

## Pharmaceutical Sciences

### Department of Pharmaceutical Sciences

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#### Overview

The Pharmaceutical Sciences major program is a four-year program leading to a bachelor of science degree in pharmaceutical sciences. While the major is structurally a basic science program (like biochemistry, biology, etc.), it is also a unique interdisciplinary field of study that seeks to achieve better understanding and control of the factors influencing clinical response to drug therapy.

Areas of interest in pharmaceutical sciences range from the physical chemistry of pharmaceutical systems, which is concerned with the development and optimization of the physical-chemical properties of traditional and novel drug dosage forms and systems; to biopharmaceutics, which encompasses the study of the relationship between the nature and intensity of biologic effects of drugs and various dosage formulation factors; to pharmacokinetics, which is the science of the quantitative analysis of drug concentration and drug effects in the body; to clinical pharmacokinetics, which is concerned with the application of pharmacokinetics to the safe and effective therapeutic management of individual patients.

#### About our Degrees

The pharmaceutical sciences are interdisciplinary fields of study which seek to achieve better understanding and control of the factors influencing clinical response to drug therapy. Emphasis is given to the application of pharmacokinetics and physical-chemical principles to questions of pharmacological and clinical importance.

The Pharmaceutical Sciences major program is a four-year program leading to a Bachelor of Science degree in Pharmaceutical Sciences. While the program is structurally a basic science program (like biochemistry, biology, and so forth), it uniquely offers an interdisciplinary field of study which seeks to achieve better understanding and control of the factors influencing clinical response to drug therapy.

Areas of interest in pharmaceuticals include the physical chemistry of pharmaceutical systems, which is concerned with the development and optimization of the physical/chemical properties of traditional and novel drug delivery systems; biopharmaceutics, which encompasses the study of the relationship between the nature and intensity of biologic effects of drugs and various dosage formulation factors; pharmacokinetics and pharmacodynamics, which are the sciences of the quantitative analyses of drug concentrations and therapeutic effect, respectively, in the body; and clinical pharmacokinetics and clinical pharmacodynamics, which are concerned with the application of pharmacokinetics and pharmacodynamics to the safe and effective therapeutic management of individual patients.

#### **Pharmaceutical Sciences - B.S.**

This four-year degree program educates students to be pharmaceutical research scientists engaged in drug discovery and development research.

#### **Pharmaceutical Sciences - B.S./M.S.**

This combined degree program for academically qualified students allows for completion of both B.S. and M.S. requirements in the pharmaceutical sciences in less than six years. Students must be enrolled in the Pharmaceutical Sciences B.S. program. Students in this program will be awarded one degree only (B.S./M.S.), and therefore do not graduate with a separate B.S.

#### **Acceptance Criteria - B.S.**

Minimum GPA of 2.5 in all prerequisite science courses.  
Application to the department with a UB DARS report is recommended early in the second semester of the second year.

#### **Acceptance Information**

Deadline: March 15 for the following Fall semester

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Number of applicants (2008-2009): 150

Number of accepted majors: 15-20

Total number of majors currently enrolled: 30

### Degree Requirements

Please see [Degrees and Policies](#).

### About our Courses

#### The typical class size for:

Upper level/advanced courses is: 12-15

#### In the Department of Pharmaceutical Sciences, what do teaching assistants (TA's) do?

They assist in laboratories and recitations.

For course descriptions, please see [Courses](#).

### About our Faculty

See a list of our [Undergraduate Faculty](#).

### Extracurricular Activities

See the [UB Student Association](#).

### Practical Experience and Special Academic Opportunities

All students are required to take [PHC 498](#), a 3-credit undergraduate research participation project. A laboratory, computer data analysis, or library research experience is an important and unique feature of the Pharmaceutical Sciences program at UB. Students with scientific research experience are highly sought after by prospective employers.

For [PHC 498](#), students identify faculty mentors who will guide them through their research projects. This course is highly flexible and individualized due to the nature of the one-on-one interaction between the student and faculty member. Students are exposed to research methods and hypothesis testing; the role of research methods in experimental design, execution and data analysis; and methods to communicate the research findings.

While each student is required to complete 3 credits of [PHC 498](#), highly interested and motivated students may choose to undertake more research credits, up to a maximum of 10 credits. Students who elect to complete the minimum 3 required credits may choose to enroll in other science elective courses offered by other departments, for a minimum of 6 credits.

