CH3F5-15 Bioorganic Chemistry

23/24

Department
Chemistry
Level
Undergraduate Level 3
Module leader
Andrew Marsh
Credit value
15
Module duration
30 weeks
Assessment
20% coursework, 80% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

N/A

Module web page

Module aims

This module aims to highlight the central importance of enzymes as catalysts in biological systems which are involved in the interconversion of all essential cellular metabolites (primary metabolites) and the production of many natural products of importance in medicine and agriculture. In addition this module aims to define the major classes into which secondary metabolites fall according to their structure and to explain how labelled precursors can be used to determine the primary metabolic building blocks from which secondary metabolites are assembled. The module includes descriptions of the molecular mechanisms of the most important enzyme catalysed reactions in natural product biosynthesis and associated coenzyme mechanisms, and some of the methods used to elucidate these mechanisms. Students will learn how the principles of organic chemistry can be critically used to discriminate between different possible mechanisms for a given enzyme catalysed reaction (12 lectures).

In addition this module aims to enable students to link fundamental components of the major classes of molecular interactions that play key roles in recognition processes. Semi-quantitative

methods for estimating strengths of these processes will be introduced and used in the analysis and study of well-described systems from biology (enzymes, drug-receptor interactions, non-covalent assemblies) and synthetic systems (small molecule, host-guest, self-assembled architectures). In studying these systems students will become familiar with underlying chemical principles and use some of the tools for computer-aided molecular visualisation and modelling encountered in years 1 and 2. The module is designed in particular to allow students working at the interface between Chemistry and Biology to begin to use these tools but is accessible to students on other Chemistry degree streams as well (10 lectures).

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.

Introduction to natural products (3 lectures)

1. Introduction
2. Classical methods in biosynthesis - labelling
3. Modern methods in biosynthesis
   Polyketide biosynthesis (5 lectures)
4. Incorporation of labelled precursors into aromatic and complex polyketides
5. Enzymology of iterative polyketide biosynthesis
6. Enzymology of modular polyketide synthases
7. Non-ribosomal peptide synthesis
   Terpenoid biosynthesis (2 lectures)
8. The mevalonate and non-mevalonate pathways to isoprenoids
9. Enzymology of linear polyprenyl pyrophosphate biosynthesis
10. Enzymology of polyprenyl pyrophosphate cyclisation reactions
    Alkaloid biosynthesis (2 lectures)
    plus 3 workshops
11. Pre-session introduction to Protein Databank and visualisation tools
    Computer workshops 1 + 2 introducing PyMol
12. Introduction to molecular interactions and overview
13. Quantifying molecular interactions part 1
14. Quantifying molecular interactions part 2 - including example class / workshop
15. Hydrogen bonding including examples
    Exploring Interactions - computer workshop 3 (using visualisation tools)
16. Electrostatic interactions ; pi-pi interactions: examples

17. Hydrophobic effect and introduction to protein folding
    Exploring Interactions - workshop 3 (computer)
18. Membrane protein folding
19. Thermodynamics and Isothermal titration calorimetry including worked examples
20. Physicochemical methods for characterising interactions
21. Self-assembly processes in biology and chemistry

Learning outcomes

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

- Subject knowledge to an appropriate level.
- Analysis and contextual understanding of contemporary examples
- Ability to interpret and evaluate examples from the literature

Indicative reading list

P.M. Dewick, Medicinal Natural Products, 2nd edition, Wiley, London, 2002.
T.D.H. Bugg, An Introduction to Enzyme and Coenzyme Chemistry, Blackwells, Oxford, 1998.

Modern Physical Organic Chemistry, E. Anslyn, D. Dougherty, University Science Books, 2005.
Alan Cooper, Biophysical Chemistry (RSC Tutorial Chemistry Text #16, ISBN 0-85404-480-9, Royal Society of Chemistry, Cambridge, 2004)

Bioorganic Chemistry, H. Dugas, 3rd Edition, Springer. Structure and Mechanism in Protein Science, A. Fersht 3rd Edition, Freeman. Supramolecular Chemistry, P. D. Beer, P. A. Gale and D. K Smith OUP Primer, Oxford: 1999. Principles and Methods in Supramolecular Chemistry, H.-J. Schneider, A. Yatsimirsky, Wiley. Introduction to protein structure, C. Branden, J. Tooze, Garland. Supramolecular Chemistry, J. Steed and J. Atwood, Wiley.

RCSB Protein Databank introduction and resources

View reading list on Talis Aspire

Research element

e.g. essay, dissertation, individual or group research, research skills activity, etc.

Subject specific skills

Numeracy
Problem solving
Written communication
Independence and initiative
Information literacy and research skills
Digital skills and literacy

Transferable skills

Numeracy
Problem solving
Written communication
Independence and initiative
Information literacy and research skills
Digital skills and literacy

Study

Study time

Type	Required
Lectures	22 sessions of 1 hour (13%)
Practical classes	8 sessions of 1 hour (5%)
Private study	120 hours (71%)
Assessment	20 hours (12%)
Total	170 hours

Private study description

Self study and direct reading: 120 hours

Costs

No further costs have been identified for this module.

Assessment

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

Students can register for this module without taking any assessment.

Assessment group D4

	Weighting	Study time
Assessed coursework	10%	10 hours

One assessed workshop report of 2-3 pages, deadline week 1, Term 3.
There are minimum of four learning and practice molecular visualisation workshops, two of which

	Weighting	Study time
can be optionally submitted for feedback before the final report is submitted in Term 3		
Assessed Work	10%	10 hours
Flash presentation on polyketide natural product biosynthesis		
In-person Examination	80%	

- Answerbook Pink (12 page)
- Students may use a calculator
- Periodic Tables

Feedback on assessment

Oral and written feedback on assessed work from module leaders. Cohort level examination feedback provided via Moodle.

Past exam papers for CH3F5

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - CH271-15 Mechanistic and Biological Chemistry

Courses

This module is Optional for:

- Year 4 of UCHA-F107 Undergraduate Master of Chemistry (with Intercalated Year)
- UCHA-F109 Undergraduate Master of Chemistry (with International Placement)
  - Year 3 of F109 MChem Chemistry (with International Placement)
  - Year 3 of F111 MChem Chemistry with Medicinal Chemistry (with International Placement)
- UCHA-4M Undergraduate Master of Chemistry Variants
  - Year 3 of F105 Chemistry
  - Year 3 of F109 MChem Chemistry (with International Placement)
  - Year 3 of F126 MChem Chemistry with Med Chem (with Prof Exp)
  - Year 3 of F125 MChem Chemistry with Medicinal Chemistry
  - Year 3 of F106 MChem Chemistry with Professional Experience
- Year 4 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry(with

Intercalated Year)

This module is Option list A for:

- UCHA-4 Undergraduate Chemistry (with Intercalated Year) Variants
  - Year 4 of F101 Chemistry (with Intercalated Year)
  - Year 4 of F122 Chemistry with Medicinal Chemistry (with Intercalated Year)
- UCHA-3 Undergraduate Chemistry 3 Year Variants
  - Year 3 of F100 Chemistry
  - Year 3 of F100 Chemistry
  - Year 3 of F121 Chemistry with Medicinal Chemistry
- Year 3 of UCHA-F110 Undergraduate Master of Chemistry (with Industrial Placement)
- Year 3 of UCHA-4M Undergraduate Master of Chemistry Variants