciplines, including biology, physics, chemistry and computing, with the underlying mathematics serving as a common language.

Subject specific skills

Be able to demonstrate the ability to apply creative analytical thinking in order to frame incisive, tractable scientific questions, especially about the structure, organisation and dynamics of embryos and organisms.
Be able to demonstrate a grasp of physical law as it applies to the properties and behaviours of living embryos and organisms.
Be able to demonstrate the hands-on practical skills required to perform experimental tests of tractable scientific questions, especially about the structure and dynamics of embryos and organisms.
Be able to describe and discuss how embryos are organised.
Be able to interpret and explain experimental data relating to the organisation and development of embryos.
Be able to describe and discuss how organisms recognise non-self.
Be able to interpret and explain experimental data relating to the migration of immune cells.

Be able to describe and discuss how parasites have evolved to invade our bodies.
Be able to interpret and explain experimental data relating to cell biology of parasites.

Transferable skills

Proficient in the use mathematical approaches to solve problems relating to the behaviours and interactions of embryos and organisms.

Demonstrate a grasp of safety rules and an ability to work safely in the lab environment. Demonstrate the ability to accurately record experimental procedures and results, in appropriate detail, using open source electronic notebooks. Harness computational data analysis techniques and statistical approaches to analyse data. Access and use the scientific literature effectively.

Study

Study time

Type	Required
Lectures	24 sessions of 2 hours (16%)
Supervised practical classes	24 sessions of 3 hours (24%)
Private study	180 hours (60%)
Total	300 hours

Private study description

180 hours self-directed study.

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 D1

Assessment component	Weighting	Study time	Eligible for self-certification
Laboratory report 1	20%		Yes (extension)

	Weighting	Study time	Eligible for self-certification
Laboratory report 1 of ~1500 words			

Reassessment component is the same

Assessment component

Laboratory report 2	20%		Yes (extension)
Laboratory report 2 of ~1500 words			

Reassessment component is the same

Assessment component

Laboratory report 3	20%		Yes (extension)
Laboratory report 3 of ~1500 words			

Reassessment component is the same

Assessment component

Written Examination	40%		No

Reassessment component is the same

Feedback on assessment

Written feedback will be provided for all submitted work. Further verbal feedback will be given to students on request.

Past exam papers for MD1A6

Availability

Courses

This module is Core for:

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