



Faculty of Medicine & Health
School of Medical Sciences

PHAR2011

Introductory Pharmacology and Toxicology

COURSE OUTLINE

Term 3, 2021

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Please read this manual/outline in conjunction with the following pages on the [School of Medical Sciences website](#):

- [Advice for Students](#)
- [Learning Resources](#)

(or see "STUDENTS" tab at medicalsciences.med.unsw.edu.au)

PHAR2011 COURSE INFORMATION

COURSE DESCRIPTION

Unit of Credit (UOC): 6

Pre-requisites: 6 UOC level I Mathematics, 6 UOC level I Biology (BABS1201 preferred), 12 UOC level I Chemistry, 6 UOC Physiology 1A*

**Note: 3999 Medicinal Chemistry (Honours) students receive a special exemption from requiring Physiology 1A, but must complete 6 UOC Biochemistry (BIOC2101 preferred)*

This course will cover the basic principles of pharmacology with an emphasis on drug action from the molecular and cellular levels to tissue, organ and whole organism levels. The course will provide an understanding of the principles of drug action (pharmacodynamics) in terms of drug chemistry, drug-receptor interaction, receptor theory and dose-response relationships. An introduction to receptor-mediated signal transduction, membrane receptors and autonomic pharmacology will be covered. The handling of drugs by the body through the processes of absorption, distribution, metabolism and excretion (pharmacokinetics) will be covered in some detail along with drug analysis and the adverse effects of drugs. The laboratory classes will involve students performing real and computer-simulated pharmacological experiments.

COURSE AIMS

To gain:

- an understanding of the principles of Pharmacology
- an appreciation of the mechanisms by which drugs act
- an understanding of indications, contraindications, side effects and toxicity of drugs

COURSE COORDINATORS

Course Coordinator:

A/Professor Lu Liu Room 325, Wallace Wurth East
Phone: 9385 8762
Email: Lu.Liu@unsw.edu.au
Consultation times: by appointment via email

Co-coordinator:

Dr Trudie Binder Room 216, Wallace Wurth
Phone: 9385 8737
E-mail: w.binder@unsw.edu.au
Consultation time: by appointment via email

LECTURERS AND TUTORS IN THIS COURSE

Lecturers:

Dr. Trudie Binder	W.Binder@unsw.edu.au
Dr. Angela Finch	A.Finch@unsw.edu.au
Dr. Nicole Jones	N.Jones@unsw.edu.au
Mr. Martin Le Nedelec	m.lenedelec@unsw.edu.au
A/Professor Lu Liu	Lu.Liu@unsw.edu.au
Dr. Matthew Perry	M.Perry@unsw.edu.au

Tutors:

Dr. Trudie Binder	W.Binder@unsw.edu.au
Dr. Jane Carland	j.carland@unsw.edu.au
Mr. Martin Le Nedelec	m.lenedelec@unsw.edu.au
Dr. Matthew Perry	M.Perry@unsw.edu.au
Dr. Lindsay Wu	lindsay.wu@unsw.edu.au

COURSE STRUCTURE AND TEACHING STRATEGIES

Due to the Covid-19 restriction, the course will be running fully online in 2021 via Microsoft Teams.

This 6 UOC course consists of:

- 2-3 lecturing topics (lectures) per week
- Practical / tutorial sessions of up to 4 hours per week
- Self-directed learning up to 1 hour per week

Learning topics (lectures): Monday 11 am – 12 pm and Wednesday 5 - 6 pm (Q & A)

(Please note: most lectures are asynchronous unless specified. A weekly Q & A session takes place during Wednesday's lecture time, 5-6 pm, via Teams. The topics will be released to you on Friday, the week before, so that you can study the topics and prepare questions you would like to ask before attending the Q & A session on Wednesday)

Practicals: Tuesday 10 am -1 pm, or 2 - 5 pm

Tutorials: Thursday 1 - 2 pm, or 2 - 3 pm, or Friday 11 am - 12 pm, or 12 - 1 pm

Students enrolled in this course are expected to attend all scheduled activities for the full duration (lectures, tutorials and practicals). You are reminded that UNSW recommends that a 6 UOC course should involve about 125-150 hours of study and learning activities. The formal learning activities are approximately 65 hours throughout the semester and students are expected (and strongly recommended) to do at least the same number of hours of additional study.

