Unit Outline
Drug Discovery and Development 631
Semester 2 2012

Unit Details

<table>
<thead>
<tr>
<th>Unit Index No:</th>
<th>310160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit points:</td>
<td>25</td>
</tr>
<tr>
<td>Prerequisite Units</td>
<td>No formal pre-requisites</td>
</tr>
<tr>
<td>Online Teaching</td>
<td>Essential.</td>
</tr>
<tr>
<td>Unit Category</td>
<td>That is, unit materials and resources are available from the unit’s Blackboard site and it is essential that students use this site to complete the unit. The online unit site is designed to be a significant component of the unit. It is absolutely necessary for students to have full internet and web access.</td>
</tr>
<tr>
<td>Requirements</td>
<td>Ownership of, or access to, recommended textbook (or companion/supplementary textbook). Ownership of, or access to, appropriately configured computer with internet and web access (either on or off campus).</td>
</tr>
<tr>
<td>Unit Coordinator</td>
<td>Professor Ricardo L. Mancera</td>
</tr>
<tr>
<td>Address</td>
<td>School of Biomedical Sciences</td>
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<tr>
<td></td>
<td>Curtin University of Technology</td>
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<tr>
<td></td>
<td>GPO Box U1987</td>
</tr>
<tr>
<td></td>
<td>Perth WA 6845</td>
</tr>
<tr>
<td>Office</td>
<td>306.201</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:R.Mancera@curtin.edu.au">R.Mancera@curtin.edu.au</a></td>
</tr>
<tr>
<td>Phone</td>
<td>(08) 9266 1017</td>
</tr>
<tr>
<td>Fax</td>
<td>(08) 9266 2342</td>
</tr>
</tbody>
</table>

Please read this outline fully before commencing your study in this unit.
Welcome!

Welcome to Drug Discovery and Development (DD 631)! Please take the time to read this handout thoroughly. It explains most of what you need to know about this unit.

Log in to the ‘Drug Discovery and Development 631’ unit Blackboard site. Blackboard is Curtin University’s e-learning infrastructure and it is essential that you access this site at the beginning of your study. Instructions on how to access this site are found in this unit outline.

Introduction

The process of drug discovery and development is complicated and requires scientific knowledge from the molecular to the systemic level. This unit will hence cover a broad range of topics: protein structure, molecular modelling and visualisation, drug-protein interactions, structural biology, computer-aided drug design, drug discovery, lead identification and turning a lead into a drug, pre-clinical and clinical phases of drug development, the importance of pharmacokinetics in drug development and intellectual property issues in drug discovery. This unit will include lectures from university- and industry-based scientists who are actively engaged in various aspects of drug discovery and development. Specialist tutorials of case studies will highlight many of the issues entailed in the drug discovery and development pathways.

Unit Outcomes

On successful completion of this unit you will have:

- an appreciation of the overall process of drug discovery
- an understanding of the concepts of novel chemical entities and pharmaceutical patents
- an understanding of lead compound optimisation
- an understanding of the concepts of pharmacophore, structure-activity relationships, isosterism and the Lipinki’s rule of five.
- an understanding of drug screening and combinatorial chemistry
- an understanding of the principles of protein structure
- a theoretical understanding of important molecular forces involved in drug-protein (receptor) interactions
- developed the practical skills, and knowledge, to use molecular visualisation programs to view and manipulate macromolecules to highlight their atomic detail and interactions
- an awareness of the role of structural biology techniques in the determination of protein structure and its importance for drug discovery
- developed knowledge and skills to appreciate the role and application of molecular modelling and structural bioinformatics in drug discovery
- understood the various stages in the drug discovery and development process
- an understanding of the basic concepts of pharmacokinetics and their importance for the development of effective drug molecules
- an appreciation of the steps required for a new drug to be approved for human use
- an understanding of the major pre-clinical and clinical phases in the drug development process and the rationale for each
- an awareness of the way to protect intellectual property rights in drug discovery.

