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Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology
Course Summary
This course extends your previous knowledge in the area of drug mode of action, molecular targets and toxicology. The process of drug development will be examined from the importance of understanding the design and metabolic profile of drugs and their transport to covering molecular aspects of pre-clinical toxicology. This course provides focus on hot topics in pharmacology and toxicology, using specific examples from research at the University of Aberdeen and thus opens up new opportunities for employability in academia and the pharmaceutical industry.

Co-ordinator: Dr Steve Tucker (437491); IMS room 6.32

Course Aims & Learning Outcomes
The course aims to develop an understanding of pharmacological targeting and molecular toxicology at an advanced level. The learning outcomes are:

- To gain knowledge of drug-induced toxicity including organ specific toxicity, oxidative stress and the role of drug transport
- To develop advanced understanding of the processes surrounding pharmacological drug design and molecular targeting using specific examples
- To develop knowledge of the processes involved in cell death including apoptosis, autophagy and necrosis
- To enhance understanding of the use of biomarkers in pharmacology and toxicology
- To develop advanced knowledge of molecular carcinogenesis (genotoxic and non-genotoxic)

Course Teaching Staff
Course Co-ordinator(s):
Dr S Tucker School of Medicine, Medical Sciences, Dentistry and Nutrition

Other Staff:
Dr J Barrow (JB), School of Medicine, Medical Sciences and Nutrition
Dr E Collie-Duguid (ECD), School of Medicine, Medical Sciences and Nutrition
Dr P Marini (PM), School of Medicine, Medical Sciences and Nutrition
Professor IJ McEwan (IJM), School of Medicine, Medical Sciences and Nutrition
Professor HM Wallace (HMW), School of Medicine, Medical Sciences and Nutrition

Assessments & Examinations
Students are expected to attend the lectures, practical classes and tutorials. Any period of absence must be covered by a medical certificate in accordance with University regulation (see Notice Boards). Practical reports and assignments must be handed in for marking by the dates indicated. A 100% attendance is required at practical classes. If assignments are not
handed in on time e.g. if an assignment is more than 1 week late without good cause, it will not be marked.

The distribution of assessments is as follows:

1. Degree written exam 2h paper, answer 2 questions = 70% of the grade for this course
2. Continuous assessment: 3D practical project (20%), editorial (10%) = 30% of the grade for this course.

Past papers for PA4302 (previous code) and PA4303 are available on the Web.

Class Representatives
We value students’ opinions in regard to enhancing the quality of teaching and its delivery; therefore, in conjunction with the Students’ Association we support the Class Representative system.

In the School of Medicine, Medical Sciences & Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?
It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training
Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit www.ausa.org.uk or email the VP Education & Employability vped@abdn.ac.uk. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: www.abdn.ac.uk/careers.

Problems with Coursework
If students have difficulties with any part of the course that they cannot cope with alone they should notify the course coordinator immediately. If the problem relates to the subject matter general advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (medsci@abdn.ac.uk) in the School Office (based in the IMS, Foresterhill), or Mrs Sheila Jones (s.jones@abdn.ac.uk) in the Old Aberdeen office associated with the teaching laboratories,
to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e. work from second semester during the summer vacation), coursework will be kept until the end of Fresher’s Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

**Course Reading List**

**Books recommended for purchase**

Rang and Dale’s, Pharmacology 8th Edition

**The following are available at Foresterhill Library Counter (Heavy Demand)**

- Casarett & Doull’s Toxicology. (Fifth edition). ISBN. 0071054766.

Foresterhill Library holds issues of Trends in Pharmacological Sciences and the British Journal of Pharmacology, which may be very useful for reading around many topics relevant to the course.

