



PATHOLOGY

GRADUATE PROGRAM

STUDENT HANDBOOK

Last modified: 07/14/2009

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I. Introduction to the Pathology Graduate Program

The Case Department of Pathology provides extensive opportunities for graduate training in Experimental Pathology, Immunology and Cancer Biology leading to the PhD (or MD/PhD) degree. A separate program leads to the MS degree. Teaching faculty are based in the Case Department of Pathology and other basic science and clinical departments at Case and Case-affiliated hospitals (University Hospitals Case Medical Center (UHCMC), Cleveland Clinic Foundation (CCF), MetroHealth Medical Center (MHMC) and the Louis Stokes VA Medical Center (VA). Our website provides an overview but is NOT a comprehensive description of the program and its requirements. STUDENTS ARE ADVISED TO READ THE PATHOLOGY GRADUATE PROGRAM HANDBOOK.

Major areas of research and graduate education include a wide range of topics in experimental pathology, immunology, immunopathology, inflammation, receptor signaling, 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. Cutting edge research applies molecular and cellular approaches for *in vitro* and *in vivo* studies of disease mechanisms in human and animal model systems. The focus on disease fosters development of basic science and translational research that applies to clinical disorders.

PhD Training in the Pathology Graduate Program occurs in three tracks that share a common core curriculum but provide additional track-specific curricular offerings. This provides a cohesive program that addresses the specific needs of different Pathology-related areas of research training.

1. Molecular and Cellular Basis of Disease Training Program (MCBTP)
2. Immunology Training Program (ITP)
3. Cancer Biology Training Program (CBTP)

The Pathology Graduate Program provides master's degree training in the following programs.

1. MS Program
2. MD/MS Program

Pathology Graduate Program Committee	
*Christine Kehoe serves as Secretary to the Graduate Studies Committee, and as Pathology Student Affairs Coordinator.	
Anderson, James	Chair, Graduate Studies Committee, MCBDTP Chair, MS Program Coordinator
Brady-Kalnay, Susann	CBTP Chair
Hamlin, Clive	Track Thesis Committee Representative
Harding, Clifford	Interim Department Chair, ITP Chair, MSTP Representative
Kaplan, David	CBTP Pathology Representative
Medof, M. Edward	
Petersen, Robert	Graduate Student Admissions representative, BSTP representative (represents all 3 Tracks), Graduate Student Seminar Series Coordinator
Smith, Mark	MD/MS Oversight Committee Representative

The Pathology Graduate Studies Committee administers the graduate programs and handles issues common to all PhD tracks (student admissions, mentor approval, final stages of academic review, core curriculum issues and other issues related to the general structure of the program). The MCBDTP, ITP and CBTP each have a track-specific Steering Committee that is charged with administering activities specific to the track (curriculum development, courses, seminars, journal clubs, advising of prospective students and students in the track, recruiting efforts, faculty development).

II. Pathology PhD Program

A. Admissions

The recommended route for admission to the PhD program is through the Case Biomedical Sciences Training Program (BSTP, <http://www.cwru.edu/med/BSTP/index.html>); MD/PhD students are admitted through the Medical Scientist Training Program (MSTP, <http://www.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, and it provides maximum flexibility for students to rotate in multiple laboratories and choose the optimum research mentor and graduate program to match their interests. A third mechanism exists for direct admission to the Pathology Graduate Program with a pre-identified mentor, but positions available through this pathway are limited. See the section "[Admission to the Pathology PhD Program](#)" for more detailed information. Admissions procedures for the MS and MD/MS programs are described under the sections devoted to those programs.

B. Student Support

All PhD or MD/PhD students receive full tuition support, stipend and health benefits. The stipend is the same for all students and is set at the level specified by the BSTP (currently \$25,000/year). One exception is up to a \$2,000 incentive bonus received by students who obtain their own individual extramural training support that meets criteria specified below, e.g., an NRSA F30 grant from the NIH (note that this policy is dependent on approval for implementation by the student's home department). PhD students are encouraged to apply for independent fellowship funding (for example, an individual NRSA from the NIH). Students who earn a fellowship that provides at least 75% of the current stipend amount will be awarded an incentive supplement of \$2,000 per year in addition to the BSTP stipend, prorated to cover the period of extramural fellowship support. A second exception is that a student who obtains an individual extramural fellowship that provides a stipend higher than the BSTP stipend will receive the level of stipend provided by the fellowship award. Note that no incentive bonus is added to the stipend for appointment to an institutional T32 training grant. Note that students of mentors with primary appointments outside of Pathology will be governed by the policies of their home department for stipend supplementation, and the Department of Pathology cannot guarantee stipend supplementation in this situation.

Students are generally supplied with a laptop computer when they enter the Pathology Graduate Program, subject to availability of budget for this purpose. This is provided by the Department of Pathology for students whose mentors have primary appointments in Pathology. Students whose mentors do not have primary appointments in Pathology should check with the mentor and home department or center regarding support for a computer. It is the student's responsibility to maintain the computer in working condition. Upon completion of the program, students keep their computers. Students who leave the program prior to completion of the PhD degree must leave their computers with the Department of Pathology.

Students may receive reimbursement for up to \$100-\$200 (subject to change, check for current support level) to defray professional expenses (professional society memberships, journal subscriptions, books, etc) that cannot be covered by the Thesis Mentor (arrangements for students of mentors who do not have primary appointment in Pathology need to be confirmed by the student and are not the responsibility of the Department of Pathology). Students of mentors with primary appointments in Pathology should submit receipts and reimbursement requests to the Pathology Student Affairs Coordinator (Christine Kehoe). It is

suggested that students inquire about reimbursement before incurring expenses. All expenses for student research are supported by the Thesis Mentor.

Fees to be paid by the student: Students are responsible for paying the student activity fee which is \$12/semester. (The \$213/semester technology fee no longer exists. It was absorbed in the tuition increase from \$1,292/hour to \$1,375/hour.)

C. First Year: Starting the Program

Entering students follow the BSTP core curriculum <http://www.cwru.edu/med/BSTP/index.html>. The BSTP allows the flexibility to rotate in laboratories in any BSTP-affiliated graduate program, including Pathology, before commitment to a particular 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 3 laboratories (see Section III: Faculty Trainers). Entering BSTP students who express an interest in the Pathology Graduate Program will be assigned by the Pathology BSTP representative to a relevant Track Advisor (Mark Smith for the MCBDTP, Cliff Harding for the ITP or David Danielpour for the CBTP). This advisor will assist the student in the selection of courses and laboratory rotations based on the student's research interests. Students who are assigned advisors in other programs are encouraged to do research rotations in the Pathology Graduate Program if they have potential research interests in Pathology. Such students may approach faculty advisors 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 Thesis Mentor.

Coursework in the fall semester includes an integrated curriculum in cellular and molecular biology (CBIO 453 and CBIO 455, 4 graded credits each) that provides a shared foundation for many graduate programs at Case School of Medicine. Students also receive 1 credit for their research rotations (BSTP 400, P/F). First year students rotating in Pathology are not required to register for PATH 511 but should attend the Pathology Student Seminars (Wednesday noon), the Pathology Department Seminars (Monday noon), and the Immunology Seminars (Tuesday noon).

D. Selection of Thesis Mentor and Track

By the end of the first semester, students select a Thesis Mentor from the list of approved Faculty Trainers. Assignment of a student to a Thesis Mentor requires approval of the Pathology Graduate Studies Committee. Selection of a Thesis Mentor indicates a commitment by the student to carry out a research program in that faculty member's laboratory to provide the basis for a PhD proposal and subsequent PhD thesis. Research activities must commence by spring semester of the first year. All students must also select a track (MCBDTP, ITB or CBTP) within the Pathology Graduate Program by the end of the first semester.

E. First year: Spring Semester

In the second semester of the first year, students take a total of 9 credits with a minimum of 7 graded course credits including two core courses (see "Sample Curriculum"). Core courses include Basic Pathophysiologic Mechanisms (PATH 510), Fundamental Immunology (PATH 416) and Basic Cancer Biology and Interface with Clinical Oncology (PATH 520 with PATH 521). Students must take the core courses specified for their track. Students take the Experimental Pathology seminar course (PATH 512) this semester. In addition, students begin their PhD research in the laboratory of the PhD mentor. Finally, students MUST take the zero credit ethics course, IBMS 500, which is REQUIRED prior to the students' thesis proposal defense. This one-week course is offered annually in May.

F. CWRU Academic Requirements for Completion of the PhD

To advance to candidacy for the PhD degree, the Graduate School of Case Western Reserve University requires a minimum of 36 credit hours of academic courses, at least two-thirds (24 credit hours) of which must be letter-graded. PATH 601 may be used for ungraded credits. A *Planned Program of Study Form*

must be completed online in the Student Information System (SIS). For SIS reference guides and manuals, go to <http://www.case.edu/projects/erp/learning/sisguides.html>. The Pathology Graduate Program requires that graded core course requirements specified by the Pathology Graduate Program and Track be completed to advance to candidacy, although students may continue to take elective courses subsequently. In addition, the Thesis Proposal Defense must be completed prior to advancing to candidacy (the proposal may be defended while students are still completing the course requirements, see note below). After advancing to candidacy, the student must take PATH 701, Dissertation PhD, to complete a minimum of 18 credit hours of this course (some of the 18 required PATH 701 credits may be taken prior to advancement to candidacy).

Note: After advancing to candidacy, a student should register for PATH 701, not PATH 601, and may register for up to 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 enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 “foundation” credits should be converted to PATH 701 by petition to Graduate Studies. These policies will reduce the subsequent number of PATH 701 credits and tuition charges to the student’s home department, as well as reducing the minimum time period required before the Ph.D. thesis defense and graduation can occur. (Reminder: conversion of PATH 601 to PATH 701 must not reduce the number of non-701 credits to less than 36 total credits, which is the minimum for advancement to candidacy). Students should contact Christine Kehoe, Student Affairs Coordinator, with any questions (368-1993 or cxk15@case.edu).

PhD students who already hold an MS or MD degree upon admission may be excused from some requirements and may be required to take as few as 18 “foundation” credits to complete the coursework requirements for the PhD degree plus 18 credits of PATH 701 Dissertation Research. The extent of reduction in course requirements is decided upon petition to the Chair of the Pathology Graduate Studies Committee 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).

G. Summary of Pathology PhD Program Curriculum Requirements

These requirements are described in more detail in other sections.

1. Coordinated Curriculum in Cell and Molecular Biology (“C3MB”, including CBIO 453 and CBIO 455, 4 graded credits each). BSTP 400 (1 credit, P/F).
2. IBMS 500 Ethics course (zero credits).
3. Basic Pathophysiologic Mechanisms (PATH 510, 4 graded credits) and at least one of the other core courses: Fundamental Immunology (PATH 416, 4 graded credits) and Basic Cancer Biology and Interface with Clinical Oncology (PATH 520 with simultaneous registration in PATH 521, 4 graded credits).
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 XIV: List of Courses); the remainder may include track electives or courses offered by other departments). To optimize course planning, students must complete a Planned Program of Study Form (see Forms section) in the second semester of the first year (submit to Christine Kehoe, Pathology Student Affairs Coordinator).
5. Pathology Student Seminar (PATH 511/PATH 512), 1 P/F credit per semester. Students must participate fully in all semesters but formally register only for their first two semesters in the program. (See Section “J” for specific requirements.)