### Career Information and Further Study

Graduates of this program are well educated as entry-level researchers. Graduates are well prepared to fulfill positions within the pharmaceutical industry, in sales, or to continue on to graduate studies.

#### Skills gained in this program include:

Researching, analyzing, interpreting, reasoning, managing, advising, organizing, problem solving, detail orientation, writing, editing, teaching, speaking to groups, reading critically, the ability to think critically, evaluating, advising, and selling.

#### Career Choices

The broad scope of scientific interest associated with the pharmaceutical sciences discipline provides students with an extensive vista of career opportunities. Qualified graduates are highly sought for employment in pharmaceutical research environments. Pharmaceutical Sciences graduates may find opportunities in university, hospital, or pharmaceutical industry settings, including positions as:

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- Consumer safety officers
- Drug analysts
- Manufacturing/production technologists
- Marketing/sales drug detail representatives
- Peace Corps/VISTA volunteers
- Research associates in: Bioanalysis, drug delivery, drug metabolism, and pharmacokinetics
- Science librarians

Alternatively, they may pursue graduate studies leading to the M.D., D.D.S., B.S./M.S., M.S., or Ph.D. degrees, and then pursue careers such as:

- Biochemists
- Health careers
- Pharmacologists
- Professors
- Researchers

### What percentage of graduates goes on to find related employment?

More than 90%

### Salary Information

Salaries range greatly from one occupation, position, and work setting to another. According to Annual AAPS-Pharm Tech Employment Surveys, a person with a B.S. and 0-5 years of experience can anticipate an average salary of \$45,000 within the pharmaceutical industry.

### Post-undergraduate Opportunities

Many graduates enter medical or dental schools, or continue their studies to obtain a Ph.D. in pharmaceuticals. These Ph.D.'s teach, carry on independent research in a university or hospital, or enter industrial research.

### What percentage of graduates goes on to graduate school?

Approximately 10%

### Additional Information

- [American Association of Pharmaceutical Scientists](#)
- [Pharmaceutical Information Network](#)

## Degrees Offered

**Undergraduate:** BS, Minor

**Combined:** BS/MS

## Links to Further Information About this Program

- [Undergraduate Catalog](#)
- [Undergraduate Admissions](#)
- [Graduate Admissions](#)
- [Department of Pharmaceutical Sciences](#)
- [School of Pharmacy and Pharmaceutical Sciences](#)

### **Pharmaceutical Sciences - B.S.**

#### **Acceptance Criteria**

Minimum GPA of 2.5 overall.

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Minimum GPA of 2.5 in all prerequisite science courses.

### Advising Notes

Application to the department with a UB DARS report is recommended early in the second semester of the second year.

### Prerequisite Courses

[BIO 200](#) Evolutionary Biology  
[BIO 201](#) Cell Biology  
[CHE 101](#) General Chemistry  
[CHE 102](#) General Chemistry  
[CHE 201](#) Organic Chemistry  
[CHE 202](#) Organic Chemistry  
[MTH 121](#) Survey of Calculus and Its Applications I or [MTH 141](#) College Calculus I  
[MTH 122](#) Survey of Calculus and Its Applications II or [MTH 142](#) College Calculus II  
[PHY 101](#) College Physics I or [PHY 107](#) General Physics I (no lab)  
[PHY 102](#) College Physics II or [PHY 108](#) General Physics II (no lab)  
One science elective

### Required Courses

[BCH 403](#) Principles of Biochemistry  
[CHE 214](#) Introduction to Analytical Chemistry  
[PGY 451](#) Human Physiology I  
[PGY 452](#) Human Physiology II  
[PMY 405](#) Principles of Pharmacology I  
[PMY 406](#) Principles of Pharmacology II  
[PHC 331](#) Case Studies in the Pharmaceutical Sciences  
[PHC 332](#) Introduction to Research  
[PHC 409](#) Pharmaceutical Calculations  
[PHC 410](#) Physical Pharmacy  
[PHC 411](#) Introduction to Pharmacokinetics and Biopharmaceutics I  
[PHC 413](#) Pharmaceutics Seminar  
[PHC 414](#) Pharmaceutics Seminar  
[PHC 420](#) Pharmaceutical Analysis  
[PHC 421](#) Pharmaceutical Principles  
[PHC 425](#) Pharmaceutical Biotechnology: From Bench to Bedside  
[PHC 426](#) Pharmaceutical Biotechnology Virtual Laboratory  
[PHC 431](#) Important Advances in Pharmaceutical Sciences  
[PHC 432](#) Methods of Scientific Communication  
[PHC 498](#) Undergraduate Research Participation in Pharmaceutical Sciences  
Science electives or [PHC 498](#) Undergraduate Research Participation in Pharmaceutical Sciences  
Two science electives

### Summary

Total required credit hours for the major...89

See [Baccalaureate Degree Requirements](#) for general education and remaining university requirements.