Lectures will provide you with the concepts and theories essential for understanding Introductory Pharmacology. The practicals and tutorials are provided to support lecture material and practise analytical skills and help you to develop graduate attributes. As these classes are relatively small, they allow you to engage in a more interactive form of learning than is possible in the larger class lectures. The skills you will learn in practical classes are relevant to your development as a professional scientist.

Practicals/Labs requires in-person attendance for ONE session scheduled between weeks 1-5. Please refer to the timetable at the end of this course outline. If unable to attend, please email the course convener A/Prof Lu Liu.

APPROACH TO LEARNING AND TEACHING

The learning and teaching philosophy underpinning this course is centred on student learning and aims to create an environment, which interests, challenges and enthuses students. The teaching is designed to be relevant and engaging in order to prepare students for future careers.

The primary source of information for this course is the lecture material, and the tutorials and practical classes will be directly related to the lectures. Nevertheless, effective learning can also be enhanced through self-directed use of other resources such as textbooks, literature references and web-based sources. Your practical classes will be directly related to the lectures and you are advised to prepare for practical classes before attendance. It is up to you

to ensure you perform well in each part of the course; preparing for classes; completing assignments; studying for exams and seeking assistance to clarify your understanding. Past exam questions are provided to assist you in preparing for examinations.

TEXTBOOK AND OTHER RESOURCES

Prescribed textbook:

- Katzung et al., Basic and Clinical Pharmacology. 14th ed. McGraw-Hill. ©2018 (The e-book is available through UNSW Library Resources database: Access Medicine): <https://accessmedicine.mhmedical.com/Book.aspx?bookid=2249>

Recommended textbooks:

- Rang and Dale's Pharmacology. 9th ed. Churchill Livingstone/Elsevier. ©2020
The textbook is available from the UNSW Bookshop or via the link below for online ordering: <https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780702074486>
- Goodman and Gilman's The Pharmacological Basis of Therapeutics. 13th ed. McGraw-Hill Companies, ©2018. (The e-book is available through UNSW Library Resources database: Access Medicine): <https://accessmedicine.mhmedical.com/book.aspx?bookID=2189>

See also medicalsciences.med.unsw.edu.au/students/undergraduate/learning-resources
The Department of Pharmacology has chosen to use the University's central Moodle service to provide teaching materials for all of its courses. See moodle.telt.unsw.edu.au

After logging on to Moodle, look for the course PHAR2011. You should have access to it if you are properly enrolled.

STUDENT LEARNING OUTCOMES

PHAR2011 will develop those attributes that the Faculty of Science has identified as important for a Science graduate to attain. These include skills, qualities, understanding and attitudes that promote lifelong learning that students should acquire during their university experience.

a) Science Graduate Attributes

- A. Research, inquiry and analytical thinking abilities
- B. The capability and motivation for intellectual development
- C. Ethical, social and professional understanding
- D. Effective communication
- E. Teamwork, collaborative and management skills
- F. Information Literacy – the skills to locate, evaluate and use relevant information

b) Pharmacology Discipline Specific Learning Outcomes

- Demonstrate an understanding of how drugs/therapeutics are developed, work and are used safely
- Critically analyse, interpret and effectively communicate pharmacology data and literature
- Design and/or execute experiments or other activities to address pharmacological scenarios

Course learning outcomes (CLO)

On completion of this course, students should be able to:

1. describe the basic pharmacological concepts including pharmacokinetics and

- pharmacodynamics
2. describe the specific pharmacology of common drug classes currently used in medical practice including their mechanisms of action, indications, clinical uses, contraindications, and major adverse effects
 3. understand the basic principles of toxicology, the mechanisms by which excess exposure to certain drugs, toxins, chemicals and poisons can lead to toxic effects
 4. effectively communicate scientific information, organise the information into a written assignment, and implement effective peer review
 5. apply analytical skills to pharmacological data