6. BSTP students must enter the Pathology Graduate Program and their thesis laboratory by the end of the first semester. MSTP students must enter the Pathology Graduate Program and a thesis laboratory by March of their second year in the MD-PhD program. Direct admit students are part of the Pathology graduate program and a thesis laboratory as soon as they matriculate as a graduate student. To clearly define timing expectations for all three admission tracks, milestones are indicated in the following text by period after entering the Pathology Graduate Program as defined here.
7. At the end of the spring semester in the first year of PhD study, students must take a course on biomedical ethics ("Being A Professional Scientist" IBMS 500). This required zero credit course is approximately one week in length, meets three hours per day for four days, and usually occurs in early May of the 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.
8. Prior to advancing to candidacy, students must take 9 credits/semester. All required courses must be completed before the thesis proposal and qualifying exam is taken. 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. Courses must be taken for a letter grade unless offered only with pass-fail grading. Courses are to be selected by the student under the guidance of the Thesis Mentor and Thesis Committee.
9. Students must maintain a grade point average of 3.0 or better. In addition, a student receiving two or more C grades may be placed on academic probation and reviewed to determine whether he/she may continue in the program. Students who receive one "C" may be reviewed by the Pathology Graduate Studies Committee or the relevant Track Committee, and tutoring, remedial coursework or other actions may be recommended to assist the student.
10. Research Elective (PATH 601, P/F) must be taken to complete a nine-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.
11. The Student must work with the Thesis Mentor to assemble a Thesis Committee by the end of the second semester.
12. Preparation and defense of the Thesis Proposal/Qualifying Examination should be completed as soon as possible and must be completed no later than the beginning of the fifth spring/fall semester after entering the laboratory. Failure to meet this timetable will result in review by the Graduate Committee and may result in dismissal from the program. Completion of the Thesis Proposal/Qualifying Examination 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 (1-10) and have a grade point average of 3.00 or better. Upon advancing to candidacy, the student must submit a Planned Program of Study online in the Student Information System (SIS). Go to <http://www.case.edu/projects/erp/learning/sisguides.html> for reference guides and manuals.
13. Note: After advancing to candidacy, a student must register for PATH 701, not PATH 601, and may register for up to 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 enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 "foundation" credits should be converted to PATH 701 by petition to Graduate Studies. These policies will reduce the subsequent number of PATH 701 credits and tuition charges to the student's home department, as well as reducing the minimum time period required before the Ph.D. thesis defense and graduation can occur. (Reminder: conversion of PATH 601 to PATH 701 must not reduce the number of non-701

credits to less than 36 total credits, which is the minimum for advancement to candidacy). Students should contact Christine Kehoe.

14. Students must complete 18 credits of PATH 701 (PhD Dissertation, U/S) prior to graduation. **IMPORTANT: STUDENTS SHOULD TAKE THE FOLLOWING STEPS TO REDUCE CHARGES TO THEIR MENTOR AND DEPARTMENT:** 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 in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of 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 or NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation..
15. Summer Registration: In general, students should not register for any credits. Students should 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. The student **MUST** be registered for PATH 701 for the semester in which he/she defends the PhD thesis. **NOTE:** Students who are 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. Student should check the guidelines of the funding source to make sure whether or not they need to be registered during the summer.
16. The student must meet with his/her Thesis Committee at least once every 6 months and make adequate progress toward completion of the PhD.
17. A PhD Thesis should be prepared and successfully defended by the end of the fifth year. Students who will go beyond this timetable will be reviewed by the Pathology Graduate Studies Committee annually beginning at the end of the fifth year and may be dismissed from the program if progress is not adequate. All students must complete the PhD by the end of the 7th year in the program.
18. Students must fully satisfy the publication requirement and Departmental Thesis Seminar requirement.

Curriculum Modifications for Direct Admit Pathology PhD students

Direct Admit students have already identified a Thesis Mentor and may start research work in the mentor's laboratory without other rotations. With agreement of the Thesis Mentor, students may rotate in other laboratories to gain additional relevant expertise.

H. Curriculum Modifications for MSTP Students

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

1. They are excused from CBIO 453 and CBIO 455 and PATH 510 due to overlap with the medical curriculum. They are excused from BSTP 400 due to overlap with the MSTP 400.
2. MSTP students in the ITP must take PATH 416, but 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 is a track elective, not a requirement, for all CBTP students.

3. They can apply up to 18 graded credits from IBIS graduate courses taken in the medical curriculum to the PhD requirements.
4. They are encouraged to take at least one Pathology core course (PATH 416 and/or PATH 520 + 521) and a track elective in the first two years of the MSTP (prior to entering the PhD phase). IT IS RECOMMENDED THAT ONE OF THESE COURSES BE TAKEN IN THE SPRING OF YEAR 1.
5. MSTP students may petition the chair of their track committee to substitute another graduate course for one track elective if the MD curriculum provides reasonable overlap with a relevant track elective. Since two core courses and two track electives are required, but MSTP students are excused from Path 510, this means that an MSTP student must take at least three graduate-level courses beyond the MD curriculum IBIS courses.
6. When MSTP students enter the PhD phase in late March 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 should be 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 Graduate Student Seminars (Wednesday noon), the Pathology Department Seminars (Monday noon) and the Immunology Seminars (Tuesday noon).

I. Sample Course Schedule

SEMESTER	COURSE	TITLE	CREDIT HOURS
YEAR 1 FALL	CBIO 453*	CELL BIOLOGY I	4
YEAR 1 FALL	CBIO 455*	MOLECULAR BIOLOGY I	4
YEAR 1 FALL	BSTP 400^	RESEARCH ROTATIONS	1
YEAR 1 FALL	TOTAL		9
MENTOR AND TRACK CHOSEN			
YEAR 1 SPRING	PATH 510	BASIC PATHOL MECH	4
YEAR 1 SPRING	CORE	CORE: PATH 416, OR PATH 520 + 521	4
YEAR 1 SPRING	IBMS 500	BEING A PROF SCIENT (REQUIRED BEFORE THESIS PROPOSAL)	0
YEAR 1 SPRING	PATH 512	EXP PATH SEMINAR II	1
YEAR 1 SPRING	TOTAL		9
SUMMER	RSCH 750	SUMMER RSCH-PHD	0

SUMMER	TOTAL		0
THESIS COMMITTEE CHOSEN; PREPROPOSAL MEETING SCHEDULED			
YEAR 2 FALL	PATH 511	EXP PATH SEMINAR I	1
YEAR 2 FALL		TRACK ELECTIVE**	3
YEAR 2 FALL		TRACK OR OTHER ELECTIVE**	3
YEAR 2 FALL	PATH 601	SPECIAL PROBLEMS	2
YEAR 2 FALL	TOTAL		9
THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY WITHIN NEXT 9 MONTHS (NOTE: PETITION TO CONVERT 601 CREDITS TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)			
YEAR 2 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 2 SPRING		ELECTIVES (CORE, TRACK OR OTHER)**	4-6
YEAR 2 SPRING	PATH 601 OR 701	SPECIAL PROBLEMS OR DISSERTATION PHD	3-5
YEAR 2 SPRING	TOTAL		9
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY MUST BE COMPLETED (NOTE: ONCE 36 CREDITS INCLUDING 24 GRADED CREDITS HAVE BEEN COMPLETED, REGISTER FOR UP TO 6 CREDITS OF PATH 701 PER SEMESTER. ALSO PETITION TO CONVERT AS MANY 601 CREDITS AS POSSIBLE TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)			
YEAR 3 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 3 FALL	PATH 701***	DISSERTATION PHD	9
YEAR 3 FALL	TOTAL		9
YEAR 3 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 3 SPRING	PATH 701***	DISSERTATION PHD	1-9 (ONLY THE NUMBER REQUIRED TO BRING TOTAL NUMBER OF COMPLETED 701 CREDITS TO 9)
YEAR 3 SPRING	TOTAL		1-9***

SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 4 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 4 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 FALL	TOTAL		1***
YEAR 4 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 4 SPRING	PATH 701***	DISSERTATION	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 SPRING	TOTAL		1***
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 5 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 5 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 FALL	TOTAL		1***
YEAR 5 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 5 SPRING	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 SPRING	TOTAL		1***

This table shows a typical schedule of courses for a Pathology PhD student.

*Alternate courses for MSTP students: IBIS 401-404

^Alternate course is MSTP 400 for MSTP students and PATH 601 for direct admit students.

#Exception: Take 1-3 credits of PATH 701 if this will accelerate graduation. Also, take 1 credit of PATH 701 if the PhD thesis will be completed in the summer semester (including anytime after the end of the spring semester).

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

***** IMPORTANT: STUDENTS SHOULD TAKE THE FOLLOWING STEPS TO REDUCE CHARGES TO THEIR MENTOR AND DEPARTMENT:** AFTER ADVANCEMENT TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 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 in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of 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 or NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation.. Even prior to advancing to candidacy, if a student has completed 36 “foundation” credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 “foundation” credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, 651 or 701 must indicate their thesis advisor as the Instructor. If a Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

NOTE: Schedule beyond year 5 will generally be the same as for year 5.

J. Seminar Requirements

The Department seminar requirement consists of two components: attendance at a departmental seminar and attendance at the graduate student seminar. In the second semester of the first year and the first semester of the second year, the student should register for PATH 512/511, respectively. In subsequent semesters, students do not register for PATH 511/512, but they are still required to fulfill seminar attendance requirements. Attendance at seminars for ALL students MUST BE documented on sign-in sheets. The attendance requirement is as follows:

Research Seminars:

For students enrolled in PATH 511/512, the student must attend at least 10 approved seminars, of which at least 5 seminars must be in the Monday Pathology Seminar Series and the other 5 seminars may be any combination of Pathology, Immunology or Cancer Center Seminar Series.

After completing the PATH 511 and PATH 512, the student must attend at least 10 approved seminars in each semester, but there is no distribution requirement; the 10 seminars may consist of any combination of Pathology, Immunology or Cancer Center Seminars. Up to 3 of the required 10 seminars in any semester may be substituted with seminars from other Departments or Institutions; to qualify, the student must submit a write-up of the seminar to the Graduate Student Seminar Director, Dr. Robert Petersen rbp@cwru.edu, for approval to count toward the 10-seminar requirement.

Graduate Student Seminars:

In all years in the program, 75% attendance (at least 9 seminars per semester) is required for the Wednesday Pathology Graduate Student Seminars.

Grading and Disciplinary Actions:

Path 512/511 are graded Pass/Fail. Students enrolled in Path 512/511 will receive an Incomplete if seminar attendance requirements are not met. Senior students will receive an Incomplete grade in Path 601 if the seminar requirement is not met; 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 Dr. Petersen.

Failure to complete these seminar requirements will result in academic probation, which ultimately may result in dismissal from the Program.

K. Preliminary Research and Selection of Thesis Committee

The student will begin research activities under the direction of the Thesis Mentor during the second semester. This work will form the basis of the PhD proposal. During the first semester of the second year, the student and Thesis Mentor will select members of the student's Thesis Committee and have a preproposal committee meeting. For all three tracks (MCBDTP, ITP and CBTP), the composition of the committee requires the approval of Dr. James Anderson, Chair of the Pathology Graduate Studies Committee. The student must have one Thesis Committee meeting every 6 months.

The Thesis Committee must contain at least four Case faculty members, at least two of whom (including the Thesis mentor) must be approved Trainers in the Pathology Graduate Program. One member must be from a department other than Pathology (Trainers without a primary appointment in Pathology may represent either Pathology or another department). The Chair of the Thesis Committee must have either a primary or secondary faculty appointment in Pathology. The 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 (members who are not Case faculty will be non-voting members). Faculty composition of the committee may be changed by the advisor/student, subject to the approval of the Chair of the Pathology Graduate Program Committee, Dr. James Anderson. The Thesis Committee should be convened in a preproposal meeting prior to the student's Thesis Proposal Defense to offer the student suggestions regarding the Thesis Proposal Defense.

