



CASE WESTERN RESERVE
UNIVERSITY
SCHOOL OF MEDICINE

**PATHOLOGY
GRADUATE PROGRAM
STUDENT HANDBOOK**

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TABLE OF CONTENTS

I. INTRODUCTION TO THE PATHOLOGY GRADUATE PROGRAM	5
II. PATHOLOGY PHD PROGRAM	6
A. ADMISSIONS	6
B. RESEARCH FACILITIES	6
C. STUDENT FINANCIAL SUPPORT	6
D. FIRST YEAR: STARTING THE PROGRAM	7
E. SELECTION OF RESEARCH/THESIS MENTOR AND TRACK.....	7
F. FIRST YEAR: SPRING SEMESTER.....	8
G. CWRU ACADEMIC REQUIREMENTS FOR COMPLETION OF THE PHD.....	8
H. SUMMARY OF PATHOLOGY PHD PROGRAM CURRICULUM REQUIREMENTS	8
I. CURRICULUM MODIFICATIONS FOR MSTP STUDENTS.....	11
J. SAMPLE COURSE SCHEDULE FOR ALL TRACKS	12
K. SEMINAR REQUIREMENTS	13
L. PRELIMINARY RESEARCH AND SELECTION OF THESIS COMMITTEE	13
M. INDIVIDUAL DEVELOPMENT PLAN (IDP)	14
N. THESIS PROPOSAL AND QUALIFYING EXAMINATION.....	14
1. GUIDELINES FOR PREPARATION OF THE WRITTEN PHD PROPOSAL.....	14
2. SEQUENCE OF EVENTS FOR THESIS PROPOSAL AND QUALIFYING EXAM	16
O. ACADEMIC PROGRESS AND THESIS COMMITTEE MEETINGS	17
P. THESIS AND GRADUATION REQUIREMENTS.....	18
1. CHECKLIST FOR THESIS DEFENSE AND GRADUATION	19
2. COMPOSITION OF DISSERTATION DEFENSE (EXAMINING) COMMITTEE	20
3. RESPONSIBILITIES OF THE EXAMINING COMMITTEE.....	20
4. PREPARATION OF WRITTEN DISSERTATION	20
5. ORAL DEFENSE OF THE DISSERTATION.....	20
6. PUBLICATION REQUIREMENTS	20
7. DEPARTMENTAL THESIS SEMINAR.....	21
8. EXIT INTERVIEWS AND MAINTAINING CONTACT.....	21
Q. EXCEPTIONS AND DEVIATIONS FROM GUIDELINES AND TIMELINES	21
R. OUTSIDE ACTIVITIES AND COMPENSATION.....	22
S. VACATION, SICK LEAVE AND PARENTAL LEAVE	22
T. POLICY FOR DISSOLUTION OF STUDENT-MENTOR RELATIONSHIPS.....	23
U. POLICY GOVERNING DEPARTING MENTORS	24
III. MOLECULAR AND CELLULAR BASIS OF DISEASE TRAINING PROGRAM (MCBDTP)	25
A. TRAINING OBJECTIVES	25
B. OVERVIEW OF THE MCBDTP.....	25
C. REQUIREMENTS FOR JOURNAL CLUBS AND RETREAT.....	25
D. ADMINISTRATIVE STRUCTURE	25
IV. IMMUNOLOGY TRAINING PROGRAM (ITP).....	26
A. TRAINING OBJECTIVES	26
B. OVERVIEW OF THE ITP	26
C. REQUIREMENTS FOR JOURNAL CLUBS AND RETREATS.....	26
D. ADMINISTRATIVE STRUCTURE	26
V. CANCER BIOLOGY TRAINING PROGRAM (CBTP).....	27
A. TRAINING OBJECTIVES	27
B. OVERVIEW OF THE CBTP	27
C. REQUIREMENTS FOR SEMINARS	27
D. ADMINISTRATIVE STRUCTURE	27
VI. MS PROGRAM.....	28

PLAN A	28
PLAN B	29
VII. MD/MS PROGRAM IN BIOMEDICAL INVESTIGATION	31
VIII. ADMISSIONS TO THE PATHOLOGY PHD PROGRAM	32
A. THE BIOMEDICAL SCIENCES TRAINING PROGRAM (BSTP)	32
B. THE MEDICAL SCIENTIST TRAINING PROGRAM (MSTP)	32
C. DIRECT ADMISSION TO THE PATHOLOGY GRADUATE PROGRAM	32
D. ADMISSION OF INTERNATIONAL STUDENTS	33
IX. LIST OF COURSES.....	34
FIRST-YEAR FALL SEMESTER CORE CURRICULUM	34
BSTP 400. RESEARCH ROTATIONS (1).....	34
CBIO 453. CELL BIOLOGY (3)	34
CBIO 455. MOLECULAR BIOLOGY (3).....	34
CBIO 456. SINCE YOU WERE BORN: NOBEL PRIZE BIOMEDICAL RESEARCH, 1995-2016 (1)	34
IBMS 450. BIostatISTICS, RIGOR AND REPRODUCIBILITY (1).....	34
CORE COURSES FOR THE PATHOLOGY PHD PROGRAM	34
PATH 416. FUNDAMENTAL IMMUNOLOGY (4).....	34
PATH 465. ADVANCED IMMUNOBIOLOGY (4).....	35
PATH 466. PROPOSAL WRITING FOR IMMUNOLOGISTS (1).....	35
PATH 510. BASIC PATHOLOGIC MECHANISMS (4).....	35
PATH 520+521. BASIC CANCER BIOLOGY AND THE INTERFACE WITH CLINICAL ONCOLOGY (4).....	35
LONGITUDINAL REQUIREMENTS FOR ALL PHD STUDENTS	35
IBMS 500. ON BEING A PROFESSIONAL SCIENTIST: THE RESPONSIBLE CONDUCT OF RESEARCH (1).....	35
PATH 511. EXPERIMENTAL PATHOLOGY SEMINAR I (1)	36
PATH 512. EXPERIMENTAL PATHOLOGY SEMINAR II (1)	36
RESEARCH COURSES (ALL TRACKS).....	36
PATH 601. SPECIAL PROBLEMS (1-9).....	36
PATH 650. INDEPENDENT STUDY (MS-B) (1-9).....	36
PATH 651. THESIS (MS-A) (1-9).....	36
PATH 701. DISSERTATION (PHD) (1-9).....	36
TRACK ELECTIVES: MOLECULAR AND CELLULAR BASIS OF DISEASE	36
NEUR 402. PRINCIPLES OF NEURAL SCIENCE (3).....	36
PQHS 431. STATISTICAL METHODS I (3).....	36
PATH 410. AGING AND THE NERVOUS SYSTEM (1)	36
PATH 416. FUNDAMENTAL IMMUNOLOGY (4).....	36
PATH 430. OXIDATIVE STRESS AND DISEASE PATHOGENESIS (1).....	37
PATH 444. NEURODEGENERATIVE DISEASES: PATHOLOGICAL, CELL MOLECULAR PERSPECTIVES (3).....	37
PATH 450. INTERDISCIPLINARY MUSCULOSKELETAL RESEARCH (3)	37
PATH 523. HISTOPATHOLOGY OF ORGAN SYSTEMS (3)	37
PATH 525. TRANSPORT AND TARGETING OF MACROMOLECULES IN HEALTH AND DISEASE (3).....	37
TRACK ELECTIVES: IMMUNOLOGY TRAINING PROGRAM.....	37
PQHS 431. STATISTICAL METHODS I (3).....	37
PATH 418. TUMOR IMMUNOLOGY (2).....	38
PATH 520+521. BASIC CANCER BIOLOGY AND THE INTERFACE WITH CLINICAL ONCOLOGY (4).....	38
PHOL 466. CELL SIGNALING (3).....	38
TRACK ELECTIVES: CANCER BIOLOGY	38
PQHS 431. STATISTICAL METHODS I (3).....	38
PATH 416. FUNDAMENTAL IMMUNOLOGY (4).....	38
PATH 418. TUMOR IMMUNOLOGY (3).....	39
BIOC 408. MOLECULAR BIOLOGY (4)	39
BIOC 420. CURRENT TOPICS IN CANCER (3)	39
UNDERGRADUATE COURSES.....	39
PATH 390. UNDERGRADUATE RESEARCH IN CANCER BIOLOGY, IMMUNOLOGY OR PATHOLOGY (1-3)	39

I. INTRODUCTION TO THE PATHOLOGY GRADUATE PROGRAM

The Department of Pathology at Case Western Reserve University provides extensive opportunities for graduate training in Molecular and Cellular Basis for Disease, Immunology, and Cancer Biology leading to the PhD or MD/PhD degree. Separate programs lead to the MS degree. Trainers are based in the Department of Pathology and other basic science and clinical departments at Case Western Reserve University (CWRU) and affiliated hospitals, including University Hospitals Cleveland Medical Center (UHCMC), Cleveland Clinic Foundation (CCF), MetroHealth Medical Center (MHMC) and the Louis Stokes VA Medical Center (VA). Our website provides an overview of the Program, while this handbook provides a comprehensive description of the requirements. It is the student's responsibility to read and understand these requirements.

Major areas of research and graduate education include a wide range of topics in experimental pathology, immunology, immunopathology, inflammation, receptor signaling, allergic and autoimmune diseases, infectious diseases (including HIV/AIDS, tuberculosis, malaria and others), apoptosis, neoplasia and cancer biology, stem cells, tissue injury and healing, biomaterials biocompatibility, neuropathology (including prion disorders, Alzheimer's disease and other topics), aging, diabetes and cardiovascular disease. Our cutting-edge research employs molecular and cellular approaches for *in vitro* and *in vivo* studies of disease mechanisms in human and animal model systems. We believe that the focus on disease fosters the development of basic science and translational research with maximal applicability to clinical disorders.

PhD Training in the Pathology Graduate Program is offered in three tracks with a shared common core and enriching track-specific curricula. The track system fosters a cohesive program while addressing the specific needs of different Pathology-related areas of research training.

1. [Molecular and Cellular Basis of Disease Training Program \(MCBDTP\)](#)
2. [Immunology Training Program \(ITP\)](#)
3. [Cancer Biology Training Program \(CBTP\)](#)

The Pathology Graduate Program provides MS degree training in the following programs:

1. [MS-A Program](#) (part-time for employees only)
2. [MS-B Program](#) (full-time)
3. [MD/MS Program](#)

The Pathology Graduate Program Committee (below) administers the graduate programs and handles issues common to all PhD tracks, such as student admissions, mentor approval, final stages of academic review, and core curriculum. The [MCBDTP](#), [ITP](#) and [CBTP](#) each have a track-specific Steering Committee that is charged with administering activities specific to the track, including curriculum development, courses, seminars, journal clubs, advising of current and prospective students in the track, recruiting efforts, and faculty development.

Pathology Graduate Program Committee	
*Christine Kehoe serves as Secretary to the Graduate Program Committee in her role as Manager, Graduate Education & Training (Manager).	
Xiongwei Zhu	Co-Director, Pathology Graduate Program; Chair, Pathology Graduate Program Committee; MCBDTP Director and track advisor; Neuro T32 Director
James Anderson	Co-Director, Pathology Graduate Program
Clive Hamlin	Track Thesis Committee Representative, all tracks
Clifford Harding	Pathology Department Chair; MSTP Representative
Mark Jackson	CBTP Director and track advisor, CBTP T32 Director
Brian Cobb	ITP Director and track advisor, ITP T32 Director
Parameswaran Ramakrishnan	Graduate Student Admissions representative; BSTP representative (all 3 Tracks)
Nicholas Ziats	MCBDTP Curriculum Rep
Pamela Wearsch	Director, MS Programs; Advisor, MD/MS Program
Varies Year to Year	Student Representative

For further information or questions about the program, please contact Christine Kehoe, Manager, Graduate Education

& Training, at cwk15@case.edu or 216-368-1993. The mailing address is: Pathology Graduate Program, c/o Christine Kehoe, Case Western Reserve University, 10900 Euclid Ave, Cleveland, OH 44106-7288.

II. PATHOLOGY PHD PROGRAM

A. ADMISSIONS

The route for admission to the PhD program is through the CWRU Biomedical Sciences Training Program (BSTP) <http://casemed.case.edu/bstp/index.php>; MD/PhD students are admitted through the Medical Scientist Training Program (MSTP) <http://mstp.cwru.edu>. Admission to the BSTP or MSTP automatically provides admission to the Pathology Graduate Program and all other graduate programs affiliated with the BSTP or MSTP, respectively, providing maximum flexibility for students to rotate in multiple laboratories and choose the optimum Research/Thesis Mentor and graduate program for their interests.

Under rare circumstances, direct admission to the Pathology Graduate Program is allowed with a pre-identified mentor. See [Section VIII. Admission to the Pathology PhD Program](#) for more detailed information.

B. RESEARCH FACILITIES

At CWRU, the Wolstein Research Building and Institute of Pathology accommodate offices and research facilities of the Department of Pathology and the Case Comprehensive Cancer Center (CCCC), including the Center for Stem Cell and Regenerative Medicine and core facilities for fluorescence-activated cell sorting (FACS), microarray gene expression studies and many other cutting-edge research methods. Trainers and research laboratories for all tracks are located in the Department of Pathology and multiple other departments at CWRU School of Medicine and its affiliated institutions: University Hospitals Cleveland Medical Center (UHCMC), including the Case Comprehensive Cancer Center, the Cleveland Clinic Foundation (CCF) including the Lerner Research Institute (LRI) and Taussig Cancer Center, MetroHealth Medical Center (MHMC) including the Rammelkamp Center for Education and Research, and the Louis Stokes VA Medical Center (VAMC).

The Center for Global Health & Disease (CGHD) and the Division of Infectious Diseases are also key partners in the Pathology Graduate Program. In addition to a wide spectrum of research on Infectious Diseases, the ID Division includes several specialized research facilities including the Center for AIDS Research (CFAR), AIDS Clinical Trials Unit (ACTU), its Special Immunology Unit (SIU), and the Tuberculosis Research Unit (TBRU). The Department of Dermatology and its Skin Diseases Research Center (SDRC) also house immunology-related research, and the Department of Ophthalmology is building a program in ocular immunology. The CCF has an entire Department of Inflammation and Immunity at its Lerner Research Institute (LRI); these faculty hold appointments in the CWRU Department of Molecular Medicine (based at the LRI) and Trainers hold faculty or trainer appointments in the CWRU Department of Pathology.

Core Facilities: The Case Comprehensive Cancer Center supports 15 core facilities that provide high-end technology instrumentation and resources. The presence of the core facilities within the Cancer Center provides a gateway for training students in sophisticated technologies that are essential for any modern program of cancer research. The directors and staff of these facilities are available for training, providing students with opportunities to learn from experts on how to apply cutting-edge technology and equipment to their research.

C. STUDENT FINANCIAL SUPPORT

Although all PhD or MD/PhD students receive full tuition support, a stipend, and health insurance, students are strongly encouraged to apply for independent fellowship funding (for example, an individual NRSA from the NIH). The stipend is the same for all students and is set at the level approved by the School of Medicine, with the exception of supplements as an incentive bonus to those students who obtain their own individual extramural training support that meets the criteria specified below or significant teaching contributions. These exceptions are detailed below; however, this policy is contingent on the approval of the student's advisor and the advisor's home department based on available funding.

