University of Wisconsin-Madison

Course Subject, Number and Title
Pharmacology, 781, Molecular and Cellular Principles in Pharmacology

Credits
4

Canvas Course URL

Course Designations and Attributes
General Education
Grad 50% - Counts toward 50% graduate coursework requirement

Tuesdays and Thursdays, 1:30 p.m. – 3:30 p.m., Room 7001B WIMR

Instructional Mode:
All face-to-face

Specify how Credit Hours are met by the Course
This class meets for a total of 4 class period hours [1:30-3:30 Tuesdays and Thursdays] each week over the spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc) for about 4 hours out of classroom for every class period. The syllabus includes additional information about meeting times and expectations for student work.

INSTRUCTORS AND TEACHING ASSISTANTS

Instructor Title and Name
Anjon Audhya, Professor

Instructor Availability
By appointment – email Prof. Audhya to schedule a meeting.

Instructor Email/Preferred Contact
audhya@wisc.edu

OFFICIAL COURSE DESCRIPTION

Course Description
Provides an in-depth introduction to the molecular and cellular principles of pharmacology. Emphasis is on the mechanisms of drug and small molecule action in cells, with a particular focus on downstream signaling pathways, second messenger systems, protein kinase cascades, and the regulation of gene transcription.
Requisites
Graduate or professional standing

LEARNING OUTCOMES

Course Learning Outcomes
 Upon successful completion of this course, both undergraduates and graduate students should be able to:

1. Recognize the fundamental principles of drug actions at their target sites (e.g. receptors, enzymes, etc)
2. Understand the various mechanisms by which drugs can mediate their pharmacological effect
3. Describe how drugs mimic or modify physiological function, including the various actions and clinical uses
4. Describe the major classes of therapeutic drugs that affect the primary systems within the body
5. Choose a relevant experimental system to test experimental hypotheses (e.g. in vitro or in vivo; animal species, etc)
6. Design experiments which are properly controlled and which use appropriate statistical methods of data analysis

GRADING

1. Evaluation will be based on:
   1) class participation (50%), including participation in the discussion of assigned literature each week (300 points possible)
   2) 50% on producing a cogent NIH F31-style research proposal that focuses on the mechanism of drug action. The course director will read and provide a critique and assign a score out of 300 points. Instruction on writing the grant proposal will be provided during the first few weeks of the course. Additionally, each discussion session will be focused on providing students with an approach to understanding the mechanism of action of a particular drug or small molecule. Based on the methodologies presented, students should be able to assemble a grant proposal to study the mechanism of action of a drug of their choice. A final draft of the proposal will be due during week 15 of the course. The proposal will be graded based on: 1) background provided on the drug selected (literature review; 150 points) and 2) approaches described and whether they would enable a feasible assessment of the mechanism of drug action (150 points).

2. Since a large portion of the grade depends on class participation, evaluation will be conducted under the following guidelines (each instructor will provide a score for participation during each class):

   300 points: This student was present for every class, always completes assigned readings, and comes to class prepared to think carefully, making connections between readings and across topics. He or she is willing to take the lead in discussion periodically, posing interesting questions or taking risks by answering tough questions. He or she avoids dominating discussion, instead participating mindfully in discussion with other students, considering their ideas and responding thoughtfully and respectfully. He or she helps to create a sense of a shared conversation in the group as a whole. This student shows passion for the work of the class and is committed fully to our work while in the classroom.

   260 points: This student does most of what a 300 pt. student does, but may be slightly deficient in one area – for instance, he or she may be a conscientious reader and thinker
who tends not to listen to other students or otherwise dominates conversation instead of engaging in productive deliberation. Or, he or she may have been late to class a few times, or may have missed a reading or two which limited contributions to discussions on occasion.

220 points:  This student participates often, but not consistently. He or she may attend every class and do all the readings but avoids taking the lead in discussion, instead only responding to questions or adding periodically to others’ ideas. This student may participate well, but may have missed a class and failed to submit the makeup assignment.

180 points:  This student may be a frequent but superficial discussion participant. The student may let shyness keep him or her from participating as fully as he or she should. At times the student may seem not to have done the readings, though he or she usually comes prepared.

140 points:  This student is intermittently prepared for class (e.g., participates well but has missed two classes without submitting a makeup assignment). He or she may have flashes of brilliance, but rarely participates beyond the occasional superficial comment.

100 points:  This student very rarely participates, and only in superficial ways.

<100 points:  This student has missed three classes without submitting a makeup assignment and/or attends most classes but never participates.

***Each instructor will be provided a handout with pictures of all students in the class and whether they are undergraduate or graduate students. This will enable the instructors to keep track of student participation. Scores and brief comments regarding participation of each student will be submitted to the course director within 24 hours after the discussion session. The course director will convey scores/comments to each student, so they can learn their strengths and weakness. As is necessary, the course director will also include suggestions for improvement.