**Lecture Synopsis**

**Drug Transporters - Professor Heather Wallace**

- Drug transporter families
- Toxicity issues with drug transporters
- Regulation of drug transport by nuclear receptors

**Biomarkers - Dr Elaina Collie-Duguid**

- Biomarkers in the management of human disease
- Types of biomarkers and their potential clinical utility
- Biomarkers in current clinical use
Pharmacology of cannabinoids – Dr Pietro Marini

- The endocannabinoid system
- Natural and synthetic ligands
- Use of cannabis in therapy
- Applied pharmacology: cannabinoid and cholinergic systems cross-talk

Quadruplex targeting – Dr John Barrow

- What are G-quadruplexes?
- G-quadruplex roles in gene regulation
- Current research in using quadruplexes as a drug target

Drug targeting in prostate cancer – Professor Iain McEwan

- Steroid Hormone Receptors: From basic biology to drug targets
- Androgen receptor-Structure and Function
- Prostate cancer
- Novel Small Molecule Inhibitors of receptor function

Endocrine pharmacology – Dr Steve Tucker

- Endocrine regulation of female reproduction
- Pharmacology of the female hormonal contraception
- Endocrine regulation of male reproduction
- Pharmacology of the male hormonal contraception

The chemistry of pharmacokinetics and pharmacodynamics – Dr Steve Tucker

- Synthetic chemistry and drug design
- Chemical groups that modify pharmacokinetics
- Chemical groups that modify pharmacodynamics

Chronotherapeutics – Dr Steve Tucker

- Circadian rhythm
- Influence of circadian rhythm on cancer initiation
- Influence of circadian rhythm on anticancer drug side effects / resistance
- Chronotherapy in cancer

Cell death - Professor Heather Wallace

- Apoptosis
- Necrosis
- Programmed cell death
- Autophagy
- Lysosomal cell death
Molecular carcinogenesis - Professor Heather Wallace

- Proto-oncogenes, oncogenes and tumour suppressor genes
- Cell cycle regulation
- Carcinogens: genotoxic and non-genotoxic

Adverse effects of manipulating the immune system – Dr Isabel Crane

Although drugs that manipulate the immune system can be very effective treatments for many conditions from cancer to multiple sclerosis, their use, not surprisingly, can also have adverse effects. We will discuss:

- Immunosuppression in transplantation
- Effects of boosting the immune system in cancer
- Monoclonal antibody therapy

Drug targeting in breast cancer – Dr Steve Tucker

- Introduction to breast cancer
- Traditional targets (hormone receptors and growth factor receptors)
- Popeye domain containing (POPDC) proteins and breast cancer
- Targeting POPDC1

Pre-clinical testing in drug discovery – Professor Heather Wallace

- Outline of the pre-clinical testing environment
- Regulatory requirements for testing
- New alternative methodologies

3D project/Editorial/Case study

3D Practical project (20% of final mark): Dr Steve Tucker

- examine target/drug structures and how these relate to pharmacological consequences
- develop an understanding of how to communicate with the public
- employ problem solving skills to design new synthetics for use on the target
- develop group and individual working skills

The project will involve small groups of students researching and selecting a drug target to focus upon and preparing individual short justification/explanation for their choice aimed at the public. Groups will then investigate a small number of drugs that act on the target, and using 3D prints of the target and drugs, prepare a short video demonstrating the molecular interaction that takes place to produce the pharmacological response. Finally, groups will use their knowledge to propose a new synthetic drug with specific pharmacodynamic/pharmacokinetic properties enabled by its chemical structure.
Assessment: individual justification (5%); group video (5%); new synthetic (10%)

Editorial (10% of final mark): Dr Steve Tucker

- condense complex information from scientific literature into clear and structured discursive writing
- to develop and explore a mature pharmacological theme considering all sides of the issue in a balanced and informed manner

The exercise will involve students being issued with a small number of research papers to read and interpret before writing a short editorial exploring the main themes linking the articles under exam conditions.