COURSE EVALUATION AND DEVELOPMENT

For course evaluation, the feedback has been gathered at the completion of the course, using, among other means, UNSW's Course and Teaching Evaluation and Improvement Process and myExperience. Student feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

ASSESSMENT PROCEDURES

	% total marks
Mid-term test (20 MCQs and 2 SAQs, 60 min duration)	20%
Commentary assignment	20%
Continuous assessment quizzes:	
2 lab quizzes (each 2.5 %), a summative quiz (Part A & B, each 2.5 %)	10%
Final exam (2 hours duration, 20 MCQs and 10 SAQs)	50%
Formative online quiz	0%

Assessment	Information about the assessment	Related CLO
Mid-term Test	The mid-term test (progress examination) will be held during the lecture time in week 5 (Wednesday, 13 th of October, 5:00 – 6:00 pm, including 10 min reading time). This exam will give you feedback on how you are succeeding in the course. The test will consist of 20 multiple choice questions (MCQs) and 2 x 10 min short answer questions (SAQs) and will be based on the materials covered in the lectures, practical classes, and tutorials. The materials covered prior to the mid-term test may be again examined in the final exam.	1, 2, 5
Commentary Assignment	The written commentary assignment task will allow you to develop your research, information literacy, communication, peer review and time management skills. The whole process will be divided into a few steps, including the introduction and analysis of a newly published pharmacology article for you to comment on by your tutor during the week 1's tutorial class. You will also learn more on adequately searching and integrating the related literature, note-taking, peer review and response to peer's feedback along the way, through tutorials and online activities. Therefore, attending all the tutorials from week 1 is useful for	4, 5

	<p>you to do well in this assessment task.</p> <p>There will involve a few online submissions, including note-taking, the original assignment, peer reviews, and the final revised version of the assignment. The final version must be submitted electronically via Moodle through Turnitin (hard copy submissions are not required). A penalty of 10% per day will apply for any late submissions. Please check Moodle under "Assignment" for the detailed information about the commentary assignment.</p>	
Quizzes	<p>During the practical classes, you will be required to participate in two <u>Lab Quizzes</u> to test your knowledge learned through the practicals and your preparation for the labs. The two Lab Quizzes will be conducted online (each 15 min duration) during Practical 3 class time (Lab Quiz 1) and Practical 5 class time (Lab Quiz 2).</p> <p>There will be a <u>Summative Quiz</u>: Part A will take place at the end of week 2 and Part B at the end of week 4. The summative online quiz is created to help you revise the materials learned in lectures, online activities, tutorials and practicals, and it will also help you become familiar with the MCQ format, preparing for the mid-term test. You will receive assessment results and feedback immediately once the task is finished. There will be a <u>Formative Online Quiz</u> at the end of the term, which is designed to help you revise the entire learning materials through the term, preparing for the final exam.</p>	1,2,3,5
End of Term Examination	The end of term examination will be held during the official examination period (26 Nov 2021 - 9 Dec 2021). The examinable material consists of what is covered in lectures, tutorials and practicals.	1,2,3,5

GENERAL INFORMATION

Attendance Requirements

For details on the Policy on Class Attendance and Absence see the University's [Policy on Class Attendance and Absence](#).

Attendance at practical and tutorial classes will be recorded on the class roll at the start of each class. Arrival more than 15 minutes after the start of the class may be recorded as non-attendance. It is your responsibility to ensure that the teacher records your attendance and no discussions will be entered into after the completion of the class. Satisfactory completion of the work set for each class is essential and the class content will be assessable. Please note, although all practical and tutorial classes for this course in 2021 will be online, these guiding principles will still apply for the class activities.

Missed Assessment Items

If you need to submit an application for special consideration for an exam or assessment, you must submit the application prior to the start of the exam or before the assessment is due, except where illness or misadventure prevent you from doing so.

