

MDSC 501
Principles and Mechanisms of Pharmacology

Instructors:

Course Coordinators and Instructors

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Instructors

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Office Hours/Policy on Answering Student Emails

Email communications with the instructors and/or TA are welcome. Please book appointments by email – using the MDSC 501 in the heading. Please note that all course communications must occur through your @ucalgary email, and we will respond to emails sent via student's @ucalgary emails within 48 hours (excluding weekends and statutory holidays).

Teaching Assistant:

Holly Vogel (holly.vogel@ucalgary.ca)

Time and Location:

Fall 2023 September 6th to December 6th
Classes are Monday and Wednesday 5:00 – 6.15pm
Location – please check D2L

Prerequisite/Co-Requisite:

Biochemistry 341 or 393; and Zoology 463 or Medical Science 404.

Course Description:

Basic principles of pharmacology, with specific emphasis on receptor signaling mechanisms. The application of pharmacological principles to the treatment of disease will also be explored.

Overarching Theme

The course is designed to introduce the basic principles of 'Pharmacodynamics and Pharmacokinetics' (what the drug does to the body and what the body does to the drug), and the 'targets and mechanisms of drug action'. In addition, students will explore the pharmacological manipulation of these in the context of clinical treatment. The class will be lecture and discussion-based, with select drug examples to build on basic concepts taught.

Global Objectives

- To introduce basic concepts of pharmacology, including how drugs act along with factors that may affect their absorption, distribution, metabolism, and elimination within the body.
- To develop a working knowledge of key pharmacology terms and concepts
- To facilitate the ability to integrate information provided and apply to the principles and mechanisms of pharmacology in the context of select disease and or pathologies.
- To be able to critically evaluate evidence and appreciate some reasons why drugs do not always have the desired effect.

Course Learning Outcomes (CLOs)

By the end of this course, students will be able to:

1. Define and differentiate the main pharmacodynamics terms (e.g., drug, ligand, receptor, antagonist, agonist, partial agonists, receptor reserve, affinity, efficacy). List the main targets for drug action (e.g., receptors, enzymes, ion channels) and outline the translation into biological responses: i.e., signal transduction mechanisms, gene transcription.
2. Explain the principles of pharmacokinetics (ADME) and describe why an understanding of each is important for clinical pharmacology.
3. Explain why select patients (e.g., elderly, children, pregnancy, disease state) may respond differently to drugs and the role genetics may play in drug metabolism.
4. Describe the basic pathophysiology of select diseases or health problems (e.g., asthma, COPD, hypertension, preterm labour, pain, drug abuse), the main classes of drug treatments / mechanism of action, and place these into context of the above principles.
5. Investigate a drug in clinical use, describe the main treatment of the drug, adverse outcomes, contraindications, and possible drug interactions, critically assess the literature, and using pharmacological principles above hypothesize why these might be occurring.
6. Facilitate classroom learning, by presenting scientific / clinical findings and addressing questions to a broad audience.

Transferable Skill Development (TSD)

Many of the skills and abilities that you are developing in your coursework are transferable to the workforce, graduate and professional studies and other facets of life. Employers seek applicants with transferable skills because they can be an asset in the workplace, regardless of industry or sector. Transferable skills are core skills for your success in building your future career.

The work that you will do in MDSC 501 will help you build the following transferable skills:

1. **Collaboration:** Work respectfully with others from different backgrounds, cultures, and countries.
2. **Verbal Communication:** Learn and share information by presenting, listening, and interacting with others.
3. **Critical Thinking:** Actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information (data, facts, observable phenomena, and research findings) to make a reasoned judgement or draw a reasonable conclusion.
4. **Information Literacy:** Find, understand, and use information presented through words, symbols, and images.
5. **Problem solving:** Identify an issue, find and implement a solution, and assess whether the situation has improved.
6. **Written Communication:** Share ideas and information by using words, images, and symbols.

Learning Resources

There is no assigned textbook for this course.
Any readings / links to readings will be posted on D2L
Access to library resources will be required.

Recommended Textbooks/Readings

Supplemental Reading: Rang and Dale's Pharmacology
6th edition. By HP Rang, MM Dale, JM Ritter & RJ Flower
7th edition. By HP Rang, MM Dale, JM Ritter, RJ Flower & G Henderson
8th edition. By HP Rang, JM Ritter, RJ Flower & G Henderson
9th edition. By JM Ritter, RJ Flower, G Henderson, Loke YK, MacEwan D & HP Rang.
Any of the above are recommended to supplement lectures. Copies are kept in the library.