University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (https://abdn.blackboard.com/bbcswebdav/institution/Policies). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the University’s Infohub webpage or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum
# Medical Sciences Common Grading Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade Point</th>
<th>Category</th>
<th>Honours Class</th>
<th>Description</th>
</tr>
</thead>
</table>
| A1    | 22          | Excellent      | First         | • Outstanding ability and critical thought  
|       |             |                |               | • Evidence of extensive reading  
|       |             |                |               | • Superior understanding  
|       |             |                |               | • The best performance that can be expected from a student at this level     |
| A2    | 21          |                |               |  
| A3    | 20          |                |               |  
| A4    | 19          |                |               |  
| A5    | 18          |                |               |  
| B1    | 17          | Very Good      | Upper Second  | • Able to argue logically and organise answers well  
|       |             |                |               | • Shows a thorough grasp of concepts  
|       |             |                |               | • Good use of examples to illustrate points and justify arguments  
|       |             |                |               | • Evidence of reading and wide appreciation of subject                      |
| B2    | 16          |                | Upper Second  |  
| B3    | 15          |                | Lower Second  |  
| C1    | 14          | Good           | Lower Second  | • Repetition of lecture notes without evidence of further appreciation of subject  
|       |             |                |               | • Lacking illustrative examples and originality  
|       |             |                |               | • Basic level of understanding                                               |
| C2    | 13          |                |               |  
| C3    | 12          |                |               |  
| D1    | 11          | Pass           | Third         | • Limited ability to argue logically and organise answers  
|       |             |                |               | • Failure to develop or illustrate points  
|       |             |                |               | • The minimum level of performance required for a student to be awarded a pass |
| D2    | 10          |                |               |  
| D3    | 9           |                |               |  
| E1    | 8           | Fail           | Fail          | • Weak presentation  
|       |             |                |               | • Tendency to irrelevance  
|       |             |                |               | • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts |
| E2    | 7           |                |               |  
| E3    | 6           | Clear Fail     |               |  
| F1    | 5           | Clear Fail     | Not used for Honours | • Contains major errors or misconceptions  
|       |             |                |               | • Poor presentation                                                           |
| F2    | 4           |                |               |  
| F3    | 3           |                |               |  
| G1    | 2           | Clear Fail/Abysmal |              | • Token or no submission                                                      |
| G2    | 1           |                |               |  
| G3    | 0           |                |               |  

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# Course Timetable PA4303: 2019-2020

