

GRADUATE STUDENT HANDBOOK

CANCER BIOLOGY GRADUATE INTERDISCIPLINARY PROGRAM

ARIZONA CANCER CENTER COLLEGE OF MEDICINE

THE UNIVERSITY OF ARIZONA TUCSON, ARIZONA

We are grateful to the graduate programs in Pharmacology/Toxicology, Molecular and Cellular Biology and Biochemistry since the present handbook was modeled in part after those programs. The handbook was prepared by the Student Progress Committee (Drs. Cress, Dalton and Liebler, 1993). Updated 8/2006, 8/2009.

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To the Student:

This handbook outlines the philosophy and requirements of the Graduate Degree offered in the discipline of Cancer Biology at The University of Arizona. It is intended to be used to understand and fulfill the requirements for your graduate degree, in conjunction with a current Graduate College Catalogue. The requirements of the Interdisciplinary Program in Cancer Biology outlined herein are under the authority and consistent with the rules and guidelines set forth by the Graduate Council of the U of A. In cases where the requirements are slightly different than those stated in the Graduate Catalogue, the requirements in this Handbook pertain. Certain general University regulations and specific Cancer Biology program degree requirements are only outlined in this document; you are urged to consult the current Graduate College Catalogue for complete details.

Attainment of the degree of Doctor of Philosophy with a major in Cancer Biology requires outstanding scholarship, a demonstration of a depth and breadth of knowledge and demonstration of the design and execution of original research leading to a dissertation that contributes significantly to the general fund of knowledge in the discipline. The degree is never granted solely as certification of faithful performance of a prescribed program of studies. All degree requirements must be fulfilled.

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INTRODUCTION

The University of Arizona offers an interdisciplinary graduate program in Cancer Biology leading to the Ph.D. degree with a major in Cancer Biology. Students in this program may choose areas of special concentration such as biochemistry, molecular and cellular biology, pharmacology or microbiology. Students may also choose from disciplines such as biochemistry, molecular biology, pathology and toxicology as areas of study toward the minor. A M.S. degree is not offered in this program.

BACKGROUND

Cancer Biology is a scientific discipline concerned with investigating the regulation of normal and neoplastic cell growth. These studies range in scope from understanding the regulation of DNA transcription, replication and repair to molecular events regulating tumor progression. The ability of cancer biologists to elucidate basic mechanisms of cellular transformation and molecular events in tumor progression has been applied toward the improved diagnosis, treatment and prevention of cancer. In addition, cancer biologists have contributed toward the understanding of basic mechanisms of growth control which can be universally applied to other disciplines such as developmental biology, virology, immunology and genetics.

The need for specialized training in the area of Cancer Biology is evidenced by the increased need for highly trained professional personnel (Ph.D., M.D.-Ph.D. degrees). This need is reflected in the number of positions available in research/teaching/service areas of health professional schools (human and veterinary medicine, pharmacy, dentistry), university graduate and undergraduate programs, pharmaceutical and chemical industries, hospitals, and state and federal government research and regulatory agencies.

The Graduate Program in Cancer Biology at the University of Arizona is oriented towards modern molecular and cellular biology and biochemistry, especially in those areas dealing with mechanisms of cellular growth control and neoplastic transformation. Emphasis is placed on the physiological, biochemical and molecular mechanisms of action. Current research by the participating faculty members in the Program include

investigations in the fields of DNA replication and transcription, molecular genetics, membrane-cytoskeletal interactions, and chemical carcinogenesis.

STUDENT RESPONSIBILITIES

The program on Cancer Biology stresses to the student the following issues: First, students earn a degree based upon the depth and breadth of their knowledge in the field of Cancer Biology and their ability to generate and defend an original research proposal. Second, students are to conduct their experiments in an ethical manner. Experimental fraud related to the creation of false data or the unethical theft of others' work will not be tolerated. Students should keep their data in a format acceptable to the research advisor and be prepared to turn over their records to the Graduate Program at any time. The student is expected to complete the required and elective coursework in a timely manner.

ORGANIZATION

Philosophy and Goals

The major objective of the Graduate Program in Cancer Biology is to admit and train doctoral candidates and postdoctoral fellows who have the potential to become independent research scientists in various areas of cancer biology. It is also expected that graduates of the program will have an opportunity to acquire effective teaching skills. Evaluation of student performance is the responsibility of individual faculty members and supervisory committees.

Administration

The Graduate Program in Cancer Biology is an interdisciplinary program with participating faculty from several departments including the departments of Cell Biology and Anatomy, Biochemistry, Genetics, Internal Medicine, Microbiology and Immunology, Molecular and Cellular Biology, Nutritional Sciences, Pathology, Pharmacology and Toxicology, Pediatrics, Radiation Oncology, and Surgery. This is an interdisciplinary program in Cancer Biology; all graduates of the Ph.D. program receive a Ph.D. in Cancer Biology. Several committees participate in the administration of the graduate program. Details of committee functions and responsibilities appear in the appropriate sections of this handbook.

