

# PATHOLOGY, PHD

**Degree:** Doctor of Philosophy (PhD)

**Field of Study:** Pathology

## Program Overview

PhD Training in the Pathology Graduate Program occurs in three tracks that share a common core curriculum but provide additional track-specific curricular offerings. This provides a cohesive program that addresses the specific needs of different Pathology-related areas of research training. Section II of the handbook "Pathology PhD Program" describes core features of the program that are shared and provides detailed descriptions of the three training tracks:

- Molecular and Cellular Basis of Disease Training Program (MCBTP)
- Immunology Training Program (ITP)
- Cancer Biology Training Program (CBTP)

## Admissions

Students are admitted to this PhD program through the Biomedical Sciences Training Program (BSTP) or the Medical Scientist Training Program (MSTP).

### Biomedical Sciences Training Program (BSTP)

The BSTP offers a common entry point to most of the School of Medicine's biomedical PhD programs. BSTP students can choose among research mentors in many different PhD programs in the School of Medicine.

### Medical Scientist Training Program (MSTP)

Students in the MSTP earn the dual MD/PhD degree. MSTP students also have the choice of mentors in many different PhD programs. The admission requirements of those programs can be viewed on their pages in the Bulletin. Program requirements for the dual can be found on the Medical Scientist Training Program, PhD/Medicine, MD program page.

## PhD Policies

For PhD policies and procedures, please review the School of Graduate Studies section of the General Bulletin.

## Program Requirements

To earn a PhD in Pathology, a student must complete rotations in at least three laboratories followed by selection of a research advisor, and complete Core and Elective coursework including responsible conduct of research as described in the Course of Study, below. Students who previously completed relevant coursework, (for example, with a MS) may petition to complete alternative courses. Each training track follows the overall regulations established and described in CWRU Graduate Studies and documented to the Regents of the State of Ohio. Completion of the PhD degree will require 36 hours of coursework (24 hours of which are graded) and 18 hours of PATH 701.

In addition, each PhD student must successfully complete a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. The qualifier is generally completed in the summer after year two. During the dissertation period, students are expected to meet twice a year with the thesis committee, present

seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program.

## Biomedical Sciences Training Program (BSTP) Requirements

### Coursework

Students take integrated courses in Cell and Molecular Biology (IBMS 453, IBMS 455). They also complete a course in biostatistics (IBMS 450) and a literature based reading course (IBMS 456A). These four courses, offered in the fall semester, emphasize the molecular approaches that form the basis of modern biology. We also seek students with strong quantitative training who may have majored in physics or math, and offer alternative courses for these students to acquire foundations in biology. Qualified students also may take more specialized elective courses. All students take IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research.

### Research Rotations

The research rotations allow students to explore research areas and become familiar with faculty members and their laboratories. The main purpose of these rotations is to aid students in selecting a laboratory for their thesis work. Students are encouraged to begin their rotations in July. Doing so gives them the opportunity to complete rotations during the summer before classes begin at the end of August. Students must complete at least three rotations.

### Choosing a Thesis Advisor

During the first year, students select an advisor for their dissertation research. Each student also joins the PhD program with which their advisor is affiliated. Once students choose a PhD program, the requirements of that program are followed to obtain the PhD. The emphasis of the PhD work is on research, culminating in the completion of an original, independent research thesis and publishing the results in the scientific literature. PhD programs also focus on educating students to work as professional scientists.

## Sample Plan of Study

### Molecular and Cellular Basis of Disease Training Program (MCBTP)

First Year		Credit Hours
Fall		
IBMS 453	Cell Biology I	3
IBMS 455	Molecular Biology I	3
BSTP 400	Research Rotation in Biomedical Sciences Training Program <sup>^</sup>	0 - 9
Mentor and track chosen		
<b>Credit Hours</b>		<b>6-15</b>
Spring		
PATH 510	Basic Pathologic Mechanisms <sup>*</sup>	4
PATH 416	Fundamental Immunology <sup>*</sup>	4
PATH 512	Experimental Pathology Seminar II	1
PATH 601	Special Problems	1 - 9
IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	1

Thesis committee chosen; preproposal meeting scheduled

<b>Credit Hours</b>		<b>11-19</b>
<b>Second Year</b>		
<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
MCBDTP Track Elective		3
MCBDTP Track or other Elective		3
PATH 601	Special Problems	1 - 9
Thesis proposal defense and advancement to candidacy within next 9 months <sup>+</sup>		