Learning Technology Requirements

Brightspace (by D2L) is located on the University of Calgary server and will be used extensively for communication with students. **It is the student's responsibility to ensure that they receive all posted communications and documents and that they receive emails sent by instructors or fellow students through D2L.** Only your @ucalgary.ca email address may be linked to D2L. Please ensure that you are regularly checking your @ucalgary.ca account.

Evaluation

The University policy on grading and related matters is described in section F of the 2023-2024 Calendar.

In determining the overall grade in the course, the following weights will be used:

Description	% grade	Due Date	CLOs (TSDs)
Assignment #1 (Basic Principles) Open book worksheet short response Qs	25%	Friday Oct 6 th 11:59pm	1-3 (3-4)
Assignment #2 (Special topics I) Open book worksheet short response Qs	20%	Friday Oct 27 th 11:59pm	4 (3-5)
Assignment #3 (Special topics II) Open book worksheet short response Qs	15%	Friday Nov 24 th 11:59pm	4 (3-5)
Drug Evaluation Report	20%	Friday Dec 8 th , 11:59pm	1-5 (3-6)
10 mins Presentation Drug pitch (group 2-4 students)	15%	Slides to D2L 24 hours before presentation	1-6 (1-5)
Participation – attend student presentations and ask Qs	5%	Participate in student presentations and clinical case scenarios	6 (2)

*Guidelines and Rubrics for each component will be provided on D2L.

*There is no Registrar-scheduled final exam for this course.

*Students who do not complete any of the following; Assignment #1, OR #2, OR #3 OR the Individual Drug report will be considered as not passing the course, this will be reflected on the students' official transcript as a grade of 'F'.

*A student's final grade for the course is the sum of the separate assignments. It is not necessary to pass each assignment separately in order to pass the course.

A Note regarding Writing Assignments:

Writing skills are important to academic study in all disciplines. In keeping with the University of Calgary's emphasis on the importance of academic writing in student assignments (section E.2 of 2023-24 Calendar), writing is emphasized, and the grading thereof in determining a student's mark in this course. The Bachelor of Health Sciences values excellence in writing. Competence in writing entails skills in crafting logical, clear, coherent, non-redundant sentences, paragraphs and broader arguments, as well as skills with the mechanics of writing (grammar, spelling, punctuation). Sources used in research papers must be properly documented. The University of Calgary offers instructional services through the Students' Success Centre's Writing Support Services (<http://www.ucalgary.ca/writingsupport/>) for students seeking feedback on assignments or seeking to improve their general writing skills. Students are **strongly encouraged** to take advantage of these programs.

Grading Scheme:

Letter Grade	Description	Percentage
A+	Outstanding performance	95-100
A	Excellent performance	90-94.99
A-	Approaching excellent performance	85-89
B+	Exceeding good performance	80-84
B	Good performance	75-79
B-	Approaching good performance	70-74
C+	Exceeding satisfactory performance	65-69
C	Satisfactory performance	60-64
C-	Approaching satisfactory performance	57-59
D+	Marginal pass	54-56
D	Minimal pass	50-53
F	Does not meet course requirements	0-49

Missed Components of Term Work:

Late assignments, and drug reports will lose 5% per day late past the deadline for all assignments. In this case, assignments will **NOT** be accepted more than 72 hours after the posted deadline and students failing to submit any assignment within this time frame will receive a mark of zero.

The only exceptions to this are those in keeping with the University Calendar (debilitating illness, religious conviction, or severe domestic affliction) that are received in writing and with supporting documentation. Traffic jams and late or full buses are common events in Calgary and are NOT acceptable reasons for late arrivals to class, meetings and examinations. Please note that while absences are permitted for religious reasons, students are responsible for providing advance notice and adhering to other guidelines on this matter, as outlined in the University Calendar (<https://www.ucalgary.ca/pubs/calendar/current/e-4.html>).

Course Evaluations and Student Feedback

Student feedback will be sought at the end of the course through the Universal Student Rating of Instruction (USRI) and a qualitative student evaluation. Students are welcome to discuss the process and content of the course at any time with the instructor. Students may also address any concerns they may have with Dr Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feapartic@ucalgary.ca).

Attendance

Attendance at lectures is strongly encouraged. Posted lecture notes provide the basic information required; however, in class questions and discussion in the lecture will add depth to the knowledge base and facilitate greater success in the course assignments.

Attendance is recommended as 5% of the final grade is based upon participation in the class discussions of student presentations.

