Overview of the Cancer Biology Program

Graduate training in Cancer Biology at Washington University is offered by the Division of Biology and Biomedical Sciences.

The goal of the Programs is to provide students with the best possible training for careers as research scientists in Cancer Biology. The Steering Committee takes on the responsibility for advising each matriculating student. Program affiliations may be changed during the course of the first semester, providing the student is in good academic standing and has the approval of the program directors involved and their admissions committees. Following the completion of at least one semester, students in good academic standing are free to transfer from one Division program to another following a discussion with both Program Directors.

Graduate training formally is divided into two stages: pre-candidacy and candidacy. Students usually complete the requirements for candidacy, which include courses, qualifying examination during the second year as well as a thesis proposal in the fall semester of the third year. The qualifying examination consists of a written research proposal in the student's field of interest followed by an oral examination on the proposal. Once the student becomes a candidate for a Ph.D. degree, training consists of directed thesis research under a mentor of the student’s choice.

Course requirements must be met by the end of their 3rd year. Approval will be required for courses taken in year 4 and beyond.

Typically, a graduate student begins the program in late August and enrolls in two core courses:
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- Foundations in Cancer Biology and Experimental Cancer Biology during the first semester.
- Students typically choose three **research rotations**, each about two months in duration, during the first year.
- During the second semester, students will enroll in Advanced Cancer Biology.
- All students are required to take a special topic course in **ethics** and one semester of **Mentored Teaching Experience** (MTE).
- Complete two **journal clubs**.

Students usually take the qualifying examination in the fall or spring of their second year, depending on the semester the MTE is assigned (at the beginning of the second year for MSTP students), after which they form a thesis committee. The thesis committee consists of faculty of the student’s choosing and assists the mentor in guiding the student’s thesis research. A formal thesis proposal is presented to the thesis committee before Dec. 31 of the third year (second year for MSTP). Students are encouraged to complete and defend their dissertations no later than the end of their fifth year (third year for MSTP).

Overall, the program is designed to provide the student with the multiple skills required to be an effective research scientist, including (i) an ability to propose, discuss, and critically evaluate ideas, (ii) an understanding of important concepts in Cancer Biology, (iii) an ability to conceive experiments that will test hypotheses, (iv) the technical skill to conduct experiments, and (v) an ability to explain experiments and concepts effectively, in both written and oral presentations. An outline of a typical student's course of study is on the following page.
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Outline of Typical Ph.D. Student's Program

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SEMESTER</th>
<th>MAJOR ACTIVITIES</th>
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| 1    | Fall          | Orientation mid August<sup>a</sup>.  
Meet with adviser and steering committee; plan rotations and coursework; begin first rotation.  
Take core curriculum courses: Foundations in Cancer Biology and Experimental Cancer Biology |
Take Advanced Cancer Biology advanced elective course.  
Summer: Choose thesis adviser and begin thesis research. |
| 2    | Fall          | Mentored Teaching Experience including teaching pedagogy workshops (Fall or Spring Semester). |
|      | Spring-Summer | Choose a thesis committee.  
A special topic course in ethics must be completed Spring of the second year. |
| 3    | Fall          | Choose a thesis committee and complete thesis proposal by Dec. 31.  
Thesis research. |
|      | Spring-Summer | Thesis research. |
| 4 & 5|               | Thesis research, complete and defend thesis. |

<sup>a</sup>Some students arrive early to begin rotation in summer. Students with little research experience are encouraged to take this opportunity.
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Outline of **Typical** MSTP Student's Program

