PHARMACEUTICAL SCIENCES, PH.D.

The Division of Pharmaceutical Sciences (https://pharmacy.wisc.edu/psd) at the School of Pharmacy offers the doctor of philosophy (Ph.D.) degree in pharmaceutical sciences. The program provides a rigorous background in a range of scientific disciplines that are critical to the success of the next generation of pharmaceutical scientists. The program’s interdisciplinary training combines pharmaceutically relevant aspects of classical disciplines such as chemistry, biology, and engineering. Students earn a Ph.D. in Pharmaceutical Sciences, concentrating in one of three research cores: Drug Discovery, Drug Action, or Drug Delivery. Extensive communication and collaboration occur between these cores, mirroring the importance of interdisciplinary research teams in the pharmaceutical field. See this program overview flyer (https://pharmacy.wisc.edu/wp-content/uploads/pharmsci-programinfo.pdf) for more detailed information regarding current faculty research directions.

Research in Drug Discovery (https://pharmacy.wisc.edu/psd/drug-discovery-core) focuses on areas related to medicinal chemistry, such as small molecule development, natural products isolation and characterization, organic synthesis, chemical biology, and rational drug design.

Drug Action (https://pharmacy.wisc.edu/psd/drug-action-core) focuses on areas related to pharmacology, toxicology, cellular differentiation, development, and disease. Interests include the impact of drugs and toxins on biological systems, mechanisms of normal biology, and mechanisms of disease. These are studied at the cellular, genetic, molecular, and biochemical levels using diverse model systems.

Drug Delivery (https://pharmacy.wisc.edu/psd/drug-delivery-core) (pharmaceutics) emphasizes principles in physical chemistry and drug transport, aiming for advances in formulation, drug targeting, and multi-modal therapy. Delivery research includes the solid-state chemistry of drugs, nano-pharmacy, biocompatibility, molecular recognition, computational chemistry, pharmacokinetics, and molecular imaging.

The UW–Madison Pharmaceutical Sciences Division has been recognized for its research productivity, extramural funding support, publication record and teaching. The School of Pharmacy is housed in Rennebohm Hall, (https://pharmacy.wisc.edu/about-rennebohm-hall) a seven-story, state-of-the-art facility that opened in 2001 and offers 120,000 assignable square feet. The Pharmaceutical Sciences Division comprises floors 4 to 7 of Rennebohm Hall and features 34 laboratories; affiliate Pharmaceutical Sciences graduate faculty and their labs are housed in other campus buildings. Located on the northwest edge of campus, Rennebohm Hall is in close proximity to the Health Sciences Learning Center (home of the UW School of Medicine and Public Health, or SMPH), UW Hospital and Clinics, the UW Institute for Clinical and Translational Research (ICTR), the Waisman Center, the Wisconsin Institutes for Medical Research (WIMR), SMPH’s Center for Human Genomics and Precision Medicine, the School of Veterinary Medicine, the School of Nursing, and Elbing Library for the Health Sciences. Many researchers affiliated with Wisconsin’s Carbone Comprehensive Cancer Center work within these adjacent facilities.

Exceptional research facilities and equipment are highlighted by the school’s Analytical Instrumentation Center (AIC) (http://www.pharmacy.wisc.edu/aic), comprising mass spectrometry, nuclear magnetic resonance, spectroscopy, and spectrophotometry facilities. The AIC’s high-tech instrumentation expedites the isolation and full structural elucidation of small molecules. These chemical entities can be subsequently evaluated via high throughput screening toward lead generation, or specifically utilized to prove novel biological phenomenon toward in-depth mechanistic study. The division offers centralized facilities for computer-aided drug and catalyst design, real-time PCR, gene array detectors, gas chromatographs, high-pressure liquid chromatographs, cell culture, ultra-centrifuges, scintillation counters, and animal care for a variety of species.

The School of Pharmacy’s Lenor Zeeh Pharmaceutical Experiment Station (http://www.pharmacy.wisc.edu/zstation) is a not-for-profit, self-sustaining center of expertise serving faculty researchers across the UW–Madison campus as well as private-sector drug product development. The station provides laboratory services related to compound physical/chemical characterization and basic formulation development to support preclinical development of promising drug candidates and other unmet pharmaceutical-related needs. Pharmaceutical Sciences graduate students are eligible to participate in summer project assistantships at the station. Pharmaceutical Sciences also houses the university’s Medicinal Chemistry Center (https://pharmacy.wisc.edu/mcc) (MCC), whose mission is to provide drug discovery expertise to the UW medical community and drive translational research at UW–Madison through designing and synthesizing novel small molecule based therapeutics. Pharmaceutical Sciences faculty direct the MCC. A Nanotechnology Center for Drug Delivery (https://www.youtube.com/watch?v=XTJASaRisQ&feature=youtu.be) is one of the nation’s most prolific research universities, located on the shores of Lake Mendota in the state’s vibrant capital city. The city of Madison (https://madison.wisc.edu) is consistently recognized as one of the best cities in the nation in multiple categories for quality of life. Visit grad.wisc.edu (http://grad.wisc.edu) to learn more about the many reasons to choose UW–Madison for graduate study.

