

ULM College of Pharmacy

Fall 2023

Principles of Drug Action-1 PHRD 4002 CRN# 41556

Contact Information**Course Coordinator:**

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I. Course Pre-requisites/Co-requisites

Pre-requisites - Credit or registration in PHRD 4020

II. Course Description

PRINCIPLES OF DRUG ACTION I. 4 cr. This course focuses on molecular-level function and processes as relates to rational and successful therapeutic intervention with medicinal substances.

III. Curricular Objectives and Outcomes

CAPE Domain 1 – Foundational Knowledge

1.1. Learner (Learner) - Develop, integrate, and apply knowledge from the foundational sciences (i.e., *pharmaceutical, social/behavioral/administrative*, and *clinical sciences*) to evaluate the scientific literature, explain drug action, solve therapeutic problems, and advance population health and *patient-centered care*.

ACPE APPENDIX 1 (Refer to Appendix at www.examsoft.com/ulmcp)

IV. Course Specific Objectives and Outcomes ACPE Appendix 1 required element

Biochemistry

Structure, properties, biological functions, applicable kinetics. Application of these concepts to identify endogenous targets for drug therapy and rational drug design strategies.

Medicinal Chemistry

Chemical basis of drug action and behavior in vivo and in vitro, with an emphasis on pharmacophore recognition and the application of physicochemical properties, structure-activity relationships, intermolecular drug-receptor interactions and biotransformation (“drug metabolism”) to therapeutic decision- making.

Pharmaceutics/Biopharmaceutics

Physicochemical properties of drugs, routes of administration, bioavailability, and biodistribution, excretion.

Pharmacogenomics/genetics

Genetic basis for disease and individual differences in metabolizing enzymes

Pharmacology

Pharmacodynamics, mechanisms of therapeutic and adverse drug actions and interactions

At the conclusion of this course, students should be able to:

Describe selected structural and functional characteristics of some of the important types of molecular targets of drug action:

- (1) enzymes
- (2) selected receptor types (cf. PHRD 4027 - Principles of Drug Action II).

Describe structural and functional characteristics of important macromolecular assemblages and tissue microstructures as affects drug absorption, distribution, biotransformation, and excretion:

- (1) cellular and intracellular lipid membranes;
- (2) enzymes catalyzing biotransformation (“drug metabolism”).

Given a molecular structure of a drug molecule, demonstrate rudimentary abilities to rationalize and make reasonable structure-based predictions concerning ...

- (1) aqueous solubility and relative hydrophilicity/lipophilicity;
- (2) ease of access to various tissues;
- (3) prospectively viable routes of administration.

Course outcomes, contd.

- With respect to acidic and basic properties of structural moieties incorporated within drug molecules and macromolecular drug targets, demonstrate a knowledge of approximate pK_a s for commonly encountered ionizable structural moieties (in drug and physiologically extant molecules), and the corresponding molecular species distribution as a function of pH (i.e., approximate proportions of ionized, un-ionized, and—if applicable—amphoteric forms).
- Given a molecular structure of a drug molecule, describe its stereochemical attributes, and potential pharmacological and biopharmaceutical significances thereof.
- As pertains to molecular recognition (including drug-target interactions), describe the significances of conformation changes involved in binding events, the types and strengths of intermolecular forces that occur between a ligand (drug or other) and its macromolecular binding site, the enthalpic and entropic gains and penalties involved in molecular recognition and the relationship of these to binding affinity, micro rate constants associated with binding interactions and significances thereof with respect to molecular pharmacodynamics, and the basis of hydrophobic interactions.
- Define and differentiate affinity and intrinsic activity (molecular-level efficacy), describe how these concepts relate to the associated concepts of agonism, antagonism, partial agonism, and inverse agonism, and further describe in general how these concepts are related to the patient-level actions (observed clinical pharmacology) of drugs.
- Define the concept of pharmacological selectivity, describe the molecular bases for selectivity from both the drug and target aspects, and describe the general clinical significance of selectivity.
- Define the concept of molecular-level equilibrium, and how such equilibria are affected by Gibbs free energy changes for molecular-level processes and transformations.
- Define the basic mathematical terms commonly encountered in descriptions of the kinetic characteristics of enzymes, and their meaning from a biochemical, drug action, and drug biotransformation (drug metabolism) perspective.
- Demonstrate an understanding of the distinct mechanistic types of enzyme inhibitors, and the consequences of these mechanistic type disparities in terms of the biochemical pharmacology of drugs that modulate enzymes.
- Define allosteric cooperativity, and describe the significance of such cooperativity to molecular cellular physiology and the biochemical pharmacology of drug action.
- Provide a list of drug-associated and tissue-associated factors affecting access by drugs to particular organs of the body, including access to the body (i.e., bioavailability).
- Describe the general physiological purposes of drug biotransformation (“drug metabolism”), and define and differentiate Phase I and Phase II biotransformation, including the nature of the chemical transformations involved with each.
- Given the molecular structure of a drug molecule, be able to predict likely or excluded routes of biotransformation.
- Describe, in general terms, the significance of drug biotransformation with respect to pharmacokinetics.
- List major sources of individual variation and drug-drug or drug-xenobiotic interactions that may arise as a result of effects on drug biotransformation, and outline the practical significance of each of these sources.

