PHARMACOLOGY AND TOXICOLOGY, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

The fields of pharmacology and toxicology are by nature interdisciplinary biomedical sciences, drawing upon the foundations and approaches of cell biology, systems physiology, biochemistry, molecular biology, and genetics. A primary objective of pharmacology is to investigate fundamental aspects of cellular and molecular regulatory mechanisms for the purpose of understanding how drugs act and in order to develop new drugs for treatment of disease. Toxicology examines how chemical agents produce adverse effects on the organism, and studies mechanisms by which these materials contribute to cancer, neurological diseases, metabolic disorders and many other diseases and conditions. Our program is truly unique. One of the only eight majors in toxicology and pharmacology in the United States, it is the only one that blends molecular/cellular and environmental studies of toxicology and pharmacology.

What is Pharmacology & Toxicology?

Pharmacology and toxicology study two sides of the same coin namely how do chemicals affect organisms positively (Pharmacology) or negatively (Toxicology). Toxicology as the study of the adverse effects of chemical, physical, or biological agents on people, animals, and the environment. It complements the study of Pharmacology, which examines the beneficial effects of chemical and biological agents. Pharmacologists and Toxicologists are scientists trained to investigate, interpret, and communicate the nature of beneficial as well as hazardous effects of manmade chemicals. These are interdisciplinary sciences, integrating information from biology and virtually all its subspecialties (e.g., genetics, endocrinology and molecular biology) as well as math, physics, and chemistry and its subspecialties (e.g., analytical, organic, and clinical chemistry).

You Might Like this Program If...

- You want to translate detailed knowledge of biology and biochemistry into a form that benefits human and ecological health as well as policy decisions
- You want to study how new drugs are discovered and evaluated for health benefit as well as potential toxic responses
- You appreciate that human-made chemicals released into the environment impact the ecosystem and want to understand how you define and manage safety

Entrance to Major

In order to be eligible for entrance to the Pharmacology and Toxicology major, a student must have:

1. attained at least a 2.00 cumulative grade point average and
2. earned a C grade or better in: BIOL 110, BIOL 230W, CHEM 110, CHEM 111, CHEM 112, CHEM 113, MATH 140, and MATH 141.

Degree Requirements

For the Bachelor of Science degree in Pharmacology and Toxicology, a minimum of 120 credits is required:

Requirement	Credits
General Education	45
Electives	0-2
Requirements for the Major	88-91

15 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses.

Requirements for the Major

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (https://senate.psu.edu/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/).

Code	Title	Credits
Prescribed Courses		
BBH/HPA 440	Principles of Epidemiology	3
BIOL 220W	Biology: Populations and Communities	4
BIOL 230W	Biology: Molecules and Cells	4
BMB 211	Elementary Biochemistry	3
BMB 212	Elementary Biochemistry Laboratory	1
BMB 221	Applied Biochemistry	2
CHEM 210	Organic Chemistry I	3
CHEM 212	Organic Chemistry II	3
CHEM 213W	Laboratory in Organic Chemistry - Writing Intensive	2
PHYS 250	Introductory Physics I	4
PHYS 251	Introductory Physics II	4
VBSC 230	The Science of Poisons	3
Prescribed Courses: Require a grade of C or better		
BIOL 110	Biology: Basic Concepts and Biodiversity	4
CHEM 110	Chemical Principles I	3
CHEM 111	Experimental Chemistry I	1
CHEM 112	Chemical Principles II	3
CHEM 113	Experimental Chemistry II	1
ERM/VBSC 431	Environmental Toxicology	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
VBSC 331	Pharmacology I: Drug Actions and Reactions	3
VBSC 430	Principles of Toxicology	3
VBSC/BMB 433	Molecular and Cellular Toxicology	3
VBSC 438	Introduction to Molecular Pharmacology	3
Additional Courses		
BIOL 141	Introduction to Human Physiology	3-4
or BIOL 240W	Biology: Function and Development of Organisms	
STAT 200	Elementary Statistics	3-4
or STAT 250	Introduction to Biostatistics	
VBSC 395	Internship	2-3
or VBSC 496	Independent Studies	
Supporting Courses and Related Areas		

Supporting Courses and Related Areas: Require a grade of C or better	
Select 9 credits of 400-level courses from department list	9

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required and Inter-Domain courses do not meet this requirement.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.)

