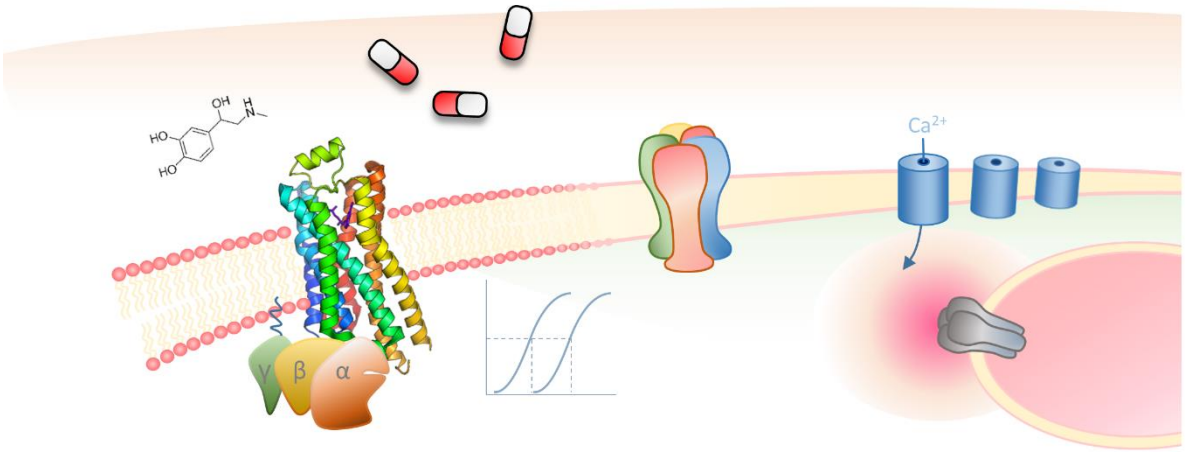
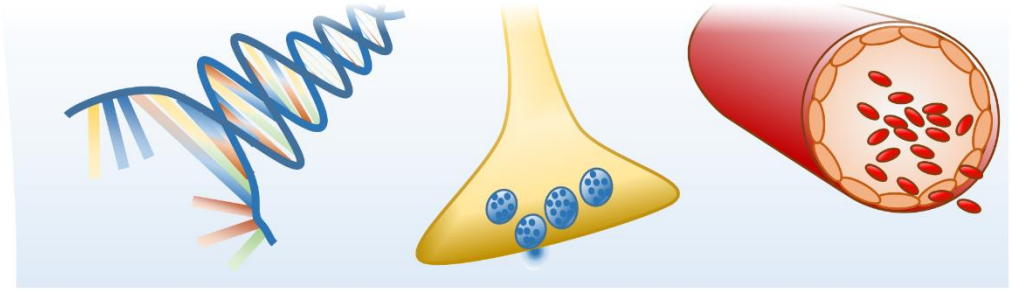


PHARMACOLOGY PART II



Natural Sciences Tripos Part II

Pharmacology

or

Biological and Biomedical Sciences

2020 – 2021

The Pharmacology course at a glance

<table>
<tr><td>Michaelmas</td><td>Lectures (usually 2 per day)
Drugs Case Studies
Tech Talks
Study skills workshops</td><td rowspan="2">Discussion groups

Tea Talks

Supervisions</td></tr>
<tr><td>Lent</td><td>Lectures (usually 1 per day)
Research project (Part II Pharmacology)
or Dissertation (BBS)</td></tr>
<tr><td>Easter</td><td colspan="2">Revision period (no lectures)
Research project presentation
Final examinations</td></tr>
</table>

Any questions?

If you have any questions, or would like to know more about any aspect of the course, please contact the course organiser, **Dr Matthew Harper.** (mth29@cam.ac.uk).

Why choose Pharmacology?

- Pharmacology lies at the heart of drug discovery.
- Pharmacology has enormous impact on clinical and veterinary medicine.
- Pharmacology is a vital approach to understanding biology.