V. Course Topics

See a listing in the Course Schedule (Section X below).

VI. Instructional Methods and Activities

Instructional methods will include: traditional and technology-based content presentations, generally aiming to be highly interactive in nature, and various formative exercises designed to invoke active learning, including outside homework/study assignments that in most cases will not be collected for a grade. Molecular modeling software such as PyMol may be used for visualization of three-dimensional structure of protein and drug molecules. Microsoft Excel will be used for plotting graphs and for active learning exercises. Zoom or Microsoft Teams may be used for distance-based learning interactions or activities.

VII. Evaluation and Grade Assignment

Exam 1	100 points	(Barabutis/Shah)
Exam 2	100 points	(Shah)
Exam 3	100 points	(Barabutis)
Exam 4	100 points	(El Sayed)
Class Exercises, Quizzes, Assignments*	Up to 50 points	(Course Faculty)
Total	~450 points*	

** Quizzes/assignments will be given as deemed necessary by each faculty member. The points available from these quizzes and assignments will be added to the denominator for the total number of points available from the course, and course grade calculated accordingly. Quiz grades will generally be available within 1-2 days.*

According to university guidelines (as given in *The University of Louisiana at Monroe 2017-2018 Graduate Catalog*, wherein the Pharm.D. program is currently listed as a professional degree program), grades should reflect the following:

A - EXCELLENT B - AVERAGE C - BELOW AVERAGE
D - POOR F- FAIL

Grading will be straight-scale:

>89.5% = A 79.5%–89.4% = B 69.5%–79.4% = C

59.5%–69.4% = D <59.5.% = F

Mid-term grades will be posted online for students to view via Banner. *Mid-term grades indicate a student's status at mid-semester only.*

Exams.

Four examinations will be administered during the course. Exams will emphasize topics as mentioned in the class schedule, but **beginning with Exam 2, will have some degree of comprehensive coverage**, the nature of which will be communicated to you soon enough for any needed review.

- *Exam dates are as scheduled in the course syllabus and will only be changed in the event of University closure.*
- *Exams may be multiple-choice, fill-in-the-blank, short-answer, case- or scenario-based discussion, essay, or any other format deemed necessary by the faculty members and Course Coordinator. The final exam will be exclusively multiple-choice.*