Where misadventure has prevented you from submitting or sitting for an assessment,

applications must be made within three working days of the assessment or the period covered by the supporting documentation <https://student.unsw.edu.au/special-consideration>

Your request for consideration will be assessed. If approved, the following permissions may be granted:

- i). For missed Mid-term Test: NO supplementary test will be offered. Your mark in the final exam will be re-weighted to include the mark reserved for the missed mid-term test (*i.e. the weight of the final exam would be adjusted from 50% to 70%*).
- ii) For missed quizzes: NO supplementary test will be offered. Your mark in the final exam will be re-weighted to include the mark reserved for the missed quiz. However, students who miss the lab quiz due to absence or being late without an adequate reason /documentation will receive no marks for the missed lab quiz.
- iii) For missed Final Exam: a supplementary final examination will be held between 10 Jan 2022 - 14 Jan 2022. The dates for the supplementary exams will be updated at <https://student.unsw.edu.au/exams/supplementary>. (**Please note:** a supplementary exam will not be offered to students who have failed the course).

Please note: Normally, if you miss an exam (without valid reasons) you will be given an absent fail. If you are late for an exam, no time extension will be granted. It is your responsibility to check timetables.

iv) For missed Summative Quiz: NO supplementary test will be offered and your final grade for the course will NOT be re-weighted to include the mark reserved for this assessment, as for both Part A and Part B summative quiz activities you have 5 days to complete, and there will be a couple of reminders before the deadline.

v) Failure to submit Commentary Assignment: If in any circumstances you cannot conduct your assignment activities and fail to submit the final version of the assignment, your final grade for the course will NOT be re-weighted to include the mark reserved for the assignment.

Repeating Students

Since there are new practical materials, practical class exemptions will NOT be granted to repeat students.

Special Consideration

Please see [UNSW-Special Consideration](#)

As mentioned above, if you unavoidably miss the assessments or require an extension of assignment submission, you must lodge an application with UNSW Student Central for special consideration.

See: [Student Advice-Reviews and Appeals](#)

Student Support Services

See: [Student Advice-Student support services](#)

Transitioning to Online Learning <https://www.covid19studyonline.unsw.edu.au/>

Guide to Online Study <https://student.unsw.edu.au/online-study>

UNSW Student Life Online <https://student.unsw.edu.au/life>

Equitable Learning Services <https://student.unsw.edu.au/els>

Academic Integrity and Plagiarism

The [UNSW Student Code](#) outlines the standard of conduct expected of students with respect to their academic integrity and plagiarism.

More details of what constitutes plagiarism can be found [here](#)

GENERAL INQUIRES

General inquiries can be made at the School of Medical Sciences Education Support Team. They are able to provide additional information on any courses offered by the School. Please submit all enquiries online via UNSW Student Portal Web Forms: <http://unsw.to/webforms>

Professor Margaret Morris is Head of the Department of Pharmacology. Prof Morris can be contacted by email m.morris@unsw.edu.au

There are two honours programs run through the School. The SoMS Honours program is coordinated by Dr Trevor Lewis (t.lewis@unsw.edu.au) and Neuroscience Honours program is coordinated by Dr Natasha Kumar (natasha.kumar@unsw.edu.au). Any students considering an Honours year should discuss the requirements with the coordinators.

The Department of Pharmacology offers students the opportunity to enter the following graduate programs:

Research Masters and Doctorate (Ph.D): In Pharmacology. Contact the post-graduate coordinators A/Prof Pascal Carrive (p.carrive@unsw.edu.au) and Dr Nicole Jones (n.jones@unsw.edu.au)

Enrolment and administrative help

The Student Administration Officers are available to help with problems with enrolment and scheduling and should be the first point of contact for administrative problems. They can be contacted via the UNSW Student Portal Web Forms <http://unsw.to/webforms>.

REQUIREMENTS FOR PRACTICAL CLASSES

The practical class is an opportunity for students to develop graduate attribute C by behaving in an ethical, socially responsible and professional manner within the practical class.