1. Policy for PhD students with NIH F grants: PhD students who obtain NIH F grant (e.g. F30, F31) funding will receive a supplement to their stipend at the current SOM-approved rate (currently \$2000/year, annualized and paid monthly during the period that the student is on the grant). The financial basis for this is a combination of mentor support and support from the department that may be justified based on the tuition support that the F grant provides. There is also a stipend gap between the NIH pre-doctoral stipend level and the CWRU SOM Stipend level. Federal

funds cannot be used to supplement the student stipend beyond the NIH pre-doctoral stipend level paid on the F grant.

- a. Financial policy: If the mentor has non-federal funds that are allowed for stipend supplementation, those will be used for the stipend gap and the stipend supplement. If the mentor does not have funds allowed for this purpose, the advisor's home department will pay the stipend gap and stipend supplement.
2. Policy for PhD students with other fellowship awards: This is assumed to be a non-federal fellowship, e.g. a foundation fellowship.
 - a. Financial policy: The mentor will be expected to supplement the fellowship funding for both stipend gap and stipend supplement. It is assumed that the level of fellowship is close enough to the NIH level to warrant this recognition; any cases that require judgement as to whether they suffice for stipend supplementation will be assessed by the Pathology Graduate Program Committee to determine whether stipend supplementation can be provided.
3. Teaching stipend supplements will be provided at the levels proposed by the Pathology Graduate Program Committee and approved by the Department of Pathology (Chair and financial administration).

D. FIRST YEAR: STARTING THE PROGRAM

Entering students follow the BSTP core curriculum (<http://casemed.case.edu/bstp/index.php>). The BSTP allows the flexibility to rotate in laboratories in any BSTP-affiliated graduate program, including Pathology, before commitment to a particular mentor/Program. Stipend support commences upon arrival of students in the summer (preferably in July and no later than the start of the fall semester in late August). In the summer and fall semesters, students must rotate in a minimum of three laboratories. A list of approved Pathology PhD Trainers can be found on the departmental website: <http://case.edu/medicine/pathology/faculty/phd-trainers/>. Entering BSTP students who express an interest in the Pathology Graduate Program will be assigned by the Pathology BSTP representative to the relevant Track Advisor: Dr. Xiongwei Zhu for the MCBDTP, Brian Cobb for the ITP or Mark Jackson for the CBTP. This advisor will assist the student in the selection of laboratory rotations based on the student's research interests. Any student with research interests in Pathology may approach potential faculty mentors directly or seek advice from the appropriate Track Advisor. Rotations expose students to research programs and mentors, provide conceptual and technical training in research, and are key to selecting a PhD Research/Thesis Mentor.

Coursework in the fall semester includes an integrated curriculum in cellular and molecular biology (CBIO 453 and CBIO 455, 3 graded credits each) that provides a shared foundation for many graduate programs at the CWRU School of Medicine. Students also receive 1 credit for their research rotations (BSTP 400, Pass/Fail). Additionally, the first BSTP fall semester includes two mini courses: IBMS 450 Fundamental Biostatistics to Enhance Rigor and Reproducibility, and CBIO 456 Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years, for one letter-graded credit each. First year students rotating in Pathology are not required to register for PATH 511 (Pathology Seminar/Fall), but should attend the Pathology Department Seminars. See [Section K](#) for seminar details.

E. SELECTION OF RESEARCH/THESIS MENTOR AND TRACK

By the end of the first Fall semester, students select a Research/Thesis Mentor from the list of [approved Faculty Trainers](#). Research activities must commence by the Spring semester of the first year. All students must also select a track ([MCBDTP](#), [ITP](#) or [CBTP](#)) within the Pathology Graduate Program by the end of the first semester. Selection of a mentor indicates a commitment to carry out research in that faculty member's laboratory on projects that will provide the basis for a PhD proposal and subsequent PhD thesis. The mentor selection also indicates a commitment by the mentor to support the student financially and academically until the student graduates.

All Research/Thesis Mentors who have not previously trained and graduated a PhD student at CWRU or any other institution will be required to identify a co-mentor who has successfully graduated at least one PhD student under their mentorship. Under these circumstances, the co-mentor:

1. will be a member of the student's thesis committee (See [Section L. Selection of Thesis Committee](#))
2. will be experienced with the CWRU Pathology Graduate Program specifically
3. will be familiar with but not necessarily an expert in the specific field underlying the student's project
4. will be independent from the primary mentor's group
5. will be subject to approval by the Track Director, Graduate Program Director, or the Graduate Program Committee

6. may or may not be a collaborator or co-author on student manuscripts

The expectations of the co-mentor are to:

1. be more directly engaged with the student's progress to a degree greater than the Thesis Committee
2. be a resource for the student's primary mentor
3. help maintain clear expectations for the student and primary mentor

The importance of this mentor-mentee commitment is discussed in the AAMC's publication, *Compact Between Biomedical Graduate Students and Their Research Advisors: A framework for aligning the graduate student mentor-mentee relationship*, which can be found here: <https://www.aamc.org/initiatives/research/gradcompact/>. It is expected that all students and mentors adhere to the general recommendations within this publication.

Please also see [Section T. Policy for Dissolution of Student-Mentor Relationships](#).

F. FIRST YEAR: SPRING SEMESTER

In the second semester of the first year, students take a total of 10 credits with a minimum of 7 graded course credits including two core courses (see [Section J. Sample Curriculum](#)). All students take the Experimental Pathology seminar course (PATH 512), the one-credit ethics course IBMS 500, which is required prior to the thesis proposal defense, and any required track-specific core course(s). Students also begin their PhD research in the laboratory of their PhD mentor. A *Planned Program of Study Form* (PPOS) must be completed online in the Student Information System (SIS) as soon as the student begins work in their selected laboratory. If a student does not have an approved PPOS in SIS, the SGS will put a registration hold on the student's account, and they will be unable to register. For SIS reference guides and manuals, go to <https://case.edu/registrar/faculty-staff/student-information-system-sis-user-guides>.

G. CWRU ACADEMIC REQUIREMENTS FOR COMPLETION OF THE PHD

To advance to candidacy for the PhD degree, the CWRU School of Graduate Studies (SGS) requires:

- A minimum of 36 credit hours of academic courses
- 24 of the 36 credit hours must be letter-graded, not pass/fail
- PATH 601 may be used for ungraded (P/F) credits

The Pathology Graduate Program further requires the following to advance to candidacy:

- All graded core course requirements specified by the Pathology Graduate Program and Track are complete
- The Thesis Proposal Defense must be completed (see [Section N. Thesis Proposal and Qualifying Exam](#))
- Note: the proposal may be defended while students are still completing the course requirements.

After advancing to candidacy, a student must complete 18 credit hours of PATH 701 Dissertation PhD, not PATH 601. See [Section H.12](#) for important additional details.

Advanced Standing: PhD students who already hold an MS or MD degree, with appropriate coursework and SGS approval, may be admitted with Advanced Standing. This requires a total of 18 foundation credits to graduate, 12 of which are required to be letter-graded, and 18 credits of PATH 701 Dissertation Research. The extent of reduction in course requirements is decided upon by petition to the Graduate Program Committee and the SGS when the student elects to enter the Pathology Graduate Program, at the end of the first semester for BSTP students and at the time of admission for direct admit students.

H. SUMMARY OF PATHOLOGY PHD PROGRAM CURRICULUM REQUIREMENTS

See Sample Course Schedule for all tracks in [Section J](#).

1. Coordinated curriculum in Cell and Molecular Biology ("C3MB", including CBIO 453 and CBIO 455, 3 graded credits each); BSTP 400 (1 credit, P/F); IBMS 450 Fundamental Biostatistics to Enhance Rigor and Reproducibility (1 graded credit); and CBIO 456 Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years (1 graded credit).

2. IBMS 500 Being a Professional Scientist course (one credit). During the spring semester in the first PhD year, students must take this course on biomedical ethics. This one-credit course is offered every spring semester. If necessary, this course can be delayed no later than spring of year 2. The ethics course MUST be completed prior to advancing to candidacy.
3. Basic Pathophysiologic Mechanisms (PATH 510, 4 graded credits) is required for all tracks. For the ITP, Fundamental Immunology (PATH 416, 4 graded credits) is required. For the CBTP, Basic Cancer Biology and Interface with Clinical Oncology (PATH 520 with simultaneous registration in PATH 521, 4 graded credits) is required. No additional core requirements exist for the MCBDTP.
4. Additional graded didactic electives or core courses to a total of 24 graded credits; 2 of these courses – 6 credits – must represent track electives (see [Section IX. List of Courses](#)), which now includes the highly recommended course PQHS431 Statistical Methods I, which covers analytical and statistical methodologies aimed at “big data”; the remainder may include track electives or courses offered by other departments). To optimize course planning, students must complete an online Planned Program of Study Form (PPOS) in the Student Information System (SIS) as soon as they have started work in their selected lab. If a PPOS has not been completed, the SGS will put a registration hold on the student’s SIS account, and the student will be unable to register.
5. Pathology Student Seminar (PATH 511/PATH 512), 1 pass/fail credit per semester. Students must participate fully in all semesters but formally register only for their first two semesters in the program. See [Section K. Seminar Requirements](#), for specifics.
6. BSTP students enter the Pathology Graduate Program and their thesis laboratory at the beginning of their second semester. MSTP students enter the Pathology Graduate Program and a thesis laboratory in spring semester of their second year in the MD/PhD program (their time commitment to the laboratory generally starts in April of that year). Direct admit students are part of the Pathology graduate program and a thesis laboratory as soon as they matriculate as a graduate student.

Note: Direct Admit students have already identified a Research/Thesis Mentor and may start research work in the mentor’s laboratory without other rotations. With prior agreement of the Research/Thesis Mentor, students may rotate in other laboratories to gain additional relevant expertise.
7. Prior to advancing to candidacy, students must take 9 credits/semester. At least 6 graded credits must be taken for each fall and spring semester until 24 graded credits have been achieved. The goal is to complete all didactic coursework within the first two years, although exceptions may occur. Additionally, prior to advancement to candidacy, research laboratory credit (PATH 601, pass/fail) must be taken to complete the 9-credit semester load. This course is critical to building laboratory and research skills and generating preliminary data necessary for preparation of the Thesis Proposal and advancement to candidacy for the PhD degree. Students must devote significant time to lab work and make substantial progress toward research objectives and preparation of the Thesis Proposal.
8. PhD students must maintain a minimum grade point average of 3.0 or better. Students falling below the minimum GPA will automatically be put on academic probation by SGS until the minimum standards are achieved. Students who receive one “C” may be reviewed by the Pathology Graduate Program Committee or the relevant Track Steering Committee, and tutoring, remedial coursework or other actions may be recommended to assist the student. See SGS Academic Policies in the General Bulletin: <http://bulletin.case.edu/schoolofgraduatestudies/academicpolicies/>
9. Students registering for PATH 601 or 701 must indicate their thesis advisor as the Instructor. If a course section does not exist with your Thesis Advisor as Instructor, please contact the Manager (Christine Kehoe) to add the section in order for you to register.
10. The Student must work with the Research/Thesis Mentor to assemble a Thesis Committee and have its first meeting by early in the fall semester of year 2 of the PhD program or by the end of the fall semester of year 3 in the MD-PhD program. Students must have at least one committee meeting prior to their thesis proposal defense. See [Section L. Preliminary Research and Selection of Thesis Committee](#).

11. Preparation and defense of the Thesis Proposal/Qualifying Examination should be completed by the end of the spring semester of year 2 of the PhD program or by the end of the spring semester of year 3 of the MD/PhD program. Failure to meet this timetable will result in review by the Graduate Program Committee and may result in dismissal from the program. Completion of the Thesis Proposal and Qualifying Examination (see [Section N Thesis Proposal and Qualifying Exam](#)) is a prerequisite for a student to advance to candidacy for the PhD degree. Prior to advancing to candidacy, students must complete all of the above requirements with a grade point average of 3.00 or better.

12. Students must complete 18 credits of PATH 701 (PhD Dissertation, U/S) in order to graduate. After advancing to candidacy, a student should register for PATH 701, not PATH 601, and may register for 1-9 credits of PATH 701. 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 apply for Predoctoral Standing in order to enroll in up to 6 credits of PATH 701. This policy will reduce the subsequent number of PATH 701 credits and tuition charges to the student advisor’s home department, as well as reducing the minimum time period required before the PhD thesis defense and graduation can occur. Students should contact the Manager for the Predoctoral Standing Form or with any questions (368-1993 or cxk15@case.edu).

Important: After advancement to candidacy, it is no longer necessary to register for 9 credits 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 needed to bring their total number of accumulated credits of PATH 701 to 9 by the end of that 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 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 that 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 an NIH T32 training grant, 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 is available, until the total credits of PATH 701 reaches 18 minus the number of semesters certainly remaining before graduation, after which registration should be for only 1 credit of PATH 701 each semester until graduation. All students must be registered for PATH 701 during the semester in which they defend the PhD thesis, unless they plan to use a waiver of registration.

13. In general, students should *not* register for any credits during the summer. In unusual circumstances, students may register for up to 3 credits of PATH 701 if this is needed to meet an imminent graduation date. The student must register for one credit of PATH 701 in the summer if the thesis will be defended in that semester, unless they are using a waiver of registration.

Note: Students who are on a J-1 Visa or receiving student loans, government support or other aid outside the Program may need to register for RSCH 750 to fulfill registration requirements for their particular funding source or situation. Students should check with International Student Services (ISS) 368-2517 or international@case.edu, or the guidelines of the funding source, to determine whether or not they need to be registered during the summer. Most students do not need to register for RSCH 750.

14. The student must meet with their Thesis Committee at least once every 6 months and make adequate progress toward completion of the PhD. Upon entering the fifth year of study, students are required to have thesis committee meetings every 3 months (quarterly) until graduation.

15. In rare cases, a student may wish to enroll in a course after achieving candidacy. In this situation, there are three options. First, the student is encouraged to audit the course, pending instructor permission. Second, the student may apply for a “Fellowship Course”. Upon approval from the School of Graduate Studies, this is a way to take the course without having to pay tuition. The form can be found at the following link: <https://case.edu/gradstudies/student-resources/fellowships-and-travel-awards>. Third, the student can enroll in the course and pay the tuition themselves.

16. A PhD Thesis should be completed and successfully defended by the end of the fifth PhD year. Students will be reviewed annually by the Pathology Graduate Program Committee beginning at the end of their fifth year and may be dismissed from the program if their progress is deemed inadequate. For PhD students entering their 7th year, the student, research advisor, and the chair of the thesis committee must meet with the Associate Dean for Graduate

Education and a group of three independent Graduate Program Directors to summarize areas that have slowed progress and to present concrete plans for the student to expeditiously defend the dissertation or other outcomes.

17. Students must fully satisfy the publication requirement and Departmental Thesis (Defense) Seminar requirement. See [Section P.6 Publication Requirements](#) for details.

