USC School of Pharmacy

RXRS 420: Organ Physiology, Drug Delivery, and Drug Action

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Office hours: 3 hours per week

Course Weight: 4 Units (course meets 3 hours per week)

Day/Time/Location: TUE/3:30-6:20 p.m./VKC256

Introduction
An understanding of the physiology of organ systems underlies the understanding of drug delivery routes and drug action and is a cornerstone of the field of biopharmaceutics. This course will integrate basics of cell and organ physiology, the pharmacology of a number of widely used drugs, and drug delivery, all discussed in the context of these organ systems. These principles and concepts will be covered through the discussion of 4 major organ systems: cardiovascular, gastrointestinal, renal, and respiratory.

Objectives
This course is designed for upper-level undergraduate and early graduate students who are interested in organ physiology, therapeutics, and drug delivery. USC students who are pursuing a career in health or biological science majors, such as pharmacy or medical professions, would be most appropriate. In addition, this course would be of interest for early stage Master students in health/biological sciences.

Upon successful completion of this course, the student should be able to demonstrate a working knowledge of:

1. The basic principles cell physiology: ion and water transport, muscle contraction.
2. The basic concepts and principles of traditional drug delivery routes.
3. The basic physiology of the following organ systems: cardiovascular, gastrointestinal, renal, and respiratory.
4. The mechanism of action of the most popular, therapeutically relevant drugs acting on these organ systems.
Assignments and Grading:

5 quizzes @ 8 pts each: 40 pts (20%)
2 midterm exams @ 50 pts each: 100 pts (50%)
1 final exam: 60 pts (30%)

Total: 200 pts (100%)

Attendance at all classes is expected and may be considered when assigning final grades. Participation will include asking and answering questions and being actively involved in the discussion. It is expected that the students read the assigned papers and book chapters prior to the lecture and be prepared to discuss background, current understanding, treatments, and gaps in knowledge for the topic in each lecture.

There will be 5 quizzes, two mid-term examinations and one final examination for this course. One of the quizzes with the lowest outcome will not be included in the grade. The questions for quizzes and exams will primarily be based on the lecture content and text books. The midterms (50 points each) and the final exam (60 points) will include multiple choice questions, fill-in the blank questions (all 2 points each), and 1 short essay (10 points).

There are no make-up exams. If exceptional circumstances prevent you from attending an exam, your reason for missing it must be accompanied by a written statement from a third party (e.g., a note from a medical doctor).

Notes, books, calculators, electronic dictionaries, regular dictionaries, cell phones, or any other aids are not allowed during exams.

Students will be asked to complete an anonymous critical evaluation of the course at its completion.

Course Readings

Required Readings

- Cellular Physiology and Neurophysiology, 2nd ed. Mordecai P. Blaustein, Joseph P. Y. Kao, and Donald Matteson. ISBN: 9780323057097
Course Outline