- Exams **will** cover material (readings, outside assignments) not necessarily covered fully or directly during class (questions concerning any such materials are always welcomed, and in this regard, please **note content-level objectives**).
- Knowledge acquired from previous portions of the course and from other courses in the professional pharmacy curriculum, or prior studies as reviewed during this course, may be needed in preparing for these examinations; in general, such knowledge will be prominently noted.
- Exams will be issued using Exam Soft, and conducted using ExamSoft/Examplify on your portable computer or tablet. All students are required to download the testing file well in advance of the time of the scheduled exam. **If a student cannot take the exam that has already been downloaded at the scheduled date and time, the student must not under any circumstances open the examination (this would constitute academic dishonesty, fully prosecutable as such).** The student must reverse-download the exam, without having opened it, at earliest pragmatically possible opportunity (i.e., you are with your computer and an internet connection is available to you).
- **Screen privacy covers must be used during exams and during any other activity during which computers are used as part of a grade-generating exercise.** Please also anticipate the probable use of seating charts for examinations.
- For examinations and some quizzes, official scratch paper will be issued on the day of the exam. All students are required to **legibly** print and sign the scratch paper and return it to the exam proctor prior to leaving the room, **even if otherwise unused**, as evidence of their in-person attendance. Any other papers available during the exam (e.g., equation sheets or extra pieces of scratch paper supplied by the proctors upon request) must also be returned prior to exiting the testing room. No other paper items will be allowed during the exam unless supplied by the faculty administering the exam.
- For exams and some quizzes, when turning in this sheet, students will also be required to show a proctor that the exam/quiz has been irreversibly closed, and also uploaded, before leaving the room; in the event of a power outage or loss of Wi-Fi connection, students are required to upload the exam/quiz at the earliest possible reconnection time, however proof of exam closeout will be required prior to leaving the classroom.
- During exams as well as during any grade-generating activities, the use of programmable calculators and electronic devices capable of storing, receiving, or transmitting data are prohibited unless expressly authorized by the course instructor. Such devices must be turned off and placed in a location that is not readily accessible to you during the activity.
- Other selected items will typically be allowed and possibly needed during an exam, such as an approved calculator or molecular models. Faculty will disseminate a list of such allowable items in advance, and you are always welcome to inquire.
- All exams must be irreversibly closed, and preferably uploaded before leaving the classroom; in the event of a power outage or loss of Wi-Fi connection all students are required to upload the exam at the earliest possible reconnection time, however proof of exam closeout will still be required prior to leaving the classroom.
- Exams will NOT be returned to the student. But, contributing instructors will have a copy of the exam and access to students results, and students may view their exam results (including correct/incorrect answers) in instructors' offices, and discussed (an important learning opportunity!) at times convenient and acceptable for all involved. The instructor may in addition conduct one or more group debriefing sessions, outside of regular class time. During such opportunities, students may also discuss exam questions with the instructors who authored them; however, any official "challenges" of questions must be done in writing. (See below)
- Problems or issues with a question should be first directed, via e-mail, to the person who authored it. The student should copy the Course Coordinator on any such Email messages, but it is the responsibility of the question's author to address the concern(s). In a written challenge, the student is expected to include references or rationale to support their challenge of the question. The challenge will be reviewed by the faculty member, and his or her decision will be shared with the

Course Coordinator. Any further discussion of a formal appeal will occur only after the written query is submitted.

- Appeals for questions from the first 3 exams will be accepted no later than one week prior to the Final Exam.
- **Dropped (or otherwise redressed) Test Questions.** When, due to faculty concerns regarding a question appearing on an administered examination, or as the result of a student-generated appeal or challenge that is judged to be valid and of merit by course faculty, the question will generally be omitted from the grade calculation for all students. The total points for the course may be reduced, or credit may be awarded to all students, or partial credit may be awarded for some answers, or the question may be made bonus, without altering **the percentages required to earn a particular course grade**, as given above in section VIII. Course faculty reserve the right to deviate further from these general guidelines, however, according to their professional judgement as pertains to the specifics of the issue with the question deemed to be flawed, or with the aim of maintaining the weighting of each individual exam as a component of the overall course grade.
- Assignments should be turned in according to the coordinator or instructor's set deadline. Late assignment submission will have a penalty or receive zero points. Students should contact the instructor or coordinator if there are any special circumstances that hinder the submission of assignments.

Student Success Policy: <http://www.ulm.edu/pharmacy/currents.html>

Remediation Policy: <http://www.ulm.edu/pharmacy/currents.html>

VIII. Other Class Policies and Procedures

At a minimum, all policies stated in the current ULM *Student Policy Manual & Organizational Handbook* should be followed (see <http://www.ulm.edu/studentpolicy/>).

- **Preparation for class.** For each class period, you will typically be held responsible for varying degrees of **prior preparation**, involving: (1) viewing any e-presentations as may be assigned in advance; (2) completing one or more advance readings if assigned as preparation for a particular class; (3) answering or attempting to answer any assigned pre-class study questions. Pre-class and post-class study assignments will be constrained to a modest length, and will serve to illustrate and elaborate key concepts, emphasizing application, in accord with specific content objectives provided. **You should plan for a minimum of 7-8 hours per week of outside study time in support of your learning in this class; some students may find that they need more time than this in some topic areas, depending in part on strength of pertinent prior academic preparation.** Assignments and any needed materials (notes, handouts, study questions) will typically be posted on Moodle at least several days in advance. You should, however, habitually check the Moodle page the evening before class for any possible corrections or clarifications.
- **Portable Computers and Response Devices.** Exercises conducted on portable computers ("laptops" or equivalent) may occur on any given day to generate grades for certain activities (such as a quiz). Therefore, please bring your computer to every class period; if you do not have it, you may not be afforded an alternative means to provide responses (i.e., you may earn a '0' on the graded activity). For some formative activities, it may be possible and fruitful to use an alternative response device (such as a cellular phone).

