

# PHARMACEUTICAL SCIENCES (MS)

The multidisciplinary field of pharmaceutical sciences has seen rapid advances that are critical to the discovery and development of drugs for chronic diseases such as cancer and diabetes, and emerging threats such as new pathogens and drug resistance. By training with our experts, you'll be on the best track to keep up with the constantly evolving field.

The Master of Science Degree in Pharmaceutical Sciences has five different tracks to choose from. A minimum of 30 credit hours is required. A short description of each track is listed below.

## CANNABIS SCIENCE and MEDICINE TRACK (CSM)

### Prerequisites

B.S. or B.A. in a biological, chemical, or health/medical science

Be a physician, nurse, pharmacist, physician assistant, or in a public health capacity

Or

Be a member of other allied health professions (the program director will individually counsel prospective students on any recommended prerequisite coursework)

Self-directed learning will be complemented by online, synchronous live, case-based discussions and/or activities guided by clinical practice experts, clinical researchers, medicinal plant chemists and pharmacologists, and legal and regulatory leaders. The only on-campus course is a 1 credit hour laboratory workshop on cannabis extraction and analytical methods that accompanies the 2 credit hour online course. Students unable to travel to Colorado for the 1 credit hour laboratory component can select an additional elective course.

## CLINICAL PHARMACOKINETICS and PHARMACODYNAMICS TRACK (CPK)

An understanding of PK and PD is thus critical to every stage of drug development, from pre-clinical research through human clinical trials. Students trained in this track employ equations and models to describe drug concentrations in plasma, blood and other biological samples. The advent of new biotechnology products, combination drug products, drug delivery platforms, and nanotechnology formulations place individuals with PK-PD expertise in high demand for pharmaceutical and medical companies.

## DRUG DISCOVERY TRACK (DGD)

This track offers you an opportunity to gain insight and experience in the drug discovery process. This includes computational design of molecules, high throughput/high content screening, structure-activity relationships, the selection of appropriate biomarkers for drug action, targeting drugs for personalized therapies, and the application of bioinformatics in the overall drug discovery process. Students trained in these approaches are well-positioned for jobs in the pharmaceutical industry, academia, and governmental regulatory bodies.

## MOLECULAR and SYSTEMS TOXICOLOGY TRACK (MST)

This track affords you the opportunity to learn about systems toxicology and receive the training necessary to succeed in a changing research environment that is rapidly becoming focused on big data. Students graduating from this track will be sought after by employers in industry, biotechnology and government.

## PHARMACEUTICAL BIOTECHNOLOGY and DRUG DELIVERY TRACK (PBT)

This track will provide you with the fundamental knowledge required for the synthesis, characterization, formulation, stabilization and delivery of these drugs. By possessing a sound understanding of how to successfully develop and deliver a biotechnology drug, students graduating from this track will be recruited by the pharmaceutical industry or new start-up biotechnology companies.

Applications for all master's and doctoral programs are submitted electronically through the Graduate School of the University of Colorado Denver. After signing up for an account, select 'Master's' under the 'Academic Interests' menu and scroll down to 'Skaggs School of Pharmacy and Pharmaceutical Sciences' and select "MS in Pharmaceutical Sciences."

Application requirements are:

- a completed Graduate School application
- a baccalaureate degree (or equivalent) in biology, chemistry, or a related field from an accredited college or university with a minimum GPA of 3.0
- a 500- to 1,000-word written statement expressing interest or demonstrated experience, if applicable, in the field of pharmaceutical sciences and indication of the applicant's intended specialty track (i.e., cannabis science & medicine, clinical pharmacokinetics & pharmacodynamics, drug discovery, molecular & systems toxicology, or pharmaceutical biotechnology & drug delivery)
- three (3) references from persons familiar with the applicant's prior academic performance, potential, character, and suitability for graduate study (using a standardized template provided to prospective students)
- Additionally:
  - the GRE (Graduate Record Examination) is **not** required
  - the TOEFL or IELTS is required of applicants for whom English is not their first language
  - **Applications will not be reviewed until all required materials have been received.**

The Master of Science Degree in Pharmaceutical Sciences has five different tracks from which to choose. A minimum of 30 credit hours is required, of which non-thesis students complete a 3-credit capstone literature review (PHSC 6990), and thesis students complete two-to-three semesters of thesis research (PHSC 6950) for 6 total credits.