This course will be in the format of a directed seminar/lecture under the guidance of the instructor for the specific session. During each weekly session the instructor will engage the students with questions and draw comments or interpretations primarily based on the assigned reading. Students are expected to ask questions and participate in an interactive fashion. In general, the first two hours of lecture will review organ physiology and anatomy; the third hour will focus on drug delivery and drug action.
<table>
<thead>
<tr>
<th>Week &amp; Date</th>
<th>Topic</th>
<th>Subtopics to be Included</th>
<th>Assigned and Supplemental Reading</th>
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</thead>
<tbody>
<tr>
<td>Week 1 Tue. 8/21/18</td>
<td>Introduction to the cell membrane and membrane transport; Introduction to intracellular signaling</td>
<td>Introduction to the principles of membrane transport and electrophysiology. Introduction to the principles of intracellular signaling pathways</td>
<td>Berne &amp; Levy, Ch. 1, 2, 5, 6 G&amp;G, Ch. 3, 5</td>
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<td>Week 2 Tue. 8/28/18</td>
<td>Muscle contraction</td>
<td>Introduction to the principles of muscle contraction: skeletal, cardiac, and smooth muscles</td>
<td>Berne &amp; Levy, Ch. 12, 13, 14</td>
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<td>Week 3 Tue. 9/04/18</td>
<td><strong>Quiz 1</strong> Basic principles of drug delivery and drug transport</td>
<td>Introduction to the principles of traditional routes of drug delivery.</td>
<td>Shargel, Ch. 7, 10, 13 G&amp;G, Ch. 1, 2, 3</td>
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<td>Week 4 Tue. 9/11/18</td>
<td><strong>Quiz 2</strong> Basic principles of drug action signaling and of drug action</td>
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<td>Berne &amp; Levy, Ch. 3 G&amp;G, Ch. 3</td>
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<td>Week 5 Tue. 9/18/18</td>
<td>Autonomic nervous system</td>
<td><strong>In Class Midterm 1 (Dr. Okamoto)</strong> Overview of the autonomic nervous system</td>
<td>Berne &amp; Levy, Ch. 11</td>
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<td>Week 6 Tue. 9/25/18</td>
<td>Cardiovascular physiology</td>
<td>Overview of circulation and cardiac function Overview of the regulation of the heart action and vasculature Antihypertensives, antiarrhythmics, anticoagulants</td>
<td>Berne &amp; Levy, Ch. 15, 16, 17, 18 G&amp;G, Ch. 28, 30, 32</td>
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<td>Week 7 Tue. 10/02/18</td>
<td><strong>Quiz 3</strong> Cardiovascular physiology</td>
<td>Integrated control of the cardiovascular system</td>
<td>Berne &amp; Levy, Ch. 19</td>
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<td>Week 8 Tue. 10/09/18</td>
<td>Gastrointestinal physiology</td>
<td>Functional anatomy and general principles of regulation in the gastrointestinal tract</td>
<td>Berne &amp; Levy, Ch. 26</td>
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<td>Week 9 Tue. 10/16/18</td>
<td><strong>Quiz 4</strong> Gastrointestinal physiology</td>
<td>Integrated response to a meal</td>
<td>Berne &amp; Levy, Ch. 27, 28, 29, and 30 G&amp;G, Ch. 49, 50</td>
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<td>Week 10 Tue. 10/23/18</td>
<td>Gastrointestinal physiology</td>
<td><strong>In Class Midterm 2 (Dr. Okamoto)</strong> Transport and metabolic functions of the liver Statins, anticoagulants</td>
<td>Berne &amp; Levy, Ch. 31 G&amp;G, Ch. 6, 33, 32, 50</td>
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<td>Week 11 Tue. 10/30/18</td>
<td>Renal physiology</td>
<td>Elements of renal function, solute and water transport along the nephron: tubular function</td>
<td>Berne &amp; Levy, Ch. 32, 33</td>
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<td>Week 12 Tue. 11/06/18</td>
<td><strong>Quiz 5</strong> Renal physiology</td>
<td>Control of body fluid osmolality and volume Diuretics, antihypertensives</td>
<td>Berne &amp; Levy, Ch. 34 G&amp;G, Ch. 25, 28</td>
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<td>Week 13 Tue. 11/13/18</td>
<td>Renal physiology</td>
<td>Control of electrolyte and pH balance</td>
<td>Berne &amp; Levy, Ch. 35, 36</td>
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<td>Week 14 Tue. 11/20/18</td>
<td><strong>Quiz 6</strong> Respiratory physiology</td>
<td>Structure and function of the respiratory system, mechanical properties of the lung and chest wall Routes of drug delivery to the lungs</td>
<td>Berne &amp; Levy, Ch. 20, 21 G&amp;G, Ch. 40</td>
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<td>Week 15 Tue. 11/27/18</td>
<td>Respiratory physiology</td>
<td>Ventilation-perfusion relationships, oxygen and carbon dioxide transport, control of respiration Bronchodilators, corticosteroids, antihypertensives</td>
<td>Berne &amp; Levy, Ch. 22, 23, 24 G&amp;G, Ch. 31, 40</td>
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Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems
A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Emergency Preparedness/Course Continuity:
In case of emergency, and travel to campus is difficult, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies. Instructors should be prepared to assign students a "Plan B" project that can be completed at a distance. For additional information about maintaining your classes in an emergency please access: http://cst.usc.edu/services/emergencyprep.html