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SEMESTER</th>
<th>MAJOR ACTIVITIES</th>
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<tbody>
<tr>
<td>1</td>
<td>Late Summer/Fall</td>
<td>Orientation. Meet with MSTP and appropriate Steering Committee to plan coursework. <strong>Core curriculum courses:</strong> MSTP students are required to take: Foundations in Cancer Biology and Experimental Cancer Biology. Choose thesis advisor and begin thesis research. Mentored Teaching Experience including teaching pedagogy workshops (Fall or Spring).</td>
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<tr>
<td></td>
<td>Spring-Summer</td>
<td>Take Advanced Cancer Biology advanced elective course <em>See program guidelines for qualifying examination.</em></td>
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<tr>
<td>2</td>
<td>Fall</td>
<td>Choose a thesis committee and meet to propose thesis by December 31.</td>
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<tr>
<td></td>
<td>Spring-Summer</td>
<td>A special topic course in ethics must be completed by the Spring of the second year. Thesis research.</td>
</tr>
<tr>
<td>3</td>
<td>Fall</td>
<td>Thesis research.</td>
</tr>
<tr>
<td></td>
<td>Spring-Summer</td>
<td>Complete and defend thesis.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Return to Medical School.</td>
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The goal of research within this program is to explain the mechanisms of the fundamental processes of cancer biology in molecular terms. Such processes include cell motility and metastasis, proliferation and growth, the tumor microenvironment, adhesion of cells to matrix and to each other, receptor-ligand interactions, DNA, RNA and protein modifications, tumor suppressor and oncogene function, and cell signaling. A common theme that unites these diverse endeavors is the desire to push the limits of our understanding of these processes to the highest possible molecular resolution.

In addition to the two course courses in the Fall semester, students are required to take the Spring advanced elective and two journal clubs.

1. Advising
Timely and good advice often can be very important to graduate students. Students in the Cancer Biology Program should take advantage of advice from a number of sources, both informally from faculty and students and more formally from appointed advisors that meet with the student at appropriate intervals.

Student Mentors
Each first-year student is assigned a student from the second- or third-year class to act as mentor. The student mentor may serve as a first source for answers to many questions but also may encourage the student to meet with a faculty adviser where appropriate.

Faculty Advising
Program directors will provide advising for students in the first two years of graduate school prior to forming a thesis committee and proposing. Each student will meet briefly with the program directors once per semester to discuss progress and address any questions the student may have. These meetings will usually occur just before the beginning of each semester and students are expected to be available during this time period. Once a student has completed a thesis proposal, meetings with the program directors will not be required. However, late stage students (i.e. 5th year and beyond) will also be expected to meet with the program directors at least once per year in order to discuss the progress toward graduation and plans after they complete their degree.

2. Formal Courses
The following courses are required for all students in the Cancer Biology Program. However, as flexibility is a hallmark of graduate training in the programs, the Steering Committee may choose to waive some requirements in unusual cases.

2.1. Core First-Year Courses
Students will take two core courses during their first fall semester in the program: Bio 5920: Foundations in Cancer Biology and Bio 5930: Experimental Cancer Biology. A grade of B- or better in these courses is one of the requirements to achieve candidacy. Students in any program may defer taking some core courses until the second year, with consent of their Steering Committee.
2.2. Advanced Elective Requirements
Students in the program complete the Bio: 5940 Advanced Cancer Biology advanced elective requirement in the spring semester of their first year in the program. The advanced elective will have a grant-writing component in the class.

2.3 Ethics and Journal Clubs
During the course of graduate studies, students take a special topic course in ethics during the spring of the second year and complete two journal clubs. The purposes of these courses are (i) to provide close student-faculty interactions in a format that is less didactic than standard lecture courses; (ii) to allow students to study current research topic in great depth; and (iii) to provide students with a mechanism to learn speaking skills. Thus, a large component of these courses include coaching in oral presentation.

Normally a student will receive one credit in a regular journal club for regular participation and for one presentation. To count, a journal club must either be in the University Course Listings or on an approved list maintained by the Governing Committee.