## CANNABIS SCIENCE & MEDICINE TRACK

### Year 1

Fall		Hours
PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 7400	Ethical Issues in Toxicology & Pharmaceutical Sciences	1
PHSC 7565	Applied Statistics for Pharm Science and Toxicology	2
PHSC 7700	Cannabis Pharmacology & Physiology	3
<b>Hours</b>		<b>9</b>

<b>Spring</b>		
PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 6720	Cannabis Therapeutics: Pain, Oncology, At-Risk Populations	2
PHSC 7710	Chemical Analysis of Cannabis	2
PHSC 7711	Chemical Analysis of Cannabis Laboratory	1
Note: Fully-remote students may replace the Chemical Analysis of Cannabis Laboratory with an additional elective credit.		
PHSC 7705	Scientific Writing in Cannabis Science & Medicine	1
<b>Hours</b>		<b>9</b>

**Year 2**

<b>Fall</b>		
PHSC 6710	Cannabis Therapeutics: Neurology & Mental Health	2
PHSC 7720	Seminar in Cannabis Science & Medicine	2
<b>Hours</b>		<b>4</b>

**Spring**

PHSC 6990	Capstone Project in Pharmaceutical Sciences	3
Students may alternatively complete a year-long research thesis (PHSC 6950 - 6 credits total), which meets the Capstone Project requirement.		
PHSC 6730	Legal & Regulatory Issues in Cannabis Medicine	2
PHSC 7720	Seminar in Cannabis Science & Medicine	2
<b>Hours</b>		<b>7</b>
<b>Total Hours</b>		<b>29</b>

## CLINICAL PHARMACOKINETICS & PHARMACODYNAMICS TRACK

**Year 1**

<b>Fall</b>			<b>Hours</b>
PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3	
PHSC 7400	Ethical Issues in Toxicology & Pharmaceutical Sciences	1	
PHSC 7565	Applied Statistics for Pharm Science and Toxicology	2	
PHSC 6015	Clinical Pharmacokinetics	3	
<b>Hours</b>		<b>9</b>	

**Spring**

PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 7665	Pharmacokinetic Principles & Applications	3
PHSC 7326	Seminar in Clinical Pharmacokinetics & Pharmacodynamics	2
<b>Hours</b>		<b>8</b>

**Year 2**

<b>Fall</b>		
PHSC 7330	Development of Drugs and Biologics	3
PHSC 7667	Population Pharmacokinetic Modeling	3

PHSC 7326	Seminar in Clinical Pharmacokinetics & Pharmacodynamics	2
<b>Hours</b>		<b>8</b>

**Spring**

PHSC 6990	Capstone Project in Pharmaceutical Sciences	3
Students may alternatively complete a year-long research thesis (PHSC 6950 - 6 credits total), which meets the Capstone Project requirement.		
<b>Hours</b>		<b>3</b>
<b>Total Hours</b>		<b>28</b>

## DRUG DISCOVERY TRACK

**Year 1**

<b>Fall</b>			<b>Hours</b>
PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3	
PHSC 7400	Ethical Issues in Toxicology & Pharmaceutical Sciences	1	
PHSC 7565	Applied Statistics for Pharm Science and Toxicology	2	
PHSC 7568	Seminar in the Pharmaceutical Sciences	2	
<b>Hours</b>		<b>8</b>	

**Spring**

PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 7320	Physical Pharmacy & Pharmaceutical Sciences	3
<b>Hours</b>		<b>6</b>

**Year 2**

<b>Fall</b>			<b>Hours</b>
PHSC 7328	Computational Design in Drug Discovery	3	
PHSC 7568	Seminar in the Pharmaceutical Sciences	2	
PHSC 7330	Development of Drugs and Biologics	3	
<b>Hours</b>		<b>8</b>	

**Spring**

PHSC 6990	Capstone Project in Pharmaceutical Sciences	3
Students may alternatively complete a year-long research thesis (PHSC 6950 - 6 credits total), which meets the Capstone Project requirement.		
<b>Hours</b>		<b>3</b>
<b>Total Hours</b>		<b>25</b>