Conduct During Lectures

The classroom should be respected as a safe place to share ideas without judgement - a community in which we can all learn from one another. Students are expected to frame their comments and questions to lecturers in respectful and appropriate language, always maintaining sensitivity towards the topic. Students, employees, and academic staff are also expected to demonstrate behaviour in class that promotes and maintains a positive and productive learning environment.

As members of the University community, students, employees and academic staff are expected to demonstrate conduct that is consistent with the University of Calgary Calendar, the Code of Conduct and Non-Academic Misconduct policy and procedures, which can be found at <https://www.ucalgary.ca/student-services/student-conduct/policy>

Students are expected to take notes during class and should not rely solely on material supplied by the instructors.

Use of Internet and Electronic Communication Devices in Class

The Bachelor of Health Sciences program aims to create a supportive and respectful learning environment for all students. The use of laptop and mobile devices is acceptable when used in a manner appropriate to the course and classroom activities. However, research studies have found that inappropriate/off-topic use of electronic devices in the classroom negatively affects the learning of others during class time.

Students are responsible for being aware of the University's Internet and email use policy, which can be found at <https://www.ucalgary.ca/policies/files/policies/electronic-communications-policy.pdf> .

UNIVERSITY OF CALGARY POLICIES AND SUPPORTS

Copyright

All students are required to reach the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdf>) and requirements of the Copyright Act (<https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>) to ensure they are aware of the consequences of unauthorized sharing of course materials (including instructor notes, electronic versions of textbooks,

etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy <https://www.ucalgary.ca/pubs/calendar/current/k.html>.

Instructor Intellectual Property

Course materials created by instructors (including course outlines, presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may **NOT** be reproduced, redistributed or copied without the explicit consent of the professor. **The posting of course materials to third party websites such as note-sharing sites without permission is prohibited.** Sharing of extracts of these course materials with other students enrolled in the course **at the same time** may be allowed under fair dealing.

Academic Accommodations

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The Student Accommodations policy is available at <https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations>. Students needing an accommodation based on disability or medical concerns should contact Student Accessibility Services (SAS) in accordance with the Procedure for Accommodations for Students with Disabilities (<https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>). SAS will process the request and issue letters of accommodations to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/.

Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to Dr Fabiola Aparicio-Ting, Associate Dean (Undergraduate Health and Science Education) in the Cumming School of Medicine (feapartic@ucalgary.ca).

Academic Misconduct

The University of Calgary is committed to the highest standards of academic integrity and honesty. The University of Calgary has created rules to govern all its members regarding the creation of knowledge and the demonstration of knowledge having been learned.

Academic Misconduct refers to student behaviour that compromises proper assessment of a student's academic activities and includes (but is not limited to): cheating, fabrication, falsification, plagiarism, unauthorized assistance, failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses, and failure to comply with exam regulations applied by the Registrar. **It also includes using of third party websites/services to access past/current course material, essay/assignment writing services, or real-time assistance in completing assessments, seeking answers to assessment questions and similar, whether paid, bartered or unpaid.**

For information of the Student Academic Misconduct Policy and Procedures, please visit; <https://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf>
<https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf>

Additional information is available on the Academic Integrity website at: <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>.

Recording of Lectures

Audio or video recording of lectures (or similar) is prohibited except where explicit permission has been received from the instructor.

Freedom of Information and Protection of Privacy Act

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary

Appeals

If there is a concern with the course, academic matter or a grade, first communicate with the instructor. If these concerns cannot be resolved, students can proceed with an academic appeal, as per Section I of the University Calendar. Students must follow the official reappraisal/appeal process and may contact the Student Ombuds' Office (<http://www.ucalgary.ca/ombuds>) for assistance with this and with any other academic concerns, including academic and non-academic misconduct. Students should be aware that concerns about graded term work may only be initiated **within 10 business days** of first being notified of the grade. <https://www.ucalgary.ca/pubs/calendar/current/i-2.html>

Media recording for self-assessment of teaching practices

The instructor may use media recordings as a tool for self-assessment of their teaching practices. Although the recording device will be fixed on the instructor, it is possible that student participation in the course may be inadvertently captured. These recordings will be used for instructor self-assessment only and will not be used for any other purpose.

Sexual and Gender-Based Violence Policy

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at <https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf>

Resources for Support of Student Learning, Success, Safety and Wellness

Student Success Centre	http://www.ucalgary.ca/ssc/
Student Wellness Centre	http://www.ucalgary.ca/wellnesscentre/
Student Advocacy and Wellness Hub (CSM students)	https://cumming.ucalgary.ca/student-advocacy-wellness-hub/home
Distress Centre	http://www.distresscentre.com/
Library Resources	http://library.ucalgary.ca

Wellness and Mental Health Resources

The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the excellent mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the

SU Wellness Centre (<https://www.ucalgary.ca/wellnesscentre/services/mental-health-services>) and the Campus Mental Health Strategy (<http://www.ucalgary.ca/mentalhealth/>).