Pharmacology is the study of the mechanism of action of drugs on biological systems, whether the drug is synthetic, natural or endogenous. Pharmacologists can use this information to reveal how the biological system itself works. Pharmacology is a multi-disciplinary field, encompassing every level of biological organisation, from atomic structures, signalling pathways, cells, tissues and organisms, to entire populations.

Ways to study Pharmacology in Part II

There are two ways to study Pharmacology at Part II level. They share the same core teaching. The difference is that Part II Pharmacology includes a practical research project and a Drug Review essay whereas Part II BBS (Biological and Biomedical Sciences) includes a dissertation and an additional single-paper Minor Subject chosen from a wide range of options. Both courses are equally rewarding and equally demanding. However, if you are considering postgraduate laboratory-based research (PhD or MB/PhD), you are strongly advised to take Part II Pharmacology with its practical research project.

The Aims of the Pharmacology course

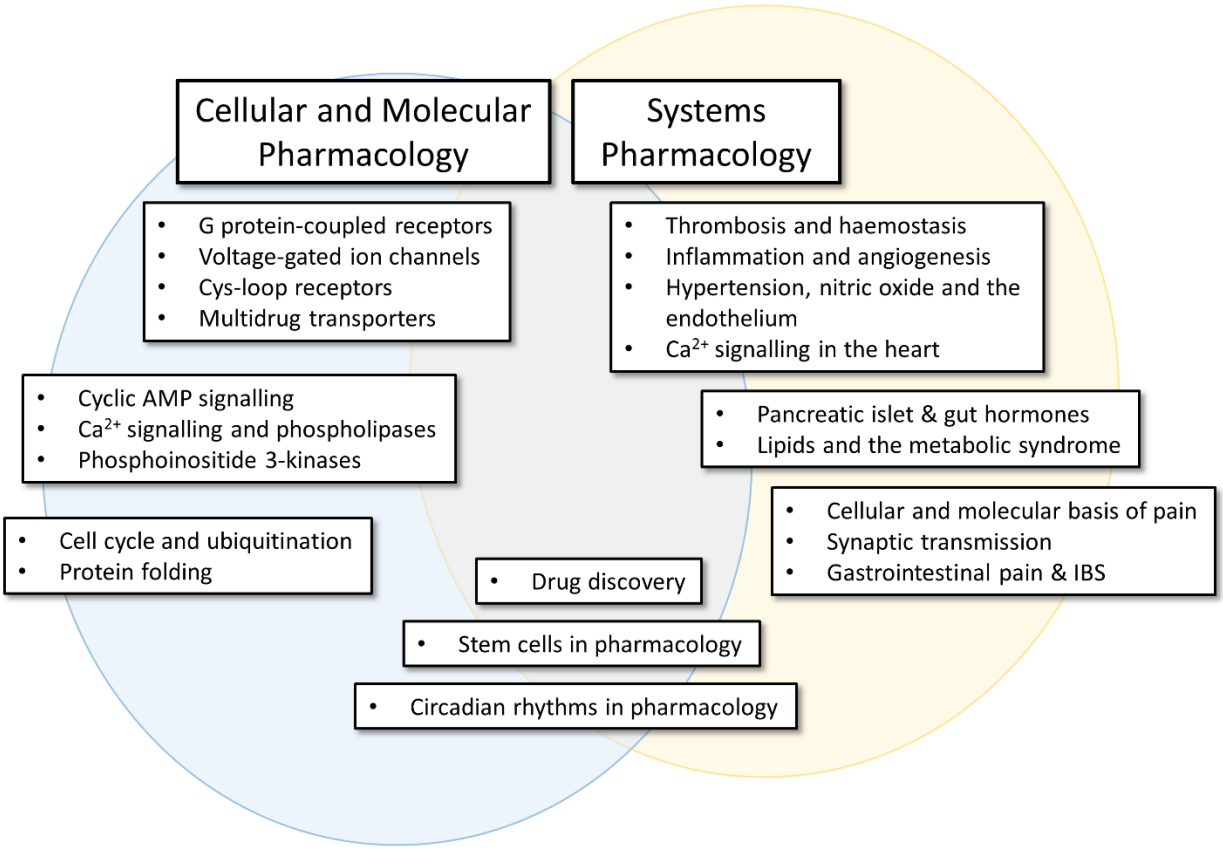
- To provide a wide-ranging, balanced and critical treatment of pharmacology as it relates to understanding mechanisms of drug action
- To equip you with a range of skills for your future career, whether it is in life sciences research, medicine, veterinary medicine, drug discovery, or other careers not directly related to pharmacology