Additional class policies include:

a. Textbook(s) and Materials:

In addition to the required textbooks listed below, various materials will be provided online via the Moodle portal.

Required textbook (online edition available via AccessPharmacy): Goodman & Gilman's *The Pharmacological Basis of Therapeutics*, 13th Edition (2018). Laurence L. Brunton, Bruce A. Chabner, Björn C. Knollmann, eds. McGraw-Hill Professional; ISBN 978-1-25-958473-2.

Required textbook: Graham L. Patrick. *An Introduction to Medicinal Chemistry*, 7th edition (2023). Oxford University Press; ISBN: 978-0-19-886666-4 (Paperback)

Required textbook: Marc W. Harrold, Robin M. Zavod. *Basic Concepts in Medicinal Chemistry, 2nd Edition* (2018). American Society of Health-Systems Pharmacists (Bethesda, Maryland). ISBN: 978-1-58528-601-0 (paperback)

Reference textbook: Lemke TL, Williams DA, eds. Foye's Principles of Medicinal Chemistry, 8th edition, Lippincott Williams & Wilkins, 2019. ISBN 9781496385024 8th ed. Baltimore, MD: Lippincott Williams and Wilkins; 2013. Electronic version available at <http://pharmacy.lwwhealthlibrary.com>

Reference Textbook: Wilson & Gisvold's *Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition*, Baltimore, MD: Lippincott Williams and Wilkins 2011. ISBN 978-0-7817-7929-6.

Reference textbook (online edition available via AccessPharmacy): *Harper's Illustrated Biochemistry*, 31 Edition (2018). Michael Weitz and Regina Y. Brown, eds. McGraw-Hill Education; ISBN 978-1-259-83793- 7.

Purchase of the Examsoft Examplify® software is also required.

- b. Attendance Policy:** Class attendance is regarded as an obligation as well as a privilege, and students are expected to know attendance regulations and to attend regularly and punctually at classes in which they are enrolled. Failure to do so may: (1) prevent access to the classroom during regularly scheduled times; (2) jeopardize a student's scholastic standing; and (3) lead to suspension from the School or University. Students must submit excuses for class absences to course coordinators within three class days after returning to classes.

Professors shall accept an official University excuse. With the following exceptions, professors are to determine whether absences are excused or unexcused: 1) Absences arising from authorized trips away from the University or from special duties at the University shall be excused. 2) Absences arising from a student's confinement in a hospital or other in-patient facility or doctor's excused absences shall be excused. Students are responsible for providing documentation to the faculty, the authenticity and validity of which can be (and will be) verified. 3) Absences arising from a death in the immediate family shall be excused, provided such documentation is supplied. The immediate family is defined as spouse, child, step-child, mother, father, sister, brother, grandmother, grandfather, step-mother, step-father, step-brother, step-sister, aunt, uncle, mother-in-law or father-in-law.