3. Research Lab Rotations
At the beginning of the first semester, students, with the advice of their program director(s) plan laboratory rotations. In general, students complete three laboratory rotations by the summer of their first year in the program, at which time they select a thesis mentor. The DBBS Website provides a description of research opportunities available for rotations. Students are urged to discuss possible rotation projects with as many potential advisors as possible, before making their selections. Students are prohibited from conducting rotations in laboratories where they have been previously employed. However, previous employment would not prevent the student from pursuing thesis work in such a laboratory. Students wishing to rotate with a faculty who is not affiliated with DBBS must receive approval from their program directors prior to starting the rotation. Also, before deciding on a particular laboratory, the student should develop an outline of the proposed work with the faculty member. The Division Office provides students with a Rotation Form for this purpose. The form should be completed by the student with the rotation mentor's help and returned to the Division Office at the start of each rotation. A second part of the form is completed at the end of the rotation to provide the program directors with an evaluation of the rotation experience.

The purpose of the rotations is to broaden the student's research experience and to expose the student to available opportunities before a thesis preceptor and problem are selected. It should be recognized by both student and rotation mentor that significant research accomplishment is not a requirement for a successful rotation, nor should the rotation be prolonged significantly beyond the normal period to meet particular research objectives. Students may choose to end a rotation at any time, should they find it desirable to move on to the next rotation.

During the rotation, the student should take advantage of the one-on-one relationship with the faculty member to discuss science as it is carried out in the lab, and to evaluate together the approach to research. Students should explore these contacts carefully during rotations, mindful that selection of a good mentor who will provide the personal instruction required to master experimental science is the most important decision they will make in graduate school.
4. Mentored Teaching Experience (MTE)

Effective communication of information and concepts is a critical skill for biomedical research scientists. While much of the teaching experience that scientists engage in is through one-on-one interactions with individuals in the laboratory, all scientists must be able to deliver lectures to a wide audience (from peers in the field to neophytes with a limited understanding of the nuances of the topic), and scientists in faculty positions will often teach courses to undergraduate and graduate students. Therefore, DBBS students must demonstrate the ability to effectively communicate complex ideas and concepts to groups of individuals at various levels of understanding. To develop these critical communication skills, DBBS students will:

- Complete the MTE orientation and three approved workshops offered by the Teaching Center by the end of the 2nd year of graduate studies
- Basic MTE: Serve as an MTE in a DBBS-approved graduate or undergraduate course for 1 or 2 semesters. Serving as an MTE will include giving lectures and/or leading lab sessions. The MTE is completed in the 2nd year of graduate studies.
- Advanced MTE: Deliver a minimum of four oral presentations at journal clubs, seminars, scientific conferences, and retreats. Presentations given as part of being a MTE, lab meetings, journal clubs or thesis committee meetings will not satisfy this requirement.

5. Qualifying Examination

The format of the Cancer Biology Program Qualifying Exam will consist of the following: (i) a written document similar to a NRSA-type F31 pre-doctoral fellowship application on a topic related to the student’s chosen field of thesis research and (ii) an oral defense of the written document. Students will also be asked to identify five key primary references (peer-reviewed articles) that serve as background to the grant, and will be expected to discuss these with the examining committee. Students are expected to complete the oral defense of the grant no later than March 1 of the second year. MSTP students will complete the oral defense no later than August 31 of the first year. Students who have teaching assistant assignments in the Spring semester of their second year are encouraged to complete their QE by the end of December in their second year.

Visit Cancer Biology Program for specific guidelines

CB QE Student Instructions.pdf

6. Thesis Research

After rotations have been completed, students select a thesis mentor (http://dbbs.wustl.edu, go to “Graduate Students” to access Student Forms). Students are encouraged to gather information from several sources, including consultations with faculty and current students, before choosing a thesis lab. Ph.D. students must be in a thesis laboratory by September 1 of their second year, MSTP students by September 1 of the first year of Ph.D. training. If a student is interested in pursuing their graduate studies with a faculty member who is not affiliated with DBBS, the student must identify a co-mentor who is affiliated with DBBS. Please refer to your program coordinator for more information.
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7. Thesis Committee and Thesis Proposal

7.1. Purpose of the Thesis Committee

The purpose of the thesis committee is to advise the student in his or her thesis research and to provide the student with a readily accessible source of advice and constructive criticism during the dissertation research. To achieve these goals, it is imperative that thesis committees meet early in a student's term and that they meet with the student at least 2 times a year (every 6 months for the Cancer Biology Program) to offer suggestions and ascertain progress. The thesis committee should actively monitor the student's progress toward completion of a thesis by no later than the end of the student's fifth year, and preferably sooner. A thesis committee's ultimate responsibility is to act in the student's best interest, by ensuring that the research undertaken will lead to an acceptable dissertation and a Ph.D. degree.