Syllabus

The syllabus presently includes the following components:
Protein structure and function
• Primary, secondary, and tertiary structure
• Structural motifs and domains
• Classification of proteins
• Enzyme catalysis
• Regulation of protein activity

Structural biology techniques used in drug discovery
• X-ray crystallography
• NMR

Molecular modelling and drug design
• Application of modelling and other structural bioinformatics approaches to drug design and discovery
• Thermodynamics and measurement of drug-protein interactions
• Molecular modelling techniques used in drug discovery and structure-based drug design

Process of drug discovery and development
• Discovery of biologically active molecules and lead compound identification
• Novel chemical entities and pharmaceutical patents
• Lead compound optimisation
• Pharmacophores and structure-activity relationships
• Isosterism, bioisosterism and Lipinski’s rule of five
• Drug screening approaches
• Combinatorial chemistry
• Pre-clinical testing of drug efficacy and safety
• Clinical testing of drug efficacy and safety
• Pharmacokinetics properties of drug molecules

Intellectual Property
• The protection of novel chemical entities
• Patent circumvention

Please note that parts of the syllabus may be changed, without notice, to keep up-to-date with a constantly changing, and rapidly developing, subject.

Contact Details

Unit Coordinator and Lecturers

If you have any questions or requests specifically relating to your ability to conduct Drug Discovery and Design 631, then you should contact your unit coordinator in the first instance. Your unit coordinator is Prof. Ricardo Mancera, who will also provide a number of lectures. A number of guest lecturers or practical demonstrators will be invited to teach aspects of the unit. These are the contact details of the main lecturers in this unit:

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>E-mail</th>
<th>Telephone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Ricardo Mancera</td>
<td>306:201</td>
<td><a href="mailto:R_Mancera@curtin.edu.au">R_Mancera@curtin.edu.au</a></td>
<td>9266 1017</td>
<td>9266 2342</td>
</tr>
<tr>
<td>(unit coordinator &amp; lecturer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Steven Bottomley</td>
<td>308:204</td>
<td><a href="mailto:S_Bottomley@curtin.edu.au">S_Bottomley@curtin.edu.au</a></td>
<td>9266 4369</td>
<td>9266 2342</td>
</tr>
</tbody>
</table>
Availability of lecturers

The lecturers are always approachable and welcome your questions. Do not be afraid to ask the lecturer questions. However, please be aware that the demands on a lecturer’s time are very great and the lecturer may not be able to respond immediately to your question. Generally, all lecturers have an ‘open door’ policy. This means that the lecturers are available at most times during semester for student consultation and questions. However, this does not mean that you can ‘barge in’ and demand attention at any time you like. It is polite to enquire if the lecturer is available to meet with you. If the lecturer cannot see you immediately, or you need to establish a definite time for the meeting, then you will be required to make an appointment. There may also be times during semester where the lecturer, for whatever reason, is unavailable for any student consultation. If, for some reason, you feel you cannot approach the lecturers in person then please do not hesitate to take advantage of the other ways of communicating with lecturers such as: telephone, during class (by asking questions), Blackboard or by email.

Prerequisites

- You should have good general computer skills and know how to access, and use, the internet.
- You are required to have access to a computer and access to the internet.

Unit Materials

Textbooks and References

No single textbooks will cover the contents of this course. However there are several good textbooks that will include chapters relevant to the various topics covered in this course:


Various other resources to help you with your study include the internet (some useful web sites are listed below) and the University library. You should make every attempt to read the textbooks and other literature.

Web-Based Resources

You will be referred to various resources, including course notes, information, and practice assessments on the World Wide Web. In particular, you will need to gain access to Curtin University’s internet teaching platform called Blackboard.

You should be able to effectively explore the internet where there is a wealth of freely available information. You may also be referred to some web sites during the course of your study. Please
note: When using the internet you must ensure that the source of information comes from a reputable, qualified, and professional institution or person. References to Wikipedia are unacceptable.

Useful web sites include:
StudyTrekk from Curtin University Library found at: http://lisweb.curtin.edu.au/guides/studytrekk/index.html
InfoTrekk from Curtin University Library found at: http://lisweb.curtin.edu.au/finding/infotrekk/index.html
School of Biomedical Sciences Biochemistry web site: http://wbiomed.curtin.edu.au/teach/biochem/
International Society for Computational Biology: http://www.iscb.org/

Blackboard

Blackboard is Curtin University’s electronic learning infrastructure. You will be referred to various resources, including lecture notes and information, on Blackboard. Please use the following procedure to access Blackboard:

- Launch Netscape Communicator or Internet Explorer and go to: http://lms.curtin.edu.au
- Login using as User ID your Curtin University student number
- You can also access Blackboard from your Oasis account.
- In your Blackboard Home you will find a list of all the units for which you are enrolled.
- Click on the name of the unit to enter its home page.