### Recommended Sequence of Program Requirements

#### FIRST YEAR

Fall [BIO 200](#), [CHE 101](#)  
Spring [BIO 201](#), [CHE 102](#)

#### SECOND YEAR

Fall [CHE 201](#); [MTH 121](#) or [MTH 141](#); [PHY 101](#) or [PHY 107](#) (no lab)  
Spring [CHE 202](#); [MTH 122](#) or [MTH 142](#); [PHY 102](#) or [PHY 108](#) (no lab); one science elective

#### THIRD YEAR

Fall [CHE 214](#), [PGY 451](#), [PHC 311](#), [PHC 331](#), one science elective  
Spring [PGY 452](#), [PHC 312](#), [PHC 332](#), [PHC 498](#), [PHC 420](#), [PHC 421](#), one science elective

#### FOURTH YEAR

Fall [BCH 403](#), [PMY 405](#), [PHC 411](#), [PHC 413](#), [PHC 431](#); or [PHC 498](#)  
Spring [PMY 406](#), [PHC 414](#), [PHC 425](#), [PHC 426](#), [PHC 432](#); science electives or [PHC 498](#)

## Pharmaceutical Sciences

### Pharmaceutical Sciences - B.S./M.S.

#### About the Program

This combined degree program for academically qualified students allows for completion of both BS and MS requirements in the pharmaceutical sciences in less than six years. Students in the BS program in pharmaceutical sciences with good-to-excellent academic records may apply. Students in this program will be awarded one degree only (BS/MS), and therefore do not graduate with a separate BS.

#### Acceptance Criteria

Accepted in the pharmaceutical sciences BS program.

Minimum GPA of 3.0 overall in all undergraduate courses and minimum GPA of 3.0 in the required third year pharmaceutical sciences courses.

Application to the department with a UB DARS report and two faculty letters of recommendation by September 30 in the first semester of the fourth year.

#### Prerequisite Courses

See Pharmaceutical Sciences - B.S. chart for prerequisite courses.

#### Required Courses

[BCH 403](#) Principles of Biochemistry  
[CHE 214](#) Introduction to Analytical Chemistry  
[PGY 451](#) Human Physiology I  
[PGY 452](#) Human Physiology II  
[PMY 405](#) Principles of Pharmacology I  
[PMY 512](#) Principles of Pharmacology II  
[PHC 311](#) Pharmaceutical Mathematics and Statistics  
[PHC 312](#) Physical Pharmacy  
[PHC 331](#) Case Studies in Pharmaceutical Sciences  
[PHC 332](#) Introduction to Research  
[PHC 411](#) Introduction to Pharmacokinetics and Biopharmaceutics I  
[PHC 413](#) Pharmaceutics Seminar  
[PHC 414](#) Pharmaceutics Seminar  
[PHC 421](#) Pharmaceutical Principles  
[PHC 420](#) Pharmaceutical Analysis  
[PHC 425](#) Pharmaceutical Biotechnology: From Bench to Bedside  
[PHC 426](#) Pharmaceutical Biotechnology Virtual Laboratory  
[PHC 431](#) Important Advances in Pharmaceutical Sciences  
[PHC 432](#) Methods of Scientific Communication  
[PHC 498](#) Undergraduate Research Participation in Pharmaceutical Sciences  
[PHC 613](#) Pharmaceutics Seminar  
[PHC 614](#) Pharmaceutics Seminar  
[PHC 615](#) Graduate Research  
[PHC 616](#) Graduate Research  
 Science electives

#### Summary

Total required credit hours for the undergraduate portion.....89

Total required credit hours for the BS/MS...119

See [Baccalaureate Degree Requirements](#) for general education and remaining university requirements.

