

Online Masters of Science in Pharmacology & Toxicology Program Information

Description of Program:

PHARMACOLOGY

The Master of Science degree in Pharmacology and Toxicology is an online program designed to train individuals in molecular, cellular and organ systems pharmacology. The program provides advanced science knowledge in pharmacology and is designed for individuals who are seeking additional academic qualifications that will facilitate their advancement in their place of employment or will enhance their competitiveness for admission to other advanced degree programs. The Master of Science degree in Pharmacology and Toxicology is appropriate for graduates of biology- or chemistry-related undergraduate programs. Course work provides freedom to explore those physiological systems that will allow students to continue to expand their knowledge of pharmacology, while providing additional academic qualifications that will facilitate student career and professional development. All courses are offered online in order to provide full opportunity for students regardless of their geographic location, work schedules, or family responsibilities.

Admission

Applicants will be accepted into the program after review of application materials by an admissions committee composed of Pharmacology & Toxicology faculty. A Pharmacology & Toxicology faculty member will serve as the student's academic adviser who will assist the student in planning the program of study that is related to the student's interests and professional goals, and fulfills college and university requirements.

Applicants must have completed a bachelor's degree from an accredited college or university, with at least 3 credits in chemistry and 3 credits in a biological science. A personal statement, one official transcript from each university attended, and two letters of recommendation are required for consideration for admission.

Applicants who do not meet all of the requirements listed above may be admitted provisionally, and permitted to enroll for collateral course work, not to count toward the degree. The coursework must be approved by the Program Director.

Students can request transfer credits for relevant courses taken previously at other institutions. Students should supply program faculty with a course syllabus for evaluation. A maximum of 6 credits of 400 level coursework can be applied towards the Master's Degree.

Required Coursework (7 credits)

PHM 830—Experimental Design and Data Analysis

(3 credits; available online Fall and Summer semesters only)

Description:

Practical application of statistical principles to the design of experiments and analysis of experimental data in pharmacology, toxicology and related biomedical sciences

Outline of Major Topics:

1.	Variables, measurements, distributions and descriptive statistics	6.	Missing data, outliers, transformations
2.	Confidence intervals, statistical significance, hypothesis testing and experimental design	7.	Interpreting laboratory results
3.	Comparing two sample means	8.	Association measures
4.	ANOVA and multiple comparisons	9.	Correlation, regression, curve fitting, multiple regression and logistic regression
5.	Sample size estimation	10.	Survival analysis

Sample Sources:

Motulsky H.: Intuitive Biostatistics. Oxford University Press, 1995.

(Print version available thru Amazon.com --

<http://www.amazon.com/gp/product/0195086074?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0195086074>)

Norman GR and Streiner DL: PDQ Statistics, 3rd Edition, BC Decker, McMaster University: Hamilton, CAN, 2003.

(Locaed at MSU eLibrary – <http://magic.msu.edu/search/X?SEARCH=PDQ%20Statistics&searchscope=39&SORT=D>

Objectives:

To provide students with a practical knowledge of statistical principles applied to the design, analysis and display of experiments in pharmacology, toxicology and related disciplines.

Pre-Requisites:

College level algebra or equivalent

PHM 819 Principles of Drug-Tissue Interactions

(2 credits; available online Fall and Summer semesters only)

Description:

General principles relevant to the interaction of chemicals with biological systems

Outline of Major Topics:

1.	Pharmacodynamics	6.	Chemical carcinogenesis
2.	Pharmacokinetics	7.	Chemical mutagenesis
3.	Receptors and second messengers	8.	Chemical teratogenesis
4.	Drug design	9.	Risk assessment
5.	Drug tolerance and dependence		

Pre-Requisites:

Undergraduate degree in biology, chemistry, physiology, biochemistry or related disciplines

Sample sources:

Goodman & Gilman's The Pharmacological Basis of Therapeutics, 11th Edition, 2006.

(Located at MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

Golan DE, Tashjian AH, Armstrong EJ, and Armstrong AW: Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy, 2nd Edition, Wolters Kluwer/LWW, 2008.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0781783550?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0781783550>)

Objectives:

Provide students with an understanding of absorption, distribution, metabolism and elimination of drugs/toxicants, drug-receptor theories, their derivation and application, methods by which drug-receptor interaction can be measured and the application of drug-receptor theory to experimental and physiological situations.