If you have difficulty accessing this site inform Ms Eleanor Morgan (Tel: 9266 7516; E.Morgan@curtin.edu.au), who manages the School’s Blackboard resources.

Learning Aids

The main learning aids for this unit include:

- The above listed textbooks
- Printed or Adobe Acrobat (pdf) files of lectures
- Interactive internet tutorials and resources at the School of Biomedical Sciences Biochemistry web site at: http://wbiomed.curtin.edu.au/teach/biochem/
- Molecular visualisation program Deep View
- A practical tutorial and practical session

You should make use of these aids to complement and enhance your own learning.

Please note: Lecture presentations should only be used as a general guide to your learning. They cannot cover everything you may need to know about the topic. Each student is unique and you may find that you need to study more (or less) than other students depending upon your own knowledge and ability. Please understand that ultimately you are responsible for your own learning!
Delivery of Unit

Time for lectures, practicals, and tutorials allocated as follows:

- Lectures 2 x 1 hour per week (see tuition schedule)
- Tutorials 1 x 1 hour per week (see tuition schedule)
- Practical 1 x 3 hours per week (weeks 4-6)

Lectures

**Attendance at all lectures is strongly recommended.** The lectures may cover material in a slightly different way or have a particular emphasis on some concepts which will not always be obvious in the online lecture presentations or study guide. Lectures also give you a convenient opportunity to ask your lecturer questions and to discuss the subject with your colleagues. Most of the lecture presentations are available on the Blackboard site in pdf format. Some lectures are presently being modified and may not yet be available on the web site.

**Please note:** Lecture topics may be changed, extended, or curtailed. These alterations may depend upon the perceived progress of the student cohort and are at the discretion of the lecturer and unit coordinator.

Lecture overheads are **not** in themselves sufficient as study material to pass this unit! It is essential that you read the appropriate chapters in your text or other reference books. The lectures should be viewed **only** as an introduction and guide to each topic. Your understanding of each topic will only be achieved satisfactorily with broader reading of your text and other reference materials. Remember, it is your understanding of the topics that will be examined in this unit! Not all questions in your assessments can be answered by simple regurgitation of overhead content. Lectures will be given according to the proposed tuition schedule.

Practicals

Attendance at the practical session is compulsory. The practical is designed to help you develop computer-based skills in molecular visualisation and problem solving skills. Other learning objectives for the practical are listed in the practical notes. Tutors will be available at practical sessions for you to ask questions and clarify concepts. All practical sessions are computer based. Practicals are conducted at dates and times according to the proposed tuition schedule.

Study Load

You will need to spend at least 5 hours a week outside of scheduled classes studying in this unit to be successful. You may need more time if you don’t have a strong background in chemistry and/or if you have not studied in the field of biomedical sciences before. Keeping up with the work is one of the keys to being successful in this unit.

Assessment Details

<table>
<thead>
<tr>
<th>Practical Assignments</th>
<th>Practical (DeepView)</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Drug Discovery Project</td>
<td>40%</td>
</tr>
<tr>
<td>Exam</td>
<td>Exam on all aspects of the syllabus.</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
IMPORTANT: In accordance with Curtin policy, students are advised that this unit is a SIGNIFICANT UNIT in which failure twice may lead to termination of a student’s course. A minimum of 50% of the total mark, derived from all of the combined assessments, is required to pass the unit. Students are required to attempt all components of the assessment. Failure to complete one, or more, components of the assessment may result in an overall failure in this unit regardless of the total marks accrued. Please note that the percent allocation of marks, or form of assessment, may be changed at the discretion of the unit coordinator. However, you will be notified of any change.