- c. **Make-up Policy:** Each student is expected to attend each exam at the date and time specified. If a student cannot attend an exam due to valid University excuse (see above), he/she must speak directly with the Course Coordinator, **prior** to an examination unless circumstantially impossible, otherwise as soon as pragmatically possible. Further, the ULM College of Pharmacy Excused Absence Policy must be followed; please refer to this official document for details. In arranging for a makeup, failure to make timely contact with the Course Coordinator may result in the awarding of a zero (0) grade for that exam. Make-up exams will be prepared at the same or higher level than the original exam, and may be in a disparate or alternative format. Failure to attend a scheduled make-up exam will result in a zero (0) grade for that exam. Students missing an exam due to a University approved excuse will typically take the make-up exam during the week prior to final exams, or as determined by the Course Coordinator in coordination with course faculty.
<http://www.ulm.edu/pharmacy/currents.html>
- d. **Academic Integrity:** Faculty and students must observe the ULM published policy on Academic Dishonesty (see Page 4 of the ULM *Student Policy Manual* - <http://www.ulm.edu/studentpolicy/>). All professional students will adhere to the standards set forth in the College of Pharmacy's Code of Conduct (<http://www.ulm.edu/pharmacy/currents.html>).
- Censures (Penalties)
Academic dishonesty will result in a referral to the Committee on Ethics and Academic Standards with a recommendation for a grade of "F" for the course and expulsion from the College of Pharmacy. Academic dishonesty includes, but is not limited to, the use of information taken from others' work or ideas, the provision of help to others on non-collaborative evaluations (tests, quizzes, etc.), collaboration on take home exams, or the use of unapproved information or electronic devices to assist in obtaining an answer to the question
- e. **Course Evaluation Policy:** At a minimum, students are expected to complete the online course evaluation.
- f. **Student Services:** Information concerning student services in the College of Pharmacy can be found in the College of Pharmacy Student Handbook. In particular, students should pay special attention to the University's technical standards and policies concerning students with special needs (<http://www.ulm.edu/studentpolicy/studentpolicy.pdf>). ULM student services, such as the Student Success Center (<http://ulm.edu/cass/>), Counseling Center (<http://ulm.edu/counselingcenter/>), and Student Health Services, is available at the following Student Services web site <http://ulm.edu/studentaffairs/>. Students with special needs requiring accommodations MUST follow the process described at <http://rxweb.ulm.edu/pharmacy/student/specialneeds.pdf>.

Mental Wellness on the ULM Campus

If you are having problems with emotional, social, and/or behavioral issues please call any of the mental health clinics on the ULM campus to make an appointment. All services are free to ULM students, staff, and faculty, and are strictly confidential.

- COP Office of Student and Professional Affairs: 342-3800
- ULM Counseling Center: 342-5220
- Marriage and Family Therapy Clinic: 342-5678
- Community Counseling Center: 342-1263
- ULM HELPS (Helping Educators and Learners Prevent Suicide) Project Office: 342-1335

The University of Louisiana at Monroe strives to serve students with special needs through compliance with Sections 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act. These laws mandate that postsecondary institutions provide equal access to programs and services for students with disabilities without creating changes to the essential elements of the curriculum. While students with special needs are expected to meet our institution's academic standards, they are given the opportunity to fulfill learner outcomes in alternative ways. Examples of accommodations may include, but are not limited to, testing accommodations (oral testing, extended time for exams), interpreters, relocation of inaccessible classrooms, permission to audiotape lectures, note-taking assistance, and course substitutions.

Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds, including federal loans and grants.

Furthermore, Title IX prohibits sex discrimination to include sexual misconduct, sexual violence, sexual harassment and retaliation. If you encounter unlawful sexual harassment or gender-based discrimination, please contact Student Services at 318-342-5230 or to file a complaint, visit www.ulm.edu/titleix.

- g. Emergency Procedures:** Please review the emergency escape plan in the classrooms and hallways of the Bienville building. Move quickly and in an orderly manner to the appropriate stairwell and exit the building. The meeting place for this class will be the far end of the north parking lot between the Bienville building and Broadmoor Blvd. Under no circumstances is the elevator to be used for emergency evacuation. Any student needing assistance should notify the professor immediately. For emergencies, to contact University Police, call 1-911 from landlines and **342- 5350 from cell phones. The course coordinators reserve the right to adjust the syllabus or schedule, in accordance with University and School policies and procedures.**
- h.** Federal Regulations require determination and verification of every students' physical location while enrolled in classes (where they are physically located while taking classes), regardless of the delivery method (on campus, online). At the beginning of every semester and whenever physical location changes, students must update or verify their current location through banner (https://ssb-prod.ec.ulm.edu/PROD/bwggkogad.P_SelectAtypUpdate.) Students should do this by the end of the first week of classes.
- i.** This course is a major requirement for the Doctor of Pharmacy degree. Completion of degree requirements leads to eligibility for professional licensure and/or certification in Louisiana upon graduation. Federal Regulations require universities to provide information to students about the alignment between Louisiana's requirements and those of other states. ULM has created a web page with discipline-specific information containing hyperlinks to Licensure Boards in the United States <https://www.ulm.edu/professional-licensure-disclosures/index.html>. Program Directors and/or faculty will discuss this information with you during advising or other program meetings but is also available to answer questions and address any concerns you might have. It is also important to note that licensure or certification requirements are subject to change. Although ULM Program Directors annually review and update licensure information for every state, the faculty recommends that before enrolling in a program and throughout enrollment, students communicate with the applicable state board to confirm understanding and whether upon completion of ULM's program, they will meet requirements.