3. Letter grades of A, AB, B, BC, C, D and F will be assigned based on the cumulative points earned in the course (out of a maximum of 600 points each semester) – the grading scale is identical for undergraduate and graduate students. A: 100 - 90%, AB: 89 – 83%, B: 82 – 76%, BC: 75 – 69%, C: 68 – 62%, D: 61 – 55%, F: below 55%

Note: Based on the broad topics covered in this course, experts in each area have been recruited to teach. Although this entails bringing in a large number of lecturers to the course, the experience of each instructor is critical to clearly illustrate the mechanisms of drug action in the various areas of Pharmacology. The course director has discussed this issue with all instructors involved, and a similar format will be used for all meetings (50-60 minutes of lecture, followed by 50-60 minutes of discussion of relevant literature). Although teaching styles will vary, the importance of having experts lead each topic outweighs continuity of having only a few lecturers that lack expertise in one or more areas to be covered.

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

- There are no required textbooks or software. However, each instructor will assign readings from primary literature that are relevant to the topic to be discussed. For
examples, see representative list of readings below. All readings will be made available to students on-line (using a shared ‘Box’ folder). Presentations given by professors will also be shared via ‘Box’.

Representative list of readings


EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

- There are no quizzes, but a final NIH-style grant proposal must be submitted and evaluated. As described earlier, instructions on grant writing will be included as part of this course, and feedback will also be provided on preliminary drafts submitted by students.

HOMEWORK & OTHER ASSIGNMENTS

The major out of class homework will be reading primary literature assigned by each professor. Students must be prepared to discuss the manuscripts assigned in detail and participate extensively in classroom discussions.

OTHER COURSE INFORMATION

- None.