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Place</th>
<th>Subject</th>
<th>Session Type</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 13</td>
<td></td>
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</tr>
<tr>
<td>Mon 21 Oct</td>
<td>10:00-11:00</td>
<td>1:147</td>
<td>Introduction to the course</td>
<td>Lecture</td>
<td>SJT</td>
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<tr>
<td></td>
<td>11:00-12:00</td>
<td>1:147</td>
<td>Drug Transporters</td>
<td>Lecture</td>
<td>HMW</td>
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<tr>
<td>Wed 23 Oct</td>
<td>11:00-12:00</td>
<td>1:147</td>
<td>3D modelling project: introduction</td>
<td>Lecture</td>
<td>SJT</td>
</tr>
<tr>
<td>Thu 24 Oct</td>
<td>1400-16:00</td>
<td>1.143/144</td>
<td>Cannabinoid pharmacology</td>
<td>Lecture</td>
<td>PM</td>
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<tr>
<td>Fri 25 Oct</td>
<td>10:00-13:00</td>
<td>Comp room 3</td>
<td>3D modelling project</td>
<td>Practical</td>
<td>SJT</td>
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<tr>
<td>Week 14</td>
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<tr>
<td>Mon 28 Oct</td>
<td>9:00-11:00</td>
<td>Polwarth LT (LT3)</td>
<td>Biomarkers</td>
<td>Lecture</td>
<td>ECD</td>
</tr>
<tr>
<td>Wed 30 Oct</td>
<td>11:00-12:00</td>
<td>1.147</td>
<td>Molecular Carcinogenesis</td>
<td>Lecture</td>
<td>HMW</td>
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<tr>
<td>Thu 31 Oct</td>
<td>10:00-11:00</td>
<td>1:147</td>
<td>Cell Death 1</td>
<td>Lecture</td>
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<tr>
<td></td>
<td>14:00-15:00</td>
<td>1.143/144</td>
<td>Cell Death 2</td>
<td>Lecture</td>
<td>HMW</td>
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<tr>
<td>Fri 1 Nov</td>
<td>10:00-13:00</td>
<td>Comp room 3</td>
<td>3D modelling project</td>
<td>Practical</td>
<td>SJT</td>
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<tr>
<td>Week 15</td>
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<tr>
<td>Mon 4 Nov</td>
<td>10:00-12:00</td>
<td>1:147</td>
<td>Quadruplex targeting</td>
<td>Lecture</td>
<td>JB</td>
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<tr>
<td>Wed 6 Nov</td>
<td>12:00-13:00</td>
<td>1:147</td>
<td>Editorial introduction</td>
<td>Lecture</td>
<td>SJT</td>
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<tr>
<td>Thu 7 Nov</td>
<td>10:00-12:00</td>
<td>1:147</td>
<td>Drug targeting in prostate cancer</td>
<td>Lecture</td>
<td>IJM</td>
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<td></td>
<td>14:00-16:00</td>
<td>Med Chi DELS</td>
<td>3D modelling project</td>
<td>Practical</td>
<td>SJT</td>
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<tr>
<td>Fri 8 Nov</td>
<td>10:00-13:00</td>
<td>Comp room 3</td>
<td>Editorial</td>
<td>Assessment</td>
<td>SJT</td>
</tr>
<tr>
<td>Week 16</td>
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<tr>
<td>Mon 11 Nov</td>
<td>10:00-12:00</td>
<td>1:147</td>
<td>Contraceptive pharmacology</td>
<td>Lecture</td>
<td>SJT</td>
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<tr>
<td>Wed 13 Nov</td>
<td>11:00-12:00</td>
<td>1:147</td>
<td>The Chemistry of Pharmacokinetics and Pharmacodynamics</td>
<td>Lecture</td>
<td>SJT</td>
</tr>
<tr>
<td></td>
<td>12:00-13:00</td>
<td>1:147</td>
<td>Chronotherapeutics</td>
<td>Lecture</td>
<td>SJT</td>
</tr>
<tr>
<td>Thu 14 Nov</td>
<td>11:00-12:00</td>
<td>1:147</td>
<td>Adverse effects of manipulating the immune system</td>
<td>Lecture</td>
<td>IC</td>
</tr>
<tr>
<td>Fri 15 Nov</td>
<td>11:00-13:00</td>
<td>1.143/144</td>
<td>Drug targeting in breast cancer</td>
<td>Lecture</td>
<td>SJT</td>
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<tr>
<td>Week 17</td>
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<tr>
<td>Mon 18 Nov</td>
<td>10:00-11:00</td>
<td>1:147</td>
<td>No class</td>
<td>Lecture</td>
<td></td>
</tr>
<tr>
<td>Wed 20 Nov</td>
<td>10:00-12:00</td>
<td>1:147</td>
<td>Pre-clinical testing in drug discovery</td>
<td>Lecture</td>
<td>HMW</td>
</tr>
<tr>
<td>Thu 21 Nov</td>
<td>11:00-13:00</td>
<td>1:147</td>
<td>Course round up and exam tutorial</td>
<td>Lecture</td>
<td>SJT</td>
</tr>
<tr>
<td>Fri 22 Nov</td>
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## Staff

<table>
<thead>
<tr>
<th>Dr SJ Tucker (SJT)</th>
<th>Course Co-ordinator, School of Medicine, Medical Sciences and Nutrition</th>
</tr>
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<tr>
<td>Dr I Crane (IC)</td>
<td>School of Medicine, Medical Sciences and Nutrition</td>
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<td>Dr P Marini (PM)</td>
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<tr>
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