I. CURRICULUM MODIFICATIONS FOR MSTP STUDENTS

MSTP students must satisfy all of the PhD program requirements with the following modifications:

1. MSTP students are excused from CBIO 453, CBIO 455, CBIO 456, and PATH 510 due to overlap with the medical curriculum. Unlike BSTP 400 for the BSTP students, MSTP 400 cannot be used toward graduation.

2. Unless exempted by the ITP Director, MSTP students in the ITP must take PATH 416. MSTP students in the ITP must also take PATH 465 and PATH 466. MSTP students in the MCBDTP are not required to take PATH 416 (but may still elect to take this course as a track elective) since the MD curriculum contains sufficient immunology to provide background for students who are not focusing on this area. PATH 416 and PATH 465 are track electives, not requirements, for all CBTP and MCBDTP students.

3. MSTP students can apply up to 18 graded credits from IBIS graduate courses taken in the medical curriculum to the PhD requirements.

4. MSTP students are encouraged to take one Pathology core course (PATH 416 and/or PATH 520 + 521) and a track elective in the first two years of the MSTP (MD phase). It is recommended that one be taken in the Spring of year 1.

5. MSTP students may petition the Director of their track to substitute a different graduate course for a track elective if the MD curriculum provides reasonable overlap with a relevant track elective. Since two core courses and two track electives are required and MSTP students are excused from Path 510, this means that an MSTP student must take at least three graduate-level courses beyond the IBIS courses in the MD curriculum.

6. When MSTP students enter the PhD phase in approximately April of their second year in the MSTP, their stage in the Pathology PhD program is similar to that of a first year BSTP student (BSTP students start in January instead of late March and so have a 4-month head start in the lab); subsequent timing of events and expectations for progress have been adjusted accordingly.

7. MSTP students should take IBMS 500 in the spring of their second year in the MSTP.

8. Prior to the PhD phase, MSTP students are encouraged to attend the Pathology Department Seminars. See [Section K Seminar Requirements](#).

J. SAMPLE COURSE SCHEDULE FOR ALL TRACKS

SEMESTER	ITP	CBTP	MCBDTP
Year 1 Fall (all the same)	CBIO 453* (3) Cell Biology I		
	CBIO 455* (3) Molecular Biology I		
	IBMS 450 (1) Fundamental Biostatistics to Enhance RRR		
	CBIO 456* (1) Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years		
Total 9	BSTP 400^ (1) Research Rotations		
Mentor and Track Chosen			
Year 1 Spring	PATH 510 (4) Basic Pathologic Mechanisms		
	PATH 416** (4) Fundamental Immunology	PATH 520+521** (4) Basic Cancer Biology Interface with Clinical Oncology	MCBDTP Track Elective (3)
Total 9	IBMS 500 (1) Being a Professional Scientist		
Year 1 Summer Total 0			
Thesis Committee Chosen; Preproposal Meeting Scheduled			
Year 2 Fall	PATH 511 (1) Experimental Pathology Seminar I		
	PATH 465 + 466 (4) Advanced Immunology + Proposal Writing for Immunologists	CBTP Track Elective (3)	MCBDTP Track Elective (3)
	ITP Track Elective (3)	CBTP Track Elective (3)	MCBDTP Elective (3)
	PATH 601 (1) Special Problems		
Total 9	Immunology Journal Club required every semester starting now through graduation		Neurodegeneration Journal Club required every semester starting now through graduation
Thesis proposal defense/advancement to candidacy by Year 2 end of Spring. Once at least 36 credits have been completed, including 24 graded, students should request predoctoral standing in order to register for PATH 701 instead of PATH 601 during semester prior to and during which thesis proposal takes place.			
Year 2 Spring	PATH 512 (1) Experimental Pathology Seminar II		
	Electives (4-6)		
Total 9	PATH 601 Special Problems (2-4) or PATH 701 Dissertation PhD (2-4)		
Year 2 Summer Total 0			
After thesis proposal defense and advancement to candidacy, must schedule committee meetings every 6 months.			
Year 3 Fall/Spring	PATH 701 Dissertation PhD (3-5)***		
Year 3 Summer Total 0 #			
After thesis proposal defense and advancement to candidacy, must schedule committee meetings every 6 months.			
Year 4 Fall/Spring	PATH 701 Dissertation PhD (3-5)***		
Year 4 Summer Total 0 #			
After thesis proposal defense and advancement to candidacy, must schedule committee meetings every 6 months.			
Year 5 Fall/Spring	PATH 701 Dissertation PhD (3-5)***		
Year 5 Summer Total 0 #			

This table shows a typical course schedule for Pathology PhD students. Schedules after year 5 will generally be the same as for year 5.

*Alternate courses for MSTP students: IBIS 401-404

^Alternate course is PATH 601 for MSTP students and PATH 601 for direct admit students.

Take 1 credit of PATH 701 if the PhD thesis will be completed in the summer semester (including any time after the end of the spring semester), unless using a waiver of registration.

**PATH 416 counts as a Track Elective for CBTP and MCBDTP students, and PATH 520 + 521 counts as a Track Elective for ITP students.

***IMPORTANT: Students should take steps to reduce charges to their mentor/department: See [Section H.12](#).

K. SEMINAR REQUIREMENTS

The Department seminar requirement consists of two components: attendance at Graduate Student Works in Progress (WIP) seminars and attendance at faculty/guest research seminars. In Fall and Spring of the second year, students should register for PATH 511/512 (Pathology Department Seminar), respectively. In subsequent semesters, students should not register for PATH 511/512, but are still required to fulfill seminar attendance requirements. Attendance at seminars for all students *must be documented on sign-in sheets or by submission of the title of the seminar attended along with a synopsis to the Graduate Student Seminar Series Director*. Under no circumstances should a student sign the sheet without attending the seminar. The attendance requirement is as follows, and failure to complete them will result in academic probation, which ultimately may result in dismissal from the Program.

Graduate Student Works-In-Progress Seminars

Presentations: Beginning in their third year of PhD study, all students are required to present their research on an annual basis within the Graduate Student Works-In-Progress Seminar Series. Third year BSTP and second year (PhD phase) MSTP students are required to give 30 minute presentations comprised of 25 minutes of formal presentation and 5 minutes of questions from the audience. Students in their fourth (BSTP) or third (MSTP) year and beyond are required to give a 1-hour presentation, again allowing for 5 minutes of questions at the end. In all cases, each student must include a separate slide at or near the end of the presentation addressing Rigor and Reproducibility in their work by describing the provenance and validation of reagents and details of randomization, blinding and statistical consults.

Attendance: Students must attend at least 50% of these Graduate Student Works in Progress (WIP) Seminars (per semester), which will take place exclusively on Mondays. In all years in the program, attendance is required at the Graduate Student WIP Seminars.

Research Seminars

Attendance: Students must attend at least 10 approved faculty/guest seminars (per semester), which will take place exclusively on Tuesdays in the Wolstein Auditorium (unless otherwise notified). Of these 10 seminars, at least 6 must be in the Tuesday Pathology Department Seminar Series and the other 4 seminars may be any combination of seminars in Pathology, Immunology, Cancer Center Seminar Series, CCF Immunology, Taussig Cancer Center or other approved seminar series (contact the Graduate Student Seminar Series Director with questions). Attendance *must be documented by sign-in*, which will be available at all approved forums. **Note:** students attending CCF Immunology or Taussig Cancer Center seminars should confirm with Christine Kehoe that attendance documentation will be transmitted to the Pathology Graduate Program. A student may obtain credit for up to three seminars outside of the approved seminar series by submitting a short summary for each seminar, including the date, location, speaker, title and seminar/department program to the Manager (Christine Kehoe, WRB 5525 or cxk15@case.edu).

PATH 511/512

PATH 511/512 Pathology Department Seminar are graded Pass/Fail, and Drs. Vincent Monnier (vmm3@case.edu) and Dr. Tsan Sam Xiao (tsx@case.edu) are course directors. Students registered in PATH 511/512 will receive an Incomplete if seminar attendance requirements are not met, which includes both the Research Seminars and the WIP Seminars. Senior students (those not registered in PATH 511/512) will receive an Incomplete grade in PATH 601 if the seminar requirement is not met, and students in PATH 701 may be assigned a failing grade. The incomplete can be cleared by attendance in subsequent semesters; these make-up seminars will *not* be counted toward the current semester requirement. Arrangements for make-up must be coordinated with Graduate Student Seminar Series Director, Dr. Vincent Monnier (vmm3@case.edu).

L. PRELIMINARY RESEARCH AND SELECTION OF THESIS COMMITTEE

The student will begin research activities under the direction of the Research/Thesis Mentor at the beginning of spring semester of year 1 of the PhD program or during the spring semester of year 2 of the MD/PhD program. This work will form the basis of the PhD proposal. By early in the fall semester of the second year of the PhD program (or by the end of the fall semester of year 3 of the MD/PhD program), the student and mentor will work together to mutually select members of the student's Thesis Committee and have a pre-proposal committee meeting. For all three tracks, the student must submit a Thesis Committee Selection form for approval by their Track Director (ITP/Brian Cobb, CBTP/Mark Jackson, or MCBTDP/Xiongwei Zhu). The student must have one Thesis Committee meeting every 6 months through year 4, and every 3 months beginning in year 5.

The Thesis Committee must contain at least four Case faculty members, at least two of whom (including the Research/Thesis Mentor) must be [approved Trainers in the Pathology Graduate Program](#). One member must have primary appointment in a department other than Pathology (Pathology-approved trainers without a primary appointment in Pathology may represent either Pathology or another department). The thesis committee must contain at least one member (preferably two) who has not co-authored a publication with the Research/Thesis Mentor, and who has graduated at least one PhD student within the Pathology Graduate Program. The Chair of the Thesis Committee must have either a primary or secondary faculty appointment in Pathology and must also have experience in training graduate students, unless specifically approved by either the Track or Program Director ahead of time. The Research/Thesis Mentor may not serve as the Thesis Committee Chair. To assist the Thesis Committee Chair and to enhance consistency of procedures, the thesis committee will also include the Track Thesis Committee Representative (currently Dr. Clive Hamlin). The Research/Thesis Mentor and at least one other member must be members of the Track selected by the student (MCBDTP, ITP or CBTP). Additional faculty, including scientists from outside Case, may be added to the committee depending on the expertise necessitated by the student's research project, although these members will be non-voting members. All MSTP students in the program are required to have an MSTP representative on their committee.

The responsibilities of the Thesis Committee Chair include leading Thesis Committee meetings and preparing a short progress report for each committee meeting. This report will include an evaluation of the student's progress and indicate expectations for the next 6 months and beyond. The Chair will also ensure that the student makes demonstrable progress towards the PhD, and will lead the monitoring of progress in course and seminar requirements, publication requirements, thesis defense preparations, required departmental lectures, participation in required track events (journal clubs, retreats) and completion of the IDP. At the conclusion of each meeting, a Graduate Student Evaluation Form must be completed and submitted along with the progress report to the Manager (Christine Kehoe, WRB 5525 or cxk15@case.edu). The Thesis Committee Chair should communicate the progress report to the student, all committee members and the Manager.

All committee members should consider themselves a mentor of the student. Faculty composition of the committee may be changed by the advisor and student, subject to the approval of the Director of the Pathology Graduate Program, Dr. Xiongwei Zhu, or the Track Director. The Thesis Committee should be convened in a pre-proposal meeting prior to the student's Thesis Proposal Defense to offer the student suggestions regarding the Thesis Proposal Defense.

See [Section O Thesis Committee Meetings](#) for details and expectations about each meeting.

M. INDIVIDUAL DEVELOPMENT PLAN (IDP)

The trainee should complete the IDP in preparation for a scheduled meeting with their mentor. The IDP is an NIH-required planning tool that is designed to help trainees identify long-term career goals, to develop plans for improving skills, to set goals for the coming year to improve efficiency and productivity, and to foster communication with their mentor(s) about career plans and development. Students are required to complete at least one IDP per academic year. The Pathology Graduate Program uses the IDP developed by the School of Medicine Office of Graduate Education. PhD students and MD/PhD students have different IDP formats to suit their different professional development needs.

Note: The IDP is fundamentally a career development aid created by the trainee based on the trainee's personal goals and interests. It is not and will not be viewed as a formal university evaluation or record-keeping document.

N. THESIS PROPOSAL AND QUALIFYING EXAMINATION

In the Pathology Graduate Program, the Thesis Proposal includes a Qualifying Examination component and a proposal of the student's planned research that is modeled on the NIH R01 grant proposal format. The Thesis Proposal Defense must be successfully completed by early in the spring semester of year 2 of the PhD program or by the end of the spring semester of year 3 of the MD/PhD program. Failure to meet this timetable will result in review by the Pathology Graduate Program Committee and may result in dismissal from the program. Defense of the Thesis Proposal has both written and oral components. The process generally requires 2 months to complete.

1. GUIDELINES FOR PREPARATION OF THE WRITTEN PHD PROPOSAL

The PhD Thesis Proposal should follow the format of an NIH R01 research grant application, but some research aims may have less supporting preliminary data than a typical R01 application. The student should address the research topic in a broad and fundamental fashion. The proposal should be focused on a hypothesis and propose a feasible set

of studies to test it, although students may propose studies broader than their eventual focus (in this case, goals should be clearly prioritized to establish a feasible plan). The Thesis Proposal is not a final contract for the path to the PhD; as research progresses the student may add new aims and modify or delete old aims.

The Thesis Proposal should be typed single-spaced (Arial 11 font; 0.5" margins), include appropriate supporting references from the literature and ongoing work in the mentor's laboratory, and be not more than 14 pages. This format (including font, spacing, and page limits) will be strictly enforced, as it reflects the NIH specifications for proposals. Work by other groups or collaborators may be shown in figures, but if so, the figure legends should explicitly acknowledge the person who did the work or provide a reference if the work is published. The Thesis Proposal should be organized according to the format described below*.

*Rare exceptions may be made in cases where the student has applied for *and received* an independent NIH Fellowship grant (F30 or F31). The student, with the approval of their committee, may substitute the successful Fellowship grant application in lieu of the written PhD proposal.

Project Summary/Abstract (Page 1): The Project Summary is meant to serve as a succinct and accurate description of the proposed work when separated from the application. State the application's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving the stated goals. This section should be informative to other persons working in the same or related fields and insofar as possible understandable to a scientifically or technically literate reader. Avoid describing past accomplishments and the use of the first person. Finally, make every effort to be succinct. This section must be no longer than 30 lines of text and should be presented on an independent page.

Specific Aims (Page 2): Concisely state the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research will exert on the research field(s) involved. List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology. The Specific Aims section is strictly limited to one single-spaced independent page.

Research Strategy (Pages 3-14): Organize the Research Strategy in the specified order (see below) and using the instructions provided. Start each section with the appropriate section heading – Introduction, Significance, Innovation, and Approach. The exact page count for each section is variable, but the total *may not exceed 12 pages*. Do *not* start each subsection on a new page. It is up to the student to divide this space appropriately, although a general recommendation is provided:

Introduction (~3-4 pages): Provide broad scientific background for the proposal. This section serves as a test of the student's knowledge of scientific areas related to the proposal. Critically evaluate existing knowledge and models in a thorough manner with references and discussion of key primary papers. Specifically identify gaps, problems, or questions that your research will address. You may present prior work by your mentor's group as well as other groups. This section should be comprehensive, should provide a thorough review of relevant literature with references, and may be considered to be a preliminary draft of the Introduction section of the PhD Dissertation. If figures are taken from other publications, references must be included in the legends.