You can expect to encounter the most recent research and the controversies surrounding it. Although this is not a course on therapeutics, its focus on underlying mechanisms provides essential insight into both drug development and the use of drugs to treat disease.

The course is taught through lectures, tech talks, discussion groups, supervisions, case studies, study skills workshops and tea talks. All of these are shared between Part II Pharmacology and Part II BBS. The teaching is delivered by staff from the

Department of Pharmacology who are all actively engaged in research and committed to teaching excellence, complemented by visitors from other departments and pharmaceutical companies.

Lectures take place in Michaelmas and Lent Terms and are timetabled to allow you to attend them all. They are grouped into *Systems Pharmacology*, and *Molecular and Cellular Pharmacology*. In reality, there is a seamless continuity between the two. Recent lecture courses are shown below. Each year there may be some changes to accommodate staff changes and sabbatical leave.



All lecturers will provide **supervisions**, to answer your questions, give feedback on essays, and discuss the topic in greater detail.

Tech talks describe a variety of advanced techniques used in pharmacology research. They are given by senior researchers with first-hand expertise in the techniques.

Discussion groups, each of 5-6 students and 1 member of staff meet throughout the year. They aim to develop your presentation skills and your ability to critically evaluate scientific research.

Study skills workshops provide practical guidance on a range of key skills, including essay writing, reading the scientific literature and interpreting statistics.

Drug Case Studies in Michaelmas Term explore examples of how drugs are developed, how they work – and how we know.

Tea talks involve a mix of external and internal speakers talking about their most recent research. They are followed by drinks and nibbles, providing a relaxed chance to catch up with the speaker and everyone else in the department.

Research projects (Part II Pharmacology only) are the best way to get a real taste of scientific research. Most of the projects are based in the research labs of the department, although a few projects are based elsewhere (e.g., Clinical Pharmacology). Examples of recent research projects can be found on page 7.
The research projects take place in Lent Term. You will spend approximately 3 days/weeks working in the lab on your project. You will submit a written report and present a talk to the examiners in Easter Term. Our Part II students can become valued members of their lab and have a real impact on its research. It is not uncommon for work arising from a Part II project to be published or presented at a scientific meeting.

Dissertations (BBS only) provide an opportunity to explore an area of interest in considerable depth. You can choose a dissertation title from lists provided by either your Major of Minor Subjects. Most of our students choose a title from the pharmacology list (see page 8 for examples of recently offered titles). Prospective supervisors will be available to discuss titles before you make your final decision. Your supervisor will provide guidance on your dissertation throughout Lent Term.

Detailed arrangements for the **Minor Subjects (BBS only)** differ between subjects. You can obtain further details from the BBS website and course booklet, including details of which minor subjects are compatible with Pharmacology.

Learning objectives

By the end of the course, you can expect to be able to:

- Think critically and with an appropriate level of knowledge across a wide range of pharmacological topics.
- Find, critically assess and integrate information from the scientific literature.
- Critically assess different methods to solve pharmacological problems.
- Communicate effectively with a scientific audience in oral presentations, written reports or dissertations, and essays.