#### Recommended Sequence of Program Requirements

##### FIRST YEAR

Fall [BIO 200](#), [CHE 101](#)

Spring [BIO 201](#), [CHE 102](#)

##### SECOND YEAR

Fall [CHE 201](#); [MTH 121](#) or [MTH 141](#); [PHY 101](#) or [PHY 107](#) (no lab)

Spring [CHE 202](#); [MTH 122](#) or [MTH 142](#); [PHY 102](#) or [PHY 108](#) (no lab); one science elective

##### THIRD YEAR

Fall [CHE 214](#), [PGY 451](#), [PHC 311](#), [PHC 331](#), one science elective

Spring [PGY 452](#), [PHC 312](#), [PHC 332](#), [PHC 498](#), [PHC 420](#), [PHC 421](#), one science elective

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### FOURTH YEAR

Fall [BCH 403](#), [PMY 405](#), [PHC 411](#), [PHC 413](#), [PHC 431](#); science electives or [PHC 498](#)  
Spring [PMY 512](#), [PHC 425](#), [PHC 432](#), [PHC 616](#); graduate PHC science electives or [PHC 616](#); graduate research

### SUMMER

[PHC 615](#)

### FIFTH YEAR

Fall [PHC 613](#), [PHC 615](#), 500/600-level PHC elective courses  
Spring [PHC 614](#), [PHC 616](#), 500/600-level PHC elective courses

## Pharmaceutical Sciences - Minor

### About the Minor

The minor program emphasizes the principles of basic science relevant to the pharmaceutical sciences discipline. A minor in pharmaceutical sciences combined with a major in a scientific or clinical discipline (e.g., biology, chemistry, biochemistry, biochemical pharmacology, medicinal chemistry) provides a unique interdisciplinary education.

### Acceptance Criteria

Minimum GPA of 2.0 in all prerequisite courses.

### Advising Notes

Application to the department with a UB DARS report is recommended early in the second semester of the second year.

### Prerequisite Courses

[BIO 200](#) Evolutionary Biology  
[BIO 201](#) Cell Biology  
[CHE 201](#) Organic Chemistry  
[CHE 202](#) Organic Chemistry  
[MTH 121](#) Survey of Calculus and Its Applications I or [MTH 141](#) College Calculus I

### Required Courses

[PHC 311](#) Pharmaceutical Mathematics and Statistics  
[PHC 312](#) Physical Pharmacy  
[PHC 411](#) Introduction to Pharmacokinetics and Biopharmaceutics I  
[PHC 425](#) Pharmaceutical Biotechnology: From Bench to Bedside

### Electives and Course Groupings

#### PHARMACEUTICAL SCIENCES ELECTIVES (6 credit hours)

Choose from the following:

[PHC 331](#) Case Studies in Pharmaceutical Sciences  
[PHC 332](#) Introduction to Research  
[PHC 413](#) Pharmaceutics Seminar  
[PHC 414](#) Pharmaceutics Seminar  
[PHC 420](#) Pharmaceutical Analysis  
[PHC 426](#) Pharmaceutical Biotechnology Virtual Laboratory  
[PHC 498](#) Undergraduate Research Project in Pharmaceutical Sciences or any 3-credit-hour graduate-level pharmaceutical sciences course (permission of Pharmaceutical Sciences director required; see department for details)

**PHC 250: Apothecarial Adventures**

**Semester(s):** Fall

**Type:** SEM

**Credits:** 3

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Honors seminar focusing on the pharmaceutical and pharmacotherapeutic sciences behind well known (and not so well known) drugs that are widely used by society.

### PHC 331: Case Studies in Pharmaceutical Sciences

**Credits:** 2  
**Semester(s):** Fall  
**Type:** LEC

Introduces pharmaceutical sciences as a scientific discipline; also explores pharmaceutical organizations, pharmaceutical resources, research ethics and scientific misconduct, elements of the scientific method, and contemporary issues facing the discipline.

### PHC 332: Introduction to Research

**Credits:** 1  
**Semester(s):** Spring  
**Type:** LEC

Introduces research methods and hypothesis testing; the role of research methods in experimental design, execution, and data analysis; and consideration of the research process in research proposals.

### PHC 407: Selected Topics

**Credits:** 1  
**Semester(s):** Fall, Spring  
**Type:** LEC

*The content of this course is variable and therefore it is repeatable for credit. The [University Grade Repeat Policy](#) does not apply.*

Covers selected topics, particularly the more recent advances in pharmaceuticals.