Significance (~half a page): Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses. Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields. Finally, describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.

Innovation (~half a page): Explain how the application challenges and seeks to shift current research or clinical practice paradigms. Describe any novel theoretical concepts, approaches or methodologies, instrumentation or interventions to be developed or used, and any advantage over existing methodologies, instrumentation or interventions. Finally, explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation or interventions.

Approach (~7-8 pages): Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project. Include how the data will be collected, analyzed, and interpreted. Discuss potential problems and alternative strategies, and benchmarks for success anticipated to achieve the aims. If the project is in the early stages of development, describe any strategy to establish feasibility, and address the management of any high-risk aspects of the proposed work. Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised.

Literature Cited: Number the references in order of appearance and provide complete citations with the names of all authors, title of the article or chapter, the name of the book or journal, volume number, page numbers, city and publisher (books and book chapters), and year of publication. There is no page limit for this section and it does not count towards the 14-page overall limit.

Figures: All figures, including their legends, should be integrated into the text of the proposal rather than presented on separate pages. As such, the space used for figures counts towards the overall page limit. It is recommended that a box be drawn around each figure to clearly separate it from the surrounding text, but this is not a requirement. The legends should be concise, but provide enough information to understand the data and conclusion without referencing the main text.

2. SEQUENCE OF EVENTS FOR THESIS PROPOSAL AND QUALIFYING EXAM

- a. The student should schedule the Thesis Committee meeting for the Thesis Proposal Defense. Pick the date with consideration of the time required to complete all steps. The student is responsible for scheduling and room arrangements. Three hours should be allowed for the Oral Defense. The student should submit the Thesis Proposal to the Thesis Committee 6 weeks prior to the oral Thesis Proposal Defense to allow time for the other steps in the process to occur.
- b. Thesis Committee members review the Thesis Proposal, and each prepares at least two written questions regarding the student's scientific field and the proposed research. These will be delivered to the student within 14 days of proposal receipt. The student is responsible for ensuring that at least two questions have been received from each thesis committee member. These questions constitute part of the Qualifying Examination and should cover a range of topics. They should test the student's scientific knowledge, grasp of current issues and questions in the field, ability to critically evaluate data, and capacity to develop hypothesis and approaches to test them. The questions may identify areas of the Thesis Proposal that need expansion, clarification or other revisions, or they may address relevant issues that are outside the scope of the proposal document itself.
- c. The student must prepare appropriate written answers to the questions within 14 days. Discussion or consultation with the Research/Thesis Mentor, committee members or other faculty, students, staff, or any other individual/scientist is not permitted, except that the student may ask an examining faculty member for clarification of a question that they have submitted. The Research/Thesis Mentor may also help advise concerning the propriety of consolidating similar questions from different committee members. References should be included in the answers where appropriate. Each committee member is to be provided with a document containing all the questions and answers 14 days prior to the Thesis Proposal defense.
- d. The Track Representative will bring a copy of the Graduate Student Evaluation Form, as well as the Advancement to Candidacy Form, to the Thesis Proposal meeting.
- e. The Thesis Proposal meeting will follow the general format and rules for Thesis Committee meetings but with some modifications. The student will give a 30- to 40-minute oral presentation of the proposal (provide a printout of the PowerPoint presentation to the committee members) and field questions. Questions will be focused on the proposal itself, the questions previously submitted by faculty members or any relevant topic that may test the student's scientific knowledge, grasp of current issues and questions in the field, ability to critically evaluate data, and capacity to develop hypothesis and approaches to test them. The questions may probe topics that are contained in the Thesis Proposal, or they may address relevant issues that are outside the scope of the proposal document itself. The committee will then evaluate the student in closed session. The chair will convey the decision of the committee and complete the Graduate Student Evaluation Form, which will be signed by the committee members. The committee chair will prepare a summary of the committee evaluation, either on the Graduate Student Evaluation Form or in a separate email, noting specific strengths and weaknesses in the student's performance and detailing

any necessary revisions or remedial actions. If a student fails the exam or passes provisionally, they are given an opportunity to correct the deficiencies no later than 6 months following the initial proposal defense. If a student fails the thesis proposal/qualifying examination, the Graduate Program Committee will review the situation and may, at its discretion, add thesis committee members or change the composition of the committee to ensure that rigorous standards are maintained for a second attempt to pass. If a student fails twice they will not be allowed to continue in the PhD program.

- f. The Thesis Committee chair must deliver the signed Graduate Student Evaluation to the Manager (Christine Kehoe).
- g. Prior to the start of the semester during which the proposal defense takes place, the student should submit for approval a Predoctoral Standing Form. This will allow the student to register for up to 6 credits of PATH 701 instead of PATH 601. Students should contact the Manager (Christine Kehoe, cxk15@case.edu or 368-1993) for the Predoctoral Standing Form.
- h. The Track Representative will bring the Advancement to Candidacy Form to the meeting. The form must be completed and submitted to the Manager for the Department Chair's signature. The Manager will then file this form with the SGS, leaving a copy in the student's file.
- i. A Planned Program of Study (PPOS) must be submitted online in the Student Information System (SIS) prior to advancement to candidacy. If an approved PPOS does not exist in SIS, SGS will put a registration hold on the student's account and the student will be unable to register.
- j. Students are encouraged to use their Thesis Proposal as the basis for a Predoctoral fellowship application at the national level.

O. ACADEMIC PROGRESS AND THESIS COMMITTEE MEETINGS

Students are responsible for scheduling a Thesis Committee meeting every 6 months, one each year being coordinated with the student's graduate student seminar if possible, which all Thesis Committee members should attend. [**Note:** Students should communicate with their Thesis Committee, including the Track Thesis Committee Representative, Dr. Hamlin, when scheduling their graduate student seminar to ensure that the committee members will be available to attend on the selected date] Thesis committee meetings should occur once every 3 months for students when progress is problematic and for all PhD students beyond the 5th year of PhD study for BSTP students and beyond the 4th PhD year for MSTP students. *One week prior to each Thesis Committee Meeting*, students are required to:

1. Inform all members of the Thesis Committee and the Manager (Christine Kehoe; cxk15@case.edu), of the date, time, and location of the upcoming meeting
2. Provide copies of all submitted manuscripts
3. Provide an updated list of all published manuscripts
4. Provide the slides for the upcoming meeting

All Thesis Committee meetings will follow a similar format. A two-hour slot should be scheduled for the meeting to insure adequate time for evaluation and discussion, but students should provide a presentation that will take no longer than 30 minutes uninterrupted. Thesis Committee meetings will be led by the Thesis Committee Chair, not the Research/Thesis Mentor, and follow a standard agenda (with [Exceptions noted below](#)):

1. The student should bring hard copies of the PowerPoint presentation to the meeting. The Track Representative will bring a Graduate Student Evaluation Form.
2. At the beginning of the meeting, the student will leave the room for a closed meeting of the committee to discuss achievement of course requirements, grades, research progress, preparation of publications and progress toward completion of the PhD Thesis and its defense. The student is then asked to return to the meeting.
3. The mentor will then leave the room for a closed meeting of the committee so that the student can discuss, confidentially, any mentor issues they may be experiencing. This is done as a routine, even if there are no apparent issues, to make sure that the opportunity is there to raise such concerns. The mentor is then asked to return to the meeting.

4. Unless the meeting has been preceded by a seminar, the student will provide a 25 to 30-minute oral presentation of research progress. If the meeting follows a seminar, the student should provide a brief presentation that deals with specific research progress and plans that were not covered in the seminar. Ideally this would address any outstanding concerns from the last thesis committee meeting. In either case, students are required to include a separate slide at or near the end of the presentation addressing Rigor and Reproducibility in their work by describing the provenance and validation of reagents and details of randomization, blinding and statistical consults.
5. Open discussion should include questions by faculty members to thoroughly evaluate student progress, Rigor and Reproducibility, and the Responsible Conduct of Research. The committee should provide advice to the student to enhance research progress and will discuss issues surrounding rigor and reproducibility as well as the responsible conduct of research. Thesis committee meetings are an extremely valuable source of advice, and students should take advantage of the very valuable resource provided by the Thesis Committee.
6. After the student's presentation, and subsequent discussion with the committee, the student is again asked to leave the room. The committee will discuss all aspects of student progress. The committee must vote on the adequacy of progress, with a decision determined by a simple majority.
7. The student will return to the meeting, and the Thesis Committee Chair will present the committee's evaluation and advice.
8. The Graduate Student Evaluation Form will be completed, signed and delivered to the Manager (Christine Kehoe, WRB 5525, cxk15@case.edu).
9. The Thesis Committee Chair will prepare a brief report using the Thesis Committee Report Form (available from Christine Kehoe, WRB 5525, cxk15@case.edu) that summarizes the committee's evaluation, decisions and advice. The report may be written on the Graduate Student Evaluation Form, although it can be communicated by e-mail to the student, all members of the committee and the Manager.
10. The mentor and student will meet to discuss the outcome and feedback derived from the committee meeting.

The Program Director and Track Directors will seek to identify weak performance at student seminars and institute appropriate additional assessment. If a student is identified to have unsatisfactory performance in thesis committee meetings or in student seminars, then a second Graduate Program Committee member (e.g. the Track Director) may be added to the thesis committee.

Agenda Exceptions and Special Thesis Committee Meetings

Pre-Proposal Meeting: The first Thesis Committee meeting (a "pre-proposal" meeting) should occur by early in the fall semester of year 2 of the PhD program or by the end of the fall semester of year 3 in the MD/PhD program. See [Section L. Preliminary Research and Selection of Thesis Committee](#). The pre-proposal meeting should usually last approximately one hour. It is intended that everyone come to know what is expected at the proposal defense. It is not a research update meeting. There should be limited data. Proposed hypothesis and aims should be described briefly, but clearly, how these aims will be tested with expected results, and what would be done if unexpected results are obtained. The presentation should be no more than 20 minutes (20 slides), with discussion following. One objective of the meeting is to ensure that the hypothesis and aims are suitable for a proposal defense, and not too broad.

Qualifying Exam Meeting: The Thesis Committee meeting for the Qualifying Exam is detailed in [Section N Thesis Proposal and Qualifying Exam](#), but will also include the standard agenda items.

Thesis Defense Meeting: The Thesis Defense meeting will follow the standard agenda, but will also include an oral Defense of the final thesis document. See [Section P Thesis and Graduation Requirements](#) for more information.

P. THESIS AND GRADUATION REQUIREMENTS

Students must satisfy the requirements of the Program for the PhD Thesis Defense; publications and a Departmental Thesis Seminar. The student should solicit permission from the Thesis Committee about when to schedule the Thesis Defense. Arrangements should be made months in advance to secure appropriate Thesis Defense times, based on SGS graduation deadlines (<http://case.edu/gradstudies/current-students/dates-deadlines/>), and to schedule a Departmental Thesis Seminar slot. If a slot is not available in either of the Departmental Seminar Series, the thesis seminar may be scheduled at an alternative time. The procedure takes at least 21-35 days from submission of the dissertation to the oral Thesis Defense, but scheduling of these events must be done much farther in advance. The student is responsible for scheduling and room arrangements for both the open and closed sessions of the Thesis Defense. Please visit the SGS website for important graduation deadlines and forms: <http://gradstudies.case.edu/>

1. CHECKLIST FOR THESIS DEFENSE AND GRADUATION

- a. Students must satisfy the publication requirement and all course requirements prior to scheduling the thesis defense. Students should forward published papers and communications indicating acceptance of papers in press to the Manager, Christine Kehoe, prior to scheduling the defense.
- b. The student must schedule the Thesis Defense in consultation with all Thesis Committee members. There will be a one-hour public Thesis Defense presentation (seminar). The defense will be publicized by the SGS based on the Notification for Scheduling the Final Oral Exam for the PhD form, which needs to be submitted to Graduate Studies no later than 3 weeks before the defense. The student should complete this form and submit it to the Manager. A closed/private Thesis Defense Committee meeting typically (and preferentially) follows the presentation (allow 90 minutes). Under unusual circumstances, the public defense seminar and the closed Thesis Defense Committee meeting can be on separate days. The student, mentor, Graduate Program Committee, and Track Director each have the right to request that the public defense seminar and private Thesis Committee Defense meeting be separated, with the private defense *preceding* the public seminar. The purpose of this is to enable the student to defend their thesis privately prior to the public seminar at which family is often in attendance. All graduation deadlines herein still apply, with the Defense not being complete until the public seminar is complete.
- c. A Departmental Thesis Seminar should be given in the student Works-In-Progress seminar series, or other publicized special seminar forum, if at all possible. See [Section P.7](#) for additional details.
- d. Students should check on the deadline for graduation in a particular semester (<http://case.edu/gradstudies/current-students/dates-deadlines/>). For example, if a student defends after the deadline for Spring (May) graduation (even if this is prior to Spring commencement ceremonies), the PhD degree will not be conferred until the graduation date for the summer (August) semester. **Note:** The student must be registered for PATH 701 in the semester in which the Thesis Defense occurs, unless using a waiver of registration.
- e. Students should check with the SGS and consult with the Manager (Christine Kehoe) to make sure that all requirements for the PhD have been met and to schedule the Thesis Defense date with sufficient advance notice to satisfy the requirements of SGS. All materials required by the Office of Graduate Studies for the Thesis Defense and graduation should be submitted to the Manager who will ensure that all required materials have been completed and will then submit them to the SGS. Copies of all materials submitted to the SGS will be kept in the student's Departmental file.
- f. The candidate must electronically deliver the completed dissertation (and in hard copy, if requested by a Thesis Committee member) to each committee member at least 14 days before the examination.
- g. At the time of the Thesis Defense, the Track Representative will bring a blank Pathology Graduate Student Evaluation Form and all forms from Graduate Studies that require Thesis Committee signatures.
- h. At the time of the defense, the Research/Thesis Mentor must identify any sections of the thesis that must be redacted to prevent public release of confidential information (e.g. data governed by Materials Transfer Agreements or other contracts governing confidentiality of data, data obtained from collaborators who have not approved its publication in the thesis, etc.). Note that all information in the thesis will be published online. It is recommended that the abstract be reviewed to restrict its content to general conclusions without confidential data, as it may become available sooner than the entire thesis. If there is any doubt as to whether results in the thesis will be fully published prior to the end of the embargo period (see next point), it is recommended that the specific data be redacted from the thesis after presentation to the thesis committee.
- i. At the time of the defense, the Research/Thesis Mentor must indicate the period of embargo that will define the delay between the submission of the thesis and its online publication. An Electronic Thesis and Dissertation (ETD) Document Approval and Certification form will be provided by the Track Representative. Choices are anticipated to be 6 months, 12 months or 24 months. The 24-month option should be chosen unless all significant data in the thesis is already accepted for publication.
- j. It is the responsibility of the student to obtain copyright permission for all figures that have been published, including the student's own prior publications. This should be done prior to the thesis defense and must be completed prior to final submission of the thesis. Documentation of all permissions (e.g. letters or emails from the publishers) should be transmitted to the Research/Thesis Mentor and provided at the thesis defense.
- k. Following the defense seminar and examination in the closed committee meeting, the Thesis Committee will indicate its decision to approve or deny the PhD degree. It is common for approval to be contingent upon specified revisions of the thesis document; in most cases the committee will sign off and allow the Research/Thesis Mentor to monitor the final revisions and provide the final approval signature.
- l. A Graduate Student Evaluation Form will be completed and submitted to the Manager. Forms in the Graduation Packet should be completed and submitted to the Manager as well.