Practical Assignments

Practical assignments are designed to: (1) help you learn, and practice, the subject material; (2) reward you for your structural bioinformatics knowledge and effective practical application of that knowledge. Your assignment will comprise computer-based tasks that you will have to complete before the submission deadline as shown in the schedule. Each assignment will assume that you have developed the appropriate computer-based skills by completing the previous practical exercises. Prior knowledge from ALL practical exercises and subject syllabus up to the week of the will be assumed. You submit practical assignments through Blackboard project drop box by 5:00pm on the day of the deadline as shown in the schedule. Instructions for submission are given in your practical notes.

Submitting Assignments

The procedure for submitting an assignment is as follows:

- Click on ‘Evaluation and Testing’ on the Blackboard homepage
- Click on ‘Assignments”
- Click on the name of the assignment (Practical 1) that you want to submit. The assignment screen then appears. To upload your file, under Student files, click Upload file. The Upload File for Assignment screen appears.
- To locate the file, click Browse to open your computer's file browser. Select the file. The Upload File for Assignment screen reappears, with the path and filename displayed in the Filename text box. Click Upload. The Assignment screen appears and the uploaded file is added to the Student files table.
- To submit the completed assignment, under Submit Assignment, click Submit assignment. The Submit Assignment screen appears. Note: All assignments in the Student files table will be submitted.
- If you want to receive email notification that your assignment was submitted successfully then enter your email address in the text box. Click on the submit assignment for a link to a confirmation screen. Click OK and the assignments screen reappears, with ‘Submitted’ displayed in the Status column.

Exam

You will be expected to use what you have learnt throughout the semester to answer exam questions. Most of the questions will be short answer and require that you integrate the knowledge that you have acquired. You will also be required to demonstrate your problem solving skills. Simple regurgitation of lecture overheads will be insufficient to appropriately answer exam questions. You are expected to demonstrate knowledge gained from additional reading and research.

The exam will be up to 2 hours long. The marks for each question in the exam are a rough guide on how much information may be requested and how much time you should spend on the question.

You can use appropriate bulleted lists, diagrams, structures, calculations, formulas, or examples to help answer questions. However, you must also present these components together within the
context of a well written, concise, and logical answer. Please note that ‘short answer’ does not mean you should use only one sentence to answer the question. In most cases you will need to answer the question with at least one well-written paragraph.

**Supplementary Assessments**

Supplementary assessments are awarded only at the discretion of the Board of Examiners. The aim of a supplementary assessment is to allow the student to correct minor problems /deficiencies in the initial assessment and not to gain extra study time or correct major problems.

**Please Note:** Supplementary assessments are not automatically awarded. The Board of Examiners will carefully review individual cases.

Supplementary assessments, if awarded, will be indicated on the official Curtin examination result statement posted to all students, and will also be listed on the School notice board 24 hours after the Board of Examiners meeting. It is your responsibility to check your status. A student who does not take a supplementary assessment has no claim to a further assessment. If you are awarded a supplementary assessment it is imperative that you confirm the time and details of the assessment. In this unit a supplementary assessment, if awarded, may comprise, one or more, written assessments, assignments, practicals, or other appropriate assessments designed to address the perceived deficiency. The type, and number, of assessments awarded will be at the discretion of the unit coordinator who will be advised by the Board of Examiners and the Head of School.

**Deferred Assessment**

Deferment of an assessment is not automatic. Students may be permitted by the unit coordinator to defer an assessment where circumstances outside their control have arisen. However, a student's overall performance may be taken into account in granting permission to defer an assessment. Applications for deferment on health grounds or as a result of extenuating circumstances must be submitted not later than seven (7) days after the end of the relevant assessment date during the semester. Detailed medical certificates should be attached to the application where appropriate.

**Plagiarism Policy**

It is not acceptable to simply copy the words of other students, or authors, when completing the assignments in this unit. This action constitutes plagiarism and is regarded as academic malpractice. The practice of getting together as a group, dividing the task of learning among the group, and then simply copying the answers from each student is a special kind of plagiarism called collusion. This is unacceptable. The penalties for plagiarism, and collusion, can be severe and may include termination from your course of study. All direct quotes must be correctly attributed to the author and should be kept to a minimum. Also, you should include a list of references to acknowledge the source(s) of information used to produce any written work.