POSTGRADUATE INFORMATION

Recent program graduates have found employment in a variety of industrial settings or in prestigious postdoctoral academic research labs. Opportunities in research and development roles for pharmaceutical, chemical, biotechnology and other innovation-minded companies are a common postgraduate path; some graduates eventually achieve faculty positions at small colleges or at larger research institutions. By partnering with other units on campus, the program has increased career services such that students can sharpen their professional and communication skills and reach a larger network of potential employers. The program graduated 46 Ph.D.s from 2012 to 2017; over 90 percent of these recent alumni were professionally placed (i.e., working in the field) within six months of graduation. For more information on first professional placement following graduation, see employers of recent PharmSci graduates (https://pharmacy.wisc.edu/programs/pharmsci-student-outcomes). The School’s Graduate Coordinator can be consulted for specific career information (both initial placement and longer-term employment information regarding Ph.D. alumni).

FACILITIES

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undergraduate-research-paths) began in 2018, aiming to improve the efficacy of new drug leads.

ADMISSIONS

Please consult the table below for key information about this degree program’s admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program’s website. Graduate admissions is a two-step process between academic programs and the Graduate School. Applicants must meet the minimum requirements (https://grad.wisc.edu/apply/requirements) of the Graduate School as well as the program(s).

Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply).

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Deadline</td>
<td>December 27</td>
</tr>
<tr>
<td>Spring Deadline</td>
<td>The program does not admit in the spring.</td>
</tr>
<tr>
<td>Summer Deadline</td>
<td>The program does not admit in the summer.</td>
</tr>
<tr>
<td>GRE (Graduate Record Examinations)</td>
<td>Required.</td>
</tr>
<tr>
<td>English Proficiency Test</td>
<td>Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (<a href="https://grad.wisc.edu/apply/requirements/#english-proficiency">https://grad.wisc.edu/apply/requirements/#english-proficiency</a>).</td>
</tr>
<tr>
<td>Other Test(s) (e.g., GMAT, MCAT)</td>
<td>n/a</td>
</tr>
<tr>
<td>Letters of Recommendation</td>
<td>Required.</td>
</tr>
</tbody>
</table>

Accepted students commonly have strong scientific backgrounds, a passion for research, and significant laboratory experience. Students with undergraduate degrees in the physical or biological sciences, engineering, pharmacy, and related fields are encouraged to apply. Students who have earned masters degrees are also welcomed to apply, but a masters degree is not a requirement. One may apply directly to the Pharmaceutical Sciences Ph.D. program with a bachelor’s degree background (as long as a bachelor’s degree would be completed by the time one would begin graduate studies).

Please see admissions (https://pharmacy.wisc.edu/programs/pharmsci/admissions) on the program website for the application deadline and required supplemental materials. Related links describe frequently-asked admissions questions (https://pharmacy.wisc.edu/programs/pharmsci/admissions/faq), selection criteria (https://pharmacy.wisc.edu/programs/pharmsci/admissions-selection-criteria), and typical pharmaceutical research paths for various undergraduate majors (https://pharmacy.wisc.edu/programs/pharmsci/admissions/undergraduate-research-paths).

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding) is available from the Graduate School. Be sure to check with your program for individual policies and processes related to funding.

PROGRAM RESOURCES

Financial support is provided to all graduate students in Pharmaceutical Sciences through a combined mechanism of fellowships, teaching assistantships, research assistantships, and project assistantships. Financial support typically extends for the full duration of a student’s graduate study. Funding packages for first-year students in the PhD program are provided by the School of Pharmacy and consist of a mixture of fellowships and/or teaching assistant support. In addition, first-year students typically are provided $1500 in flexible funds to aid in the transition to Madison. After the first academic year, students are supported by their thesis advisor through research or teaching assistantship appointments (some students earn funding via federally supported predoctoral fellowships or campus training grants). All students receive a stipend (the recommended minimum level for students in the division is $26,000 for 2018-19, a figure that is adjusted annually), full tuition remission (waiver), and most of the cost of reasonably priced, comprehensive health insurance for the duration of their PhD studies, if they retain good academic standing and a faculty advisor. For more details, see this program-specific funding page (https://pharmacy.wisc.edu/programs/pharmsci/tuition-financial-aid).