<b>Credit Hours</b>		<b>8-16</b>
<b>Spring</b>		
PATH 511	Experimental Pathology Seminar I	1
Electives (Core, MCB DTP track or other)		4-6
PATH 601	Special Problems	1 - 9
or PATH 701	or Dissertation Ph.D.	
Thesis proposal defense and advancement to candidacy must be completed <sup>++</sup>		

<b>Credit Hours</b>		<b>6-16</b>
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**Third Year**

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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**Fourth Year**

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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**Fifth Year**

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. <sup>**</sup>	1 - 9

<b>Credit Hours</b>		<b>2-10</b>
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<b>Total Credit Hours</b>		<b>43-126</b>
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PATH 510 or PATH 416 although PATH 416 may still be taken as a Track Elective

+ Petition to convert 601 credits to 701 credits for semester in which advancement occurs

++ Once 36 credits including 24 graded credits have been completed, register for up to 6 credits of PATH 701 Dissertation Ph.D.

\*\* PATH 416 Fundamental Immunology is included as a Track Elective for CBTP students

**Immunology Training Program (ITP)****First Year**

<b>Fall</b>		
IBMS 455	Molecular Biology I	3
IBMS 453	Cell Biology I	3
BSTP 400	Research Rotation in Biomedical Sciences Training Program <sup>^</sup>	0 - 9
Immunology Journal Club (optional this semester)		
Mentor and Track chosen		
<b>Credit Hours</b>		<b>6-15</b>

**Spring**

PATH 510	Basic Pathologic Mechanisms	4
PATH 416	Fundamental Immunology	4
PATH 512	Experimental Pathology Seminar II	1
Immunology Journal Club (optional this semester)		
PATH 601	Special Problems	1 - 9
IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	1

Thesis committee chosen; preproposal meeting scheduled

<b>Credit Hours</b>		<b>11-19</b>
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**Second Year**

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 465	Advanced Immunobiology	4
Electives (Core, ITP Track or other) <sup>**</sup>		3
PATH 601	Special Problems	1 - 9
Immunology Journal Club (required this semester)		

Thesis proposal and advancement to candidacy within 9 months<sup>+</sup>

<b>Credit Hours</b>		<b>9-17</b>
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**Spring**

PATH 512	Experimental Pathology Seminar II	1
Electives (Core, ITP Track or other) <sup>**</sup>		4-6
PATH 601	Special Problems	1 - 9
or PATH 701	or Dissertation Ph.D.	

Immunology Journal Club (required this semester)

Thesis proposal defense and advancement to candidacy must be completed<sup>++</sup>

<b>Credit Hours</b>		<b>6-16</b>
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**Third Year**

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. <sup>***</sup>	1 - 9

<sup>^</sup> Alternate course is MSTP 400 for MSTP students and PATH 601 for direct admit students<sup>\*</sup> Alternate courses for MSTP students: IBIS 401-404. MSTP students in the MCB DTP do not need to take IBMS 453, IBMS 455,

Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Spring</b>		
PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Fourth Year</b>		
<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. ***	1 - 9
Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Spring</b>		
PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Fifth Year</b>		
<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D.	1 - 9
Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Spring</b>		
PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
IBMS 501	Responsible Conduct of Research for Advanced Trainees	0
Immunology Journal Club (required this semester)		
<b>Credit Hours</b>		<b>2-10</b>
<b>Total Credit Hours</b>		<b>44-127</b>

- <sup>^</sup> Alternate course is MSTP 400 Research Rotation in Medical Scientist Training Program for MSTP students and PATH 601 Special Problems for direct admit students
- <sup>\*\*</sup> PATH 520 Basic Cancer Biology and the Interface with Clinical Oncology + PATH 521 Special Topics in Cancer Biology and Clinical Oncology is included as a Track Elective for ITP students
- <sup>+</sup> Petition to convert 601 credits to 701 credits for semester in which advancement occurs
- <sup>++</sup> Once 36 credits including 24 graded credits have been completed, register for up to 6 credits of PATH 701 Dissertation Ph.D.
- <sup>\*\*\*</sup> **Important: Students should take the following steps to reduce charges to their mentor and department:** AFTER ADVANCE TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 Dissertation Ph.D. needed to bring their total number of accumulated credits of PATH 701 to 9 by the end of the semester (and should register for no other courses). In subsequent semesters, students should register for only 1 credit of PATH 701 (and no other courses), except that in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits

by the end of the semester. EXCEPTION: IT IS IMPORTANT TO MAXIMIZE THE NUMBER OF PATH 701 CREDITS THAT CAN BE COMPLETED DURING PERIODS WHERE TRAINING GRANT SUPPORT IS AVAILABLE. If the student is on the NIH T32 training grant of NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation. Even prior to advancing to candidacy, if a student has completed 36 "foundation" credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 "foundation" credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, PATH 651 or PATH 701 must indicate their thesis advisor as the Instructor. If a Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