- **Arts (GA):** 3 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 3 credits
- **Social and Behavioral Sciences (GS):** 3 credits
- **Natural Sciences (GN):** 3 credits

Integrative Studies

- **Inter-Domain Courses (Inter-Domain):** 6 credits

Exploration

- **GN,** may be completed with Inter-Domain courses: 3 credits
- **GA, GH, GN, GS, Inter-Domain courses.** This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher**:** 6 credits

University Degree Requirements

First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (https://senate.psu.edu/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/)). For more information, check the Suggested Academic Plan for your intended program.

Program Learning Objectives

- **Physical, Biological and Toxicology Competencies:** Students will exhibit specialized competencies in toxicology and pharmacology based upon a solid grounding in the physical and biological sciences.
- **Research Experience:** Students will have access to meaningful research experience and the professional development that accompanies such training including the ability to formulate a research question and design experimental procedures.
- **Collaborative Learning, Critical Thinking and Communication:** Graduates will demonstrate collaborative learning, critical thinking, and research skills, as well as skills to communicate effectively to professional and lay audiences.
- **Career planning and advancement:** Graduates will be prepared to succeed in industry, government, academic research, and in graduate and professional study.
- **Ethics and Toxicology Outreach:** Students will apply ethical principles in conducting scientific research and apply their expertise to a broader health and societal context.

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (https://senate.psu.edu/students/policies-and-rules-for-undergraduate-students/32-00-advising-policy/)

University Park

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Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2025-26 academic year. To access previous years' suggested academic plans, please visit the archive (https://bulletins.psu.edu/undergraduate/archive/) to view the appropriate Undergraduate Bulletin edition.

Pharmacology and Toxicology, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits	Spring	Credits
VBSC 50	3	ENGL 15, 30H, or ESL 15‡†	3
BIOL 110*#†	4	BIOL 230W*#	4
CHEM 110*#†	3	CHEM 112*#†	3
CHEM 111*#†	1	CHEM 113*#†	1
MATH 140*‡#†	4	MATH 141*‡#†	4
General Education Course	0-3	General Education Course or VBSC 190	1-3
	15-18		**16-18**

Second Year

Fall	Credits	Spring	Credits
BIOL 220W	4	BIOL 240W or 141	3-4
PHYS 250	4	PHYS 251	4
CHEM 210	3	CHEM 212	3
CAS 100A, 100B, or 100C‡†	3	CHEM 213	2
General Education Course (GHW)	1.5	VBSC 230	3
General Education Course	0-3	General Education (GHW)	1.5
	15.5-18.5		**16.5-17.5**

Third Year

Fall	Credits	Spring	Credits
BMB 211	3	BMB 221	2
BMB 212	1	ENGL 202C‡†	3
BBH/HPA 440	3	STAT 200 or 250	3-4
VBSC 331*	3	VBSC 496 or 395	0-3
General Education Course	3	General Education Course	3
VBSC 496 or 395	0-3		
	13-16		**11-15**

Fourth Year

Fall	Credits	Spring	Credits
VBSC 430*	3	VBSC/BMB 433*	3
VBSC/ERM 431*	3	VBSC 438*	3
VBSC 395 or 496	0-3	Supporting Course 400 Level or Elective*	3-6
Elective or 400-level Supporting Courses*	3-6	General Education Course	3
General Education Course	3	VBSC 496 or 395	0-3
	12-18		**12-18**

Total Credits 111-139

* Course requires a grade of C or better for the major
‡ Course requires a grade of C or better for General Education
# Course is an Entrance to Major requirement
† Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

Advising Notes:

- Students must complete all of the BIOL 220W, BIOL 230W, and BIOL 240W sequence to fulfill the Writing Across the Curriculum requirement.
- If completing CHEM 212, CHEM 213 must also be completed.
- Work with your academic adviser in the development of your plan as some courses are not taught every semester.
- Electives and Supporting Courses – Supporting courses are 400-level courses chosen from a department-approved list or approved by the Program Coordinator. Students must take 9 credits of supporting courses (6 credits of which must have a grade of C or better). Elective credits may be used to earn a minor, usually commencing in the fifth semester. Please consult with your academic adviser for planning.