Examinations

Exams are in the second half of the Easter Term. There is no formal teaching in the Easter Term, giving you plenty of time to revise and prepare for your exams.

There are 4 written papers in Pharmacology. All 4 papers are taken by all candidates from BBS and Part II Pharmacology. Papers 1-3 are essay papers. Paper 4 assess your ability to critically assess pharmacological experiments. Part II Pharmacology students also submit a review of a recently approved drug. This Drug Review contributes 10% of the total mark. There is no written practical examination for either course.

For Part II Pharmacology students, the research project contributes 20% of the total mark. You will also present your research project in a 10-minute talk to the examiners. The talk is assessed.

For BBS students, the dissertation and Minor Subject paper contribute with the marks from the 4 written papers to the final mark.

The examiners may also invite candidates from either course for an oral examination on any part of the course.

How to apply for Pharmacology

The maximum number of students allowed onto the Part II Pharmacology course is 30 and is determined by the number of research projects available. There are up to 20 places for BBS Pharmacology. Our selection policy is to accept students with the best overall performance in Part IB examinations. Students from MVST and NST are treated identically.

There are no interviews and no application need be made other than on the list of Part II preferences submitted through your College.

Recent research project titles in Part II Pharmacology

Below are a selection of the projects offered in 2019/20. The subheadings are fairly arbitrary – many projects have clear impact in a range of areas – but hopefully convey the breadth of research topics available.

Understanding receptors

- Discovery of potential A3R agonist/antagonists
- Regulation of PAR pharmacology by RAMPs
- Discovery of potential GLP-1 allosteric modulators

Intracellular signalling

- Inhibition of PARP-1 by neurosteroids and phytosteroids
- Screening gut microbiome-derived small molecules against the store-operated calcium entry pathway
- Type 2 IP_3 receptors and the regulation of adhesion molecules in glioblastoma multiforme

Neuropharmacology

- Protein modulators of $GABA_A$ receptors
- Characterisation of vagal afferents innervating the ileum

Cardiovascular pharmacology

- Programming synthetic platelets as therapeutic delivery vehicles
- The haemodynamic effects of relaxin in humans
- Role of FXIIIa in red blood cell retention in thrombi

Cancer pharmacology

- Targeted protein degradation as anti-cancer therapeutics
- Detecting and preventing aberrant cellular differentiation in TNBC

Antibacterial pharmacology

- Assessing the potential antibacterial activity of syncollin
- Transport mechanism of a multidrug transporter from *Vibrio cholerae*

Recent pharmacology dissertation titles offered in Part II BBS

The subheadings are somewhat arbitrary, but hopefully convey the wide scope of themes on offer and the huge importance of pharmacology to biomedical science.

New therapeutic strategies

- Targeting GPCRs as anti-cancer therapies
- Are modified RNAs the future of gene therapy?
- Is there a clinically effective alternative to opioids?
- Is it possible to improve anaesthetics?

Challenging the dogma

- Is BoTox safe?
- Alzheimer's drug failures: Are researchers on the wrong track with the amyloid hypothesis?
- What are the mechanisms of drug entry in cells and tissues?
- Personalised medicine in the clinic – fantasy or reality?

Understanding disease to guide therapy

- Are viruses the causative factor in neurodegenerative diseases?
- Cystic fibrosis-related diabetes
- How do gut microbiota affect cardiovascular disease risk?
- Can we treat fatigue?
- Bacterial host interactions in the development of chronic visceral pain: does early life exposure to pathogen influence pain sensitivity in adulthood?
- Bacterial host interactions in cystic fibrosis

From molecular mechanism to drug target

- The therapeutic potential of biased modulators of GCPRs
- Do lysosomes contribute to Ca^{2+} signalling?
- Trapping pain with TRPs: are TRP channels good targets for alleviating pain?
- Can phospholipase C improve IVF?
- Lipid transporters in health and disease
- Can the naked mole-rat cure cancer?