The Thesis Committee Chair must have a primary or secondary faculty appointment in Pathology. The Thesis Mentor may not serve as the Thesis Committee Chair. The responsibilities of the Thesis Committee Chair include leading Thesis Committee meetings, preparing a short written record of each committee meeting (evaluating the student's progress and indicating expectations for the next 6 months and beyond), and ensuring that the student makes demonstrable progress towards the PhD (monitoring of progress in course and seminar requirements, publication requirements, thesis defense preparations and required departmental lecture).

To assist the Chair and to enhance consistency of procedures, committee meetings will be attended by the Track Thesis Committee Representative. The Track Thesis Committee Representative will be Dr. Clive Hamlin for the MCBTDP and ITP, and Dr. Edward Stavnezer for the CBTP. The Track Thesis Committee Representative should be informed in advance of all committee meetings (which he/she will attend as time allows), particularly the Thesis Proposal and the PhD Dissertation Defense.

At the conclusion of each meeting, a Graduate Student Evaluation Form (see Forms section) must be completed and submitted to Christine Kehoe, Pathology Graduate Studies Coordinator (cxk15@case.edu). The Thesis Committee Chair must prepare a written summary on this form or in a separate email sent to the student, all committee members and the Pathology Graduate Studies Coordinator.

L. 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 after an NIH R01 grant proposal. The

Thesis Proposal Defense MUST be successfully completed by the end of the fourth semester (end of second year) of the program (first year in the PhD phase for MSTP students). Failure to meet this timetable will result in review by the Pathology Graduate Studies Committee and may result in dismissal from the program. Defense of the Thesis Proposal is both written and oral. The process generally requires 1-2 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, except that the student is expected to provide more background than a typical R01, and some research aims may have less 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 and propose a feasible set of studies, but 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 double-spaced and must be of sufficient length to provide a detailed discussion. The suggested length is 30-50 pages (double spaced with figures). The Thesis Proposal should be organized according to the following format.

A. *SPECIFIC AIMS*: Give a concise conceptual background that develops the problems that you wish to solve in your research. Concisely summarize your research plan. Each aim should be stated with a conceptual justification and statement of hypotheses. Briefly indicate the experimental approach. You may wish to explicitly state subaims in the same manner (hypothesis, approach). This section is a summary of the planned research and should be organized in parallel with the Research Plan (Section D). It is recommended that each Aim correspond to a subsection of Section D. *No more than two pages double-spaced.*

B. *SIGNIFICANCE AND BACKGROUND*: Provide broad scientific background for the proposal. This section serves as a test for the student's knowledge of scientific areas related to the proposal. Critically evaluate existing knowledge and models in a thorough manner with referencing 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 referencing, 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 and attribution must be included in the figure legends. This section serves as part of the Qualifying Examination, and students are expected to provide a learned discussion of areas related to their research.

C. *PRELIMINARY RESULTS*: This section should describe preliminary data for as many of the aims as possible. Most of the data should reflect work done by the student, but it is permissible to show one or more figures with data from a colleague or collaborator that may demonstrate feasibility of the approach (use of such data from others must be clearly attributed in the figure legend). Show experimental data in graphs and tables that effectively and clearly portray results for critical evaluation. Clearly state your conclusions. The results should support proposed hypotheses and/or establish technical feasibility of proposed experiments. It is sometimes helpful to organize the subsections to correspond to the aims as organized in Section D.

D. *RESEARCH PLAN*: This is more than a Methods section! Provide a comprehensive conceptual approach to the research goals and discuss the proposed research in detail. Devote a subsection to each specific aim. This section should be "hypothesis-driven". Start with conceptual discussion of the rationale for the experiments and the hypothesis. Describe experimental design, procedures, protocols and methods to accomplish the specific aims. Describe any new methodology and its advantage over existing methodologies. Include the means by which the data will be analyzed and interpreted. Discuss potential difficulties and limitations of the proposed procedures and alternative approaches to achieve the aims.

Describe the tentative sequence of the investigations. Indicate predicted results and alternative possibilities. State the conclusions that you expect to reach and indicate the significance of those conclusions.

E. *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.

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. Note: The student may schedule the Thesis Proposal oral defense to follow immediately after his/her presentation in the Pathology Graduate Student Seminar Series if this is convenient and acceptable to the Thesis Committee.
- b. The student should submit the Thesis Proposal to the Thesis Committee approximately 5 weeks prior to the oral Thesis Proposal Defense to allow time for the other steps in the process to occur.
- c. 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 should be delivered to the student within 14 days). 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.
- d. The student should prepare appropriate written answers to the questions within 14 days. Only library resources available on campus may be used in preparing the answers. Discussion or consultation with the thesis mentor, committee members or other faculty or staff is not permitted (except that the student may ask an examining faculty member for clarification of a question that he/she has submitted; the Thesis Mentor may 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 (3-7 days prior to the Thesis Proposal defense).
- e. The Track Representative should bring a copy of the Graduate Student Evaluation Form (see Forms section) to the Thesis Proposal meeting.
- f. The Thesis Proposal meeting will follow the general format and rules for Thesis Committee meetings but with some modifications. The student will give a 30-40 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, he/she is given an opportunity to correct the deficiencies no later than 6 months following the initial proposal defense. If a student fails twice he/she will not be allowed to continue in the PhD program.
- g. The chair must deliver the signed Graduate Student Evaluation to the Pathology Student Affairs Coordinator (Christine Kehoe).

- h. If a student is registered for PATH 601 in the semester in which the Thesis Proposal is successfully completed, the student and advisor should petition Graduate Studies to retroactively convert PATH 601 credits for that semester into PATH 701 credits to the degree possible. This will reduce the subsequent number of PATH 701 credits and tuition charges to the student's home department, as well as reducing the minimum time period required before the Ph.D. thesis defense and graduation can occur. (One limitation: this conversion of PATH 601 to PATH 701 must not reduce the number of non-701 credits to less than 36 total credits, which is the minimum for advancement to candidacy). Students should contact Christine Kehoe, Student Affairs Coordinator (cxk15@case.edu or 368-1993).
- i. The student must obtain the Advancement to Candidacy Form (see Forms Section XII) from the School of Graduate Studies. The form must be completed and submitted to the Pathology Student Affairs Coordinator ([Christine Kehoe](#)) for the Department Chair's signature. The student must then file this form with the School of School of Graduate Studies, leaving a copy with the Pathology Graduate Program Coordinator.
- j. A Planned Program of Study must be submitted online. Go to <http://www.case.edu/projects/erp/learning/sisguides.html> for reference manuals and guides. At the time of application for graduation, this information will be used by the Office of Graduate Studies to determine whether the student has met academic requirements.
- k. Students are encouraged to use their Thesis Proposal as the basis for a pre-doctoral fellowship application at the national level.

M. Academic Progress and Thesis Committee Meetings

Students are responsible for scheduling a Thesis Committee meeting every 6 months. A two-hour slot should be scheduled for the meeting to permit adequate evaluation and discussion. One meeting each year may be coordinated with the student's graduate student seminar, which all Thesis Committee members should attend. Note: Students should communicate with their Thesis Committee when scheduling their graduate student seminar to insure that the committee members will be available to attend on the selected date. Once a date/time has been confirmed, this information should be communicated to the Student Affairs Coordinator. Thesis Committee meetings will be led by the Thesis Committee Chair, not the Thesis Mentor. Prior to the meeting, students should email an electronic copy of their presentation to all committee members; a hard copy of the presentation should be provided to all committee members at the meeting as well as any appropriate forms.

Agenda for Thesis Committee meetings:

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.
3. Unless the meeting has been preceded by a seminar, the student will provide a 25-30 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.
4. Open discussion should include questions by faculty members to evaluate student progress and address all questions and concerns. The committee should provide advice to the student to enhance research progress. 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.
5. The student and Thesis Mentor will be excused from the room. The committee should discuss any concerns about the adequacy of the Thesis Mentor and thesis project.
6. The Thesis Mentor will then return to the meeting. 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 evaluation and advice.
8. The Graduate Student Evaluation Form (see Forms section) will be completed, signed and delivered to the Pathology Student Affairs Coordinator (Christine Kehoe).

9. The Thesis Committee Chair will prepare a brief report that summarizes the committee's evaluation, decisions and advice. The report may be written on the Graduate Student Evaluation Form, but it is usually sent by e-mail to the student, all members of the committee and the Student Affairs Coordinator.

N. Thesis and Graduation Requirements

Students must satisfy requirements of the Program for the PhD Thesis Defense, publications and a Departmental Thesis Seminar. The student should solicit advice from the Thesis Committee about when to schedule the Thesis Defense. Arrangements should be made months in advance to secure appropriate Thesis Defense times (with sufficient prior notification of Graduate Studies) and to schedule a Departmental Thesis Seminar slot. 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 School of Graduate Studies website for important graduation deadlines and forms: <http://www.case.edu/provost/gradstudies/graduation.html>.

1. Checklist for Thesis Defense and Graduation

- a. Students must satisfy the publication requirement and all course requirements PRIOR TO SCHEDULING THE THESIS 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, which may be done at the same time as the Departmental Thesis Seminar (below). The defense will be publicized by the School of Graduate Studies (publicity forms are included in the Graduation packet provided by the Office of Graduate Studies). A closed Thesis Committee meeting follows the presentation (allow 90 minutes).
- c. A Departmental Thesis Seminar must be given in a track-related research seminar series (Pathology Department Seminar or Cancer Center Blood Club Seminar) or other publicized special seminar forum. This is often scheduled at the time of the Thesis Defense so as to combine the Seminar with the Thesis Defense presentation, but two separate presentations may be scheduled. Students must contact the organizer of the relevant seminar series well in advance to schedule the Departmental Thesis Seminar.
- d. Students should check on the deadline for Thesis Defense for graduation in a particular semester. For example, if a student defends after the deadline for spring graduation (even if this is prior to spring commencement ceremonies), the PhD degree will not be conferred until the graduation date for the following (summer) semester. Note: The student must be registered for PATH 701 in the semester in which the Thesis Defense occurs.
- e. Students should check with the School of Graduate Studies and consult with the Student Affairs Coordinator (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 Graduate Studies. Obtain, complete and submit all materials required by the Office of Graduate Studies for Thesis Defense and graduation. Copies of all materials submitted to the School of Graduate Studies must be submitted to the Student Affairs Coordinator.
- f. The candidate must deliver the completed dissertation (in both hard copy and electronic forms) to each committee member at least 14 days before the examination.
- g. At the time of the Thesis Defense, the student should bring a blank Pathology Graduate Student Evaluation Form, all forms from Graduate Studies that require Thesis Committee signatures, and printed copies of the PowerPoint presentation.
- h. 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 Thesis Mentor to monitor the final revisions and provide the final approval signature.
- i. A Graduate Student Evaluation Form will be completed and submitted to the Pathology Student Affairs Coordinator. Forms in the Graduation Packet should be completed and submitted to the Pathology Student Affairs Coordinator as well.
- j. When final corrections to the written Dissertation are completed, the student must submit their Dissertation electronically to the School of Graduate Studies. (See Graduation Instructions for Doctoral

Candidates in the Forms Section XII.)The student is entitled to binding services for 4 copies of the Dissertation. One of the 4 is for the Pathology library, and the others are to be distributed at the student's discretion. (usually 1 to your thesis mentor). The student may order additional copies at his/her expense. Contact Jeannie St. Marie in the Pathology Library (368-2482 or Jeannie.stmarie@uhhospitals.org) for further information.

- k. 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 School of Graduate Studies, which will coordinate details regarding Convocation.
- l. The student must notify their department administrator to arrange timely termination of the stipend, thereby avoiding pay-back difficulties.
- m. The student should notify the Pathology Student Affairs Coordinator of his or her post-graduate position and contact information.