Pharmacology and Toxicology, B.S. at Commonwealth Campuses

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits	Spring	Credits
BIOL 110*#†	4	ENGL 15, 30H, or ESL 15‡†	3
CHEM 110*#†	3	BIOL 230W*#	4
CHEM 111*#†	1	CHEM 112*#†	3
MATH 140*‡#†	4	CHEM 113*#†	1
General Education Course	3	MATH 141*‡#†	4
General Education Course (GHW)	1.5-3	General Education Course	3
	16.5-18		**18**

Second Year

Fall	Credits	Spring	Credits
BIOL 220W	4	BIOL 240W or 141	3-4
PHYS 250	4	PHYS 251	4
CHEM 210	3	CHEM 212	3
CAS 100A, 100B, or 100C‡†	3	CHEM 213	2
General Education Course (GHW)	1.5-3	General Education Course	3
	15.5-17		**15-16**

Third Year

Fall	Credits	Spring	Credits
BMB 211	3	BMB 221	2
BMB 212	1	ENGL 202C‡†	3
BBH/HPA 440	3	VBSC 230	3
VBSC 331*	3	STAT 200 or 250	3-4
VBSC 496 or 395	0-3	VBSC 496 or 395	0-3
General Education Course	3		
	13-16		**11-15**

Fourth Year

Fall	Credits	Spring	Credits
VBSC 430*	3	VBSC/BMB 433*	3
VBSC/ERM 431*	3	VBSC 438*	3
VBSC 395 or 496	0-3	Supporting Course 400 Level or Elective*	3-6
Elective or 400-level Supporting Courses*	3-6	General Education Course	3
General Education Course	3	VBSC 496 or 395	0-3
	12-18		**12-18**

Total Credits 113-136

* Course requires a grade of C or better for the major
‡ Course requires a grade of C or better for General Education
# Course is an Entrance to Major requirement
† Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

Advising Notes:

- Students must complete all of the BIOL 220W, BIOL 230W, and BIOL 240W sequence to fulfill the Writing Across the Curriculum requirement.
- If completing CHEM 212, CHEM 213 must also be completed.
- Work with your academic adviser in the development of your plan as some courses are not taught every semester.
- Electives and Supporting Courses – Supporting courses are 400-level courses chosen from a department-approved list or approved by the Program Coordinator. Students must take 9 credits of supporting courses (6 credits of which must have a grade of C or better). Elective credits may be used to earn a minor, usually commencing in the fifth semester. Please consult with your academic adviser for planning.

Career Paths

Concerns over drug safety, environmental quality, and occupational exposure to chemicals all lead to a high demand for specialists. Our major in Toxicology is one of only a handful of such programs in the United States. Graduates distinguish themselves with focused courses in toxicology and pharmacology while retaining the freedom to choose from a wide variety of courses in biomedicine and biotechnology.

Careers

Thanks to the specialization students can obtain in toxicology and pharmacology, there are plentiful employment opportunities for graduates after four years. Some of these opportunities include research positions in biotechnology or pharmaceutical firms, government or international health and environmental agencies, and academic research laboratories. Career possibilities can be found in the pharmaceutical industry, the biomedical industry, government laboratories, academic research and education, and private research organizations.

Opportunities for Graduate Studies

The Toxicology major can provide excellent preparation for professional and graduate programs. The major helps prepare students for graduate school in all biomedical and life science fields, including toxicology, pharmacology, biochemistry and cancer research. The direct relevance of the course work to human and animal health strongly attracts students interested in medicine and related fields, while the emphasis on biotechnology allows students to continue their education in professional programs including law and business.

Professional Resources

- Society of Toxicology (https://www.toxicology.org)
- National Institute of Environmental Health (https://www.niehs.nih.gov)
- National Toxicology Program (https://ntp.niehs.nih.gov)
- Toxipedia (https://www.asmalldoseoftoxicology.org/home/)

Contact

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