- m. When final corrections to the written Dissertation are completed, the student must submit their Dissertation electronically to the SGS for a format check (<http://case.edu/gradstudies/current-students/electronic-theses/>). See Graduation Instructions for Doctoral Candidates at the SGS website: <http://case.edu/gradstudies/current-students/graduation/>. The student is entitled to binding services for 4 copies of the Dissertation. One of the 4 is for the Pathology library, one should go to the Research/Thesis Mentor, and the other 2 are distributed to the student. The student may order additional copies at their own expense. Contact the Manager.
- n. Following successful completion of the defense, including any requested revisions of the thesis document, the student will be considered to be a candidate for graduation, subject to final review of graduation credentials by the SGS, which will coordinate details regarding Convocation (<https://case.edu/commencement/>).
- o. The student's mentor must notify their department administrator to arrange timely termination of the stipend, thereby avoiding pay-back difficulties.
- p. The student should notify the Manager of their post-graduate position and contact information (see [Section P.8](#)).

2. COMPOSITION OF DISSERTATION DEFENSE (EXAMINING) COMMITTEE

The Department of Pathology requirements for the Thesis Committee comply with SGS requirements for the Dissertation Defense (Examining) Committee. The Thesis Committee must be approved and appointed to the examining committee by the Dean of Graduate Studies on recommendation of the Chair of the Department of Pathology. This approval is obtained by submitting a Notification for Scheduling the Final Oral Exam for the PhD form, which is part of the graduation packet that is available through the SGS.

3. RESPONSIBILITIES OF THE EXAMINING COMMITTEE

The examining committee is responsible for certifying that the quality and suitability of the material presented in the dissertation meet accepted scholarly standards. *Each member must be physically present for the entire examination to vote on the acceptability of the student's performance.* A student will be certified as passing the final oral examination if no more than one of the voting members of committee dissents.

4. PREPARATION OF WRITTEN DISSERTATION

Guidelines on preparation of the written dissertation such as formatting requirements are included at the SGS website (<http://case.edu/gradstudies/current-students/electronic-theses/>). Additionally, copies of past dissertations by students are available in the Department of Pathology. Contact the Manager.

5. ORAL DEFENSE OF THE DISSERTATION

The defense must be scheduled with the SGS no later than three weeks before the date of the examination, by submitting the Notification for Scheduling the Final Oral Exam for the PhD form. The form should first be submitted to the Manager, who will get the Chair's signature, and then submit the form to SGS. The chair of the examining committee should give approval to schedule the defense when the written dissertation is ready for public scrutiny and review by the examining committee.

6. PUBLICATION REQUIREMENTS

A Pathology PhD candidate must have a minimum of two papers on which the student is first author, at least one of which must be accepted, with proof of acceptance, by a reputable peer-reviewed journal prior to scheduling of the thesis defense. The second publication, if not submitted, must be reviewed and approved by their Thesis Committee before scheduling the Thesis Defense, however, this second publication must be submitted prior to graduation. The two publications must be full primary research reports; reviews and other commentaries do not count toward the requirement. The Thesis Committee has discretion to determine whether papers and manuscripts, published or submitted, meet academic expectations, and it is possible that some publications will not be counted toward this requirement. Publications resulting from work done prior to enrollment in the PhD program will not be considered for this requirement, even if they are published after the start of the PhD program. Since the PhD requires scientific mastery that is not completely defined by a number of papers, the thesis committee may require completion of work beyond publication of two papers if needed to complete a scope of work indicated for the PhD degree.

There should be careful discussion of the arrangement of authorships in the thesis committee before a manuscript resulted from student's thesis work is submitted, especially in the case where a shared first authorship is envisioned. The student's contribution and the justification for the authorship placement must be carefully documented and approved by the thesis committee in conjunction with the student and mentor before the manuscript is submitted for publication. In the case where the Thesis Committee does not approve the use of shared first authorship to fulfill the

requirements of the Program, the student and/or mentor may appeal in writing directly to the Pathology Graduate Program Committee, outlining why the article should count towards fulfillment of publication requirements.

If a shared first authorship will be used to satisfy the first authorship requirement, the following conditions must be met:

- The published form of the paper must state that the student fulfilled the shared first author role.
- There must be documented agreement between the student's mentor and a majority of the Thesis Committee that the student did fulfill such a role.
- There must be documented agreement between the student's mentor and a majority of the Thesis Committee that the contribution of the student to this paper was of sufficient magnitude and impact to justify counting it as one of the required papers.
- If both first-authored publications are shared first authorship, one of the papers must have the student listed as the first of the co-first authors on the paper unless the next condition is fully satisfied.
- If neither of the two required manuscripts for graduation have the student listed first among the co-authors, on the written petition by both the mentor and the majority of the Thesis Committee, the Graduate Program Committee will review the second article in order to determine whether it will be allowed to fulfill the requirement for graduation. In such cases, the student and mentor will be required to provide (1) details about the student's contributions, (2) the justification for the author order, (3) all documents pertaining to the approved plan for authorship and contribution, and (4) copies of all progress reports.

7. DEPARTMENTAL THESIS SEMINAR

The Department of Pathology requires that the student give both a Departmental Thesis Seminar and to defend the thesis in a private meeting of the Thesis Committee on the same day, as stated by the SGS guidelines. The seminar should be given in the student Works-In-Progress seminar series, or other publicized seminar forum, if at all possible, by working with the seminar series coordinator. If this is not possible, a special seminar may be scheduled. It is the student's responsibility to notify the Thesis Committee members of the date and time of presentation and confirm their ability to attend.

8. EXIT INTERVIEWS AND MAINTAINING CONTACT

Before departing, graduating students must complete a written evaluation form of their experiences in the Pathology Graduate Program. This document will be submitted to the Manager (Christine Kehoe, cxk15@case.edu) accompanying all other required forms for graduation after the successful defense of the dissertation. The Manager will de-identify and compile aggregate scores and comments for all internal and external reporting purposes. Graduating students are also required to meet with their respective Track Director for an in-person exit interview. During this meeting, students will be asked to provide feedback on the program, including perceived strengths and weaknesses. The goal of this process is to continually improve the program and provide outcomes data to the NIH. As such, completion of these two steps is required before final graduation will be approved by the Department.

In order to fulfill our educational mission over time, and to meet NIH expectations for tracking, graduates are expected to maintain contact with the Department of Pathology program Manager (Christine Kehoe, cxk15@case.edu). Current job position and email contact is the minimum expectation. To assist with this, a LinkedIn account for the CWRU Pathology Graduate Program has been established. Students are encouraged to establish and maintain a personal LinkedIn account and to Follow the program's account at the link below:

<https://www.linkedin.com/company/case-western-reserve-university-department-of-pathology-graduate-program/about/>

At regular intervals, job status update request emails will be sent to all graduates.

Q. EXCEPTIONS AND DEVIATIONS FROM GUIDELINES AND TIMELINES

Any exceptions to Pathology Graduate Program guidelines must be approved by the School of Graduate Studies and/or the Pathology Graduate Program Committee prior to implementation. *Individual thesis committees are not empowered to grant these exceptions.*

1. Timing of PhD Thesis Defense and Publications. Students must have at least one first-authored paper accepted and another, if not submitted, at least reviewed and approved by their Thesis Committee, prior to scheduling of the Thesis

Defense. Under unusual circumstances, an exception may be granted, but this is *rare* and must be well justified. Such an exception must be recommended by the thesis committee *and* approved by the Pathology Graduate Committee or its Chair *prior* to scheduling of the defense. If the thesis defense proceedings are initiated under these circumstances, the Track Representative to the Thesis Committee will *not* sign the forms certifying completion of the thesis and will hold them until the student or Thesis Advisor provides evidence that at least one paper has been accepted for publication in a reputable journal and an additional paper has been submitted. The student must be registered for PATH 701 in the semester in which these requirements are completed, unless they are using a waiver of registration, and the forms are submitted to Graduate Studies.

2. If the PhD mentor is changed prior to the thesis proposal, an extension of the time allowed for completion of the thesis proposal *may* be granted upon approval by the Graduate Program Committee and its Chair (Xiongwei Zhu, PhD).

3. Conversion from PhD to [MS program](#) may occur if a student cannot satisfy PhD program requirements or must leave without completing the PhD program. In this case, the MS will be governed by the rules of [Master's Plan A](#) (research/thesis), unless the [Master's Plan B](#) (coursework/exam) is approved by the Pathology Graduate Program Committee through formal application.

R. OUTSIDE ACTIVITIES AND COMPENSATION

Pathology graduate students are expected to devote full-time attention to their studies, for which a full-time stipend is awarded. Outside employment or other time-extensive activities are discouraged and must not detract from the time and attention needed for the graduate program. Occasionally students will have the opportunity to serve as a Teaching Assistant (TA), for which some additional compensation may be offered, but placement into such a position requires the approval of the Research/Thesis Mentor and successful completion of Professional Development for Graduate Teaching Assistants (UNIV400) prior to any TA position beginning. Students and faculty involved in such placements need to be aware that NIH training support (e.g. T32, F30, F31) precludes payment for such services under the category of supplementation of stipend, but does allow payment under the category of compensation contingent upon the requirements that the activity will be limited in time, is not one of the normal training activities of the program, and will not detract from or prolong the training program.

S. VACATION, SICK LEAVE AND PARENTAL LEAVE

These policies apply to graduate students in the SGS who receive stipends that support their effort toward earning a degree during the period when they receive support. They represent the minimum to which graduate students are entitled. If a graduate student receives a stipend, they will receive support for holidays, vacations, sick leave and parental leave as set forth below. The stipend support for those days will be at the same rate as for normal work days. For all anticipated leaves longer than two weeks, appropriate departmental approvals must be obtained and paperwork submitted to the Dean of SGS prior to the start of the leave. These policies do not supersede other University policies concerning attendance or residence at the University, e.g. participating in classroom activities as a student or teaching assistant. These policies only apply to student effort toward earning a degree.

Holidays. Graduate students are entitled to observe University closings for Holidays and other recognized events. The University currently recognizes 8 named holidays, 1 university designated holiday and 1 personal floating holiday.

Vacations. Graduate students are allowed two weeks of vacation per calendar year (10 traditional work days) if they receive full support during a 12-month period. Students who receive less than 12 months of support are not entitled to vacation during the period of support. Vacation is not provided during the supported period when students receive support for part of the year. The dates of vacations must be approved in advance by the student's Research/Thesis Mentor to ensure that time-sensitive work is not disrupted. Vacation days can be accrued from one year to the next year only with the prior written approval of the Program and only up to a maximum of 20 traditional work days, to allow for international travel, for example. There is no terminal leave. The times between academic terms and the summer are considered part of the active training period and are not to be regarded as vacation time.

Sick Leave. Graduate students are entitled to two weeks (10 traditional work days) of sick leave per year, with no year-to-year accrual. Sick leave may be used for medical conditions related to pregnancy and childbirth. Under exceptional circumstances, additional sick leave days may be granted following receipt of a written request from a physician, and prior written approval by the Program.

Parental Leave. Graduate students are entitled to paid parental leave for the adoption or birth of a child. The primary caregiver is entitled to 6 weeks leave and the other parent or domestic partner is entitled to 3 weeks leave. When both parents are supported graduate students, the leave may be used consecutively or together. The leave must be used within 12 months of birth or adoption. Parental leave must be approved in advance in writing by the Program. It is permissible to add parental leave and sick leave together for the adoption or birth of a child.

Unpaid leave. Students who require additional leave beyond what is stipulated above, must seek prior written approval from the Dean of SGS for an unpaid leave of absence. Approval for a leave of absence must be requested in advance by the student and the student should provide documentation for the leave request and obtain approval. Conditions for the leave and approval must be submitted to the Dean of SGS. Continued coverage of health insurance is allowable as permitted within the guidelines of University Health Services and with written approval by the Program and Dean of SGS.

Unused Leave. A student is not entitled to receive any form of compensation for any unused holidays, vacation days, sick leave, parental leave, and/or other accrued time off.

Disclaimers. These policies do not supersede any HR policy. In addition, these policies do not create a contractual relationship with any student and the policies may be amended at any time by the Faculty and the SGS. *Approved by the Faculty Senate, November 20, 2012.*

Parental Leave. The Kirschstein NRSA grants policy allows stipend for up to 60 calendar days of parental leave, “when individuals in comparable training positions at the sponsoring institutions have access to this level of paid leave for this purpose.” Accordingly, these grants will cover the period of parental leave allowed by CWRU.

T. POLICY FOR DISSOLUTION OF STUDENT-MENTOR RELATIONSHIPS

Preamble: The vast majority of student-mentor relationships are positive experiences and ones where both parties work together to resolve differences and conflicts. Students and mentors are encouraged to seek advice continuously from colleagues, Graduate Program Directors (GPDs), Chairs, thesis committee members, and others to develop positive, productive relationships with one another. However, some relationships ultimately reach a point where separation becomes a realistic solution. This policy was developed to provide a consistent and equitable process that all PhD programs in the SOM will follow when mentors and students separate prior to the completion of their PhD degree. It sets minimal standards for the student-mentor separation process, the main component being a required mediation by an *ad hoc* committee that meets with the student and mentor before an official separation can occur. A mentor cannot summarily dismiss a student from their lab and likewise, a student cannot decide to switch to a new mentor’s laboratory without prior approval of this committee.

Note: the following policy does not apply to separations resulting from the mentor leaving the institution.

SOM Policy: If a student or mentor decides to terminate their relationship, then they must first inform one another and inform their Graduate Program Director (GPD). Within two weeks of notification, the GPD will convene an *ad hoc* committee that will assist in crafting the best possible resolution. The committee will be comprised of the GPD, the chair of the student’s Thesis Committee (if one exists), the Associate Dean for Graduate Education in the SOM, and at least two highly experienced PhD mentors. Special consideration should be given to international students to ensure that one of the members is familiar with their situation. In cases of a conflict of interest (*e.g.*, the mentor is the Chair, GPD, or pre-thesis committee chair) or when availability interferes with arranging the meeting in a timely fashion, an alternate member should be recruited. The purpose of this committee is to gather information, mediate, discuss potential solutions, and determine a course of action to move forward. It is not meant to place blame. Usually, in one continuous session (~1.5-2hr), the *ad hoc* committee will first discuss the situation and then will meet individually with the mentor, the student and then amongst themselves to formulate a consensus recommendation. In all cases, several key considerations will be discussed. Specifically:

- 1) Are the student and mentor performing satisfactorily?
- 2) Is it possible to improve communications between mentor and student?
- 3) Is reconciliation between the student and mentor a realistic possibility?
- 4) Is the student still committed to pursuing the PhD degree?
- 5) What are the opportunities for transfer of the student to another lab?
- 6) Is there any indication that continuation in the Program is no longer warranted?