Student Ombuds' Office

The Student Ombuds' Office supports and provides a safe, neutral space for students. For more information, please visit www.ucalgary.ca/ombuds/ or email ombuds@ucalgary.ca

BHSc Student Faculty Liaison Committee (SFLC)

The BHSc SFLC, with elected representatives from all majors, serves to raise issues of interest to BHSc students to the program administration, including items pertaining to curriculum, scheduling and events. A list of current representatives can be found on the BHSc website.

Student Union (SU) Information

The SU Vice-President Academic can be reached at (403) 220-3911 or suvpaca@ucalgary.ca; the SU representatives for the Cumming School of Medicine can be reached at medrep1@su.ucalgary.ca or medrep2@su.ucalgary.ca.

Student Success Centre

The Student Success Centre provides services and programs to ensure students can make the most of their time at the University of Calgary. Our advisors, learning support staff, and writing support staff assist students in enhancing their skills and achieving their academic goals. They provide tailored learning support and advising programs, as well as one-on-one services, free of charge to all undergraduate and graduate students. For more information visit: <https://www.ucalgary.ca/student-services/student-success>

Emergency Evacuation/Assembly Points

As part of the University of Calgary Emergency Evacuation plan, students, faculty, and staff should locate the closest Assembly Point in case of Fire Alarm. Safety signage is posted throughout the campus showing the locations and the possible route to these locations. All students, faculty, and staff are expected to promptly make their way to the nearest Assembly Point if the Fire Alarm is activated. No one is to return into campus facilities until an all clear is given to the warden in charge of the Assembly Area. For more information, see <https://www.ucalgary.ca/emergencyplan/building-evacuation/assembly-points>

Safewalk

Campus security will escort individuals, day or night, anywhere on campus (including McMahon Stadium, Health Sciences Centre, Student Family Housing, the Alberta Children's Hospital and the University LRT station). Call 403-220-5333 or visit <http://www.ucalgary.ca/security/safewalk>. Use any campus phone, emergency phone or the yellow phone located at most parking lot pay booths. Please ensure your personal safety by taking advantage of this service.

Class Schedule: Principles and Mechanisms of Pharmacology:

The following is a list of topics for class and assignment due dates. Please note that unforeseen circumstances may cause changes to the schedule with respect to the timing of topics. Students will be notified of all changes in a timely manner by way of email and D2L announcements.

Principles and Mechanisms of Pharmacology: MDSC 501 Class Schedule – Fall 2023 Theatre 1

DATE	TOPICS	Instructor
T. Sept 5	<i>Fall Classes Start</i>	
<i>Basic Principles</i>		
W. Sept 6	Intro to Pharmacology. Assignments. Overview, what is pharmacology, drug discovery & clinical development, successes, failures, & the FDA.	Slater
M. Sept 11	Targets for Drug Action & intro to IUPHAR	Slater
W. Sept 13	Pharmacodynamics I – how drugs act on the body	Giembycz
M. Sept 18	Pharmacodynamics II	Giembycz
W. Sept 20	Pharmacokinetics I (ADME) – what the body does to the drug	Slater
M. Sept 25	Pharmacokinetics II (ADME)	Slater
W. Sept 27	Personalized Medicine I (Drug effects – individual variation)	Slater
M. Oct 2	Personalized Medicine II (Pharmacogenetics)	Bousman
W. Oct 4	Clinical Case scenarios	Slater / Vogel
W. Oct 4	Take home Qs 'Basic Principles' - Due Oct Friday 6th 11:59pm (25%)	
M. Oct 9	<i>NO Class - Thanksgiving</i>	
<i>Special Topics I</i>		
W. Oct 11	The Autonomic Nervous System – sympathetic targets for drug action	Baker
M. Oct 16	The Autonomic Nervous System – cholinergic targets for drug action	Baker
W. Oct 18	Drugs used in hypertension I	Deniset
M. Oct 23	Drugs used in hypertension II	Deniset
W. Oct 25	Drugs used for Asthma and COPD	Giembycz
W. Oct 25	Take home Qs Special Topics I - Due Oct Friday 27th 11:59pm (20%)	
<i>Special Topics II</i>		
M. Oct. 30	Anti-inflammatory drugs (NSAIDs / steroids)	Slater / Agbani
W. Nov 1	Drugs affecting blood coagulation - Hemostasis and thrombosis	Agbani
M. Nov 6	Clinical translation of thrombosis mechanisms	Agbani
W. Nov 8	Pain management: Analgesia (Opioids and Cannabinoids)	Van Den Hoogen
Nov 11 - 18	<i>NO Class – Fall Term Break</i>	
M. Nov 20	Topic TBD	TBD
W. Nov 22	Clinical Case scenarios / Topic TBD	Slater / Vogel
	Take home Qs Special Topics II - Due Nov 24th 11:59pm (15%)	
M. Nov 27	Topic TBD	TBD
W. Nov. 29	Student Presentations – 5-minute drug pitch (15%)	
M. Dec 4	Student Presentations – 5-minute drug pitch	
W. Dec 6	Student Presentations - 5-minute drug pitch – Class Wrap Up	
F. Dec 8	Individual Drug Report – due on D2L 11.59pm (20%)	
	Participation in SPs and Clinical case scenario – 5%	