PHM 980 Special Problems in Pharmacology

(2 credits, section 730; available online Fall, Spring and Summer semesters)

Description:

Students complete a literature-based research paper related to a topic in pharmacology. The paper should provide a description of the importance of the topic, survey the relevant peer-reviewed literature and provide an assessment and conclusion about the current state of the topic. The paper should be appropriate for publication as a scholarly review of the topic. The topic of the paper should be discussed with the student's advisor prior to initiation of the review.

Objective:

The project is intended to provide the student with experience in publication database searches and critical analysis of the peer reviewed literature. This course provides an opportunity for faculty to evaluate the student's grasp of broad pharmacological concepts and to use these in an integrative context.

Example projects:

- Review and critique of drugs currently available for treatment of specific diseases
- Review and critique of the literature relevant to a current topic in basic pharmacology

Pre-requisites:

PHM 819, PHM 830 and completion of at least 12 hours of electives for the Master of Science.

Elective Coursework (24 credits required)(27 credits available)

PHM 431 Pharmacology of Drug Addiction

(3 credits; available online Summer semesters only)

Description:

Overview of the fundamentals of pharmacology, sites and mechanisms of action of drugs of abuse and social and political impact of drug addiction

Outline of Major Topics:

1.	Pharmacodynamics	7.	Cocaine and amphetamine abuse
2.	Pharmacokinetics	8.	Barbiturate use and abuse
3.	Introductory neuroanatomy	9.	Benzodiazepine use and abuse
4.	Introductory neurophysiology	10.	Hallucinogen abuse
5.	Alcohol use and abuse	11.	Performance enhancing drugs
6.	Opiate use and abuse	12.	Drug addiction and public health policy

Objective:

Provide students with an introduction to pharmacology in the context of understanding the mechanisms of action of drugs of abuse.

Sample sources:

Goldstein A: Addiction: From Biology to Drug Policy, 2nd Edition, Oxford University Press, 2001.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0195146646?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0195146646>)

Siegel GJ, Agranoff BW, Albers RW, Fisher SK, Uhler MD (editors): Basic Neurochemistry, Philadelphia: Lippincott, Williams & Wilkins; c1999. **(Print available thru Amazon.com --**

<http://www.amazon.com/gp/product/012088397X?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=012088397X>

Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P: Molecular Biology of the Cell, New York and London: Garland Science; c2002. **(Print available thru Amazon.com --**

<http://www.amazon.com/gp/product/0815341059?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0815341059>)

PHM 450- Introduction to Toxicology

(3 credits; available online Fall and Summer semesters only)

Description: Presentation of the basic mechanisms of chemical toxicity on mammalian systems.

Outline of Major Topics:			
1.	Disposition of chemicals in the body	6.	Pesticides
2.	Detoxification and elimination of xenobiotics	7.	Lead
3.	Mechanisms of chemical toxicity in major organ systems	8.	Mercury
4.	Carcinogenicity	9.	Additional toxins
5.	Reproductive toxicology		

Objectives: Provide students with core knowledge of mechanisms of chemical toxicity.

Prerequisites: Background in biology or chemistry

Sample sources:

Timbrell J: Principles of Biochemical Toxicology, 3rd Edition, Taylor & Francis Inc. , 2000.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0471333344?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0471333344>)

Berne & Levy: Principles of Physiology, 4th Edition, Mosby, 2005.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0323031951?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0323031951>)

Casarett and Doull's "Toxicology: The Basic Science of Poisons," 6th Edition, McGraw Hill-Professional, 2001.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0071470514?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0071470514>)

(Kindle version available thru Amazon.com -- http://www.amazon.com/Casarett-Doulls-Toxicology-Science-ebook/dp/B000XPNUHC/ref=ed_oe_k)

PHM 563 Medical Pharmacology

(3 credits; available online Summer semesters only)

Description: A survey course cover core pharmacological principles and the uses, mechanisms of action and side effects of drugs used to treat human disease.

Outline of Major Topics:			
1.	Pharmacokinetics and pharmacodynamics	6.	Drugs used to treat gastrointestinal and liver disorders
2.	Drugs used to treat cardiovascular disease	7.	Drugs used to treat skeletal muscle disorders
3.	Drugs used to treat mental illness	8.	Anti-inflammatory and analgesic drugs
4.	Drugs used to treat metabolic disorders	9.	Autonomic drugs
5.	Antibiotics and anti-neoplastic drugs		

Objectives: To provide students with a basic understanding of the principles of pharmacology and with specific information about drugs classes used to treat human disease.