- There will be a pre-recorded video and a few quiz questions on Moodle to help you become familiar with the health and safety issues as well as the important procedures of each practical. You MUST complete the video and the quiz at least 1 hour prior to the start of your practical class.
- For the face-to-face wet lab:
 - Punctual arrival is expected.
 - Turn off mobile phones before entering the class.
 - You must read the "Student Risk Assessment" form before the lab starts.
 - Enclosed shoes, lab coat and safety glasses are compulsory

Students must take due care with biological and hazardous material and make sure all equipment is left clean and functional. In the interests of safety, special attention should be paid to any precautionary measures recommended in the notes. If any accidents or incidents occur, they should be reported immediately to the demonstrator in charge of the class who will record the incident and recommend what further action is required.

Information on relevant Health and Safety policies and expectations will be provided in the practical notes, as outlined at <http://safety.unsw.edu.au>
For more details see [Advice for Students-Practical Classes](#)

LECTURE THEMES

The main themes of the lectures will cover

- (1) How drugs act at cellular, tissue and organ levels (Pharmacodynamic; mechanisms of drug actions)
- (2) How the body handles drugs (Pharmacokinetics, side effects of drugs and toxicity)
- (3) How drugs target specific body systems (specific examples of drugs used for therapeutics and social reasons, sources of drugs)

LECTURE OUTLINES

WHAT IS PHARMACOLOGY? AGONISTS AND ANTAGONISTS

This lecture introduces the discipline of pharmacology. The history of pharmacology and different subspecialties that make up pharmacology will be discussed. The lecture will also introduce pharmacodynamics and explore the general principles of drug action including dose-response as well as the concept of agonism and antagonism.

QUANTIFYING DRUG ACTION

This lecture further explores pharmacodynamics including competitive antagonism, irreversible antagonism, functional antagonism, and the concept of tone. It includes potency and efficacy, side effects, desensitisation, up and down regulation, quantitative response, quantal response, and therapeutic ratio.

DRUG DISCOVERY (ONLINE LECTURE)

This lesson will present the process of drug discovery and development, outlining the journey from test tube to patient treatment. It will introduce terminology used in drug discovery and development programs and discuss the role pharmacology and pharmacologists plays in this lengthy, expensive, and complicated process.

Sites of drug action

In this lecture we are going to explore the concept of drug targets. We will be covering the role these proteins play in the body with a focus on receptors. Exploring receptors in more depth we will be looking at the differences in structure and function of these drug targets. This lesson builds on the lectures you have already covered in "Agonists and antagonists" and "Quantifying drug action".

CELL SIGNALLING

In this lecture we are going to explore cell signalling pathways and how they are modulated by receptors. Using airway smooth muscle as an example we will examine downstream signalling events that occur after receptor activation and the role kinase cascades play in propagating and amplifying signals that are initiated by receptors. We will also cover the cellular processes involved in turning off cell signalling.

INTRODUCTION TO AUTONOMIC PHARMACOLOGY (ONLINE LECTURE)

In this lecture, students will be introduced to the autonomic nervous system (ANS), i.e. the parasympathetic and sympathetic nervous systems. The integrative action of the ANS will be discussed. The cholinergic and adrenergic neurotransmissions and cholinergic and adrenergic receptor classifications will be introduced.

CHOLINERGIC MECHANISMS

This lecture will discuss the parasympathetic branch of the ANS, including cholinergic neurotransmission and receptor subtypes. It will focus on cholinergic drug classes that target at the different steps of neurotransmission. Representative agents of each class and mechanisms of action will be introduced.

MODULATION OF AUTONOMIC NEUROTRANSMISSION TO TREAT DISEASE

This lecture will build on the knowledge learned in the lectures of Introduction to Autonomic Pharmacology and Cholinergic Mechanisms and use glaucoma and overactive bladder as examples to learn the clinical uses of autonomic drugs, their mechanisms of action, side effects and contraindications.

DRUG SELECTIVITY: THE ADRENERGIC RECEPTOR FAMILY

This lecture will build on the concepts you have learnt in the preceding lectures on pharmacodynamics, drug targets and receptor signalling along with the introduction to the ANS online lesson. The major concepts covered in this lecture will be drug selectivity and on- and off-target adverse effects. The adrenergic receptor family will be used as the example to explore these concepts. We will examine how the nine adrenergic receptor subtypes provide the opportunity to design drugs that are selective for one subtype over the others and the benefits this brings.