2. Dissertation Requirements

Each doctoral candidate is required to submit a written dissertation and pass a final oral examination in defense of the dissertation as evidence of their ability to conduct independent research at an advanced level. The dissertation must represent a significant contribution to existing knowledge (see Publication Requirement). The examination includes inquiry into the candidate's competence in Pathology and related fields.

When it has been determined by the student and his or her Thesis Mentor, in consultation with the Thesis Committee, that the research has progressed sufficiently to prepare the dissertation, the student should obtain "Graduation Instructions for Doctoral Candidates" from the School of Graduate Studies website (<http://www.case.edu/provost/gradstudies/graduation.html>) or the Department of Pathology website (<http://www.case.edu/med/pathology/training/graduate.html>). This packet will contain information on steps for scheduling the Thesis Defense; how to prepare the Dissertation document; and the necessary forms for graduation.

3. Composition of Dissertation Defense (Examining) Committee

The Department of Pathology requirements for the Thesis Committee comply with Graduate School 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 School of Graduate Studies.

4. 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 acceptable 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.

5. Preparation of Written Dissertation

Guidelines on preparation of the written dissertation such as formatting requirements are included in the Graduation Packet (available through the website of the School of Graduate Studies). In addition to the resources listed in the Graduation Packet, copies of dissertations by students are available in the Pathology Library.

6. Oral Defense of the Dissertation

The defense must be scheduled with the School of Graduate Studies no later than three to six weeks before the date of the examination, allowing time for the sequence of events listed below to occur prior to

the date of Defense. 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.

7. Publication Requirements

A Pathology PhD candidate must have 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 at least reviewed/approved by their Thesis Committee BEFORE scheduling the Thesis Defense. The two publications must be research reports; reviews and other commentaries will 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.

Of the two required first-authored publications, one may be fulfilled with a publication for which the student is not the first listed author but is listed as a joint first author (or an author who contributed to a degree equal to the first author), as long as the following conditions are also met:

- a. The published form of the paper must state that the student fulfilled the joint first author role.
- b. There must be agreement between the student's mentor and a majority of the Thesis Committee that the student did fulfill such a role.
- c. There must be 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.
- d. The other required first-authored paper must actually have the student listed first in the author order (the existence of other joint first authors will not affect the standing of the first-listed author).
- e. The other required first-authored paper with the student first in the author order must be accepted for publication prior to the thesis defense.

8. Departmental Thesis Seminar

The Department of Pathology requires that the student give a Departmental Thesis Seminar in their last semester. If the student anticipates final thesis defense in the summer semester, the Departmental Thesis Seminar should be presented in the spring semester. The seminar should be scheduled with the coordinator of a relevant seminar series (Pathology Department Seminar or Cancer Center Blood Club Seminar); 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. The Departmental Thesis Seminar should be scheduled well in advance of the student's last semester to obtain a spot on the seminar schedule in the last semester. Ideally, the Departmental Thesis Seminar is scheduled to coincide with the Thesis Defense. If this is not possible, the student can present the Thesis Defense (with a public presentation) and the Departmental Thesis Seminar on different dates.

O. Exceptions and Deviations from Guidelines and Timelines

ANY EXCEPTIONS TO PATHOLOGY GRADUATE PROGRAM GUIDELINES MUST BE APPROVED BY THE PATHOLOGY GRADUATE COMMITTEE PRIOR TO IMPLEMENTATION. INDIVIDUAL THESIS COMMITTEES ARE NOT EMPOWERED TO GRANT THESE EXCEPTIONS.

1. Timing of Ph.D. Thesis Defense and Publications: Students must have at least one first-authored paper accepted and another, if not submitted, at least reviewed/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 cards 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 and the cards are submitted to Graduate Studies.

2. If the Ph.D. 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 (Dr. Anderson).

3. Conversion from Ph.D. to M.S. program may occur if a student cannot satisfy Ph.D. program requirements or must leave prior to completing the Ph.D. program. In this case, the M.S. will be governed by the rules of Master's Plan A (research/thesis) , NOT Master's Plan B (coursework/exam).

P. 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 teaching assistants, for which some additional compensation may be offered, but placement into such a position requires the approval of the thesis mentor and (pending changes currently under consideration by the university) may require the approval of a Pathology Program faculty representative and the Dean of Graduate Studies (Dr. Charles Rozek). 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.

III. Faculty Trainers

Please visit the Department of Pathology website for our current listing of Faculty Trainers:
<http://www.case.edu/med/pathology/faculty/index.html>.

IV. 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, Alzheimers 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. To accomplish these training goals, the MCBBDTP has been developed as a track within the Pathology PhD Program.

B. Overview of the MCBBDTP

Training for the PhD degree in the MCBBDTP includes course work, research rotations, formal and informal seminars, a Thesis Proposal Defense/Qualifying Examination, and research experience resulting in scholarly publications and a PhD dissertation. The MCBBDTP includes the core curriculum of the Pathology Graduate Program and track-specific electives. Core components of the Pathology PhD curriculum include the BSTP curriculum coursework in cell and molecular biology (CBIO 453 CBIO 455), a minimum of three research rotations and two Pathology core courses (PATH 510 Basic Pathophysiologic Mechanisms and PATH 416 Fundamental Immunology). The third Pathology core course (PATH 520 Basic Cancer Biology & Interface with Clinical Oncology with simultaneous registration in PATH 521) is optional for MCBBDTP students. MCBBDTP students take at least two MCBBDTP Track Electives (see Section X: List of Courses) and other elective courses to meet the PhD requirements (Section II: Pathology PhD Program). 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 his/her 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 his/her Thesis Mentor, and a Planned Program of Study (see Forms section) must be completed to insure adequate planning for coursework and other curriculum components. This plan must be reviewed and approved by the MCBBDTP Track Thesis Committee Representative (Clive Hamlin), and then submitted to the Pathology Student Affairs Coordinator (Christine Kehoe). The MCBBDTP Track Thesis Committee Representative will be an ex officio member of all Thesis Committees for MCBBDTP students and will insure consistency in advising and adherence to guidelines.

C. Training Faculty

MCBDTP trainers are indicated in the list of Pathology Graduate Program Faculty Trainers at the Department website: <http://www.case.edu/med/pathology/faculty/index.html>.

D. Research Facilities

Trainers and research laboratories are located in the Department of Pathology and multiple other departments at Case School of Medicine and its affiliated institutions, University Hospitals Case Medical Center, the Cleveland Clinic Foundation (including the Lerner Research Institute), MetroHealth Medical Center and the Louis Stokes VA Medical Center. At Case, the Wolstein Research Building and Institute of Pathology house offices and research facilities of the Department of Pathology.

E. Seminars and Journal Clubs

MCBDTP students take the PATH 511 and PATH 512 Experimental Pathology Seminar courses. These courses include two components, the Pathology Graduate Student Seminar Series, where students report on research progress, and research seminars. For the research seminar component, MCBDTP students are expected to attend the weekly Pathology Department Seminar Series, which features speakers from Case and other universities (see description of seminar requirements in Section II: Pathology PhD Program). Students must attend the seminar components of PATH 511 and PATH 512 even in semesters when they are not registered for the course. Students should also attend other relevant seminars. Finally, students present their dissertation research in a Departmental Thesis Seminar.

F. Administrative Structure

As a track within the Pathology Graduate Program, the MCBDTP is represented on the Pathology Graduate Studies Committee by a representative who also serves as the Chair of the MCBDTP Steering Committee. The Pathology Graduate Studies Committee handles issues common to all tracks (student admissions, mentor approval, final stages of academic review and other issues related to the general structure of the program). The MCBDTP Steering Committee is charged with all activities specific to the MCBDTP (curriculum development, including courses, seminar and journal clubs, advising of prospective students and students in the MCBDTP, recruiting efforts, faculty development and other issues). The two committees work together in many areas with joint efforts coordinated by the MCBDTP Chair who serves on the Pathology Graduate Studies Committee. The MCBDTP Steering Committee composition and function may be dictated by the chair of the committee. For example, a subset of the committee members may meet to deal with issues focused on their roles in the committee.

MCBDTP Steering Committee

Member	Role
Anderson, James	Chair
Hamlin, Clive	Track Thesis Committee Rep
Smith, Mark	Track Advisor
Ziats, Nick	Curriculum representative

G. Sample Curriculum

SEMESTER	COURSE	TITLE	CREDIT HOURS
YEAR 1 FALL	CBIO 453*	CELL BIOLOGY I	4
YEAR 1 FALL	CBIO 455*	MOLECULAR BIOLOGY I	4
YEAR 1 FALL	BSTP 400^	RESEARCH ROTATIONS	1
YEAR 1 FALL	TOTAL		9
MENTOR AND TRACK CHOSEN			
YEAR 1 SPRING	PATH 510*	BASIC PATHOL MECH	4
YEAR 1 SPRING	PATH 416*	FUNDAMENTAL IMMUNOL	4
YEAR 1 SPRING	IBMS 500	BEING A PROF SCIENT	0
YEAR 1 SPRING	PATH 512	EXP PATH SEMINAR II	1
YEAR 1 SPRING	TOTAL		9
SUMMER	RSCH 750	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
THESIS COMMITTEE CHOSEN; PREPROPOSAL MEETING SCHEDULED			
YEAR 2 FALL	PATH 511	EXP PATH SEMINAR I	1
YEAR 2 FALL		MCBDTP TRACK ELECTIVE	3
YEAR 2 FALL		MCBDTP TRACK OR OTHER ELECTIVE	3
YEAR 2 FALL	PATH 601	SPECIAL PROBLEMS	2
THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY WITHIN NEXT 9 MONTHS (NOTE: PETITION TO CONVERT 601 CREDITS TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)			
YEAR 2 FALL	TOTAL		9
YEAR 2 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 2 SPRING		ELECTIVES (CORE, MCBDTP TRACK OR OTHER)	4-6
YEAR 2 SPRING	PATH 601 OR 701	SPECIAL PROBLEMS OR DISSERTATION PHD	3-5
YEAR 2 SPRING	TOTAL		9
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0

THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY MUST BE COMPLETED (NOTE: ONCE 36 CREDITS INCLUDING 24 GRADED CREDITS HAVE BEEN COMPLETED, REGISTER FOR UP TO 6 CREDITS OF PATH 701 PER SEMESTER. ALSO PETITION TO CONVERT AS MANY 601 CREDITS AS POSSIBLE TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)

YEAR 3 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 3 FALL	PATH 701**	DISSERTATION PHD	9
YEAR 3 FALL	TOTAL		9
YEAR 3 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 3 SPRING	PATH 701**	DISSERTATION PHD	1-9 (ONLY THE NUMBER REQUIRED TO BRING TOTAL NUMBER OF COMPLETED 701 CREDITS TO 9)
YEAR 3 SPRING	TOTAL		1-9**
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 4 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 4 FALL	PATH 701**	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 FALL	TOTAL		1
YEAR 4 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 4 SPRING	PATH 701**	DISSERTATION	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 SPRING	TOTAL		1
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0

SUMMER	TOTAL		0
YEAR 5 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 5 FALL	PATH 701**	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 FALL	TOTAL		1
YEAR 5 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 5 SPRING	PATH 701**	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 SPRING	TOTAL		1

*Alternate courses for MSTP students: IBIS 401-404. MSTP students in the MCBDTP do not need to take CBIO 453, CBIO 455, PATH 510 or PATH 416, although PATH 416 may still be taken as a Track Elective.

^Alternate course is MSTP 400 for MSTP students and PATH 601 for direct admit students.

#Exception: Take 1-3 credits of PATH 701 if this will accelerate graduation. Also, take 1 credit of PATH 701 if the PhD thesis will be completed in the summer semester (including anytime after the end of the spring semester).

