



# CBMS304

## Organic and Biological Chemistry B

S2 Day 2014

*Chemistry and Biomolecular Sciences*

### Contents

---

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>Assessment Tasks</u>	4
<u>Delivery and Resources</u>	6
<u>Policies and Procedures</u>	8
<u>Graduate Capabilities</u>	9

---

#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Convenor and Lecturer

Andrew Try

[andrew.try@mq.edu.au](mailto:andrew.try@mq.edu.au)

Contact via 9850 8291

F7B 228

Arrange via email

Lecturer

Peter Karuso

[peter.karuso@mq.edu.au](mailto:peter.karuso@mq.edu.au)

Contact via 9850 8290

F7B 232

Arrange via email

Lecturer

Fei Liu

[fei.liu@mq.edu.au](mailto:fei.liu@mq.edu.au)

Contact via 9850 8312

F7B 330

Arrange via email

Credit points

3

Prerequisites

CBMS204 and (3cp from CBMS200-CBMS203 or CBMS205-CBMS234)

Corequisites

Co-badged status

CBMS804

### Unit description

Biological systems carry out a huge range of complex organic reactions to achieve growth, to reproduce and to compete. This unit, together with CBMS303, examines advanced topics in organic chemistry, relevant to biology and biological systems. This unit has an underlying theme of the structure and reactivity of DNA. Specific topics include: metal-mediated coupling (bond-forming) reactions; aromaticity; heterocyclic chemistry; nucleotides, DNA and RNA; and pericyclic reactions. These topics build upon the foundation of CBMS204, using the same text book supplemented by notes given out in lectures and inexpensive Oxford Chemistry Primers on specialised topics. This unit requires good skills in organic chemistry; a background in other aspects of chemistry and/or biochemistry will be advantageous. The laboratory sessions are aimed at developing skills in organic chemistry, using reactions studied in lectures to reinforce principles and exemplify typical reactions.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment Tasks

Name	Weighting	Due
<u>Quiz and Workshop performance</u>	10%	Throughout semester
<u>Practical Performance</u>	25%	See description
<u>Mid-semester Test</u>	10%	To be advised
<u>Final Examination</u>	55%	To be advised

### Quiz and Workshop performance

Due: **Throughout semester**

Weighting: **10%**

Answering and explaining questions

On successful completion you will be able to:

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

### Practical Performance

Due: **See description**

Weighting: **25%**

Pre-work (mechanisms, flow chart and safety data), laboratory report, including procedures, results, analysis, conclusions and answering post-lab questions

Due date: Reports due 1 week after conclusion of the relevant lab

On successful completion you will be able to:

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Mid-semester Test

Due: **To be advised**

Weighting: **10%**

Will cover the first 6 weeks of the unit.

On successful completion you will be able to:

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Have a detailed chemical understanding of stereoselectivity and chirality

- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications

## Final Examination

Due: **To be advised**

Weighting: **55%**

It is designed to address specific understanding of all the topics presented within the course and to show that the knowledge obtained can be applied to new problems

On successful completion you will be able to:

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Delivery and Resources

### Classes

CBMS304 is a traditional Chemistry subject that is organised around lectures and laboratories (5 different experiments). Lectures will be on Fridays (11-1 E7A 133), with labs on Friday (2-6pm E7B 349, Third Year Laboratory), except for weeks 5, 9 and 13 (when there will be workshops

instead of the Wednesday Labs (room to be advised, 2-6 pm and attendance at these sessions is compulsory). These 3 workshops are problem solving sessions associated with the three sections of the course (more details later).

The timetable may be subject to change so please check on the University web site.

Spot tests will be run in the lecture classes. The lab notes, which include safety information and tips on writing the reports are available from the CBMS304 web page on iLearn.

Labs will open at 2 pm and you must wear closed shoes, a lab coat and safety glasses. More detailed instructions are given in the lab notes. Laboratory work must cease at 5:45 pm.

All the equipment and glassware used in the laboratory classes is very expensive. Please handle everything with care. Please also clean and put away all the glassware that you used. In addition, before you leave ensure that you wipe down your work area, turn off all gas, water and electricity you turned on and place all residues in the appropriate waste containers.

The laboratory will close at 6:00 pm. All students are expected to be out at this time.