### PHC 409: Pharmacy Calculations

**Credits:** 3  
**Type:** LEC/REC

Applies pharmaceutical mathematical concepts and techniques to contemporary pharmacy practice. Explores problem solving and covers descriptive and inferential statistical techniques, applying them to pharmaceutical study and practice.

### PHC 410: Physical Pharmacy

**Credits:** 3  
**Pre-requisites:** [PHC 311](#) Or [PHM 311](#)  
**Type:** LEC

Covers physical chemical properties of drugs, theory and practice applicable to design and evaluation of drug dosage forms, principles of solubility, solution equilibria, chemical kinetics, heterogenous systems, and solids.

### PHC 411: Introduction to Pharmacokinetics and Biopharmaceutics I

**Credits:** 3

**Semester(s):** Fall  
**Type:** LEC/REC

Examines factors influencing the absorption, distribution, excretion, and metabolism of drugs in humans; also studies the roles these processes play in therapeutic and adverse effects of drug products.

### PHC 412: Introduction to Pharmacokinetics and Biopharmaceutics II

**Credits:** 2  
**Semester(s):** Spring  
**Pre-requisites:** [PHC 411](#)  
**Type:** LEC

Continuation of [PHC 411](#). Presents examples of the rationale for therapeutic monitoring.

### PHC 413: Pharmaceutics Seminar

**Credits:** 1  
**Semester(s):** Fall  
**Type:** SEM

Students, faculty, and visiting scientists discuss the latest developments in pharmaceutical research.

### PHC 414: Pharmaceutics Seminar

**Credits:** 1  
**Semester(s):** Spring  
**Type:** SEM

Students, faculty, and visiting scientists discuss the latest developments in pharmaceutical research.

### PHC 420: Pharmaceutical Analysis

**Credits:** 1  
**Semester(s):** Spring  
**Type:** LEC

Reviews modern methods used in analyzing drugs and drug products, focusing on HPLC.

### PHC 421: Pharmaceutical Principles

**Credits:** 2  
**Semester(s):** Spring  
**Type:** LAB

Examines drug degradation kinetics, drug dosage formulation, solid drug dosage form dissolution kinetics, and pharmacokinetics.

### PHC 425: Pharmaceutical Biotechnology: from Bench to Bedside

**Credits:** 2  
**Semester(s):** Spring  
**Type:** LEC

Overview of recombinant DNA techniques relevant to pharmaceutical biotechnology. Covers pharmaceutical chemistry,

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basic pharmaceutical sciences, pharmacokinetics, pharmacology, and pharmacotherapeutics of selected biopharmaceuticals.

### PHC 426: Pharmaceutical Biotechnology Virtual Laboratory

**Credits:** 1  
**Semester(s):** Spring  
**Type:** DIS

A discussion-based course that incorporates a virtual, interactive software program to illustrate the biopharmaceutical drug discovery, research, and development process.

### PHC 431: Important Advances in Pharmaceutical Sciences

**Credits:** 2  
**Semester(s):** Fall  
**Type:** LEC

Examines classical and contemporary advances in the drug-development process, including drug analysis, drug delivery, biopharmaceuticals, pharmacokinetics, and pharmacodynamics.

### PHC 432: Methods of Scientific Communication

**Credits:** 1  
**Semester(s):** Spring  
**Type:** DIS

Students learn how to communicate their research project results using the scientific poster and paper as a communication tool.

### PHC 488: Faculty Research Seminar

**Credits:** 1  
**Type:** SEM

Faculty members of the department will present their research to facilitate research mentorships and laboratory selection.

### PHC 497: Departmental Honors Thesis or Project

**Credits:** 1  
**Type:** TUT

*The content of this course is variable and therefore it is repeatable for credit. The [University Grade Repeat Policy](#) does not apply.*

Department honors or thesis project.

### PHC 498: Undergraduate Research and Creative Activity

**Credits:** 1-8  
**Semester(s):** Fall, Spring  
**Type:** TUT

*The content of this course is variable and therefore it is repeatable for credit. The [University Grade Repeat Policy](#) does not apply.*

Involves lab and/or literature research participation on current problems.

### PHC 499: Independent Study

**Credits:** 1-5  
**Semester(s):** Fall, Spring  
**Type:** TUT

*The content of this course is variable and therefore it is repeatable for credit. The [University Grade Repeat Policy](#) does not apply.*

Involves development and assessment, through literature review and discussions, of a topic of student interest.