TOPICS

Basic Principles of Pharmacology

Drug discovery and clinical development: brief overview of the process of drug discovery, from the bench to clinical trials and pharmacovigilance

Targets for drug action: overview of the diverse targets, endogenous ligands and drugs and the impact of this diversity for understanding drug action. Introduction to IUPHAR and the pharmacology education project

Pharmacodynamics I and II: study of the relationship between drug concentration and its interaction with a receptor to produce a response. Brief history of receptor theory, and ligand/drug – receptor interactions as they are fundamental for drug design. Concentration response curves, potency, affinity, receptor occupancy and response, efficacy and spare receptors. Drugs as agonists (partial, inverse, biased), antagonists (competitive surmountable, competitive insurmountable), and allosterism (negative and positive allosteric modulators) will be presented and how these effect the concentration/dose response curves.

Pharmacokinetics I and II: What happens to a drug within the body? Understanding how a drug is absorbed, distributed, metabolised and excreted (ADME) by the body is important to enable clinicians to target the therapeutic window (enhance efficacy and reduce toxicity). The effect of how CYP450 enzyme induction, inhibition and drug interactions can affect drug metabolism will be discussed.

Personalised Medicine I: Epidemiology and inter-individual variation in drug response. Differences may occur with ethnicity, age, sex, pregnancy, breastfeeding, disease and with genetic contributions.

Personalised Medicine II: overview of how pharmacogenetics is currently used in the clinic, interpretation of pharmacogenetic tests.

Special Topics in Pharmacology and Therapeutics

The Autonomic Nervous System (ANS) I and II: overview of the ANS as a key target for many drugs. Effect of drugs on cholinergic and noradrenergic transmission, and the 5-HT receptors

Drugs used for Asthma and COPD: many drugs developed to treat respiratory disease mimic or block the ANS, overview of current and developing treatments for asthma and COPD.

Cardiovascular disease: hypertension, common therapeutic options for blood pressure regulation will be discussed, (e.g., β -blockers, Ca²⁺ antagonists, α 1-Adrenoceptor Antagonists, ACE inhibitors, Angiotensin AT 1 Receptor antagonists, Aldosterone antagonists, Diuretics). Drugs for lipid lowering (Statins) to prevent atherosclerosis.

Anti-inflammatory Drugs: chronic inflammation is associated with many diseases, including for example, asthma, COPD, rheumatoid arthritis, allergies, diabetes, cardiovascular disease. The NSAIDs, COXIBs and corticosteroids will be discussed along with a brief overview of alternate and developing anti-inflammatory treatments.

Drugs affecting blood coagulation: anticoagulants, antiplatelet drugs, fibrinolytic drugs (thrombolytics)

Pain management: overview of pain and analgesics, with a focus on opioids and analgesics in development

ADDITIONAL TOPICS TBD

Contraception & Reproductive Choices: pharmacological manipulation of the Hypothalamus-pituitary-gonadal axis offers reproductive choices, for fertility, contraception, and sex dysfunction – overview of the targets of drug action, mechanism of action, and potential side effects.

Drugs in Pregnancy and Tocolysis: with a focus on past, present and developing treatments for preterm labour

Harmful Effects of Drugs: Adverse Reactions / Toxicology: risk factors for adverse drug reactions (ADRs), principles of toxicology and managing the poisoned patient

Neuropsychopharmacology: overview of addiction, the variables affecting onset and continuation, the role of dopamine, the mechanism of action of examples of addictive drugs, and current treatments for opioid use disorder

Gastrointestinal Pharmacology: