

# PATHOBIOLOGY

<b>Graduate Program Head</b>	K. Sandeep Prabhu
<b>Program Code</b>	PATHB
<b>Campus(es)</b>	University Park (Ph.D., M.S.)
<b>Degrees Conferred</b>	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Dual-Title Ph.D. in Pathobiology and Clinical and Translational Sciences
<b>The Graduate Faculty</b>	View ( <a href="https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=PATHB">https:// secure.gradsch.psu.edu/gpms/? searchType=fac&amp;prog=PATHB</a> )

The graduate program in Pathobiology is designed to provide flexibility in graduate work while providing opportunities to study immunology, microbiology, nutrition, biochemistry, virology, veterinary pathology, physiology, or toxicology, usually as related to problems seen in human, domestic animal, and wildlife health.

Graduate instruction is directed by Graduate Faculty members from the Department of Veterinary Science and related units with research interests in animal science, biochemistry, biology, biophysics, immunology, nutrition, physiology, zoology, and others.

## Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

Scores from the Graduate Record Examinations (GRE), or from a comparable substitute examination accepted by the Pathobiology graduate program, are required for admission. At the discretion of Pathobiology, a student may be admitted for graduate study in a program without these scores.

Applicants with a 3.0 or better grade-point average (on a 4.00 scale) in undergraduate science courses and appropriate course backgrounds will be considered for admission. Applicants should have a baccalaureate degree in a biological science-related field, or a degree as a graduate veterinarian or equivalent. Undergraduate preparation should include biology, chemistry, physics, mathematics through calculus, and preferably biostatistics and biochemistry.

## Degree Requirements

### Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

After a student has been admitted to graduate study in the department, an adviser will be appointed by the program director. This person may be a member of the eventual M.S. committee or someone else assigned the responsibility for directing the student's scheduling of course work.

A minimum of 30 credits of coursework at the 400, 500, 600, and 800 levels is required for the M.S. degree, of which at least 18 credits must be taken in 500- and 600-level courses.

Satisfactory completion of the following courses or their equivalent is required of all M.S. degree candidates:

- Statistics, 3 credits;
- Biochemistry or molecular and cell biology, 3 credits (usually chosen from BMB 400 and BMMB 501)
- VBSC 520

All Pathobiology students are required to complete one semester of VBSC 590 each year as well as 8 elective credits from a list of courses that is maintained by the Pathobiology program office.

Pathobiology requires no program-specific qualifying examinations, and there is no communication/language requirement for the M.S.

A thesis is required of all candidates for the M.S. degree, including 6 credits of VBSC 600.

### Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

The Ph.D. program is designed for completion in three to four academic years. Doctoral students usually complete certain required courses and obtain laboratory experience before selecting an area of specialization and completing an original research problem, including the defense of the Ph.D. dissertation.

After a student has been admitted to graduate study in the department, an adviser will be appointed by the program director. The person may be a member of the eventual Ph.D. committee or someone else designated the responsibility for directing the student's scheduling of course work. The adviser is also responsible for initiating the scheduling of the qualifying examination.

The doctor of philosophy degree places a strong emphasis on research. It is conferred in recognition of the capacity to carry out independent research and the attainment of a high level of scholarship. General requirements for the doctorate specify:

- a minimum period of residence (two semesters, excluding summer sessions, within a 12-month period),
- the passing of a qualifying examination,
- comprehensive and final oral examinations, and
- the writing of a satisfactory dissertation.

The particular combination of courses, seminars, individual study, and research that constitutes an individual student's program is arranged by the Ph.D. committee and should include the courses that have been designated in the Pathobiology graduate curriculum.

The Pathobiology graduate program requires a total of 21 credits of course work at the 400, 500, 600, and 800 level for the Ph.D. degree. A minimum grade-point average of 3.00 for work done at the University is required.

There are formal communications requirements for the Ph.D. degree in Pathobiology that are required by Graduate Council. The Ph.D. committee will assess the technical writing and oral communication skills of the candidate and may require that formal course work or other means to improve these skills be undertaken.