***** IMPORTANT: STUDENTS SHOULD TAKE THE FOLLOWING STEPS TO REDUCE CHARGES TO THEIR MENTOR AND DEPARTMENT:** AFTER ADVANCEMENT TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 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 in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of 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 or NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation.. Even prior to advancing to candidacy, if a student has completed 36 "foundation" credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 "foundation" credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, 651 or 701 must indicate their thesis advisor as the Instructor. If a

Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

NOTE: Schedule beyond year 5 will generally be the same as for year 5.

V. 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. To accomplish these training goals, the ITP has been developed as a track within the Pathology PhD Program.

B. Overview of the ITP

Training for the PhD degree in the ITP includes course work, research rotations, formal and informal seminars, a Thesis Proposal Defense/Qualifying Examination, and research experience resulting in scholarly publications and a PhD dissertation. The ITP includes the core curriculum of the Pathology PhD Program (see Section II: Pathology PhD Program) and a well-developed curriculum focused on immunology. Core components of the Pathology PhD curriculum include the BSTP curriculum coursework in cell and molecular biology (CBIO 453 and CBIO 455), a minimum of three research rotations and two Pathology core courses (PATH 510 Basic Pathophysiologic Mechanisms and PATH 416 Fundamental Immunology). The third Pathology core course (PATH 520 Basic Cancer Biology & Interface with Clinical Oncology with simultaneous registration in PATH 521) is optional for ITP students. ITP students take at least two ITP Track Electives (see Section X: List of Courses) and other elective courses to meet the PhD requirements (see Section II: Pathology PhD Program). 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 his/her Thesis Mentor and must follow the program guidelines. A Planned Program of Study Form (see Forms section) must be completed to insure adequate planning for coursework and other curriculum components. This plan must be reviewed and approved by the ITP Track Thesis Committee Representative (Clive Hamlin), and then submitted to the Pathology Student Affairs Coordinator (Christine Kehoe). The ITP Track Thesis Committee Representative will be an ex officio member of all Thesis Committees for ITP students and will insure consistency in advising and adherence to guidelines.

C. Training Faculty

ITP trainers are indicated in the list of Pathology Graduate Program Faculty Trainers at the Department website <http://www.case.edu/med/pathology/family/index.html>.

D. Research Facilities

Trainers and research laboratories are located in multiple departments at Case School of Medicine and its affiliated institutions, University Hospitals Case Medical Center (UHCMC), the Cleveland Clinic Foundation (CCF, including the Lerner Research Institute), Metro Health Medical Center (MHMC) and the Louis Stokes VA Medical Center (VAMC). At Case, the Wolstein Research Building houses offices and research facilities of the Department of Pathology (which includes a major emphasis on Immunology), the Center for Global Health (with multiple active programs in infectious diseases, especially parasitic diseases) and the Case Comprehensive Cancer Center (including the Center for Stem Cell and Regenerative Medicine and core facilities for FACS, microarray gene expression studies and many other cutting-edge research methods). The Division of Infectious Diseases is nearby on the Case campus and in adjacent facilities at UHCMC; in addition to a wide spectrum of research on Infectious Diseases, it includes several specialized research facilities, including the Center for AIDS research (CFAR), AIDS Clinical Trials Unit (ACTU) and its Special Immunology Unit (SIU), and the Tuberculosis Research Unit

(TBRU). The Department of Dermatology and its Skin Diseases Research Center also house immunology-related research, and the Department of Ophthalmology is building a program in ocular immunology. The CCF houses an entire Department of Immunology at its Lerner Research Institute (LRI); these faculty hold appointments in the Case Department of Molecular Medicine (based at the LRI) and ITP Trainers hold faculty or trainer appointments in the Case Department of Pathology. Other immunology research groups are located in a wide number of other departments at Case, CCF, UHCMC, MHMC and VAMC.

E. Requirements for Seminars, Journal Clubs and Retreats

ITP students take the PATH 511 and PATH 512 Experimental Pathology Seminar courses and continue to meet the seminar requirements of the Pathology Graduate Program for all semesters in the program (Section II, Part J). ITP students are required to attend at least 75% of the Tuesday noon Immunology Seminar Series (sign-in required). Students are also required to participate regularly in the weekly ITP Journal Club (scheduled by Dr. Brian Cobb), which is held at noon on Thursday in Wolstein 5136. All ITP students are required to present a paper once each year in ITP Journal Club. In addition, attendance requirements will be explained in a memo from Dr. Cobb and will be monitored by a sign-in sheet. ITP students in labs on the CCF campus are required to present one paper each year in the journal club in Wolstein, but they may satisfy their regular attendance requirement by attending the Immunology Journal Club at CCF (Dr. Fairchild, coordinator). 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. At the end of their PhD studies, students present their dissertation research in a Departmental Thesis Seminar.

F. Administrative Structure

As a track within the Pathology Graduate Program, the ITP is represented on the Pathology Graduate Studies Committee by a representative who also serves as the Chair of the ITP Steering Committee. The Pathology Graduate Studies Committee handles issues common to all tracks (student admissions, mentor approval, final stages of academic review and other issues related to the general structure of the program). The ITP Steering Committee is charged with all activities specific to the ITP (curriculum development, including courses, seminar and journal clubs, advising of prospective students and students in the ITP, recruiting efforts, faculty development and other issues). The two committees work together in many areas with joint efforts coordinated by the ITP Chair who serves on the Pathology Graduate Studies Committee. The ITP Steering Committee composition and function may be dictated by the chair of the committee. For example, the chair may call a meeting of a subset of the committee members to deal with issues related to their roles in the committee.

ITP Steering Committee

Member	Role
Harding, Clifford	Interim Department Chair, ITP Chair, Track Advisor
Cobb, Brian	Co-Director, Immunology Journal Club
Fairchild, Robert	CCF Immunology Representative, CCF Immunol Journal Club Rep
Greenspan, Neil	MD Immunology Curriculum
Hamilton, Thomas	Chair, CCF Dept of Immunology
Hamlin, Clive	Track Thesis Committee Rep
Kazura, James	Center for Global Health representative
Lederman,	CFAR/ACTU/ID representative
Levine, Alan	Curriculum representative
Nedrud, John	Curriculum representative

G. Sample Curriculum

SEMESTER	COURSE	TITLE	CREDIT HOURS
YEAR 1 FALL	CBIO 453*	CELL BIOLOGY I	4
YEAR 1 FALL	CBIO 455*	MOLECULAR BIOLOGY I	4
YEAR 1 FALL	BSTP 400^	RESEARCH ROTATIONS	1
YEAR 1 FALL		IMMUNOLOGY JOURNAL CLUB (OPTIONAL THIS SEMESTER)	
YEAR 1 FALL	TOTAL		9
MENTOR AND TRACK CHOSEN			
YEAR 1 SPRING	PATH 510	BASIC PATHOL MECH	4
YEAR 1 SPRING	PATH 416	FUNDAMENTAL IMMUNOL	4
YEAR 1 SPRING	IBMS 500	BEING A PROF SCIENT	0
YEAR 1 SPRING	PATH 512	EXP PATH SEMINAR II	1
YEAR 1 SPRING		IMMUNOLOGY JOURNAL CLUB (OPTIONAL THIS SEMESTER)	
YEAR 1 SPRING	TOTAL		9
SUMMER	RSCH 750	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
THESIS COMMITTEE CHOSEN; PREPROPOSAL MEETING SCHEDULED			
YEAR 2 FALL	PATH 511	EXP PATH SEMINAR I	1
YEAR 2 FALL		ITP TRACK ELECTIVE	3
YEAR 2 FALL		ELECTIVES (CORE, ITP TRACK OR OTHER)**	3
YEAR 2 FALL	PATH 601	SPECIAL PROBLEMS	2
YEAR 2 FALL		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
THESIS PROPOSAL AND ADVANCEMENT TO CANDIDACY WITHIN 9 MONTHS (NOTE: PETITION TO CONVERT 601 CREDITS TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)			
YEAR 2 FALL	TOTAL		9
YEAR 2 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 2 SPRING		ELECTIVES (CORE, ITP TRACK OR OTHER)**	4-6

YEAR 2 SPRING	PATH 601 OR 701	SPECIAL PROBLEMS OR DISSERTATION PHD	3-5
YEAR 2 SPRING		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 2 SPRING	TOTAL		9
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
<p>THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY MUST BE COMPLETED (NOTE: ONCE 36 CREDITS INCLUDING 24 GRADED CREDITS HAVE BEEN COMPLETED, REGISTER FOR UP TO 6 CREDITS OF PATH 701 PER SEMESTER. ALSO PETITION TO CONVERT AS MANY 601 CREDITS AS POSSIBLE TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)</p>			
YEAR 3 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 3 FALL	PATH 701***	DISSERTATION PHD	9
YEAR 3 FALL		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 3 FALL	TOTAL		9
YEAR 3 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 3 SPRING	PATH 701***	DISSERTATION PHD	1-9 (ONLY THE NUMBER REQUIRED TO BRING TOTAL NUMBER OF COMPLETED 701 CREDITS TO 9)
YEAR 3 SPRING		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 3 SPRING	TOTAL		1-9***
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 4 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 4 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 FALL		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	

YEAR 4 FALL	TOTAL		1
YEAR 4 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 4 SPRING	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 SPRING		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 4 SPRING	TOTAL		1
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 5 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 5 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 FALL		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 5 FALL	TOTAL		1
YEAR 5 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 5 SPRING	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 SPRING		IMMUNOLOGY JOURNAL CLUB (REQUIRED THIS SEMESTER)	
YEAR 5 SPRING	TOTAL		1

*Alternate courses for MSTP students: IBIS 401-404. MSTP students in the ITP do not need to take C BIO 453, C BIO 455 or PATH 510. PATH 416 is required for MSTP students in the ITP unless they have sufficient prior immunology background as determined by the ITP Chair and curriculum coordinators (e.g. Drs. Harding and Nedrud).

^Alternate course is MSTP 400 for MSTP students and PATH 601 for direct admit students.

#Exception: Take 1-3 credits of PATH 701 if this will accelerate graduation. Also, take 1 credit of PATH 701 if the PhD thesis will be completed in the summer semester (including anytime after the end of the spring semester).

**PATH 520 + 521 is included as a Track Elective for ITP students.

***** IMPORTANT: STUDENTS SHOULD TAKE THE FOLLOWING STEPS TO REDUCE CHARGES TO THEIR MENTOR AND DEPARTMENT:** AFTER ADVANCEMENT TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 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 in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of 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 or NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation.. Even prior to advancing to candidacy, if a student has completed 36 “foundation” credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 “foundation” credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, 651 or 701 must indicate their Thesis Advisor as their Instructor. If a Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

NOTE: Schedule beyond year 5 will generally be the same as for year 5.

VI. 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

Training for the PhD degree in the CBTP includes course work, research rotations, formal and informal seminars, a Thesis Proposal/Qualifying Examination, and research experience resulting in scholarly publications and a PhD dissertation. The CBTP includes the core curriculum of the Pathology Graduate Program (see Section II: Pathology PhD Program) and a well-developed curriculum focused on cancer biology. Core components of the Pathology PhD curriculum include the BSTP curriculum coursework in cell and molecular biology (CBIO 453 and CBIO 455), a minimum of three research rotations and two Pathology core courses (PATH 510 Basic Pathophysiologic Mechanisms, PATH 520 Basic Cancer Biology & Interface with Clinical Oncology with simultaneous registration in PATH 521). PATH 510 provides a solid foundation in mechanisms of disease, including topics related to cancer. PATH 520 + 521 provides a detailed survey of basic cancer biology. Together, PATH 520 and PATH 521 constitute a single coordinated 4-credit course in Cancer Biology; students register for the core didactic portion as PATH 520 (3 credits) and a coordinated seminar component represented by PATH 521 (1 credit) to constitute the entire 4-credit course. CBTP students also take at least two CBTP Track Electives (see Section X: Courses) and other elective courses to meet the PhD requirements (Section II: Pathology PhD Program). 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 his/her Thesis Mentor and must follow the program guidelines. A Planned Program of Study Form (see Forms section) must be completed to insure adequate planning for coursework and other curriculum components. This plan must be reviewed and approved by the CBTP Track Thesis Committee Representative, and then submitted to the Cancer Biology Program Coordinator (Jackie Hollis). The CBTP Track Thesis Committee Representative (Ed Stavnezer) will be a full member of all Thesis Committees for CBTP students and will insure consistency in advising and adherence to guidelines.