The School of Biomedical Sciences advises students that it will use screening software to check for plagiarism in submitted work suspected of containing plagiarised material and also for routine screening of text as deemed appropriate by the Head of School.

Useful examples and explanations of plagiarism may be seen at the following web site – [http://www.indiana.edu/~wts/wts/plagiarism.html](http://www.indiana.edu/~wts/wts/plagiarism.html). These will help you understand the nature of this academic malpractice. You MUST be aware of what constitutes plagiarism.

You should also familiarize yourself with Curtin University’s policy, and penalties, on plagiarism which can be found at: [http://www.policies.curtin.edu.au/documents/plagiarism.doc](http://www.policies.curtin.edu.au/documents/plagiarism.doc)
A new website is also currently being developed on academic or educational integrity. The URL will be http://academicintegrity.curtin.edu.au. The current policy on Academic Misconduct can be found at: http://www.policies.curtin.edu.au/documents/academic_misconduct.doc

**Other Curtin University Policies**

Other University policies you should be familiar can be found at the following URL: http://www.policies.curtin.edu.au/

**Copyright Requirements**

As a student of Curtin you must be familiar with the requirements of the University's Copyright Procedures. Guidance is available to you at the following web page http://lisweb.curtin.edu.au/copyright/ under the heading Information for All Students. Curtin's Copyright Procedures can be found under the heading Related Curtin Policies and Procedures whilst the Copyright Act can be accessed from the Additional information heading at that web site should you wish to understand the source of the Procedures.

Failure to comply with the University's policies and procedures on Copyright and IT/IS use may include suspension or termination of enrolment, fines, withdrawal of privileges for use of the University's ICT facilities and services and, depending on what is copied, stored or communicated, may also render you liable to prosecution in the courts.

**Mobile Phones**

As a courtesy to both lecturers and other students, if you have a mobile phone, please ensure that it is TURNED OFF during lecture, tutorial and practical sessions. Students who do not comply with this request may be asked to leave the class.

**Orientation Information**

Curtin University’s Orientation website is a useful free resource for students and contains links to many University resources, details about the ‘Oasis’ student email system, and other information. The web site is: http://orientation.curtin.edu.au/missed/.
<table>
<thead>
<tr>
<th>Week No.</th>
<th>Dates (2012)</th>
<th>Lecturer</th>
<th>Lecture Schedule</th>
<th>Lecture Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>13-17 Aug</td>
<td>Simon Carroll</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Drug discovery in the pharmaceutical industry 1 Practical: DeepView (10% of final mark)</td>
</tr>
<tr>
<td>6</td>
<td>20-24 Aug</td>
<td>Simon Carroll / Guest lecturer</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Drug discovery in the pharmaceutical industry 2</td>
</tr>
<tr>
<td>7</td>
<td>3-7 Sep</td>
<td>Simon Carroll</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Drug development and regulatory programs 1</td>
</tr>
<tr>
<td>8</td>
<td>10-14 Sep</td>
<td>Simon Carroll</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Drug development and regulatory programs 2</td>
</tr>
<tr>
<td>9</td>
<td>27-31 Aug</td>
<td></td>
<td>TUITION FREE WEEK</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>17-21 Sep</td>
<td>Simon Carroll</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Visit to Pfizer and Epichem (details to be advised)</td>
</tr>
<tr>
<td>11</td>
<td>24-28 Sep</td>
<td>Simon Carroll &amp; Ricardo Mancera</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Student presentations on case studies in drug discovery and development (Presentations and report worth 40% of final mark)</td>
</tr>
<tr>
<td>12</td>
<td>1-5 Oct</td>
<td>Kevin Batty</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Pharmacokinetics and its importance in drug development</td>
</tr>
<tr>
<td>13</td>
<td>8-12 Oct</td>
<td>Penelope Farbey</td>
<td>Lecture: Tue 9 - 11 AM (400.219)</td>
<td>Intellectual property in drug discovery and development</td>
</tr>
<tr>
<td>14</td>
<td>15-19 Oct</td>
<td></td>
<td>STUDY WEEK</td>
<td></td>
</tr>
<tr>
<td>15 &amp; 16</td>
<td>22 Oct - 2 Nov</td>
<td></td>
<td>EXAM PERIOD</td>
<td>Final exam (50%)</td>
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