The graduate program in Pathobiology requires that each graduate student have 3 credits in statistics. Ph.D. students in Pathobiology additionally are expected to have statistical skills equivalent to those learned in STAT 501 and STAT 502. In addition, the qualifying examination committee and the Ph.D. committee may require that additional course work in statistics be taken if deficiencies are noted.

A qualifying examination is given to students in the Ph.D. program after they complete at least 18 credits of post-baccalaureate course work.

After passing the qualifying examination, each doctoral student is guided by a Ph.D. committee that meets all Graduate Council requirements (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>).

## Dual-Titles

### Dual-Title Ph.D. in Pathobiology and Clinical and Translational Sciences

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-titles/>).

Doctoral students with research and educational interests in clinical and translational science may apply for the Dual-Title Ph.D. Degree in Pathobiology and Clinical and Translational Sciences (CTS) following admission to the Graduate School and Pathobiology and prior to taking the qualifying examination in Pathobiology. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the CTS dual-title program. Refer to the Admission Requirements section of the CTS Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/clinical-translational-sciences/>).

This dual-title degree program emphasizes interdisciplinary scholarship at the interface of basic sciences, clinical sciences and human health. Students in the dual-title program are required to have two advisers from separate disciplines: one individual serving as the primary mentor in the graduate program in Pathobiology and another individual serving as the secondary mentor in an area covered by the dual-title program who is a member of the CTS faculty.

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Pathobiology. In addition, students must complete the degree requirements for the dual-title in CTS, listed on the CTS Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/clinical-translational-sciences/>). Up to 6 credits of course work may be double-counted as elective courses to meet the requirements for the Ph.D. in Pathobiology.

For students in the dual-title program, the qualifying examination will include content from both the Graduate Program in Pathobiology and the CTS programs and will be completed with the other Pathobiology students in the third semester. The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Pathobiology and must include at least one Graduate Faculty member from the CTS program. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Pathobiology and CTS. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the

qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for Ph.D. committees (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>), the Ph.D. committee of a Pathobiology and CTS dual-title Ph.D. student must include at least one member of the CTS Graduate Faculty. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in CTS, the member of the committee representing CTS must be appointed as co-chair. The CTS representative on the student's Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in Pathobiology and CTS. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

## Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>) and GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/>)
- GCAC-641 Minor - Research Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/>)
- GCAC-709 Minor - Professional Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/>)
- GCAC-741 Minor - Professional Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/>)

## Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<https://gradschool.psu.edu/graduate-funding/>) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (<https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/>) set by The Graduate School.

## Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up

deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Veterinary and Biomedical Sciences (VBSC) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/vbsc/>)

## Learning Outcomes

### Master of Science (M.S.)

1. Know. Graduates will demonstrate specific mastery of core concepts related to molecular mechanisms of disease in humans and animals, as well as evidence-based decision making in general.
2. Research. Graduates will demonstrate ability to create and execute a research plan aimed at understanding disease mechanisms and/or developing disease detection and diagnosis strategies.
3. Communicate. Graduates will demonstrate ability to effectively communicate scientific ideas, proposals, and research findings using both written and oral formats.
4. Analyze. Graduates will demonstrate ability to critically analyze and assess scientific ideas and results related to the area of human/animal disease research.
5. Practice ethically. Graduates will demonstrate knowledge and understanding of core ethical values and right conduct in research, and maintain the highest ethical standards in their own research.

### Doctor of Philosophy (Ph.D.)

1. Know. Graduates will demonstrate specific mastery of core concepts related to molecular mechanisms of disease in humans and animals, as well as evidence-based decision making in general.
2. Research. Graduates will demonstrate ability to identify a knowledge gap based on reading and understanding the current scientific literature, to create a research plan that addresses the gap in knowledge, and to execute that research plan so that the result is a meaningful contribution to the understanding of disease mechanisms.
3. Communicate. Graduates will demonstrate ability to effectively communicate scientific ideas, proposals, and research findings using both written and oral formats.
4. Analyze. Graduates will demonstrate ability to critically analyze and assess scientific ideas and results related to the area of human/animal disease research.
5. Practice ethically. Graduates will demonstrate knowledge and understanding of core ethical values and right conduct in research, and maintain the highest ethical standards in their own research.

## Contact

<b>Campus</b>	University Park
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