C. Training Faculty

CBTP trainers are indicated in the list of Pathology Graduate Program Faculty Trainers at the Department website and are all members of the Case Comprehensive Cancer Center: <http://www.case.edu/med/pathology/faculty/index.html>.

D. Research Facilities

Trainers and research laboratories are located in multiple departments at Case School of Medicine, UHCCM (including the Ireland Cancer Center), CCF (including the Lerner Research Institute and Taussig Cancer Center), MHMC (including the Rammelkamp Center for Education and Research) and the VAMC. At Case, the Wolstein Research Building houses offices and research facilities of the Case Comprehensive Cancer Center and the Department of Pathology. The Wolstein Building also houses the Center for Stem Cell and Regenerative Medicine, part of the Case Comprehensive Cancer Center.

Core Facilities: The Case Comprehensive Cancer Center supports 15 core facilities that provide expensive and/or high-end technology instrumentation and resources to Cancer Center investigators. 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 have cutting-edge expertise and an ongoing commitment to advance their fields. This provides students with opportunities to learn from experts and use cutting-edge technology and equipment in their research.

E. Seminars

CBTP students take the PATH 511 and PATH 512 Experimental Pathology Seminar courses and continue to meet the seminar requirements of the Pathology Graduate Program for all semesters in the program (Section II, Part J). 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. Finally, students present their dissertation research in a Pathology Department Thesis Seminar.

F. Administrative Structure

The CBTP is sponsored by the Case Comprehensive Cancer Center and the Department of Pathology. As a track within the Pathology Graduate Program, the CBTP is represented on the Pathology Graduate Studies Committee by two representatives, Dr. Brady-Kalnay (Chair, CBTP) and Dr. Kaplan (Pathology Representative for CBTP). The Pathology Graduate Studies Committee handles issues common to all tracks (student admissions, mentor approval, final stages of academic review and other issues related to the general structure of the program). The CBTP Chair and Steering Committee are charged with all activities specific to the CBTP (curriculum development, including courses, seminar and journal clubs, advising of prospective students and students in the CBTP, recruiting efforts, faculty development and other issues).

CBTP Steering Committee

Member	Role
Brady-Kalnay,	Chair
Kaplan, David	Pathology Department Representative
Gerson, Stanton	Director, Case Comprehensive Cancer Center
Danielpour, David	Track Advisor and Curriculum Director
Distelhorst, Clark	Training Grant Liason
Harding, Clifford	Interim Department Chair, Track Development, MSTP
Stavnezer, Edward	Track Thesis Committee Representative

G. Sample Curriculum

SEMESTER	COURSE	TITLE	CREDIT HOURS
YEAR 1 FALL	CBIO 453*	CELL BIOLOGY I	4
YEAR 1 FALL	CBIO 455*	MOLECULAR BIOLOGY I	4
YEAR 1 FALL	BSTP 400^	RESEARCH ROTATIONS	1
YEAR 1 FALL	TOTAL		9
MENTOR AND TRACK CHOSEN			
YEAR 1 SPRING	PATH 510	BASIC PATHOL MECH	4
YEAR 1 SPRING	PATH 520 + 521	BASIC CANCER BIOL INTERFACE CLIN ONCOL	4
YEAR 1 SPRING	IBMS 500	BEING A PROF SCIENT	0
YEAR 1 SPRING	PATH 512	EXP PATH SEMINAR II	1
YEAR 1 SPRING	TOTAL		9
SUMMER	RSCH 750	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
THESIS COMMITTEE CHOSEN; PREPROPOSAL COMMITTEE MEETING SCHEDULED			
YEAR 2 FALL	PATH 511	EXP PATH SEMINAR I	1
YEAR 2 FALL		CBTP TRACK ELECTIVE	3
YEAR 2 FALL		ELECTIVES (CORE, CBTP TRACK OR OTHER)**	3
YEAR 2 FALL	PATH 601	SPECIAL PROBLEMS	2
THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY WITH NEXT 9 MONTHS (NOTE: PETITION TO CONVERT 601 CREDITS TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)			
YEAR 2 FALL	TOTAL		9
YEAR 2 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 2 SPRING		ELECTIVES (CORE, CBTP TRACK OR OTHER)**	4-6
YEAR 2 SPRING	PATH 601 OR 701	SPECIAL PROBLEMS OR DISSERTATION PHD	3-5
YEAR 2 SPRING	TOTAL		9
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0

SUMMER	TOTAL		0
<p>THESIS PROPOSAL DEFENSE AND ADVANCEMENT TO CANDIDACY MUST BE COMPLETED (NOTE: ONCE 36 CREDITS INCLUDING 24 GRADED CREDITS HAVE BEEN COMPLETED, REGISTER FOR UP TO 6 CREDITS OF PATH 701 PER SEMESTER. ALSO PETITION TO CONVERT AS MANY 601 CREDITS AS POSSIBLE TO 701 CREDITS FOR SEMESTER IN WHICH ADVANCEMENT OCCURS)</p>			
YEAR 3 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 3 FALL	PATH 701***	DISSERTATION PHD	9
YEAR 3 FALL	TOTAL		9
YEAR 3 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 3 SPRING	PATH 701***	DISSERTATION PHD	1-9 (ONLY THE NUMBER REQUIRED TO BRING TOTAL NUMBER OF COMPLETED 701 CREDITS TO 9)
YEAR 3 SPRING	TOTAL		1-9***
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 4 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 4 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 4 FALL	TOTAL		1
YEAR 4 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 4 SPRING	PATH 701***	DISSERTATION	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)

YEAR 4 SPRING	TOTAL		1
SUMMER	RSCH 750#	SUMMER RSCH-PHD	0
SUMMER	TOTAL		0
YEAR 5 FALL	PATH 511	EXP PATH SEMINAR I	PARTICIPATE WITHOUT REGISTERING
YEAR 5 FALL	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 FALL	TOTAL		1
YEAR 5 SPRING	PATH 512	EXP PATH SEMINAR II	PARTICIPATE WITHOUT REGISTERING
YEAR 5 SPRING	PATH 701***	DISSERTATION PHD	1 (IF GRADUATION IS ANTICIPATED THIS SEMESTER, REGISTER FOR #CREDITS REQUIRED TO BRING 701 TOTAL TO 18)
YEAR 5 SPRING	TOTAL		1

*Alternate courses for MSTP students: IBIS 401-404. MSTP students in the CBTP do not need to take CBIO 453, CBIO 455, PATH 510 or PATH 416, although PATH 416 may still be taken as a Track Elective.
^Alternate course is MSTP 400 for MSTP students and PATH 601 for direct admit students.

#Exception: Take 1-3 credits of PATH 701 if this will accelerate graduation. Also, take 1 credit of PATH 701 if the PhD thesis will be completed in the summer semester (including anytime after the end of the spring semester).

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

***** IMPORTANT: STUDENTS SHOULD TAKE THE FOLLOWING STEPS TO REDUCE CHARGES TO THEIR MENTOR AND DEPARTMENT:** AFTER ADVANCEMENT TO CANDIDACY, IT IS NO LONGER NECESSARY TO REGISTER FOR 9 CREDITS PER SEMESTER TO MAINTAIN FULL-TIME STUDENT STATUS. In the first semester after advancement to candidacy, students should register only for the number of credits of PATH 701 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 in the final semester registration should be for the number of credits of PATH 701 needed to complete a total of 18 credits by the end of 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 or NRSA award or other funding mechanism that supports this level of tuition, registration should be for the full 9 credits during semesters when grant support for tuition will be available, until a total of 18 credits of PATH 701 is accumulated, after which registration should be for only 1 credit of PATH 701 each semester until graduation.. Even prior to advancing to candidacy, if a student has completed 36 “foundation” credits of graduate courses (at least 24 of which must be graded courses), the student should enroll in as many credits of PATH 701 as possible up to a maximum of 6 credits with the remaining credits to be graded courses or PATH 601. In the semester in which the student advances to candidacy, any PATH 601 credits for that semester that are beyond the 36 “foundation” credits should be converted to PATH 701 by petition to Graduate Studies. Students registering for PATH 601, 651 or 701 must indicate their Thesis Advisor as the Instructor. If a Class Section does not exist with your Thesis Advisor as Instructor, please see the Student Affairs Coordinator to add the Section in order for you to register.

NOTE: Schedule beyond year 5 will generally be the same as for year 5.

VII. Current Students

Please visit the Department of Pathology website for a list of our current students:

<http://www.case.edu/med/pathology/index.html> .

VIII. MS Program

A program leading to the Master of Science degree in Pathology is available to laboratory staff who are employed by Case Western Reserve University. Students in this program must be full-time university employees and must have the agreement of their supervisor to begin studies as a part-time student. Courses are available as an employee fringe benefit (up to 6 credits per semester) and can only be taken as limited by the fringe benefit regulations.

A formal application for this program must be submitted to the graduate school. Prior to submission of this application, the employee, the supervisor, and the Chair of the Pathology Graduate Studies Committee must meet to review and facilitate the student’s application for admission.

This program leads to an MS degree through Master’s Plan A (research/thesis), not Master’s Plan B (coursework/exam). Required core courses include CBIO 453 (4 credits), CBIO 455 (4 credits), PATH 510 (4 credits), and participation in the seminar course (PATH 511 and/or PATH 512) for at least one semester. CBIO 453, CBIO 455 and PATH 510 must be taken as graded courses (not P/F).

Plan A requires a minimum of 27 total coursework credits. The student must take a minimum of 6 credits of PATH 651 Thesis, which involves research in the laboratory of the supervisor (who serves as the MS Thesis Mentor) and thesis preparation. The student must register for at least one credit of PATH 651

every semester until graduation. A GPA of 3.0 or better must be maintained. 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 MS Degree Examination Committee is chaired by the MS Thesis Mentor and includes two other trainers in the Pathology Graduate Program. Members of the committee must be approved by the Chair of the Pathology Graduate Studies Committee. 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.

IX. MD/MS Program

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 his or her 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). In addition to Pathology, tracks offered include biochemistry, clinical investigation, epidemiology, health services research, nutrition, and physiology and biotechnology. Each track has specific course requirements. There is no tuition charge for the research year, and a stipend is provided.

For more information on the MD/MS program in general (including admissions), contact William Merrick, Ph.D., Department of Biochemistry, at 216-368-3578 or william.merrick@case.edu; or Dennis Stacey, Ph.D. at 216-444-0633 or staceyd@ccf.org. For information about the Pathology Track in the MD/MS program, contact Dr. James Anderson at james.anderson@case.edu or Dr. Clive Hamlin at crh4@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 pre-requisites.

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, members of the Program Oversight Committee will assist each student in designing an individualized schedule of graduate courses for any track. Students are expected to complete at least two graduate courses (3 credits each or total 6 credits) 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.