SELECTIVE TARGETING TO TREAT DISEASE

The major concept covered in this lecture will be the different ways in which we can manipulate receptor activation to effectively alleviate disease symptoms. Using the adrenergic system as an example we will explore the mechanism of actions of sub-type selective adrenergic agonists and antagonists and their use, the method of their administration and adverse effects in the treatment of asthma and angina.

NEUROTRANSMITTER REGULATION

This lecture will cover the basic aspects of synthesis, storage and release of monoamines (serotonin, dopamine and noradrenaline) and also cover pathways involved in metabolism and reuptake. In addition, the manipulation of neurotransmitter activity as effective strategies for alleviating various diseases and/or their symptoms will be discussed.

DRUGS OF ADDICTION (ONLINE LECTURE)

This online lecture encompasses drug dependence and abuse. Patterns of drug use in Australia. Why take drugs? Reward, pleasure and addiction. How drugs act at a cellular level; tolerance, dependence and withdrawal. Different classes of Drugs: Opioids, Alcohol, Stimulants, Cannabis, Hallucinogens, Nicotine.

PHARMACOLOGY OF AUTACOIDS

Autacoids are a diverse group of biological molecules which are produced locally by one group of cells but exert effects on other types of cells in the same region, acting like local hormones. This lecture will introduce a few well-characterised autacoids, including histamine, serotonin and nitric oxide, and their main actions in the body.

MODULATION OF AUTACOID SIGNALLING TO TREAT DISEASE

Building on the knowledge learned in the lecture on Autacoids, this lecture will use two medical conditions, peptic ulcer disease (PUD) and migraine as examples to explore further the clinical uses of autacoids related drugs. In this lecture, current views on the pathogenesis of PUD and migraine headache will be discussed. The lecture will also provide an overview on the regulation of gastric acid secretion and the strategies for the treatment of PUD using histamine H₂ blockers, proton pump inhibitors (PPI), the combination of antibiotics and PPI. The association between serotonin and migraine and triptans for symptomatic treatment of migraine headache will be discussed.

ANTI-INFLAMMATORY MECHANISMS

Inflammation is the response of the body to invasion by a pathogen (infection) or injury. This lecture will provide an overview of the therapeutic strategies to treat inflammation. The lecture will introduce eicosanoid biosynthesis and discuss the mechanism of action of steroidal and non-steroidal anti-inflammatory drugs as well as paracetamol and DMARDs.

USE OF ANTI-INFLAMMATORY DRUGS TO TREAT DISEASE

This lecture introduces drug treatment and disease and focuses on the use of anti-inflammatory drugs to treat asthma and arthritis. Bronchial asthma, inflammatory cells and mediators as well as asthma management will be explored. The use and mechanism of action of anti-arthritic drugs will also be described.

TOXICOLOGY

This lecture focuses on the effect of drugs in overdose. It includes an introduction to toxicology and the mechanisms by which high doses of drugs elicit adverse effects in the human body. Toxicokinetic and toxicodynamic aspects and their clinical relevance will be explored including pathophysiological effects and treatment of overdose. In addition, natural toxins including snake and spider venoms will be described.

PHARMACOKINETICS - INTRODUCTION TO DRUG CHEMISTRY AND ABSORPTION

This lecture will discuss acidic, basic and neutral drugs; the relationship between lipid solubility and ionization; characteristics of transfer of drugs across cell membranes, passive diffusion, active transport.

PHARMACOKINETICS - DRUG METABOLISM

Drug absorption and pathways of metabolism of drugs leading to either inactive or active metabolites. Contribution of Phase I (oxidative) and Phase II (conjugative) pathways to drug metabolism. Factors affecting drug metabolism - other drugs (induction, inhibition), age, disease states, genetic factors. Polymorphic drug metabolism and its consequences. Renal secretion of drugs affecting secretion. Effects of other drugs, protein binding, pH and age on renal elimination. Renal dysfunction and drug elimination.