Prerequisites: None

Sample sources:

Brunton LL, et al.: Goodman & Gilman's The Pharmacological Basis of Therapeutics, 11th Edition, McGraw-Hill, 2007.

(Online version thru MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

[Goodman & Gilman is the gold standard reference text in pharmacology. As such the coverage of any topic is in much more depth than that in Katzung.]

Katzung BG: Basic and Clinical Pharmacology, 10th Edition, 2007.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0071451536?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0071451536>)

PHM 813 Cardiovascular Pharmacology

(3 credits; available online Summer semesters only)

Description:

Effects of drugs on normal and diseased physiological and biochemical process in vascular and cardiac cells

Outline of Major Topics:

1.	Diuretics	5.	Anti-coagulant drugs
2.	Antihypertensive drugs	6.	Lipid lowering drugs
3.	Anitarrhythmic drugs	7.	Drugs used to treat angina
4.	Drugs used to treat congestive heart failure		

Objectives:

To provide students with a basic understanding of the action of drugs on the cardiovascular system and the major classes of drugs used to treat cardiovascular disease.

Prerequisites:

PHM 819 or permission of department

Sample sources

Klabunde, RE: Cardiovascular Physiology Concepts, 1st Edition, Lippincott, Williams & Wilkins, 2005.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/078175030X?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=078175030X>)

PHM 829 Neuropharmacology

(2 credits; available online Fall semesters only)

Description: Discussion of targets in the mammalian central nervous system for clinically useful drugs and the mechanism of action, clinical use, and side effects of those drugs.

Outline of Major Topics:

1.	Aspects of normal cellular neurophysiology	5.	Anticonvulsants, hypnotics, & anxiolytics: Targeting GABA receptors
2.	Treatment of Pain: Opiate receptor agonists	6.	Antidepressants: Targeting noradrenergic and serotonergic systems
3.	Treatment of Pain: Targeting ion channels I	7.	Antipsychotics and Parkinson's Disease: Targeting dopaminergic systems
4.	Anticonvulsants: Targeting ion channels II	8.	Stroke and dementia: Cholinergic and glutaminergic systems

Sample Sources:

Katzung BG: Basic and Clinical Pharmacology, 10th Edition, 2007.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0071451536?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0071451536>)

Brunton LL (Editor-in-Chief), Lazo JS and Parker KL (Associate Editors): Goodman and Gilman's The Pharmacological Basis of Therapeutics, 11th Edition, The McGraw-Hill Companies, Inc, 2006.

(Online version thru MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

Objectives:

To provide students with an overview of neuropharmacology with emphasis on drug classes used to treat major diseases and pathologies that impact the brain and spinal cord.

Pre-Requisites:

PHM 819 or permission of department

PHM 831 Endocrine Pharmacology

(2 credits; available online Fall semesters only)

Description:

Physiology, pharmacology and toxicology of the endocrine system. Endocrine diseases, pharmacological intervention, hormone therapy, endocrine disruptors, role of hormones in normal metabolism and metabolic disorders, animal models of endocrine/metabolic disorders.

Outline of Major Topics:

1.	Historical perspective and review of basic concepts	6.	Thyroid hormones
2.	Hypothalamic hormones	7.	Prostaglandins, local hormones, adipose tissue
3.	Anterior pituitary hormones	8.	Metabolism: Role of hormones and metabolic disorders
4.	Posterior pituitary hormones	9.	Endocrine disrupters and animal models of endocrine/metabolic disease
5.	Steroids - adrenal and gonadal		

Sample Sources:

Saunders WB: Williams Textbook of Endocrinology, 10th Edition, Elsevier, 2003.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/1416029117?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=1416029117>)

Bowen RA: Endocrinology site. Colorado State University.

(Located at <http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/basics/index.html> [Retrieved on 6 Nov. 2006])

Henderson J: Ernest Starling and 'Hormones': An historical commentary. Journal of Endocrinology, 184:5-10, 2005.