A. Example of Minimum Coursework for the MD/MS in the Department of Pathology

SEMESTER	COURSEWORK
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YEAR 1 FALL	MD CURRICULUM
YEAR 1 SPRING	MD CURRICULUM, 3-CREDIT GRADUATE COURSE*
SUMMER	RESEARCH (PATH 601 OPTIONAL, 1-3 CREDITS)
YEAR 2 FALL	MD CURRICULUM REGISTERED AS IBIS 403 (6 CREDITS), 3-CREDIT GRADUATE COURSE*
YEAR 2 SPRING	MD CURRICULUM, 3-CREDIT GRADUATE COURSE*
*NOTE: 15 GRADED CREDITS OF GRADUATE SCHOOL COURSES SHOULD BE TAKEN IN THE FIRST TWO YEARS, INCLUDING IBMS 403 (6 CREDITS) PLUS THREE PATH COURSES (3 CREDITS EACH). STUDENTS MAY DEFER A MAXIMUM OF ONE 3-CREDIT COURSE TO YEAR 3.	
YEAR 3 FALL	PATH 601 (8 CREDITS), PATH 511 (1 CREDIT)
YEAR 3 SPRING	PATH 601 (7 CREDITS), PATH 512 (1 CREDIT), EXAM 600 (1 CREDIT)
YEAR 4 FALL	MD CURRICULUM
YEAR 4 SPRING	MD CURRICULUM
YEAR 5 FALL	MD CURRICULUM
YEAR 5 SPRING	MD CURRICULUM

X. 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 Case School of Medicine. The BSTP is comprised of 13 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 thesis mentors
- * Highly interactive relationships with faculty
- * Graduate programs at a top-tier School of Medicine

An online application for admission to the BSTP is provided on the BSTP website: <http://www.case.edu/med/BSTP/index.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 biomedical research. The PhD degree may be pursued in any of 14 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, Case MSTP, Case 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 for special circumstances only. 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 application see Forms Section XII). The applicant should state long-term career goals and purpose for undertaking graduate work, and explain research interests as they relate to the proposed graduate study and professional goals.
3. Arrange for the following items to be submitted to Pathology Graduate Studies Committee, c/o Christine Kehoe, Case Western Reserve University, 10900 Euclid Ave, Cleveland, OH 44106-7288.
 - a. Official transcripts of all previous undergraduate and graduate courses taken for credit. These must be original documents from the previous Institution(s), and cannot be returned to the applicant.

- b. Graduate and/or undergraduate degree verification, which can be posted on the academic transcript or certified by the academic institution where the degree has been awarded.
- c. Three letters of recommendation from former professors or other persons familiar with the applicant's ability and probable performance as a graduate student.
- d. The official report of Graduate Record Examination (GRE) results.
- e. For international applicants, a TOEFL score report is also required.

Required Faculty Assurances for Direct Admit Applicants:

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. Applications will only be considered if accompanied by a mentor agreement (contact Christine Kehoe, cxxk15@case.edu) signed by the sponsoring faculty member who assumes financial responsibility. 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 his/her 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. Standards for Admission

Prerequisites for admission include organic chemistry and mathematics through calculus. Coursework in biology is also required and a full course in biochemistry and molecular biology is strongly recommended. Preference is also given to students with prior research experience.

E. 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 the Test of English as a Foreign Language (TOEFL) exam and earning a minimum score of 550.

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: <http://studentaffairs.case.edu/international/>

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

XI. Alumni

Please visit the Department of Pathology website for a listing of our program alumni: ****under construction****.

XII. Forms

The following forms are available on the Pathology Graduate Program website.

Forms for students:

1. Application for Admission
2. Advancement to Candidacy
3. Petition for conversion of 601 credits to 701 credits
4. Graduation Instructions for Doctoral Candidates
5. Graduation Instructions for Master's Plan A Candidates
6. Application for Graduation
7. Waiver of Registration
8. Notification for Scheduling PhD Defense
9. ETD Submission Checklist--Doctoral
10. Formatting your ETD
11. Final Certification Ph.D.
12. Final Certification Master's
13. Signature Sheet

Forms for faculty:

1. PhD Trainer Application Form
2. Mentor Agreement

XIII. Contact Information

For further information, please contact the Pathology Student Affairs Coordinator, Christine Kehoe, at cxk15@case.edu or 216-368-1993. The mailing address is:

Pathology Graduate Program
c/o Christine Kehoe
Case Western Reserve University
10900 Euclid Ave, WRB 5530
Cleveland, OH 44106-7288

XIV. List of Courses

First-Year Fall Semester Core Curriculum

CBIO 453. Cell Biology (4)

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 (4)

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

BSTP 400. Research Rotations (1)

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: Consent of Instructor, Biol 210

XLIST: Biol 416, CLBY 416

Instructors: Nedrud, J.G., Levine, A.

Offered: Spring

PATH 510. Basic Pathophysiologic 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: Consent of Instructor

Instructor: Anderson, J.M.

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: Consent of Instructor

Instructor: Danielpour, D.

Offered: Spring

Longitudinal Requirements for All PhD Students

PATH 511. Experimental Pathology Seminar I (1)

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

Prereq: Consent of Instructor

Coordinator: Petersen, R.

Offered: Fall

PATH 512. Experimental Pathology Seminar II (1)

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

Prereq: Consent of Instructor

Coordinator: Petersen, R.

Offered: Spring

Research Courses (All Tracks)

PATH 601. Special Problems (1-8)

Research on the nature/causation of disease and host factors which tend to protect against disease. Special courses/tutorials in subspecialties of general and/or systemic anatomic and/or clinical pathology.

Prereq: Consent of Instructor

Offered: Spring and Fall

PATH 651. Thesis (MS) (1-9)

PATH 701. Dissertation (PhD) (1-9)

Track Electives: Molecular and Cellular Basis of Disease

NOTE: PATH 520 + 521 counts as a Track Elective for MCBDTP students. See Core Courses section.

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: Consent of Instructor

Instructor: Perry, G.

Offered: Spring

PATH 412. Theories of Aging and Longevity (1)

Insight into current theories of aging of molecules, cells, extracellular elements and their relationship to lifespan in human beings and other vertebrates. Lecture/journal club format.

Prereq: Consent of Instructor

Instructor: Monnier, V.M.

Offered: Spring

PATH 415. Cytoskeleton and Disease (1)

Discussion of recent papers that have added to knowledge of normal cytoskeletal functions and their alterations in disease.

Prereq: Consent of Instructor

Instructor: Smith, M.A.

Offered: Fall, Spring

PATH 420. The Rhetoric Of Science (3)

Prereq: Completion of the first year of the BSTP Program, Consent of Instructor

Instructor: Kaplan, D.

Offered: Fall

PATH 425. Stem Cell Biology and Therapeutics (3)

Provides a broad overview of various fetal and adult stem cells and their potential application in regenerative medicine. At the heart of regenerative medicine in cancer is the continually evolving practice of stem cell transplantation. New uses of stem cells as delivery vehicles for cancer treatment and gene therapy for cancer are also being developed and moving toward clinical trials. For example, genetic modification of the stem cells in patients receiving stem cell transplants can be used to protect the bone marrow from the dose-limiting toxicity of DNA damaging agents, allowing dose-escalation. Mesenchymal stem cells [MSC] are being used to suppress graft-vs.-host disease and promote hematopoietic stem cell engraftment in cancer patients. An additional ability of MSCs to track to tumors provides a unique mode of tumor-targeted therapy.

Prereq: Consent of Instructor

Instructor: Bunting, K.

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: Consent of Instructor

Instructors: Zhu, X. and Smith, M.A.

Offered: Spring, Fall

PATH 435. Tissue Engineering and Regenerative Medicine (3)

XLIST: EBME 408

This course will provide advanced coverage of tissue engineering with a focus on stem cell-based research and therapies. Course topics of note include stem cell biology and its role in development, modeling of stem cell function, controlling stem cell behavior by engineering materials and their microenvironment, stem cells' trophic character, and state-of-the-art stem cell implementation in tissue engineering and other therapeutic strategies. Undergraduate background in cell/molecular biology, partial differential equations, engineering mechanics (solid), and natural and synthetic biomaterials is recommended.

Prereq: EBME 325 (or equivalent), graduate standing, or permission of instructor

Instructors: Alsberg, E. and Dennis, J.

Offered: Spring

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

Instructor: Smith, M.A., Petersen, R.B.

Offered: Spring

PATH 487. Cell Biology of the Nucleus (3)

Discussion of current cell biology research on the structure/functions of the nuclear envelope, the matrix and chromatin.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456 or consent of instructor

XLIST: CLBY 487 and PHRM 487

Instructor: Tartakoff, A.M.

Offered: Even Springs

PATH 488. Yeast Genetics and Cell Biology (3)

Discussion of contemporary literature exemplifying the unique accessibility of yeasts as model eukaryotes.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456 or consent of instructor

XLIST: MBIO 488, CLBY 488, GENE 488

Instructor: Tartakoff, A.M.

Offered: Even Falls

PATH 516. Experimental Pathology (3)

Lecture series in cell injury, inflammation, degenerative and aging processes. Morphologic and biochemical considerations. Emphasis on investigational approaches and current work.

Prereq: Consent of Instructor

Instructor: Anderson, J.M.

Offered: Odd Falls

PATH 522. Skeletal Biology (3)

This is an advanced, graduate-level course for students interested in the morphogenesis, structure, function and maintenance of the skeletal system taught jointly by faculty from CWRU, Cleveland Clinic and the Northeastern Ohio Universities College of Medicine. It will meet twice per week for 90 minutes per session. The format will include an overview of the topic by the responsible faculty, followed by a discussion of important papers on the topic. The students will be expected to discuss the papers for each session and grading will be based on those discussions. The intent of the course is to enable students to understand the important problems in skeletal biology and both classical and modern approaches for solving them.

Prereq: Consent of Instructor

Instructor: Greenfield, E.

Offered: Spring

PATH 523. Histopathology of Organ Systems (3)

First half of this course is in pathophysiology of disease covering general pathology and pathophysiology, followed by systemic pathology and pathophysiology (systems approach).

Prereq: Histology course, Consent of Instructor

Instructor: Ziats, N.P.

Offered: Spring

PATH 555. Advanced Cell Regulation (3)

This course is focused on the recent major developments in the field of cell signaling and their impact on our understanding of the signaling pathways. The class structure is based on lectures as well as on student presentation of assigned papers. The discussion will be led by the students.

Prereq: CBIO 453, CBIO 454 or consent of instructor

XLIST: CLBY 555, BIOC 555

Instructor: Pimplikar, S.W., Kao, H.-Y.

Offered: Spring

Track Electives: Immunology Training Program

NOTE: PATH 520 + 521 counts as a Track Elective for ITP students. See Core Courses section.

PATH 417. Cytokines: Function, Structure and Signaling (3)

Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. Will examine the function, expression, gene organization, structure, receptors, and intra-cellular signaling of cytokines. Topics include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intra-cellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. The course includes lectures using texts, scientific reviews and research articles.

Prereq: PATH 416, Biol 210, or equivalent

XLIST: BIOL 417, CLBY 417

Instructor: Levine, A.D.

Offered: Odd Falls

PATH 465. Advanced Immunobiology (3)

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

XLIST: MBIO 465

Instructor: Pelfrey, C.M.

Offered: Inactive, TBA

PATH 467. Advanced Molecular Immunology (3)

In-depth study of biochemistry and molecular biology of immunologically important molecules and physiochemical aspects of antigen-antibody interactions. Lectures and student presentations of current research.

Prereq: PATH 416, BIOC 307 or 407, CBIO 455, or consent of instructor

Instructor: Staff

Offered: Inactive, TBA

PATH 477. Cellular and Molecular Basis of Immune Dysfunction (3)

Lectures and student presentation will focus on immunologic mechanisms of tissue injury, disorders of the immune response and diseases of immunocompetent cells. Hypersensitivity, allergy, immune complex disease, immune deficiency, lymphoma and multiple myeloma discussed from chemical, cellular and physiological perspectives. Consent of instructor required.