TOXIC EFFECTS OF DRUGS

This lecture will explore the harmful effects of drugs, particularly in the context of therapeutic use. It will cover basic concepts relating to adverse drug reactions, including differentiating between predictable and unpredictable reactions, as well as introducing the Therapeutic Index (TI) and margin of safety. Common mechanisms of drug toxicity will be discussed using real examples, and the causes of variable drug responses and risk factors for drug toxicity will also be considered.

DRUG SAFETY/PHARMACOVIGILANCE

This lecture will cover key concepts related to assessing and monitoring drug safety. It will examine some of the current methods and procedures used to assess safety during the drug development process, as well as the limitations of this practice. It will explain the process of pharmacovigilance following drug approval and the importance of drug safety and pharmacovigilance will be examined using real world examples. It will also consider some recent trends aimed at improving drug safety testing and pharmacovigilance in the future.

TIMETABLE (SUBJECT TO CHANGE)

Week	Learning topics	Practical* (Tue 10am-1pm or 2-5pm)	Q&A (Wed 5 pm)	Tutorials** (Thu 1 pm, 2 pm, Fri 11 am, 12 pm)
1 (13 Sep)	<ul style="list-style-type: none"> What is pharmacology? Agonists and antagonists (TB, <i>Live via Teams, Monday 13 Sep, 11 am – 12 pm</i>) Quantifying drug action (TB) Pharmacodynamics (TB, self-directed exercise) 	Introduction to practicals (LL)	Q&A via Teams (TB)	Commentary introduction (paper presentation & online lesson for research paper notetaking) (LL/AF)
2 (20 Sep)	<ul style="list-style-type: none"> Sites of drug action (AF) Cell signalling (AF) Drug discovery (AF) 	Concentration response: agonists (LL/ML)	Q&A via Teams (AF)	Receptors and receptor Signalling (AF)
3 (27 Sep)	<ul style="list-style-type: none"> Introduction to autonomic pharmacology (LL) Cholinergic mechanisms (LL) Modulation of autonomic neurotransmission to treat disease (LL) 	Concentration response: agonists (LL/ML)	Q&A via Teams (LL)	Cholinergic mechanisms (LL)
4 (4 Oct)	<ul style="list-style-type: none"> Drug selectivity: the adrenergic receptor family (AF) The selective targeting of adrenoceptors in the treatment of asthma & angina (AF) How to effectively prepare for your tests/exams 	Concentration response: antagonists (LL/TB)	Q&A via Teams (AF)	Adrenergic mechanisms (AF)
5 (11 Oct)	<ul style="list-style-type: none"> Neurotransmitter regulation to treat disease (NJ) Drugs of addiction (TB) 	Concentration response: antagonists (LL/TB)	Mid-term test (LL)	Peer review exercise (AF)
6 (18 Oct)	Flexibility Week			
7 (25 Oct)	<ul style="list-style-type: none"> Autacoids (LL) Modulation of autacoid signalling to treat disease (LL) 	Autocoids (LL/ML)	Q&A via Teams (LL)	Response to peer review exercise (AF)
8 (1 Nov)	<ul style="list-style-type: none"> Anti-inflammatory mechanisms (TB) The use of anti-inflammatory drugs to treat disease (TB) Toxicology (TB) 	Autocoids (LL/ML)	Q&A via Teams (TB)	Anti-inflammation drugs (TB)
9 (8 Nov)	<ul style="list-style-type: none"> Pharmacokinetics-Drug chemistry and absorption (ML) Drug Metabolism (ML) 	Ion Trapping & Drug Excretion (ML/TB)	Q&A via Teams (ML)	Drugs & diseases – case studies (LL & TB)
10 (15 Nov)	<ul style="list-style-type: none"> Toxic effects of drugs (MP) Drug safety / Pharmacovigilance (MP) 	Ion Trapping & Drug Excretion (ML/TB)	Q&A (MP) & Exam preparation (LL)	Drug metabolism and drug safety (ML)