## MOLECULAR & SYSTEMS TOXICOLOGY TRACK

**Year 1**

<b>Fall</b>			<b>Hours</b>
TXCL 7310	Fundamentals of Pharmaceutical Sciences I	3	
TXCL 7400	Ethical Issues in Toxicology and Pharmaceutical Sciences	1	
TXCL 7565	Applied Statistics for Pharm Science and Toxicology	2	

TXCL 7322	Molecular and Target Organ Toxicology	3
<b>Hours</b>		<b>9</b>

**Spring**

TXCL 7310	Fundamentals of Pharmaceutical Sciences I	3
TXCL 7323	Environmental and Target Organ Toxicology	3
TXCL 7321	Careers in Toxicology	1
<b>Hours</b>		<b>7</b>

**Year 2****Fall**

TXCL 7330	Development of Drugs and Biologics	3
TXCL 7325	Current Topics in Toxicology Research	1
<b>Hours</b>		<b>4</b>

**Spring**

PHSC 6990	Capstone Project in Pharmaceutical Sciences	3
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Students may alternatively complete a year-long research thesis (PHSC 6950 - 6 credits total), which meets the Capstone Project requirement.

TXCL 7325	Current Topics in Toxicology Research	1
<b>Hours</b>		<b>4</b>
<b>Total Hours</b>		<b>24</b>

## PHARMACEUTICAL BIOTECHNOLOGY & DRUG DELIVERY TRACK

**Year 1**

<b>Fall</b>		<b>Hours</b>
PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 7400	Ethical Issues in Toxicology & Pharmaceutical Sciences	1
PHSC 7565	Applied Statistics for Pharm Science and Toxicology	2
PHSC 7653	Protein Formulation	2
<b>Hours</b>		<b>8</b>

**Spring**

PHSC 7310	Fundamentals of Pharmaceutical Sciences I	3
PHSC 7345	Nanotechnology & Drug Delivery	2
PHSC 7568	Seminar in the Pharmaceutical Sciences	2

Choose either PHSC 7608 or PHSC 7609

PHSC 7608	Molecular Interactions	3
PHSC 7609	Biophysics & Spectroscopy	1.5
<b>Hours</b>		<b>11.5</b>

**Year 2****Fall**

PHSC 7330	Development of Drugs and Biologics	3
PHSC 7568	Seminar in the Pharmaceutical Sciences	2
<b>Hours</b>		<b>5</b>

**Spring**

PHSC 6990	Capstone Project in Pharmaceutical Sciences	3
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Students may alternatively complete a year-long research thesis (PHSC 6950 - 6 credits total), which meets the Capstone Project requirement.

<b>Hours</b>	<b>3</b>
<b>Total Hours</b>	<b>27.5</b>

## ELECTIVES

Code	Title	Hours
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Students may choose electives from specialty tracks other than their own or from the list of other approved electives below. The Program Director meets with each student prior to the beginning of each semester to devise and refine a personalized curriculum that best suits each student's needs.

PHSC 7025	Pharmacogenomics	2
TXCL 7353	Immunology: Immunotoxicology and Immunopharmacology	2
PHSC 7660	Liposome-based Drug Delivery	2
PHSC 7345	Nanotechnology & Drug Delivery	2
PHSC 7653	Protein Formulation	2
PHSC 7658	Advanced Topics in Pharmaceutical Sciences	1-5
TXCL 7750	Proteomics & Metabolomics for Biomarker Discovery	3
TXCL 7751	Neurotoxicology	2
BIOS 6648	Design and Conduct of Clinical Research	3
BSBT 6802	Reg Env of Life Science Innovation - Drug Discovery	1.5
PMHW 6621	Mental Health and Wellbeing Promotion	3
CBHS 6610	Social and Behavioral Factors and Health	3
HSMP 6605	Health Policy	3
PMHW 6601	Mental Health	3
PMHW 6620	Mental Health Systems and Policy	3
PMHW 6622	Opioid Use, Overdose and Public Health	1
PMHW 6625	Substance Use: A Public Health Perspective	3