Prereq: PATH 416, introductory immunology course or consent of instructor

Instructor: Emancipator, S.N.

Offered: Odd Springs

PATH 480. Logical Dissection of Biomedical Investigations (3)

Upper-level graduate course encompassing discussion and critical appraisal of both published and pre-published research papers, book chapters, commentaries and review articles. Emphasis will be placed on evaluating the logical relationships connecting hypotheses to experimental design and experimental data to conclusions drawn. Thus, the course will aim to develop students¹ capacities for independent thinking and critical analysis. Half of the course will be devoted to an analysis of fundamental conceptual issues pertaining to Immunology, but this material will be applicable to a wide variety of fields. The other half of the course will be devoted to the analysis of papers that have been submitted for publication (with the students acting as primary reviewers of these papers). Our expectation is that this course will have practical relevance for students by providing them with methods to review their own pre-publication manuscripts and eliminate common errors. It should also give students the tools to question widely held beliefs in diverse biomedical fields.

Prereq: Completion of C3MB curriculum and 2nd-year or beyond graduate school training.

Instructor: Greenspan, N.S. and Abbott, D.

Offered: Even Falls

PATH 481. Immunology of Infectious Diseases (3)

Lectures and discussion on the immune response to infectious organisms, including bacteria, viruses and parasites. Emphasis on human responses but includes discussions of animal models. Other topics will include vaccines and infections in immunocompromised hosts.

Prereq: PATH 416, introductory immunology course or consent of instructor

XLIST: MVIR 481

Instructor: Nedrud, J.G.

Offered: Even Falls

PATH 486. HIV Immunology (3)

This course will examine the unique immunology of HIV disease. Content includes the study of HIV pathogenesis, immune control, immune dysfunction, HIV prevention and immune restoration. Students are expected to attend lectures and participate in class discussions. Strong emphasis placed on reviewing scientific literature. Students will be asked to help organize/administer an HIV immunology journal club and to prepare a written proposal in the area of HIV immunology.

Prereq: Fundamental immunology or consent of instructor.

XLIST: MBIO 486

Instructor: Sieg, S.

Offered: Spring

Track Electives: Cancer Biology

NOTE: PATH 416 counts as a Track Elective for CBTP students. See Core Courses section.

PATH 417. Cytokines: Function, Structure and Signaling (3)

Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. This course examines the function, expression, gene organization, structure, receptors, and intra-cellular signaling of cytokines. Topics to be covered include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intra-cellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. The course includes lectures using texts, scientific reviews and research articles.

Prereq: PATH 416, Biol 210, or equivalent

XLIST: BIOL 417, CLBY 417

Instructor: Levine, A.D.

Offered: Odd Falls

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: Inactive, TBA

PATH 425. Stem Cell Biology and Therapeutics Course (3)

This course provides a broad overview of various fetal and adult stem cells and their potential application in regenerative medicine. At the heart of regenerative medicine in cancer is the continually evolving practice of stem cell transplantation. New uses of stem cells as delivery vehicles for cancer treatment and gene therapy for cancer are also being developed and moving toward clinical trials. For example, genetic modification of the stem cells in patients receiving stem cell transplants can be used to protect the bone marrow from the dose-limiting toxicity of DNA damaging agents, allowing dose-escalation. Mesenchymal stem cells [MSC] are being used to suppress graft-vs.-host disease and promote hematopoietic stem cell engraftment in cancer patients. An additional ability of MSCs to track to tumors provides a unique mode of tumor-targeted therapy.

Prereq: Consent of Instructor

Instructor: Bunting, K.

Offered: Spring

PATH 477. Cell and Molecular Basis of Immune Dysfunction (3)

Lectures and student presentations focus on immunologic mechanisms of tissue injury, disorders of the immune response and diseases of immunocompetent cells. Hypersensitivity, allergy, immune complex disease, immune deficiency, lymphoma and multiple myeloma are discussed from chemical, cellular and physiological perspectives.

Prereq: PATH 416 or equivalent

Instructor: Steven Emancipator

Offered: Fall

PATH 555. Advanced Cell Regulation (3)

This course is focused on the recent major developments in the field of cell signaling and their impact on our understanding of the signaling pathways. The class structure is based on lectures as well as on student presentation of assigned papers. The discussion is led by the students.

Prereq: CBIO 453, CBIO 454, or consent of instructor

XLIST: CLBY 555, BIOC 555

Instructor: Pimplikar, S.W.

Offered: Spring

BIOC 408. Genes and Genetic Engineering (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. Mol. Genetics of 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: Stavnezer, E.

Offered: Fall, alternate years

BIOC 618. The Biology and Mathematics of Microarray Studies (3)

This hands-on computer-based course will enable participants to conduct meaningful analyses of microarray data. Participants will gain a thorough understanding of the principles underlying available micro-array technologies, including: theory of sample preparation, sample processing on microarrays, familiarity with the use of Affymetrix MAS [Microarray Suite] software including algorithms, generation of micorarray data sets, an ability to move and globally manipulate and pre-package data. The students will gain an understanding of the theory and practice of clustering. Data from cancer cells are compared to normal cells, and compared to cancer cells following therapeutic doses of anticancer agents. Participants will become knowledgeable about the rationale behind the choice of normalization and data filtering strategies, distance metrics, and use of appropriate clustering choices.

Prereq: BIOC 406

Instructor: Leahy, P.

Offered: Spring

BIOC 620. Transcription and Gene Regulation (3)

This course will cover fundamental mechanisms of transcription as well as general principals of gene regulation in both prokaryotes and eukaryotes. Topics to be covered include: 1) structure and function of RNA polymerases; 2) RNA polymerase-specific accessory factors involved in initiation, elongation, and termination; 3) steps and regulation of transcriptional processes; 4) transcriptional coactivators and corepressors; 5) regulation of transcription factor activity; 6) coupling of transcription and RNA processing. The overall objectives of this course are to develop a solid understand of basic mechanisms involved in the regulation of gene expression in biological processes, and to also develop critical thinking in experimental design and evaluation of journal articles.

Instructor: Chiang, C-M.

XLIST: MBIO 620

Offered: Spring

EPBI 473. Integrative Cancer Biology (3)

This is a project-focused research level course in integrative cancer biology, an emergent field in which mathematical models and computer simulations are used to synthesize various forms of cancer data to yield experimentally testable scientific hypotheses. The course is designed for oncologists and cancer biologists who are interested in learning how to apply mathematics and a high level programming language [the freeware R] to analyses of cancer research data. Data on all levels will be considered, ranging from epidemiological datasets to DNA microarray datasets.

Prereq: BIOC 407, EPBI 432, or consent of instructor

Instructor: Radivoyevitch, T.

Offered: Fall

EVHS 401B. Fundamentals of Environmental Health: Effects of Exposure to Environmental Mutagens (1.5)

This course provides an introduction to toxic agents found in the environment and presents an overview of chemical and physical agents which adversely affect human health. Cancer is the primary disease endpoint. Toxicity, mutagenicity, carcinogenicity and teratogenicity of the agents are examined, as well as the potential for human exposure through environmental, occupational and medicinal routes.

Prereq: EVHS 402A

Instructor: Veigl, M.

Offered: Spring

EVHS 402A. Fundamentals of Environmental Health: Risk Assessment (1.5)

In this course an overview of the scientific approaches used to determine whether environmental agents are potentially dangerous to people is presented. Criteria utilized for establishing exposure limits are presented and short term assays, design of epidemiology studies and protocols for clinical trials, which are used to assess the impact of environmental exposure on normal and genetically susceptible individuals, are discussed.

Instructor: Veigl, M.

Offered: Spring

EVHS 502. DNA Damage and Repair (3)

This course provides In-depth consideration of agents that alter DNA directly or indirectly through effects on its synthesis. It also examines the mechanisms and repair processes through which cells respond to this damage. Topics include fidelity of DNA replication, excision repair, mismatch repair, transcription-linked repair, SOS repair and recombinational repair. Other DNA damage responses controlling decision points between DNA repair and apoptosis are considered. Agent-specific DNA damage, such as that caused by agents leading to bulky adducts, AP sites, base-base mismatches and damage to DNA bases are considered in the context of specific repair processes responding to these DNA insults in prokaryotes and eukaryotes.

Prereq: CBIO 453, CBIO 454, or consent of instructor

Instructor: Sedwick, D. and Veigl, M.

Offered: Spring

GENE 521. Chromatin Structure & Transcription (3)

A critical review of selected topics and current literature on the role of chromatin structure in the regulation of gene expression.

Instructor: Harte, P. and Stavnezer, E.

XLIST: BIOC 521

Offered: Spring

MBIO 518. Signaling Via Cell Adhesion (3)

This course emphasizes current advances in cell-cell and cell-substrate interactions including molecular mechanisms by which cells interact with and are regulated by extracellular matrices and other cells. There is an emphasis on aberrant adhesion in cancer.

Prereq: CBIO 453, CBIO 454, or consent of instructor

XLIST: NEUR 518, CBIO 518, CLBY 518

Instructor: Brady-Kalnay, S. and Culp, L.

Offered: Spring

PHRM 413. Molecular and Genetic Pharmacology (3)

The primary goal of this seminar style course is the development of a critical approach to the evaluation and design of research in the broad context of the interaction of receptors with endogenous ligands and with drugs, including steroid hormones, growth factors and chemotherapeutic agents used to treat cancer, and the determination of the polygenetic basis of disease states and inter-individual variation in responsiveness to drugs. Lectures and/or journal article presentation will illustrate the application of fundamental principles of chemistry, biochemistry, thermodynamics, genomics, and pharmacology to experimental problem solving. Students and faculty participate as discussion leaders.

Prereq: Consent of instructor

Instructor: Berdis, A.

Offered: Spring

PHRM 423. Drug Action and Biodistribution (3)

Mechanisms of therapeutic action and adverse side effects for major drug classes leading to a rational approach to drug choice using a problem-solving approach based on selected disease states. A team approach is taken to teaching with a clinician paired with a basic scientist, to couple issues associated with practical application of drugs with fundamental mechanisms of drug action and biodistribution. Included are sessions devoted to the management of breast cancer, led by Beth Overmoyer, MD, and management of lymphoid malignancies, led by Clark Distelhorst, MD.

Prereq: Consent of Instructor

Instructor: John Mieyal, Ph.D., Professor

Offered: Spring

PHRM 434. Mechanisms of Drug Resistance (3)

This course focuses on and compares the drug resistant mechanisms selected by viruses, bacteria, parasites, fungi, and tumor cells. Topics include anti-retroviral resistance [e.g., AZT and protease inhibitors], antibiotic resistance [e.g., B-lactams], resistance to chemotherapeutic agents, and resistance to anti-malarial drugs [e.g., chloroquinone]. Experts in the field at both CASE and from other institutions across the US provide the comprehensive lectures. The journal, Drug Resistance Updates is provided as a support text.

Prereq: Consent of Instructor

Instructor: Arts, E.

Offered: Spring

XLIST: MBIO 424, MVIR 434

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

PATH 395. Selected Readings in Immunology, Cancer Biology or Pathology (1-3)

Relevant readings and literature search on particular immunology, cancer biology or pathology topic(s) chosen by student and directed by the instructor. Written proposal outlining chosen topic, type of work to be done, a schedule of meetings and format and length of final written report is to be prepared prior to registration for credit.

Prereq: Consent of Instructor

Instructor: Staff

Offered: Fall, Spring

Summer Program in Undergraduate Research (SPUR) (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 his/hers 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