(Located at <http://joe.endocrinology-journals.org/cgi/content/full/184/1/5>)

Goodman HM: Endocrinology Concepts for Medical Students. Advances in Physiology Education, 25:213-224, 2001.

(Located at <http://advan.physiology.org/cgi/content/full/25/4/213>)

Nutropin product information. Genotech.

(Located at <http://www.gene.com/gene/products/information/opportunistic/nutropin-aq/insert.jsp> [6 Nov. 2006])

Goffin V, Bernichtein S, Touraine P, and Kelly PA: Development and Potential Clinical Uses of Human Prolactin Receptor Antagonists. *Endocrine Reviews*, 26(3):400-422, 2005. The Endocrine Society.

(Located at <http://edrv.endojournals.org/cgi/content/full/26/3/400>)

Objectives:

To provide students with an overview of the pharmacology of the endocrine system with emphasis on drug classes used to treat major diseases and pathologies that impact this system

Pre-Requisites:

PHM 819 or permission of department

PHM 833 GI and Liver Pharmacology

(2 credits; Available online Spring semesters only)

Description:

Specific drugs and their mechanisms of action in the treatment of gastrointestinal and liver diseases. Toxic effects of drugs and other xenobiotics on the gastrointestinal tract including the liver.

Outline of Major Topics:

- | | |
|----|---|
| 1. | Drug therapy of gastrointestinal secretory and motor disorders |
| 2. | Drug therapy of gastrointestinal and liver inflammatory diseases |
| 3. | Drug and other xenobiotics in gastrointestinal and hepatic toxicology |

Sample Sources:

Katzung BG: Basic and Clinical Pharmacology, 10th Edition, 2007.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0071451536?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0071451536>)

Brunton LL (Editor-in-Chief), Lazo JS and Parker KL (Associate Editors): Goodman and Gilman's The Pharmacological Basis of Therapeutics, 11th Edition, The McGraw-Hill Companies, Inc, 2006.

(Online version thru MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

Objectives:

Familiarize students with the uses and mechanisms of action of drugs used to treat gastrointestinal diseases and disorders. Students will also become familiar with gastrointestinal and liver toxins and their mechanisms of action.

Pre-requisites:

PHM 819 or permission of department

PHM 834 Respiratory Pharmacology

(2 credits; available online Spring semesters only)

Description:

Integrative study of drugs, their mechanism of action and their side effects in the treatment of major diseases and pathologies of the respiratory system

Outline of Major Topics:

- | | | | |
|----|---|----|---|
| 1. | Review of respiratory physiology relevant to respiratory pharmacology | 4. | Pathophysiology, drug classes and animal models in emphysema and chronic bronchitis |
| 2. | Assessment of pulmonary function in animal models | 5. | Pathophysiology, drug classes and animal models in fibrosis |
| 3. | Pathophysiology, drug classes and animal models in asthma | 6. | Pathophysiology, drug classes and animal models in pulmonary hypertension |

Sample Sources:

Katzung BG: Basic and Clinical Pharmacology, 10th Edition, 2007.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0071451536?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0071451536>)

Brunton LL (Editor-in-Chief), Lazo JS and Parker KL (Associate Editors): Goodman and Gilman's The Pharmacological Basis of Therapeutics, 11th Edition, The McGraw-Hill Companies, Inc, 2006.

(Online version thru MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

McPhee SJ and Ganong WJ: Pathophysiology of Disease: An Introduction to Clinical Medicine, 5th Edition, The McGraw-Hill Companies, Inc., 2006.

(Online version available thru MSU eLibrary -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

Ganong WF: Review of Medical Physiology, 22nd Edition, McGraw-Hill Companies, Inc., 2006.
(**Online version available thru MSU eLibrary** -- http://er.lib.msu.edu/title_find.cfm?type=All&letter=)

Hoymann HG: New developments in lung function measurements in rodents. Exp. Toxicol. Pathol. 57(Suppl2):5-11, 2006. (**Located at** http://www.sciencedirect.com/science?_ob=ArticleListURL&method=list&ArticleListID=937511732&sort=d&view=c&acct=C000051676&version=1&urlVersion=0&userid=1111158&md5=a46546e666ffa46405e4a5459849e38f)