Accordingly, the committee will usually recommend one of the following general action plans:

- 1) that the student and mentor will commit to a trial period of reconciliation, initiating specific changes that address the areas of disagreement;
- 2) that the student will enter a one-month research rotation with a new mentor; either the mentor or student may withdraw from the commitment within this period. If a suitable match is not found within 2 months of the ad hoc committee meeting, then the student must petition the ad hoc committee for additional time or withdraw from the PhD program;
- 3) that the student will resign from the PhD program and if possible, attain a [Master's degree](#).

A written report of the *ad hoc* committee meeting is prepared by the GPD summarizing the various discussion points and outlining the Action Plan. The Action Plan must contain a detailed timeline for the student to accomplish major milestones in finding a new mentor. After approval by the entire committee, the final report will be distributed to all committee members, the mentor, the student, the Chair, and the SOM Graduate Education Office.

Financial support of the student during this 1- to 2-month transition period is the shared responsibility of the previous mentor and the department in which the previous mentor holds their primary appointment. Financial commitments to support any additional time beyond 2 months must be arranged by the GPD and the Chair or Director of the PhD program

In a case where the mentoring skills or professionalism of the faculty advisor are identified as problematic, the faculty member is required to enroll in a faculty development workshop aimed at improving mentoring and professionalism. This request should be indicated in the final committee report.

See [Section E](#) for the expectations of the mentor-mentee relationship.

U. POLICY GOVERNING DEPARTING MENTORS

On occasion, a student's mentor may choose to leave CWRU for another academic institution. Should this occur, options for the student depend on their current academic status, as detailed below.

1) If the PhD student has *not* satisfactorily completed their qualifying exam, the student has two options. First, the student could choose to find a new mentor for their PhD research at CWRU. Second, the student could choose to move with the mentor and transfer to the relevant graduate program at the new institution. Students who are not yet PhD candidates are not allowed to move with their mentor and remain in the CWRU Pathology Graduate Program.

2) If the PhD student has satisfactorily completed their qualifying exam and ascended to PhD candidacy, the student has two options. First, the student could choose to find a new mentor for their PhD research at CWRU. In this case, the student would not be required to re-take their Thesis Defense/Qualifying Exam as long as they remain in the same Program and Track. Second, the student could choose to move with their mentor to complete their CWRU PhD, thereby remaining in the CWRU Pathology Graduate Program until graduation. **Note:** moving to a new institution does not alter any of the requirements for thesis committee meetings. *With the exception of the Thesis Defense*, the regular Thesis Committee Meetings can be via online video conference.

III. MOLECULAR AND CELLULAR BASIS OF DISEASE TRAINING PROGRAM (MCBDTP)

A. TRAINING OBJECTIVES

The goal of the MCBBDTP is to train PhD and MD/PhD scientists who will advance research in experimental Pathology and the molecular and cellular basis of disease. The MCBBDTP provides a PhD training program that includes the many facets of experimental pathology, including inflammation, receptor signaling, tissue injury and healing, necrosis, apoptosis, cell growth control, neoplasia, biomaterials biocompatibility, neuropathology (including prion disorders, Alzheimer's disease and other topics), aging, diabetes and cardiovascular disease. The program includes basic scientific research, translational research and applications to clinical settings. The Pathology Department and other participating departments provide a rich confluence of basic science and clinical activities and resources, enriching the training of PhD students as they engage in both basic science and translational research in Pathology.

B. OVERVIEW OF THE MCBBDTP

The MCBBDTP includes the core curriculum of the Pathology Graduate Program and track-specific electives. See [Section J Sample Course Schedule](#), as well as the [List of Courses in Section IX](#). Elective courses should be selected in consideration of the research emphasis of the individual student and may include a wide range of courses offered by the Department of Pathology or other basic science graduate departments. The student and their Research/Thesis Mentor may use the flexibility of the program to design a customized curriculum to address the specific research interests of the student. A student's course selections must be approved by their Research/Thesis Mentor.

C. REQUIREMENTS FOR JOURNAL CLUBS AND RETREAT

MCBDTP students, who are doing research related to neurodegenerative diseases, are required to attend weekly meetings of the Neurodegeneration Journal Club (Dr. Xiongwei Zhu, Director) which meets on Fridays at noon. Additionally, those same students are required to attend the Neurodegenerative Diseases Retreat which is held every other year.

D. ADMINISTRATIVE STRUCTURE

MCBDTP Steering Committee	
Xiongwei Zhu	MCBDTP Director and Track Advisor; Neuro T32 Director
Clive Hamlin	Track Thesis Committee Rep
Nick Ziats	MCBDTP Curriculum Representative

The MCBBDTP Director represents this track on the Pathology Graduate Program Committee and serves as the Chair of the MCBBDTP Steering Committee. The Pathology Graduate Program Committee handles issues common to all tracks and other issues related to the general structure of the program. The MCBBDTP Steering Committee is charged with all activities specific to the MCBBDTP, such as curriculum development, the advising of prospective and current students in the MCBBDTP, and recruiting efforts. The two committees work together in many areas with joint efforts coordinated by the MCBBDTP Director. The MCBBDTP Steering Committee composition and function may be dictated by the chair of the committee.

IV. IMMUNOLOGY TRAINING PROGRAM (ITP)

A. TRAINING OBJECTIVES

The goal of the ITP is to train PhD and MD/PhD scientists who will advance research in immunology and related fields. The program includes a wide range of immunology-related topics, spanning from basic research in areas such as innate immunity, T cell activation, tolerance, antigen processing and presentation, MHC function, complement, antibody structure and function, and mucosal immunity to research in clinically relevant models of infectious diseases (e.g. tuberculosis, HIV), vaccine development, immunopathology, transplantation and autoimmunity. Participating departments provide a rich confluence of basic science and clinical activities and resources, enriching the training of PhD students as they engage in basic and/or translational research in the field of immunology.

B. OVERVIEW OF THE ITP

The ITP includes the core curriculum of the Pathology Graduate Program and track-specific electives. See [Section J Sample Course Schedule](#), as well as the [List of Courses in Section IX](#). Elective courses should be selected in consideration of the research emphasis of the individual student and may include a wide range of courses offered by the Department of Pathology or other basic science graduate departments. A student's course selections must be approved by their Research/Thesis Mentor.

C. REQUIREMENTS FOR JOURNAL CLUBS AND RETREATS

All ITP students are required to participate regularly in the weekly ITP Journal Club (Dr. Brian Cobb, Director), which is held weekly on Thursdays at noon. All ITP students are required to present a paper once each year. ITP students in labs on the CCF campus are required to present one paper each year in this journal club starting in year 2, but they may satisfy their regular attendance requirement by attending the Immunology Journal Club at CCF (Dr. Robert Fairchild, Director). All ITP students are required to attend the annual ITP Retreat, and students beyond the initial year in the program will give a poster or oral presentation.

D. ADMINISTRATIVE STRUCTURE

ITP Steering Committee	
Brian Cobb	ITP Director, Immunology Journal Club, Track Advisor, T32 Director
Robert Fairchild	CCF Immunology Representative, CCF Immunology Journal Club Rep
Neil Greenspan	MD Immunology Curriculum
Thomas Hamilton	Chair, CCF Dept. of Inflammation and Immunity
Clive Hamlin	Track Thesis Committee Rep
Clifford Harding	Pathology Department Chair; MSTP Representative
James Kazura	Center for Global Health representative
Michael Lederman	CFAR/ACTU/ID representative
Alan Levine	Curriculum representative

The ITP Director represents this track on the Pathology Graduate Program Committee and serves as the Chair of the ITP Steering Committee. The Pathology Graduate Program Committee handles issues common to all tracks and other issues related to the general structure of the program. The ITP Steering Committee is charged with all activities specific to the ITP, such as curriculum development, the advising of prospective and current students in the ITP, and recruiting efforts. The two committees work together in many areas with joint efforts coordinated by the ITP Director. The ITP Steering Committee composition and function may be dictated by the chair of the committee.

V. CANCER BIOLOGY TRAINING PROGRAM (CBTP)

A. TRAINING OBJECTIVES

The goal of the CBTP is to train PhD and MD/PhD scientists who will advance research on the causes, diagnosis, progression and treatment of experimental and human cancer. The CBTP provides a PhD training program that is focused on cancer research and includes the many facets of cancer biology, including cancer pathology, cancer genetics, cell signaling, control of cell growth, tumor apoptosis, cancer pharmacology, cancer therapeutics, stem cell biology, cancer imaging, tumor immunology and others. The field of cancer biology includes basic scientific research and its applications to clinical settings. The Case Comprehensive Cancer Center provides a rich confluence of basic science and clinical activities and resources, enriching the training of PhD students as they engage in both basic science and translational research in the field of cancer. To accomplish these training goals, the CBTP has been developed as an interdisciplinary track within the Pathology PhD Program and is jointly sponsored by the Case Comprehensive Cancer Center and the Department of Pathology.

B. OVERVIEW OF THE CBTP

The CBTP includes the core curriculum of the Pathology Graduate Program and track-specific electives. See [Section J Sample Course Schedule](#), as well as the [List of Courses in Section IX](#). Elective courses should be selected in consideration of the research emphasis of the individual student and may include a wide range of courses offered by the Department of Pathology or other basic science graduate departments. A student's course selections must be approved by their Research/Thesis Mentor and must follow the program guidelines. The CBTP Track Thesis Committee Representative (Clive Hamlin) will be a full member of all Thesis Committees for CBTP students and will ensure consistency in advising and adherence to guidelines.

C. REQUIREMENTS FOR SEMINARS

CBTP students are required to attend some of the Cancer Center Seminar Series (sign-in required) to fulfill their Pathology Seminar requirement. Students will be required to participate in a monthly Cancer Trainee Seminar, where each student will give a presentation once a year on their research.

D. ADMINISTRATIVE STRUCTURE

CBTP Steering Committee	
Mark Jackson	CBTP Director, Track Advisor, CBTP T32 Director
Stanton Gerson	Director, Case Comprehensive Cancer Center
David Danielpour	Curriculum Director
Clive Hamlin	Track Thesis Committee Representative
David Wald	Pathology Representative

The CBTP is sponsored by the Case Comprehensive Cancer Center and the Department of Pathology. The CBTP Director represents this track on the Pathology Graduate Program Committee and serves as the Chair of the CBTP Steering Committee. The Pathology Graduate Program Committee handles issues common to all tracks and other issues related to the general structure of the program. The CBTP Steering Committee is charged with all activities specific to the CBTP, such as curriculum development, the advising of prospective and current students in the CBTP, and recruiting efforts. The two committees work together in many areas with joint efforts coordinated by the CBTP Director. The CBTP Steering Committee composition and function may be dictated by the chair of the committee.

VI. MS PROGRAM

Pamela Wearsch, Ph.D. (paw28@case.edu, 216-368-5059) is the Director of the Pathology MS Programs, and the programs are administered by Christine Kehoe, M.A. (cxk15@case.edu, 216-368-1993), Manager of Graduate Education and Training (Manager).

PLAN A

A part-time program leading to the Master of Science degree in Pathology is available to laboratory staff who are employed by CWRU. Students in this program must be full-time university employees and must have the agreement by their supervisor to begin studies as a part-time student. Courses are available as an employee fringe benefit (up to 6 credits per semester during Fall/Spring, and up to 3 credits during Summer) and can only be taken as limited by the fringe benefit regulations. See the tuition waiver policy here: <http://case.edu/finadmin/humres/benefits/education.html>

A formal application for this MS program must be submitted to the SGS online through Hobson's (<http://case.edu/gradstudies/prospective-students/degree-programs-offered/>). Prior to submission of this application, the employee will meet with the Director of Pathology MS Programs to determine whether the program is appropriate for the applicant. This program leads only to an MS degree through Master's Plan A (research/ thesis option).

The Plan A MS degree requires 30 total credits. Required core courses include CBIO/IBMS 453, Cell Biology (3 credits), CBIO/IBMS 455 Molecular Biology (3 credits), PATH 510 Basic Pathologic Mechanisms (4 credits), and participation in the seminar course (PATH 511 or PATH 512) for at least one semester. CBIO/IBMS 453, CBIO/IBMS 455 and PATH 510 must be taken as graded courses (not P/F). The student must also take a minimum of 6 credits of PATH 651 Thesis, which involves research in the laboratory of the supervisor (who also serves as the MS Research/Thesis Mentor) and thesis preparation. The student must register for at least one credit of PATH 651 every semester until graduation.

PATHOLOGY MS – PLAN A COURSEWORK (PART-TIME/ EMPLOYEES ONLY)		
SEMESTER	Required	Sample Electives
Falls	CBIO/IBMS 455 (3) Molecular Biology	CBIO/IBMS 456 (1) Nobel Prize Biomedical Research
	CBIO/IBMS 453 (3) Cell Biology	PATH 422 (3) Current Topics in Cancer
	PATH 511* (1) Pathology Seminar	PATH 465 (4) Advanced Immunology
	PATH 651** (1-6) Thesis M.S.	PATH 466 (1) Proposal Writing for Immunologists
		PATH 513 (1) Immunology Journal Club
		PATH 525 (3) Transport and Targeting of Macromolecules in Health and Disease
Total 6		
Springs	PATH 510 (4) Basic Pathologic Mechanisms	IBMS 500 (1) On Being a Professional Scientist
	PATH 512* (1) Pathology Seminar	PATH 406 (3) Basic Cancer Biology and the Interface with Clinical Oncology
	PATH 651** (1-6) Thesis M.S.	PATH 416 (4) Fundamental Immunology
		PATH 444 (3) Neurodegenerative Diseases: Pathological, Cell and Molecular Perspectives
Total 6		
Summers	PATH 651** (1-3) Thesis M.S.	
Total 3**		
*PATH 511/512: Registration for only one semester of Pathology seminar is required.		
**PATH 651: Must be registered for at least one hour every Fall/Spring; required for Summer only if graduating in August.		

Beginning with the 2019-2020 academic year, Plan A MS students must earn a GPA of 3.00 or higher to maintain good academic standing. This is in alignment with the SGS requirement of a minimum 3.00 GPA for graduation with an MS degree. A student who wishes to enter the PhD Program must have at least a 3.0 GPA for transfer from the MS Program into the PhD Program.