RULES, RIGHTS & RESPONSIBILITIES

- See the Guide’s to Rules, Rights and Responsibilities

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.
ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world. https://diversity.wisc.edu/
<table>
<thead>
<tr>
<th>WK</th>
<th>DATE/</th>
<th>TOPICS</th>
<th>INSTRUCTORS</th>
<th>SECTION</th>
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</table>
| 1  | January 21 | Pharmacology of β3AR in brown adipose tissue  
Discussion (literature paper)  
**Drugs:** B3-adrenergic receptor agonists mirabegron and CL-316243 for weight loss | Simcox  
Simcox and students | Metabolic Pharmacology |
| 1  | January 23 | Instruction on grant writing  
Discussion | Audhya  
Audhya and students | Miscellaneous Pharmacology |
| 2  | January 28 | Pharmacology of the Immune System  
Discussion (literature paper)  
**Drugs:** Steroids, NSAIDs, anti-IL1, anti-TNF, and anti-IL6 | Huttenlocher  
Huttenlocher and students | Neuro Pharmacology |
| 2  | January 30 | Pharmacology of Neurotoxins  
Discussion (literature paper)  
**Drugs:** Botulinum neurotoxins A-G (and beyond), tetanus toxin | Chapman  
Chapman and students | Neuro Pharmacology |
| 3  | February 4 | CSF1R inhibitors and the effects on microglia  
Discussion (literature paper)  
**Drugs:** Perxivadartininib, BLZ-945 | Collier  
Collier and students | Neuro Pharmacology |
| 3  | February 6 | Pharmacology of Parkinson’s Disease  
Discussion (literature paper)  
**Drugs:** L-dopa, Carbidopa, Entacapone, Selegiline, alpha-synuclein | Johnson  
Johnson and students | Neuro Pharmacology |
| 4  | February 11 | PI3 Kinase in neurodevelopment and disorders  
Discussion (literature paper)  
**Drugs:** PI3 Kinase/AKT/MDM2 in neurodevelopment and disorders | Zhao  
Zhao and students | Neuro Pharmacology |
| 4  | February 13 | Pharmacology of Pain and Reward  
**Drugs:** Opiods | Wentthur  
Wenthur and students | Neuro/Immuno Pharmacology |
| 5  | February 18 | Mass Spectrometry in Neuropharmacology  
Discussion (literature paper)  
**Mass spec technologies for low-level endogenous neuropeptide discovery, sequencing, quantitation and spatial distribution** | Li  
Li and students | Neuro/Immuno Pharmacology |
| 5  | February 20 | Pharmacology of Pluripotency  
Discussion (literature paper)  
**Drugs/chemicals:** Ascorbic Acid, MEK and GSK inhibitors, and DotI methyltransferase inhibitor | Sridharan  
Sridharan and students | Miscellaneous Pharmacology |
| 6  | February 25 | Pharmacology of Cardiac Regeneration  
Discussion (literature paper)  
**Drugs/Targets:** Cell cycle activators, Hippo signaling inhibition | Mahmoud  
Mahmoud and students | Cardio Pharmacology |
| 6  | February 27 | Pharmacology of Heart Development and Disease  
Discussion (literature paper)  
**Drugs:** Neuregulin1, Trastuzumab, and ErbB receptors in heart development and disease | Lee  
Lee and students | Cardio Pharmacology |
| 7  | March 3 | Pharmacology of HCN Channels  
**Drugs/chemicals:** Ivabradin, other therapeutical applications and pathological significance | Glukhov  
Glukhov and students | Cardio Pharmacology |
| 7  | March 5 | Pharmacology of Cardiovascular Disease  
Discussion (literature paper)  
**Drugs:** β-adrenergic – propranolol, metoprolol, albuterol | Kamp  
Kamp and students | Cardio Pharmacology |
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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Literature paper</th>
<th>Instructor</th>
<th>Course</th>
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<tbody>
<tr>
<td>8</td>
<td>March 10</td>
<td>Pharmacological Control of Hematopoiesis</td>
<td>Discussion (literature paper)</td>
<td>Bresnick Bresnick and students</td>
<td>Cardio Pharmacology</td>
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<td></td>
<td>March 12</td>
<td>Anti-mitotic agents in Cancer Pharmacology</td>
<td>Discussion (literature paper)</td>
<td>Weaver Weaver and students</td>
<td>Cancer Pharmacology</td>
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<td></td>
<td>March 12</td>
<td>Anti-mitotic agents in Cancer Pharmacology</td>
<td>Drugs: Taxanes, vinca alkaloids</td>
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<td></td>
<td>March 24</td>
<td>Pharmacology of Ubiquitin Ligase and Targeted Protein Degradation</td>
<td>Drug: Thalidomide, dBET1</td>
<td>Tang and students</td>
<td>Cancer Pharmacology</td>
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<td></td>
<td>March 26</td>
<td>Pharmacology of Diabetes</td>
<td>Drug: Recombinant insulin(s), sulfonylureas, and stable GLP-1 analogs/DPP4 inhibitors</td>
<td>Kimple and students</td>
<td>Metabolic Pharmacology</td>
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<tr>
<td></td>
<td>March 31st</td>
<td>Pharmacology of Epigenetics</td>
<td>Drug: DNMT inhibitors (Azacytidine) and histone deacetylase inhibitors</td>
<td>Svaren and students</td>
<td>Cancer Pharmacology</td>
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<tr>
<td>10</td>
<td>April 2</td>
<td>Jon will work with the students on finalizing grant proposals</td>
<td>Workshop</td>
<td></td>
<td>Miscellaneous Pharmacology</td>
</tr>
<tr>
<td>11</td>
<td>April 7</td>
<td>Precision medicine in Cancer Therapy</td>
<td>Drug: Trastuzumab, crizotinib, and PARPi</td>
<td>Burkard Burkard and students</td>
<td>Cancer Pharmacology</td>
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<tr>
<td>11</td>
<td>April 9</td>
<td>Mass Spectrometry in Pharmacology – Mass Spec for characterization of antibody-drug conjugates</td>
<td></td>
<td>Ge and students</td>
<td>Miscellaneous Pharmacology</td>
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<tr>
<td>12</td>
<td>April 14</td>
<td>Pharmacology of Aging</td>
<td>Drug: Rapamycin, Metformin, Resveratrol, Farnesyltransferase inhibitors (treatment for Progeria), Senolytics like navitoclax or Hsp90 inhibitors</td>
<td>Moore and students</td>
<td>Miscellaneous Pharmacology</td>
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<tr>
<td>12</td>
<td>April 16</td>
<td>Pharmacology of NF-kappaB signaling</td>
<td>Drug: Proteasome inhibitors - Bortezomib, ixazomib, carfilzomib</td>
<td>Miyamoto Miyamoto and students</td>
<td>Miscellaneous Pharmacology</td>
</tr>
<tr>
<td>13</td>
<td>April 21</td>
<td>Pharmacology of HIV and other viruses</td>
<td>Drug: antiviral nucleoside analogs (acyclovir, AZT), HIV protease and integrase inhibitors, flu antivirals (adamantadine, oseltamivir/Tamiflu), HCV antiviral cure drugs (ribavirin, telaprevir, interferon)</td>
<td>Sherer Sherer and students</td>
<td>Miscellaneous Pharmacology</td>
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<tr>
<td>13</td>
<td>April 23</td>
<td>Pharmacology of Natural Products</td>
<td>Drug: Using chemical genomics to understand the mechanism of action of natural products</td>
<td>Bugni Bugni and students</td>
<td>Miscellaneous Pharmacology</td>
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<tr>
<td>14</td>
<td>April 28</td>
<td>Pharmacology of DNA Repair and Chemosensitization</td>
<td>Drug: cyclophosphamide, methotrexate, cisplatin, doxorubicin, and etoposide</td>
<td>Tibbetts Tibbetts and students</td>
<td>Miscellaneous Pharmacology</td>
</tr>
<tr>
<td>14</td>
<td>April 30</td>
<td>Pharmacology of sex steroid hormones in brain development, function, and disease</td>
<td>Drug: sex steroid hormones in brain development, function, and disease</td>
<td>Werling Werling and students</td>
<td>Miscellaneous Pharmacology</td>
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May 6 | **FINAL RESEARCH PROPOSAL DUE** |