7.2. Conflict of Interest Policy

Research funding from sources that have intellectual property interests in the research, or in which the PI has personal financial interest, may create a real or perceived conflict of interest, given the dual roles of the principal investigator in obtaining funding for the lab and as a mentor for graduate students. Issues of paramount importance are (i) the ability to publish results in a timely fashion; (ii) the ability to communicate research results openly, especially to members of the thesis committee; and (iii) academic rights to publish and speak freely, especially as related to a graduate student’s thesis and defense.

Statement of policy.

The following principles should apply to any situation involving a graduate student supported by funding that is associated with a confidentiality agreement:

The limitations and nature of the confidentiality agreement must be fully disclosed to and approved by the student, the thesis committee, and the DBBS Associate Dean for Graduate Affairs; The confidentiality agreement must not place an unreasonable burden or delay in publication or reporting at scientific meetings; The confidentiality agreement must not delay the writing or defense of the thesis. The complete policy can be viewed at on the second page of the Thesis Affiliation form:

http://dbbs.wustl.edu/curstudents/StudentForms/Pages/StudentForms.aspx

7.3. Constitution of the Thesis Committee

Students should choose their thesis committees during their second year. The thesis committee consists of four faculty members and the thesis preceptor. The University requires that the final dissertation defense committee be composed of three faculty from the student's program and one from inside or outside the students program; and one from any of the other programs, or from departments outside the Division. All but one of the members of the committee must be members of the Washington University faculty and must hold regular academic appointments in the University. A quorum of four members including the thesis adviser is needed for any pre-defense meeting. The student and
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preceptor nominate these committee members subject to approval by the Program Director. The committee members are selected for their expertise in areas on which the research will touch, and for their willingness to contribute advice and meet at least once per year. The committee is chaired by a faculty member other than the thesis preceptor, and the chairperson should be designated in advance of the proposal, based on his or her willingness to be responsible for the committee's activities. The student and preceptor should view the committee system as a source of objective criticism and expert advice. At the time of the thesis defense, the thesis committee serves as the defense committee. The addition of committee members or changes of committee composition should be made no later than six months before the defense date.

7.4. Timing of the Thesis Proposal

Students are encouraged to present a thesis proposal during their second year, but should complete the proposal no later than December 31 of their third year (second year for MSTP students) in the Division. If the student anticipates that he or she will not be able to meet this deadline, the thesis advisor must write a letter to the Steering Committee by November 1, explaining the situation and indicating when the student can be expected to propose. Final approval of the thesis proposal by the thesis committee must take place by the end of the student’s third year, or the student will no longer remain in good academic standing, which could lead to a formal academic probation period.

7.5. Thesis Proposal

The thesis proposal should include a statement of purpose and rationale for the project, an outline of the methods to be used and an assessment of their feasibility, a summary of the work performed already, an idea of the potential outcome, and alternative plans for high-risk portions of the project. Although these are all essential components of a proposal, it is not intended that the proposal be lengthy, and preliminary data, while desirable, need not be profuse or conclusive. Thesis proposals require a cogent, but scholarly written assessment of the field and a testable hypothesis with possible branch points to be in the hands of the committee one week prior to an oral presentation. A single-spaced proposal, with references, of five-ten pages is appropriate. The thesis proposal meeting provides a student with guidance in selecting appropriate research goals and is not a test that the student must pass or fail.