Travel grants are available annually; the program has funding to provide seven graduate students with grants each year. Students who are presenting at scientific conferences are preferred applicants; awards range from $1000–$1500. Most students are additionally supported in scientific conference travel via faculty funds.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

<table>
<thead>
<tr>
<th>Face to Face</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Mode of Instruction Definitions

Evening/Weekend: These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.
Online: These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

Hybrid: These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

Accelerated: These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

### CURRICULAR REQUIREMENTS

<table>
<thead>
<tr>
<th>Requirements Detail</th>
<th>Minimum Credit Requirement</th>
<th>Minimum Residence Credit Requirement</th>
<th>Minimum Graduate Coursework Requirement</th>
<th>Overall Graduate GPA Requirement</th>
<th>Other Grade Requirements</th>
<th>Assessments and Examinations</th>
<th>Language Requirements</th>
<th>Doctoral Minor/Breadth Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>51 credits</td>
<td>32 credits</td>
<td>Half of degree coursework (26 credits out of 51 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university’s Course Guide (<a href="http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle">http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle</a>).</td>
<td>3.00 GPA required.</td>
<td>Cандiates may be dropped from the program if they receive more than 7 credits of grades at the BC level or lower. This applies to formal courses and research credits.</td>
<td>The preliminary examination is expected to be completed before the beginning of the third year of graduate study. For specifics regarding the preliminary examination’s structure and requirements, see Preliminary Examination in the PSD Student Handbook (<a href="https://pharmacy.wisc.edu/graduate-handbook-pharmaceutical-sciences/preliminary-examination/">https://pharmacy.wisc.edu/graduate-handbook-pharmaceutical-sciences/preliminary-examination/</a>).</td>
<td>There are no language requirements in the Pharmaceutical Sciences Ph.D. program.</td>
<td>No doctoral minor is required.</td>
</tr>
</tbody>
</table>

### REQUIRED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHM SCI 780</td>
<td>Principles of Pharmaceutical Sciences</td>
<td>3</td>
</tr>
</tbody>
</table>

Select at least two of the following core courses: 6 credits

<table>
<thead>
<tr>
<th>Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PHM SCI 768</td>
<td>Pharmacokinetics</td>
<td></td>
</tr>
<tr>
<td>PHM SCI 786</td>
<td>Natural Product Synthesis, Biosynthesis and Drug Discovery</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/PHMCOL-M/ZOOLOGY 630</td>
<td>Cellular Signal Transduction, Mechanisms</td>
<td></td>
</tr>
</tbody>
</table>

Research ethics/responsible conduct of research course 1 credit

Three additional credits from the Drug Action, Drug Delivery, or Drug Discovery elective lists are required (courses meeting this requirement are listed in the Pharmaceutical Sciences Graduate Handbook)

<table>
<thead>
<tr>
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<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHM SCI 931</td>
<td>Pharmaceutical Sciences Seminar (required every fall term during enrollment as a graduate student in the program)</td>
<td>1</td>
</tr>
<tr>
<td>PHM SCI 932</td>
<td>Pharmaceutical Sciences Seminar (required every spring during enrollment as a graduate student in the program)</td>
<td>1</td>
</tr>
<tr>
<td>PHM SCI 990</td>
<td>Research</td>
<td>2</td>
</tr>
</tbody>
</table>

1 Seminar is required every fall and spring semester during enrollment as a graduate student in the program.

2 Research credits are typically taken every semester in the program, beginning in the second semester. Credits will vary.

To enhance a required core curriculum, an individualized course of study is planned with a faculty advisor. Faculty advisors have the option to require additional courses beyond the minimum requirements listed above.

### POLICIES

### GRADUATE SCHOOL POLICIES

The Graduate School’s Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

### MAJOR-SPECIFIC POLICIES

#### GRADUATE PROGRAM HANDBOOK

The Graduate Program Handbook (https://pharmacy.wisc.edu/graduate-handbook-pharmaceutical-sciences) is the repository for all of the program’s policies and requirements.

#### PRIOR COURSEWORK

**Graduate Work from Other Institutions**

With program approval, students are allowed to count no more than 15 credits of graduate coursework from other institutions.
(the student must have graduate student status on the other institution's transcript at the time the courses were taken). Coursework should be presented to the SoP graduate dean in the first semester of enrollment for consideration. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

UW–Madison Undergraduate
With approval of the School of Pharmacy's graduate studies dean, students are allowed to count no more than 7 credits of UW–Madison courses numbered 500 or above (earned as a UW–Madison undergraduate) toward the Ph.D. Coursework should be presented to the SoP graduate dean in the first semester of enrollment for consideration. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

UW–Madison University Special
With program approval, students are allowed to count no more than 15 credits of coursework numbered 500 or above taken as a UW–Madison special student toward the Ph.D. Coursework should be presented to the SoP graduate dean in the first semester of enrollment for consideration. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

PROBATION
A semester GPA below 3.0 will result in the student being placed on academic probation. If a semester GPA of 3.0 is not attained during the subsequent semester of full time enrollment (or 12 credits of enrollment if enrolled part-time) the student may be dismissed from the program or allowed to continue for one additional semester based on advisor appeal to the Graduate School.