IX. Course Schedule**Class will meet in Bienville 340 Monday, Wednesday at 8:00-8:50 & 9:00-9:50 am**

	Date		Topics	Hrs	Faculty Contrib.
1	08/21	M	Drug invention/creation (focus on small-molecule/non-biologic agents with illustrative examples), with embedded introduction to selected pharmacology and biopharmaceutics	2	Barabutis
2	08/23	W	Drug creation with introduction to selected pharmacology and biopharmaceutics concepts, <i>contd</i>	2	Barabutis
3	08/28	M	Drug creation with introduction to selected pharmacology and biopharmaceutics concepts, <i>contd</i>	2	Barabutis
4	08/30	W	Drug creation with introduction to selected pharmacology and biopharmaceutics concepts, <i>contd</i>	2	Barabutis
	09/04	M	Labor Day HOLIDAY		
5	09/06	W	Molecular structure as relates to acidity, basicity, and solution ionization of organic molecules; ionic equilibria of biochemically and medicinally common structural moieties.	2	Shah
6	09/11	M	Solution ionization equilibria, <i>contd</i> , including drug action and disposition aspects	2	Shah
7	09/13	W	For Test 2: Stereochemistry as pertains to drug action and biohandling	2	Shah
8	09/18	M	Test 1 Content Reteaching/Consolidation	2	Barabutis/ Shah
9	09/20	W	Exam 1 (Content 08/21–09/11, 09/18)	2	El Sayed
10	09/25	M	Molecular recognition (ligand-target interactions)	2	Shah
11	09/27	W	Response vs. concentration relationships	2	Shah
12	10/02	M	Amino acids and Proteins: Brief review/overview of their various biological functions as pertains to drug targets and drug action	2	Shah
13	10/04	W	Proteins as drug targets, <i>contd</i> , Structure-function focus	2	Shah
14	10/09	M	Proteins as drug targets, <i>contd</i> Multimeric protein assemblages	2	Shah
15	10/11	W	For Test 3: Enzyme function basics & generalities Enzyme kinetics	2	Barabutis
			Fall Holiday Thurs. 12 October – Sunday 15 October		
16	10/16	M	Test 2 Content Reteaching/Consolidation	2	Shah
17	10/18	W	Exam 2 (Content 09/13, 09/25–10/09)	2	El Sayed
18	10/23	M	Enzyme kinetics, <i>contd</i>	2	Barabutis
19	10/25	W	Active Learning (Enzyme Kinetics) Enzyme-targeted drug design with examples	2	Barabutis
20	10/30	M	Enzyme-targeted drug design with examples, <i>contd</i>	2	Barabutis
21	11/01	W	Enzyme-targeted drug design with examples, <i>contd</i>	2	Barabutis

22	11/06	M	Exam 3 (Topics 10/11, 10/23-11/01)	2	El Sayed/ Barabutis
23	11/08	W	Biotransformation of xenobiotics (including drugs: “drug metabolism”) Phase I metabolism, including some enzymology Phase II metabolism, including some enzymology Drug biotransformation and genetic variation Drug biotransformation and drug interactions	2	El Sayed
24	11/13	M	Biotransformation of xenobiotics, <i>contd</i>	2	El Sayed
25	11/15	W	Biotransformation of xenobiotics, <i>contd</i>	2	El Sayed
26	11/20	M	Biotransformation of xenobiotics, <i>contd</i> Quiz	2	El Sayed
	11/22	W	THANKSGIVING HOLIDAY Wednesday 11/22 – Sunday 11/26		
27	11/27	M	Biotransformation of xenobiotics - Active Learning-Review	2	El Sayed
	TBD 11/30 12/1-4	TBD	Final Examination, 9:00-11:00 a.m. (Topics 11/08–11/27)	2	El Sayed

NOTE: ALL TEST DATES REMAIN SUBJECT TO CHANGE UNTIL FINALIZED BY THE BEGINNING-OF-THE-SEMESTER REVIEW PROCESS, AND SUCH CHANGES, IF ANY, WOULD REQUIRE FURTHER ADJUSTMENTS TO THE OVERALL COURSE SCHEDULE.