7.6. Thesis Committee Meetings

During the thesis proposal, emphasis should be given to the student's understanding of the research proposed and the likelihood that it will allow the student to produce a thesis in a timely manner. Toward this end, it is customary for the thesis adviser, although present, not to participate in the discussion except where specifically requested to do so by a thesis committee member. For both the proposal and for subsequent thesis committee meetings, the committee will meet briefly to prepare its recommendations with the student absent. On occasion, the committee may also choose to meet with the student in the absence of the thesis adviser.

After the thesis proposal, thesis committees will meet with students no less than twice a year. Students should schedule thesis meetings. In the event that a student does not
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schedule timely meetings, the thesis committee chairperson will schedule thesis committee meetings. The thesis committee may choose to meet more often than twice per year, if it finds more frequent meetings appropriate. After each meeting, the thesis committee chairperson will be responsible for ensuring that recommendations of the committee are communicated to the student. The student should provide a minimum one-page critique of the work thus far, sending it to the committee one week prior to the date of the meeting.


The program is designed with the goal that students complete their thesis research and prepare, present, and defend a Ph.D. dissertation four to five years from the time they begin the program. The dissertation must be based upon an original investigation that results in a significant contribution to knowledge in Cancer Biology. Subject to approval of the thesis committee, the dissertation may include reprints of published work of which the student is an author, but where published material is included, a prefatory introduction should describe the extent of the candidate's contribution to both the experimental work and the preparation of the manuscript. When published material constitutes a significant fraction of the dissertation, it is desirable that a separate Introduction that describes the background to the research and a Discussion that describes its significance be written for the dissertation itself.

In order to assure that the dissertation will meet with general approval of the thesis committee, and to provide the required notice to the graduate school of the oral defense, the student will present an outline of the dissertation to the thesis committee six months before the defense date, and meet with the committee to discuss the outline and gain its approval. Once a date for the defense has been set, the Division Office should be notified promptly.

The thesis committee must read and approve the dissertation prior to the oral defense. To allow adequate time for remedy of potential problems, a complete draft of the dissertation must be given to the thesis committee at least two weeks prior to the date of the defense. Unless otherwise requested by the student and advisor and agreed to by the thesis committee, the format for the defense typically will be a public seminar followed by a closed session with the entire thesis committee.

9. Students' Responsibility to Meet Program Requirements

Graduate students in the Cancer Biology Program are responsible for completing the requirements of the program in a timely fashion. In particular, the requirements for courses, preliminary examinations, thesis proposals, and thesis committee meetings are important components of graduate training and should be regarded seriously. In the event that a student has trouble meeting any requirement, he or she should request consideration of the situation by the Steering Committee, which may agree to waive or delay the requirement.

10. Transfer From and To Another Programs

Students are free to transfer to and from any other program in the Division of Biology and Biomedical Sciences provided they are “in good academic standing”. Students who transfer will
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be expected to meet all of the normal requirements of the programs, although special exceptions may be granted in rare cases by the Steering Committee. Students are free to transfer from the programs to another program, with the approval of both program directors and provided a qualifying examination committee or program steering committee has not recommended against the student continuing in the Ph.D. program. Transfer is accomplished most easily during the first year, but can be done at later times if necessary.

11. MSTP Students

Students who join the Cancer Biology Program from the Medical Scientist Training Program must take the Cancer Biology and Cancer Biology Discussions courses. They must also take the Advanced Cancer Biology course along with the grant-writing component of this course. MSTP students generally meet all other requirements in the Cancer Biology Program, except where requirements are specifically waived by the Steering Committee.

12. Publications

There is no specific requirement for publication to receive the Ph.D. However, high quality, peer-reviewed publications are an important determinant for a student’s career. Similarly, the process of writing and submitting a manuscript and responding to reviewer critiques is an essential part of a student’s training. Therefore, the publication record is one of several important and appropriate measures to be used by a thesis committee in evaluating a Ph.D. candidate. It is generally expected that students will have submitted and/or published one or more first author manuscripts in peer-reviewed journals at the time of the defense.