## Cancer Biology Training Program (CBTP)

### First Year

		<b>Credit Hours</b>
<b>Fall</b>		
IBMS 453	Cell Biology I	3
IBMS 455	Molecular Biology I	3
BSTP 400	Research Rotation in Biomedical Sciences Training Program <sup>^</sup>	0 - 9
Mentor and track chosen		
<b>Credit Hours</b>		<b>6-15</b>
<b>Spring</b>		
PATH 510	Basic Pathologic Mechanisms	4
PATH 520	The Cellular and Molecular Hallmarks of Cancer	3
PATH 521	Special Topics in Cancer Biology and Clinical Oncology	1
IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	1
PATH 512	Experimental Pathology Seminar II	1
PATH 601	Special Problems	1 - 9
Thesis committee chosen; preproposal committee meeting scheduled		
<b>Credit Hours</b>		<b>11-19</b>

### Second Year

<b>Fall</b>		
PATH 511	Experimental Pathology Seminar I	1
CBTP Track Elective		3
Electives (Core, CBTP track or other) **		3
PATH 601	Special Problems	1 - 9
Thesis proposal defense and advancement to candidacy with next 9 months <sup>+</sup>		
<b>Credit Hours</b>		<b>8-16</b>

**Spring**

PATH 512	Experimental Pathology Seminar II	1
Electives (Core, CBTP track or other) **		4-6
PATH 601 or PATH 701	Special Problems or Dissertation Ph.D.	1 - 9
Thesis proposal defense and advancement to candidacy must be completed ++		
<b>Credit Hours</b>		<b>6-16</b>

**Third Year****Fall**

PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. ***	1 - 9
<b>Credit Hours</b>		<b>2-10</b>

**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
<b>Credit Hours</b>		<b>2-10</b>

**Fourth Year****Fall**

PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. ***	1 - 9
<b>Credit Hours</b>		<b>2-10</b>

**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
<b>Credit Hours</b>		<b>2-10</b>

**Fifth Year****Fall**

PATH 511	Experimental Pathology Seminar I	1
PATH 701	Dissertation Ph.D. ***	1 - 9
<b>Credit Hours</b>		<b>2-10</b>

**Spring**

PATH 512	Experimental Pathology Seminar II	1
PATH 701	Dissertation Ph.D. ***	1 - 9
IBMS 501	Responsible Conduct of Research for Advanced Trainees	0
<b>Credit Hours</b>		<b>2-10</b>

**Total Credit Hours** **43-126**

total number of accumulated credits of PATH 701 to 9 by the end of the semester (and should register for no other courses).

In subsequent semesters, students should register for only 1 credit of PATH 701 (and no other courses), except that in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of the semester. EXCEPTION: IT IS IMPORTANT TO MAXIMIZE THE NUMBER OF PATH 701 CREDITS THAT CAN BE COMPLETED DURING PERIODS WHERE TRAINING GRANT SUPPORT IS AVAILABLE. If the student is on the NIH T32 training grant of NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation. Even prior to advancing to candidacy, if a student has completed 36 "foundation" credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 "foundation" credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, PATH 651 or PATH 701 must indicate their thesis advisor as the Instructor. If a Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

\* Alternative courses for MSTP students: IBIS

401-404. MSTP students in the CBTP do not need to take IBMS 453, IBMS 455, PATH 510, or PATH 416, although PATH 416 may still be taken as a Track Elective.

† IBMS 501 is offered every spring semester (beginning 2020). The SOM requires that PhD students who are 4 years beyond their initial RCR training in IBMS 500, register for IBMS 501.

# Exception: Take 1-3 credits of PATH 701

^ Alternate course is MSTP 400 Research Rotation in

Medical Scientist Training Program for MSTP students with PATH 601 Special Problems for direct admit students

\*\* PATH 416 Fundamental Immunology is included as a Track Elective for CBTP students

+ Petition to convert 601 credits to 701 credits for semester in which advancement occurs

++ Once 36 credits including 24 graded credits have been completed, register for up to 6 credits of PATH 701 Dissertation Ph.D.

\*\*\* **Important: Students should take the following steps to reduce charges to their mentor and department:** AFTER ADVANCE TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 Dissertation Ph.D. needed to bring their