An MS thesis must be prepared based on the research, and the student must pass an MS degree examination in which the thesis is defended. The guidelines are as follows. In year one, the student and Supervisor/ MS Thesis Mentor determine the thesis project and select a thesis committee. The MS Degree Examination Committee is chaired by the Supervisor/MS Thesis Mentor and includes two additional members: the MS Program Director and another trainer in

the Pathology Graduate Program with relevant expertise. The third member of the committee must be approved by the MS Program Director. In year two, the student holds a preliminary committee meeting 9-12 months before the anticipated graduation date. This includes a 30-minute student presentation to discuss the thesis project. If the student receives a satisfactory rating, a defense date can then be scheduled. The written thesis must be submitted to the committee at least 2 weeks prior to the defense date, and formatting must follow the School of Graduate Studies guidelines (<https://case.edu/gradstudies/current-students/electronic-theses-and-dissertation-guidelines>). The thesis defense involves a student presentation and oral examination. Successful completion requires unanimous agreement of the committee members that the candidate has passed the examination. A student must be registered for at least one credit of PATH 651 during the semester in which the MS Degree Examination is completed.

PLAN B

The MS–Plan B degree program is comprised of a Research Track and a Medicine Track with core courses in Pathology with elective coursework from related disciplines and a comprehensive final project in the form of a review paper that will be ideally suitable for publication. The core requirements of the program are geared toward providing the student a solid basis in molecular biology, cell biology and pathology. Students specialize by choosing at least two concentration electives in their area of interest: Immunology, Cancer Biology, Neurodegeneration or Anatomy/Histology. In the final two semesters, the student will register for PATH 650 while writing their paper. The topic of the review paper is determined by the student and their academic advisor, and a faculty mentor for the review paper project should be identified by mutual interest during the first year.

The general requirements for the MS-Plan B degree are 30 total credits of coursework and a 20-page review paper on a clinical or basic science topic. All Plan B MS students are required to take the following courses: Molecular and Cell Biology (PATH 475 for the Healthcare Track; CBIO/IBMS 455 and CBIO/IBMS 453 for the Research Track), PATH 510 Basic Pathologic Mechanisms, two “Pathology Concentration Electives”, and two semesters of PATH 650. The Concentration Electives are:

- ANAT 410 (6 credits) Gross Anatomy
- ANAT 412 (4 credits) Histology
- PATH 406 (3 credits) Basic Cancer Biology and the Interface with Clinical Oncology
- PATH 416 (4 credits) Fundamental Immunology
- PATH 418 (2 credits) Tumor Immunology
- PATH 444 (3 credits) Neurodegenerative Diseases: Pathological, Cell, and Molecular Perspectives
- PATH 422 (3 credits) Current Topics in Cancer
- PATH 430 (3 credits) Oxidative Stress and Disease Pathogenesis
- PATH 465 (4 credits) Advanced Immunology
- PATH 481 (2 credits) The Immunology of Infectious Diseases
- PATH 525 (3 credits) Transport and Targeting of Macromolecules in Health and Disease

Beginning with the 2019-2020 academic year, Plan B MS students must earn a GPA of 3.00 or higher to maintain good academic standing. This is in alignment with the SGS requirement of a minimum 3.00 GPA for graduation with an MS degree. A student who wishes to enter the PhD Program must have at least a 3.0 GPA to transfer from the MS Plan B Research Track.

The goal of the review paper is to research and write on a topic of interest in conjunction with a Faculty Mentor who has related expertise. This project is pursued over the course of two academic terms with concurrent registration in PATH 650. In the first semester, the student is expected to survey the literature, refine their paper topic, write a detailed outline and write a preliminary abstract. In the second semester, students complete the paper according to deadlines specified in the handout “MS Review Paper Guidelines”. Although not a requirement for graduation, students and mentors are encouraged to publish their work in a relevant scientific journal. Research-track students may submit a research paper in lieu of a review paper, but this requires prior approval from the Director of Pathology MS Programs.

PATHOLOGY MS – PLAN B COURSEWORK (FULL-TIME)

RESEARCH TRACK		
Semester	Required	Sample Electives
Falls	CBIO/IBMS 453 (3) Cell Biology	IBMS/CBIO 456 (1) Nobel Prize Biomedical Research
	CBIO/IBMS 455 (3) Molecular Biology I	PATH 422 (3) Current Topics in Cancer
	PATH 650* (1-3) Independent Study	PATH 465 (4) Advanced Immunology
		PATH 511 (1) Pathology Seminar I
		PATH 513 (1) Immunology Journal Club
		PATH 525 (3) Transport and Targeting of Macromolecules in Health and Disease
Total 9-10		
Springs	PATH 510 (4) Basic Pathologic Mechanisms	IBMS 500 (1) On Being a Professional Scientist
	PATH 650* (1-3) Independent Study	PATH 406 (3) Basic Cancer Biology
		PATH 416 (4) Fundamental Immunology
		PATH 444 (3) Neurodegenerative Diseases
		PATH 512 (1) Pathology Seminar II
Total 9-10		
Summers Total (1-3*)	PATH 650* (1-3) Independent Study	
MEDICINE TRACK		
Falls	PATH 475 (3) Molecular and Cellular Basis of Disease	ANAT 412 (4) Histology
	PATH 650* (1-3) Independent Study	BIOC 407 (4) Biochemistry: Molecules to Medicine
		MGRD 410 (3) Introduction to Clinical Inquiry
		PATH 422 (3) Current Topics in Cancer
Total 9-10		PATH 465 (4) Advanced Immunology
Springs	PATH 510 (4) Basic Pathologic Mechanisms	PATH 406 (3) Basic Cancer Biology
	PATH 650* (1-3) Independent Study	PATH 416 (4) Fundamental Immunology
		PATH 444 (3) Neurodegenerative Diseases: Pathological, Cell Molecular Perspectives
Total 9-10		
Summers Total (1-6*)	PATH 650* (1-3) Independent Study	ANAT 410 (6) Human Anatomy
NOTE for PATH 650*: Two semesters are required. Must be registered for Summer, if graduating in August		

VII. MD/MS PROGRAM IN BIOMEDICAL INVESTIGATION

The Pathology Graduate Program participates in the MD/MS combined degree program that grants an MS in Biomedical Investigation. This five-year dual degree program is designed for students who wish to prepare for careers in basic or clinical research at academic medical centers. Students pursue a joint, 5-year MD/MS at Case School of Medicine in either the University Program or the Cleveland Clinic Lerner College of Medicine (CCLCM or “College Program”). The core components of the MS curriculum within the MD/MS program are three graduate courses in a specific track (e.g., Pathology) chosen by the student based on their interest, six graded credits of medical school coursework, a common seminar series, training in scientific integrity, and a full-year research project culminating in a written MS thesis and examination by an MS Degree Examination Committee (Advisor plus 2 additional faculty). There is no tuition charge for the research year, and a stipend is provided.

For more information on the MD/MS program in Pathology, contact Dr. Pamela Wearsch, Director of Pathology M.S. Programs, 216-368-5059; paw28@case.edu or Christine Kehoe, Manager, Pathology Graduate Education & Training, 216-368-1993; cxk15@case.edu.

All students begin in the University or College MD program. Students may apply to the MD/MS program at any time prior to their second year of medical school, but are encouraged to apply as soon as possible to begin taking graduate courses with the medical curriculum at the earliest possible time. Applications from students in the second year of medical school may be considered, but these students may require additional time to complete the degree requirements. Admission into the MD/MS program will be decided by the MD/MS Program Oversight Committee, which will consider good academic performance in the medical curriculum and research interest as prerequisites.

During the first year of medical school the student should identify a mentor and begin planning coursework and a research project leading to the MS degree. Because the background and interest of applicants varies widely, the MS Program Director will assist each student in designing an individualized schedule of graduate courses (see below). The Pathology course requirements are 1 semester of seminar (PATH 511 or PATH 512) plus 9 or more credits of graded Pathology electives. Students are expected to complete at least two graduate courses before beginning the laboratory research period (year 3), and students should take three graduate courses before the research period if this is possible. For students to receive graduate credit for any medical coursework (as IBIS credit, e.g. IBIS 403), they must register at the beginning of the semester. Students in the MD/MS joint degree program must attain a cumulative GPA of 3.0 in the graduate courses. Students in this program may participate in any of the three tracks of the Department of Pathology Graduate Program.

		Fall	Spring	Summer
Year 1	Integrated Biological Sciences I (IBIS 401)	3		
	Integrated Biological Sciences II (IBIS 402)		3	
	Some tracks begin research - 601			3
	Year Total:	3	3	3
Year 2	Track-specified Grad Course	3		
	Track-specified Grad Course	3		
	Track-specified Grad Course		3	
	Exam in Biomedical Investigation (IBIS 600)		0	
	On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)		1	
	Year Total:	6	4	
Year 3	Research - Track Specific 601	9		
	Research - Track Specific 601		6-9	
	Year Total:	9	6-9	
Year 4	Medical School Curriculum - no credit	0	0	0
	Year Total:	0	0	0
Year 5	Medical School Curriculum - no credit	0	0	0
	Year Total:	0	0	0
Total Units in Sequence: 34-37				
PATH 511/Falls, PATH 512/Springs Departmental Seminar is also taken for 1 credit hour; timing depends upon the track.				

VIII. ADMISSIONS TO THE PATHOLOGY PHD PROGRAM

There are three avenues to entry into the Pathology PhD Program:

A. THE BIOMEDICAL SCIENCES TRAINING PROGRAM (BSTP)

The BSTP is the principal means of entry to PhD degree study at CWRU School of Medicine. The BSTP is comprised of 11 PhD programs, one of which is the Pathology Graduate Program. BSTP students may earn their degrees in any of these training programs, allowing students to choose their thesis topics from almost any area of biomedical research. The BSTP admissions process offers tremendous advantages to a beginning PhD student:

- * Over 200 faculty members who can serve as PhD Research/Thesis Mentors
- * Highly interactive relationships with faculty
- * Graduate programs at a top-tier School of Medicine

BSTP program information can be found at <http://casemed.case.edu/bstp/index.php>. An online application for admission to the BSTP is provided on the BSTP website: <http://www.case.edu/med/BSTP/apply.html>. Further information can be obtained from Deborah Nouredine, BSTP Coordinator, Case School of Medicine WG-46, 10900 Euclid Ave, Cleveland, OH 44106-4934. Phone: 216-368-3347. Email: deborah.nouredine@case.edu.

B. THE MEDICAL SCIENTIST TRAINING PROGRAM (MSTP)

A combined MD/PhD program, the MSTP is available for students desiring careers in both biomedical research and medicine. The PhD degree may be pursued in any of 16 MSTP-affiliated graduate programs, including the Pathology Graduate Program. Application information is available on the MSTP website: <http://mstp.case.edu/>. For additional information, contact Kathy Schultz, Program Manager, CWRU MSTP, CWRU School of Medicine T401, 10900 Euclid Ave, Cleveland, OH 44106-4924. Phone: 216-368-3404. Email: mstp@cwru.edu.

C. DIRECT ADMISSION TO THE PATHOLOGY GRADUATE PROGRAM

Students who have already decided to pursue PhD studies within a particular laboratory in the Pathology Graduate Program may be admitted by a direct admission procedure, outside of the BSTP, but this application approach is rarely used and only used under special circumstances. Direct admission to the Pathology Graduate Program must be initiated by a sponsoring faculty member, who must provide information and assurances as specified below. Applications will be reviewed by the Pathology Graduate Education Committee, which will make a recommendation for acceptance/rejection of the application for final consideration by the Chair of Pathology.

Final deadlines for receipt of complete applications are May 1 for matriculation in the fall semester and November 1 for matriculation in the spring semester (Spring semester matriculation may not always be available). Note that the MSTP and BSTP have earlier application deadlines (consult the websites indicated above).

Application Procedure for Direct Admission

1. Communicate with the sponsoring faculty member and arrange for him/her to submit materials for sponsorship, including a mentor agreement (see faculty assurances, below).
2. Complete the online application <http://gradstudies.case.edu/>.

Required Faculty Assurances for Direct Admit Applicants:

Prior to completing the online application, the applicant must obtain commitment from an approved trainer in the Pathology Graduate Program, who agrees to serve as the sponsoring faculty member and must guarantee financial commitment for student support until the student graduates. Applications will only be considered if accompanied by a mentor agreement signed by the sponsoring faculty member who assumes financial responsibility. Please contact Christine Kehoe, Manager, Graduate Education & Training, cxk15@case.edu. Applicants should communicate with the sponsoring faculty member to plan arrangements for the application.

The faculty member requesting direct admission for a student must provide a letter detailing written justification for special consideration as a direct admission. This written justification should describe the reason that the faculty member desires to have the applicant in their laboratory, the skills, experience, and special techniques the student would bring

to the laboratory and the Pathology Graduate Program, the student's research experience in the faculty member's area, and the publication record (peer reviewed publications) and other productivity record of the student.

For all students, and especially foreign students, who are not eligible for training grant support, the faculty member and the Chair of the department of the faculty member's primary appointment must provide written verification that the faculty member/department will provide total support including stipend, tuition and related expenses for the student during their duration as a student in the Pathology Graduate Program.

D. ADMISSION OF INTERNATIONAL STUDENTS

Standards for admission to the PhD program are the same for international students and U.S. residents except for the following: International students whose first language is not English must demonstrate English proficiency by taking one of the following exams, and receive the minimum score indicated below. **Note:** reaching a minimum score does not guarantee admission.

International English Language Testing System (IELTS): 7.0 minimum

Test of English as a Foreign Language (TOEFL): 90 minimum

Pearson's Test of English (PET-Academic): 61 minimum

More information about testing can be found at:

<https://case.edu/international/international-student-services/academic-english-program>

A copy of the letter of acceptance will be sent to the International Students Office, which will process an I-20 and send it to the student. The student must then obtain a student visa to begin study in the U.S. More detailed information can be obtained from the International Students Office: <https://case.edu/international/international-student-services/>

Admission to the MSTP is limited to U.S. citizens or permanent residents.

IX. LIST OF COURSES

FIRST-YEAR FALL SEMESTER CORE CURRICULUM

BSTP 400. RESEARCH ROTATIONS (1)

CBIO 453. CELL BIOLOGY (3)

Designed to give students an intensive introduction to prokaryotic and eukaryotic cell structure and function. Topics include membrane structure and function, mechanisms of protein localization in cells, secretion and endocytosis, the cytoskeleton, cell adhesion, cell signaling and the regulation of cell growth. Important methods in cell biology are also presented. Suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation.

Prereq: BIOC 307 or BIOC 407

Instructor: Snider, M.

Offered: Fall

CBIO 455. MOLECULAR BIOLOGY (3)

Designed to give students an intensive introduction to prokaryotic and eukaryotic molecular biology. Topics include protein structure and function, DNA and chromosome structure, DNA replication, RNA transcription and its regulation, RNA processing, and protein synthesis. Important methods in molecular biology are also presented. Suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation.

Prereq: BIOC 307 or BIOC 407

Instructor: Snider, M.

Offered: Fall

CBIO 456. SINCE YOU WERE BORN: NOBEL PRIZE BIOMEDICAL RESEARCH, 1995-2016 (1)

This course offers the choice of 4 different sections, each of which will cover a different discipline and related major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor.

Prereq: Instructor Consent

Instructor: Dubyak, G.