### **Required and Recommended texts and/or materials**

Required texts (all placed in Reserve in the Library)

1. McMurry, John. Organic Chemistry, 8th Edition (introductory reading only).  
QD251.2.M43. There are multiple copies in the library and this is your CBMS204 text book
2. Davies, David T. Aromatic Heterocyclic Chemistry, Oxford University Press.  
QD400.D38/1992. ISBN-10: 0198556608
3. Fleming, Ian, Pericyclic Reactions, Oxford; Oxford University Press, 1999.  
QD281.R5.F58/1999. ISBN 0198503075
4. Jenkins, Paul. Organometallic Reagents in Synthesis, Oxford; Oxford University Press, 1992. QD411.J451/1992. ISBN-10: 0198556675

### **Supplementary texts (all restricted to 7 day loan in the library)**

Garrett, R. and Grisham, C.M. Biochemistry, Fort Worth, Saunders College Pub., 1999.  
QD415.G29/1999

Smith, W.B. Introduction to Theoretical Organic Chemistry and Molecular Modeling, New York: VCH Publishers, c1996. QD476.S567/1996

Gilchrist, T.L. Heterocyclic Chemistry, Longman Scientific & Technical. QD400.G55/1997

Gilchrist, T.L. Organic Reactions and Orbital Symmetry, New York: Wiley, c1976. QD476.G54/1979

Joule J.A. and Mills K. Heterocyclic Chemistry, 4<sup>th</sup> edition, Oxford, Blackwell Science Ltd, 2000. QD400.J59/2000 (available in the Reserve section of the library)

Bellamy, Anthony J. An Introduction to Conservation of Orbital Symmetry. Longman, 1974.

QD476.B363

Fleming, Ian. Frontier Orbitals and Organic Chemical Reactions, Wiley, London 1990, c1978.

QD461.F53/1978

Henderson, Richard, The Mechanisms of Reactions at Transition Metal Sites, Oxford University Press, 1993. QD172.T6 .H46/1993

Thomas, Susan. Organic Synthesis—The Roles of Boron and Silicon, Oxford; Oxford University Press, 1991 QD412.B1 .T56/1991

### For those that are *really* keen

Entwistle, Norman. Orbital Symmetry Correlations in Organic Chemistry. London: Van Nostrand Reinhold, 1972. QD476.E5

Meijere, de Armin; Diederich, Francois. Metal-Catalyzed Cross-Coupling Reactions, Wiley-VCH, 2004. QD262.M48 2004 vol 1

### Unit web page

The web page is accessed via the iLearn site. You are expected to access the web pages regularly, where you may find announcements, links to interesting internet facilities and sites of interest to the course, downloadable software, and lots of other interesting stuff.

### Technology Used

You are expected to access the unit web site on a frequent basis and download pdf files.

- To view notes on all the topics and past exams on the unit web site, you will require Adobe Acrobat Reader Version 9 or later to be installed on your computer. Acrobat Reader can be downloaded from the Adobe website <http://get.adobe.com/uk/reader/>. If you are using the computers in the library, then Acrobat has already been installed.
- Please note information may also be sent by email to your student email account so please look at your email account on a frequent basis.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Grievance Management Policy [http://mq.edu.au/policy/docs/grievance\\_management/policy.html](http://mq.edu.au/policy/docs/grievance_management/policy.html)



[t/policy.html](#)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html) *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: [https://students.mq.edu.au/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit <http://informatics.mq.edu.au/help/>.

When using the University's IT, you must adhere to the [Acceptable Use Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement.

They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

## Learning outcomes

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment task

- Practical Performance

## Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

## Learning outcomes

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules

- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## **Assessment tasks**

- Quiz and Workshop performance
- Practical Performance
- Mid-semester Test
- Final Examination

## **Discipline Specific Knowledge and Skills**

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

## **Learning outcomes**

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials

- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## **Assessment tasks**

- Quiz and Workshop performance
- Practical Performance
- Mid-semester Test
- Final Examination

## **Critical, Analytical and Integrative Thinking**

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## **Learning outcomes**

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological

## Chemistry

- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment tasks

- Quiz and Workshop performance
- Practical Performance
- Mid-semester Test
- Final Examination

## Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## Learning outcomes

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)

- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment tasks

- Quiz and Workshop performance
- Practical Performance
- Mid-semester Test
- Final Examination

## Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

## Learning outcomes

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment tasks

- Quiz and Workshop performance
- Practical Performance
- Mid-semester Test
- Final Examination

## Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## Learning outcomes

- Have an understanding of the factors affecting reactivity of organic chemicals including biomolecules
- Be able to use of liganded coupling processes and heterocycles in the synthesis of biologically active molecules and materials
- Be able to use of orbital diagrams and orbital symmetry to predict the outcomes of pericyclic reactions
- Have a detailed chemical understanding of stereoselectivity and chirality
- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry
- Plan a synthesis of simple heterocycles
- Predict the products of substitution reactions on simple heterocycles
- Plan a synthesis involving the metal mediated coupling of two components
- Deduce a mechanism for heterocyclic and coupling reactions given the starting material and product(s)
- Recognise the structure and mechanism of common coupling reagents and understand their reactions and biological applications
- Deduce the structure of products produced by pericyclic reaction, including stereochemistry

## Assessment tasks

- Quiz and Workshop performance
- Practical Performance

- Mid-semester Test
- Final Examination

## Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### **Learning outcome**

- Have a basic laboratory skills necessary for research in Organic and Biological Chemistry

### **Assessment task**

- Practical Performance