ADVISOR / COMMITTEE
All students in the Ph.D. program are required to have a major professor/advisor through the duration of their studies. Typically a permanent advisor is found by the end of one’s first semester.

All students are required to conduct an annual progress meeting with their thesis committee each year. The meeting should be completed by the end of August of each consecutive academic year. In years where the preliminary exam or the Ph.D. thesis defense are completed by the end of August of each consecutive academic year, students are allowed to count no more than 7 credits of coursework numbered 500 or above taken as a UW–Madison special student toward the Ph.D. Coursework should be presented to the SoP graduate dean in the first semester of enrollment for consideration. Coursework earned ten years or more prior to admission to a doctoral degree is not allowed to satisfy requirements.

CREDITS PER TERM ALLOWED
15 credits

TIME CONSTRAINTS
It is expected that Ph.D. major course requirements will be completed by the end of year two in the program.

A candidate for a doctoral degree who fails to take the final oral examination and deposit the dissertation within five years after passing the preliminary examination may be required to take another preliminary examination and to be admitted to candidacy a second time.

OTHER
First-year students are typically offered fellowships and School of Pharmacy teaching assistantships in their initial two semesters. Funding as research assistants is assumed by the student's principal investigator/thesis advisor in the first summer. Subsequently (year 2 and beyond), students are funded by RA-ships, TA-ships and via other extramural funding (fellowship) support.

PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES
Take advantage of the Graduate School’s professional development resources (https://grad.wisc.edu/pd) to build skills, thrive academically, and launch your career.

Professional development opportunities for Pharmaceutical Sciences graduate students include annual performance reviews by their respective thesis committee, providing constructive criticism regarding each student’s academic and research progress. Further, each student, beginning in one’s second year, gives an annual seminar to one’s research core (Drug Discovery, Drug Action, or Drug Delivery), providing an additional community of support and feedback. Moreover, the Pharmaceutical Sciences Seminar series welcomes numerous academic and industrial scientists throughout the year; students have regular opportunities to meet such leaders in small settings. The division’s annual poster session brings the community together and is another forum for research interaction.

The UW-Madison student chapter of the American Association of Pharmaceutical Scientists (AAPS) is vibrant and active, providing a wide variety of career development "workshops" and discussion "roundtable" events with scientists and faculty. AAPS also selects and hosts an annual industrial-based scientist as a speaker. Many students attend the Pharmaceutics Graduate Student Research Meeting (PGSRM) each summer, a graduate student-organized conference for graduate students across the upper Midwest (UW-Madison will host such in summer 2019). A parallel student-led medicinal chemistry-oriented conference (MIKI) is another annual opportunity.

There are a wide variety of opportunities for STEM-based graduate students to develop entrepreneurial and business skills. These include the Morgridge Entrepreneurial Bootcamp (https://bus.wisc.edu/degrees-programs/non-business-majors/morgridge-entrepreneurial-bootcamp), WISolve Consulting Group (https://www.wisolve.org), the graduate certificates (https://wsb.wisc.edu/programs-degrees/certificates) in Entrepreneurship or Strategic Innovation, and many others, summarized by the School of Business’ Insite Guide. (https://apps.wsb.wisc.edu/insite-entrepreneurship-guide)

The program is committed to graduate students organizing an all-day retreat every other summer; such events typically involve career exploration and professional development themes. Informational interviews are organized with PhD alumni, either in person or via Skype, to help students understand various post-graduate opportunities. Graduate students who aspire to develop as instructors and future faculty can work with the School’s Director of Graduate Studies for appropriate teaching assistant opportunities that will challenge them in this realm.
LEARNING OUTCOMES

1. Demonstrate critical knowledge and in-depth understanding of principles in the student's area of expertise.
2. Identify important research questions, formulate testable hypotheses, and design experiments to test those hypotheses.
3. Conduct original research that contributes to the student's field of study.
4. Communicate scientific knowledge and research results effectively to a range of audiences.
5. Demonstrates breadth within their learning experiences.
6. Advances contributions of the field of study to society.
7. Apply ethical principles in conducting scientific research.

PEOPLE

A list of Pharmaceutical Sciences graduate faculty and their respective areas of research specialization is available from the division website (https://pharmacy.wisc.edu/psd/faculty-research) and related links. The Pharmaceutical Sciences Graduate Program has educated generations of scientists for challenging positions in industry, academia, and government.