Offered: Fall

IBMS 450. BIostatISTICS, RIGOR AND REPRODUCIBILITY (1)

This course focuses on providing students with a basic working knowledge and understanding of best practices in biostatistics that can be applied to common biomedical research activities in numerous fields. Weekly sessions involve a combination of basic programming activities, lectures, exercises, hands-on data manipulation and presentation. Topics include experimental design and power analysis, hypothesis testing, descriptive statistics, linear regression, and others with an emphasis on when and in which experimental design a particular test is properly used. The overall goal of the course is to empower students to use these biostatistics to enhance the rigor of their experimental design and reproducibility of their primary data. The major focus is not on theory, but on a practical acquisition of a working knowledge of basic data processing analysis, interpretation, and presentation skills.

Prereq: Instructor Consent

Instructor: Schumacher, F.

Offered: Fall

CORE COURSES FOR THE PATHOLOGY PHD PROGRAM

PATH 416. FUNDAMENTAL IMMUNOLOGY (4)

Introductory immunology providing an overview of the immune system, including antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity and basic molecular biology of B and T lymphocytes lectures and analysis of current literature stressing interpretation of experimental data.

Prereq: Instructor Consent, BIOL 210

XLIST: BIOL 416, CLBY 416

Instructors: Levine, A., Wearsch, P.

Offered: Spring

PATH 465. ADVANCED IMMUNOBIOLOGY (4)

Advanced immunology topics course covering the most important and recent advancements in specific areas of immunobiology. Course organization will include lectures by the faculty to give an overview of each topic emphasizing the recent advancements in that area, followed by student presentations of important papers and discussion on related topics. Course will also include participation in an immunology journal club (literature review/discussion session).

Prereq: PATH 416

Instructor: Cobb, B.

Offered: Falls

PATH 466. PROPOSAL WRITING FOR IMMUNOLOGISTS (1)

This graduate-level 1 credit course is focused upon communicating one's ideas in writing to a diverse audience. A key aspect of a scientific career is the ability to communicate effectively. In academia, this takes the form of writing primary research articles, review articles, editorials, and (of course) grant proposals. Industrial settings are not much different, in that it can still involve publishing; however, communicating ideas to upper management and proposing research collaborations (more and more with academia) is very much a part of the job. Outside of the bench research arena, scientific policy, editing, teaching, patent law, and many other career paths all rely heavily upon written communication - and often writing with the intended purpose to *persuade the reader to your point of view*. As a result, the goal of this course is to provide practical tools for students to write more effectively within the scientific realm.

Prereq: PATH 416 and Instructor Consent

Co-req: PATH 465

Instructor: Cobb, B.

Offered: Fall

PATH 510. BASIC PATHOLOGIC MECHANISMS (4)

An interdisciplinary introduction to the fundamental principles of molecular and cellular biology as they relate to the pathologic basis of diseases. Lectures, laboratories, conferences.

Prereq: Instructor Consent

Instructor: Ziats, N.

Offered: Spring

PATH 520+521. BASIC CANCER BIOLOGY AND THE INTERFACE WITH CLINICAL ONCOLOGY (4)

Cancer influences the lives of one in three people in the U.S. Cancer is multi-staged and is a series of diseases within every organ of the body. Recent rapid advances in the fundamental causes, treatment, and prevention of cancer make research in this area important and interesting, not just to students interested in cancer, but to those interested in other fields such as DNA Repair, Cell Cycle Regulation, Hormonal Regulation, Gene Regulation, Angiogenesis, and basic Molecular and Cellular Biology. This team-taught lecture/seminar course is an introduction to the genetics, prevention, and treatment of cancers and represents a survey covering: DNA damage and repair; cancer genetics; chemical carcinogenesis and prevention; signal transduction; cell cycle checkpoint regulation; hormonal regulation; chemotherapy and apoptosis. Includes an examination of the pathology of cancer and cancer epidemiology and biostatistics, in addition to the cellular and molecular biology of cancer. Note: PATH 521 (1 credit) must be taken simultaneously with PATH 520 (3 credits) to constitute the entire coordinated 4-credit course.

Prereq: Instructor Consent

Instructor: Danielpour, D.

Offered: Spring

LONGITUDINAL REQUIREMENTS FOR ALL PHD STUDENTS

IBMS 500. ON BEING A PROFESSIONAL SCIENTIST: THE RESPONSIBLE CONDUCT OF RESEARCH (1)

The goal of this course is to provide graduate students with an opportunity to think through their professional ethical commitments before they are tested, on the basis of the scientific community's accumulated experience with the issues. Students will be brought up to date on the current state of professional policy and federal regulation in this area, and, through case studies, will discuss practical strategies for preventing and resolving ethical problems in their own work. The course is designed to meet the requirements for "instruction about responsible conduct in research" for BSTP and MSTP students supported through NIH/ADAMHA institutional training grant programs at Case. Attendance is required.

Instructor: Wilson-Holden, T.

Offered: Spring

PATH 511. EXPERIMENTAL PATHOLOGY SEMINAR I (1)

Weekly discussions of current topics and research by students, staff and distinguished visitors.

Prereq: Instructor Consent

Coordinator: Monnier, V. and Xiao, T.S.

Offered: Fall

PATH 512. EXPERIMENTAL PATHOLOGY SEMINAR II (1)

Weekly discussions of current topics and research by students, staff and distinguished visitors.

Prereq: Instructor Consent

Coordinator: Monnier, V. and Xiao, T.S.

Offered: Spring

RESEARCH COURSES (ALL TRACKS)

PATH 601. SPECIAL PROBLEMS (1-9)

PATH 650. INDEPENDENT STUDY (MS-B) (1-9)

PATH 651. THESIS (MS-A) (1-9)

PATH 701. DISSERTATION (PHD) (1-9)

TRACK ELECTIVES: MOLECULAR AND CELLULAR BASIS OF DISEASE

NEUR 402. PRINCIPLES OF NEURAL SCIENCE (3)

Lecture/discussion course covering concepts in cell and molecular neuroscience, principles of systems neuroscience as demonstrated in the somatosensory system, and fundamentals of the development of the nervous system. This course will prepare students for upper level Neuroscience courses and is also suitable for students in other programs who desire an understanding of neurosciences.

Prereq: Instructor Consent

Instructors: Strowbridge, B.

Offered: Spring

PQHS 431. STATISTICAL METHODS I (3)

Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs.

Prereq: Instructor Consent

Instructors: Team

Offered: Fall

PATH 410. AGING AND THE NERVOUS SYSTEM (1)

Lectures and discussion on aspects of neurobiology of aging in model systems; current research on Alzheimer's, Parkinson's, and Huntington's diseases.

Prereq: Instructor Consent

Instructors: Zhu, X. and Wang, W.

Offered: Fall

PATH 416. FUNDAMENTAL IMMUNOLOGY (4)

Introductory immunology providing an overview of the immune system, including antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity and basic molecular biology of B and T lymphocytes lectures and analysis of current literature stressing interpretation of experimental data.

Prereq: Instructor Consent, BIOL 210

XLIST: BIOL 416, CLBY 416

Instructors: Levine, A., Wearsch, P.

Offered: Spring

PATH 430. OXIDATIVE STRESS AND DISEASE PATHOGENESIS (1)

Oxidative stress and free radicals are implicated in a number of disease processes including aging, arthritis, emphysema, Alzheimer disease and cancer. During this lecture course recent studies will be discussed concerning the formation and destructive mechanisms of free radicals in the context of various disease processes. Students will be expected to read assigned papers to discuss in class.

Prereq: Instructor Consent

Instructors: Zhu, X. and Wang, W.

Offered: Spring, Fall

PATH 444. NEURODEGENERATIVE DISEASES: PATHOLOGICAL, CELL MOLECULAR PERSPECTIVES (3)

This course, taught by several faculty members, encompasses the full range of factors that contribute to the development of neurodegeneration. Subjects include pathological aspects, neurodegeneration, genetic aspects, protein conformation and cell biology in conditions such as Alzheimer Disease, Parkinson disease, amyotrophic lateral sclerosis and prion diseases. Students will read assigned primary literature and present and discuss these in class.

Prereq: Instructor Consent, CBIO 453, CBIO 454, CBIO 455, CBIO 456

Instructors: Zhu, X. and Zou, W.

Offered: Spring

PATH 450. INTERDISCIPLINARY MUSCULOSKELETAL RESEARCH (3)

This course will stress the interdisciplinary nature (Biology, Engineering, and Clinical) nature of modern musculoskeletal research. Students will be expected to be active participants in weekly Musculoskeletal Research Seminars that include faculty lectures, journal club presentations, and research updates. Students will also be expected to participate in weekly Orthopaedic Grand Rounds as well as additional related faculty presentations.

Prereq: Instructor Consent

Instructors: Greenfield, E. and Akkus, O.

Offered: Fall

PATH 523. HISTOPATHOLOGY OF ORGAN SYSTEMS (3)

This is course designed as a review course for 2nd year Medical students, as well as for advanced Graduate students (by permission only). The material covered in this course is a review of the content of the SOM Blocks 2-6, as well as additional information currently not covered in the WR2 curriculum. Lectures. Final exam. Course meets MWF for only 9 weeks.

Prereq: Instructor Consent

Instructor: Ziats, N.

Offered: Spring

PATH 525. TRANSPORT AND TARGETING OF MACROMOLECULES IN HEALTH AND DISEASE (3)

This course familiarizes students with human diseases resulting from aberrant protein biosynthesis, processing, transport, recycling, and turnover. Specific examples include but are not limited to diseases resulting from alterations at the plasma membrane (familial hypercholesterolemia), endoplasmic reticulum (cystic fibrosis), lysosomes (Krabbe disease), mitochondria, and peroxisomes (Adrenoleukodystrophy). Heavy metal mis-metabolism, especially of iron and copper (hemochromatosis, Wilson's disease) will also be covered. Other diseases will be included on popular demand. Major emphasis will be on cellular and biochemical basis of disease, not clinical presentation or treatment. The class meets once a week to discuss key publications in each area. Students will be expected to submit a short summary of their understanding of each section, and prepare and present a small grant proposal of ~ 6 pages for their final exam.

Prereq: None

Instructor: Singh, N.

Offered: Fall

TRACK ELECTIVES: IMMUNOLOGY TRAINING PROGRAM

PQHS 431. STATISTICAL METHODS I (3)

Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs.

Prereq: Instructor Consent

Instructors: Team
Offered: Fall

PATH 418. TUMOR IMMUNOLOGY (2)

Interactions between the immune system and tumor cells. Topics include the historical definition of tumor specific transplantation antigens, immune responses against tumor cells, the effects of tumor cell products on host immune responses, molecular identification of tumor specific transplantation antigens and recent advances in the immunotherapy of human cancers.

Prereq: PATH 416 or equivalent

Instructor: Sy, M.-S.

Offered: Springs

PATH 520+521. BASIC CANCER BIOLOGY AND THE INTERFACE WITH CLINICAL ONCOLOGY (4)

Cancer influences the lives of one in three people in the U.S. Cancer is multi-staged and is a series of diseases within every organ of the body. Recent rapid advances in the fundamental causes, treatment, and prevention of cancer make research in this area important and interesting, not just to students interested in cancer, but to those interested in other fields such as DNA Repair, Cell Cycle Regulation, Hormonal Regulation, Gene Regulation, Angiogenesis, and basic Molecular and Cellular Biology. This team-taught lecture/seminar course is an introduction to the genetics, prevention, and treatment of cancers and represents a survey covering: DNA damage and repair; cancer genetics; chemical carcinogenesis and prevention; signal transduction; cell cycle checkpoint regulation; hormonal regulation; chemotherapy and apoptosis. Includes an examination of the pathology of cancer and cancer epidemiology and biostatistics, in addition to the cellular and molecular biology of cancer. Note: PATH 521 (1 credit) must be taken simultaneously with PATH 520 (3 credits) to constitute the entire coordinated 4-credit course.

Prereq: Instructor Consent

Instructor: Danielpour, D.

Offered: Spring

PHOL 466. CELL SIGNALING (3)

This is an advanced lecture/journal/discussion format course covering cell signaling mechanisms. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, microtubule-based motility, actin/myosin-based motility, signals for regulation of cell cycle, signals for regulation of apoptosis.

Prereq: Instructor Consent

Instructor: Dubyak, G.

Offered: Spring

Xlist: CLBY 466, PHOL 466, PHRM 466.

TRACK ELECTIVES: CANCER BIOLOGY

PQHS 431. STATISTICAL METHODS I (3)

Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs.

Prereq: Instructor Consent

Instructors: Team

Offered: Fall

PATH 416. FUNDAMENTAL IMMUNOLOGY (4)

Introductory immunology providing an overview of the immune system, including antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity and basic molecular biology of B and T lymphocytes lectures and analysis of current literature stressing interpretation of experimental data.

Prereq: Instructor Consent, BIOL 210

XLIST: BIOL 416, CLBY 416

Instructors: Levine, A., Wearsch, P.

Offered: Spring

PATH 418. TUMOR IMMUNOLOGY (3)

Interactions between the immune system and tumor cells. Topics include the historical definition of tumor specific transplantation antigens, immune responses against tumor cells, the effects of tumor cell products on host immune responses, molecular identification of tumor specific transplantation antigens and recent advances in the immunotherapy of human cancers.

Prereq: PATH 416 or equivalent

Instructor: Sy, M.-S.

Offered: Springs

BIOC 408. MOLECULAR BIOLOGY (4)

This course will give an in-depth understanding of the flow of genetic information from DNA to RNA to protein. Topics will include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and RNA processing and modification. Eukaryotic and prokaryotic systems will be compared. Special topics will be yeast as a model organism, molecular biology of cancer, and molecular biology of development. Course will also include the discussion of current literature and introduction to techniques of genetic engineering.

Prereq: BIOC 207, BIOC 307

Instructor: Samols, D.

Offered: Spring

BIOC 420. CURRENT TOPICS IN CANCER (3)

The molecular basis of cancer is covered in lectures and discussion of the scientific literature. The principal topics covered in this course are cellular mechanisms of carcinogenesis through the perspective of viral oncogenes and tumor suppressors. Their identification, function, role in cellular transformation, and contribution to malignant progression in humans and in animal model systems are emphasized.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456

Instructor: Yang, Y-C.

Offered: Fall, alternate years

UNDERGRADUATE COURSES

Note: Undergraduates may also take some of the 400 level courses listed above.

PATH 390. UNDERGRADUATE RESEARCH IN CANCER BIOLOGY, IMMUNOLOGY OR PATHOLOGY (1-3)

Students undertake a research project directly related to ongoing research in the investigator's/instructor's laboratory. Written proposal outlining research topic, a schedule of meetings and format and length of final written report is to be prepared prior to registration for credit.

Prereq: One year of college chemistry and consent of instructor

Instructor: Staff

Offered: Fall, Spring

SPUR (SUMMER PROGRAM IN UNDERGRADUATE RESEARCH)

(no credit but stipend of \$3,500 + \$1,000 housing allowance)

The program, funded by the Howard Hughes Foundation, supports a stipend for 10 weeks of work in the summer. The faculty mentor provides funds for the research effort as related to their laboratory's interest. Students are matched with appropriate mentors and participate in seminars and are expected to write a short paper describing the summer research project as well as present a poster at the conclusion of the session.

Prereq: Consent of Instructor

Instructor: Ziats, N.P. and Staff

Offered: Summer