Lorenz JN: A practical guide to evaluating cardiovascular, renal, and pulmonary function in mice. Am. J. Physiol. Regul. Integr. Comp. Physiol 282(6): R1565-82, 2002. (**Located at** <http://ajpregu.physiology.org/cgi/content/full/282/6/R1565?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&author1=Lorenz%2C+JN&searchid=1&FIRSTINDEX=0&sortspec=relevance&volume=282&firstpage=R1565&resourcectype=HWCIT>)

Data and Statistics on Lung Diseases: <http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=33347>
Information on Current Treatments for Lung Diseases: <http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=22547>
Lung Diseases Information: <http://www.nhlbi.nih.gov/health/public/lung/index.htm>

Objectives:

To provide students with an overview of the pharmacology of the respiratory system with emphasis on drug classes used to treat major diseases and pathologies that impact this system.

Pre-Requisites:

PHM 819 or permission of department

PHM 840 Safety Pharmacology

(2 credits; Available online Spring semesters only)

Description:

This is an introductory course that provides students with an overview of the key topics in safety pharmacology, appropriate testing for the safety profile of new drugs and regulatory issues associated with drug approval and ongoing monitoring of the safety of approved drugs.

Outline of Major Topics:	
1. Overview of safety pharmacology as a discipline	5. Cardiovascular pharmacology safety screens
2. Regulatory issues related to drug development	6. Respiratory pharmacology safety screens
3. Risk assessment	7. Central nervous system safety screens
4. Animal welfare in the drug development process	

Sample Sources:

Pugsley, Authier S, Curtis MJ: Principles of Safety Pharmacology. Br. J. Pharmacol. 154: 1382-1399, 2008.
(**Located at** <http://www3.interscience.wiley.com.proxy2.cl.msu.edu/cgi-bin/fulltext/121666678/HTMLSTART>)

Gad SC: Safety Pharmacology in Pharmaceutical Development and Approval, CRC Press, Boca Raton, FL, 2004.
(**Print version available thru Amazon.com** -- <http://www.amazon.com/gp/product/0849313805?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0849313805>)
(**Kindle version available thru Amazon.com** -- <http://www.amazon.com/gp/product/B000OI0ZD0?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=B000OI0ZD0>)

Objectives:

Provide students with an introduction to safety issues related to drug development and to the safety pharmacology protocols and procedures related to major drug classes.

Prerequisites:

PHM 819 or permission of department

BLD 830 (Biomedical laboratory diagnostics program) Concepts in Molecular Biology

(2 credits; Available online Fall and Spring semesters)

Description:

Introduction to the practice of molecular biology and its applications in the clinical laboratory

Outline of Major Topics:

1.	Genetics	6.	Hybridization, amplification, sequencing
2.	DNA chemistry	7.	Laboratory practice and design
3.	Nucleic acid extraction and modification	8.	Laboratory business and marketing
4.	Electrophoresis	9.	Regulatory standards
5.	Southern blotting		

Sample Sources:

Passarge E: Color Atlas of Genetics, 2nd Edition, Thieme, Inc., 2001.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/1588903362?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=1588903362>)

Strachan T: Human Molecular Genetics, 3rd edition, Garland Science/Taylor & Francis Group, 2003.

(Print version available thru Amazon.com -- <http://www.amazon.com/gp/product/0815341822?ie=UTF8&tag=pharmtoxic-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=0815341822>)

Objectives:

The course is designed to provide basic molecular biology knowledge related to modern molecular biology applications in research and diagnostic laboratories.

Prerequisites:

Undergraduate courses in biochemistry and biology

VM 812 Food Safety Toxicology

(3 credits; Available Spring semesters only)

Description:

Nature and properties of toxic substances through the food chain; nature and magnitude of hazards to human health

Outline of Major Topics:

1.	Principles of toxicology applicable to foods and food toxicants	6.	Natural toxins in mushrooms
2.	Food allergy and hypersensitivity	7.	Mycotoxins
3.	Natural toxins in seafoods	8.	Toxic environmental inorganic and organometallic food contaminants
4.	Safety of biotechnology-derived novel foods	9.	Toxic man-made organic food contaminants
5.	Natural toxins in plant foodstuffs		

Objectives:

Students will gain knowledge of the scope of food toxicology and they will be able to distinguish between safety, hazard and toxicity. Students will also develop skills necessary to critically evaluate food toxicology publications in lay and scientific literature.

Prerequisites:

Departmental approval