Executive Committee

The Executive Committee consists of eight faculty members, a graduate student representative and a postdoctoral trainee. Faculty members of the Executive Committee serve a four-year term and the terms are staggered so two members of the Executive Committee are replaced every year. New members of the Executive Committee are appointed by the Director of Graduate Interdisciplinary Programs based on recommendations from the Executive Committee. Faculty members of the Executive Committee may serve a maximum of three consecutive terms. The student member serves a one-year term and is elected by the students in the graduate program and students currently supported by the Training Grant. The student member of the Executive Committee can only serve one term. The postdoctoral trainee is selected by the Chair of the program.

The chairperson of the executive committee is appointed by the Director of Graduate Interdisciplinary Programs based on a candidate selected by a vote of the entire faculty of the Cancer Biology Program. Nominations for the chair position will be accepted from any member of the committee.

Graduate Student Representation

Each year one graduate student representative from the Ph.D. program is elected by the graduate students in the Cancer Biology program for a term beginning in August and ending the following July. This position serves as an official liaison between the student and faculty of the program. The representatives are responsible for

organizing graduate student participation in graduate program endeavors (such as the student research forums), as well as serving on Program committees in an advisory capacity. Each student should seriously consider his/her choice for the graduate student representative in order to maintain an effective student voice in graduate program issues.

Financial Support

Financial assistance in the form of research assistantships is available to all students admitted into the program. Support in the first year may take the form of a fellowship. After the first year, support will be in the form of research assistantships, fellowships or traineeships. Outstanding students are encouraged to apply for individual predoctoral fellowships from sources outside the University. Graduate research assistant appointments provide a waiver of tuition, partial payment of registration and student-only health insurance.

Participating Faculty Research

See Cancer Biology GDP website for most current list of faculty and research interests.

<http://www.azcc.arizona.edu/academics/cbio>

RESOURCES AND FACILITIES

Laboratory Space

Laboratory space is available within the separate departments represented by the participating faculty. The resources available are listed in literature available from those departments. There are affiliated laboratories at the Main campus of the University of Arizona, Arizona Cancer Center, Arizona Health Sciences Center, University Medical Center and the College of Pharmacy.

Equipment Resources

Availability of modern scientific instruments is crucially important to research and graduate education programs. Sufficient instrumentation is available to conduct research with a molecular biology, biochemistry and/or cell biology emphasis.

For example, the laboratories in the Arizona Cancer Center contain instruments necessary for biological analysis, including spectrophotometers, high performance liquid chromatographs, and FPLC machines and equipment necessary for protein and DNA analysis. All laboratories have access to modern computers and data processing systems. Each laboratory is equipped with specialized instrumentation required for research in its particular field. In addition to individual research laboratories, shared laboratory space includes a tissue culture facility, a dishwashing service, an experimental irradiator, an equipment room containing centrifuges, spectrophotometers, electroporators and thermocyclers. A shared resources directory of the Arizona Cancer Center is available upon request and describes in detail core facilities which include cell culture, cytogenetics, flow cytometry, biometry, research pharmacy and a P3 biohazard facility.

Library Resources

The University of Arizona takes pride in the outstanding quality of its libraries. The General Library and the Science Library, both on the main campus, hold extensive collections of general and scientific periodicals and books. The Arizona Health Sciences Library, located in the College of Medicine, is readily available to graduate students in Cancer Biology 24 hours a day. In addition to its holdings of pertinent periodicals and books, the library provides access to most science-related journals through the internet.

Experimental Animals

The availability of high quality animals is of importance to some experimental research aspects of Cancer Biology. Graduate students are expected, and required by Federal law, to become familiar with safe and humane animal care and handling techniques. The University Animal Care Facility procures and cares for all

animals used in teaching and research by the faculty in Cancer Biology. The staff of University Animal Care is available to students for consultation on problems related to the use of animals in scientific research.

All students must comply with federal, state and local regulations governing animal care, and are required to attend a training course offered several times each year by University Animal Care staff if conducting research with animals.

Laboratory Safety and Environmental Health

It is the responsibility of all personnel involved in scientific study to be aware of the safety precautions and the proper disposal of hazardous wastes specific to the research effort. The student has an obligation to not only be familiar with but also follow the specifics of laboratory safety associated with the desired area of research.

The offices of Risk Management (risk.arizona.edu/training) and Radiation Control

(www.radcon.arizona.edu/training) offer workshops covering basic laboratory safety, fire prevention, hazardous waste disposal, compressed gas safety, basic radiation protection, and industrial hygiene, etc.

Students are required to attend these courses early in their graduate career. Laboratory directors and technicians are the best source for day-to-day laboratory safety techniques and advice on safety seminars required for laboratory personnel.

Animal and/or Human Subjects Approval

Research involving human subjects or live vertebrate animals requires permission from the relevant University committee. Consult your research director for details. If you are working on a project for which your director has obtained permission, be sure your name is listed on the protocol approval and that you have the control number of the approval in your records. Failure to do this will make all research done without the protocol approval in place INVALID for your dissertation.

Research activities involving the use of human subjects require the review and approval of the University Human Subjects Committee. A copy of the Human Subjects approval letter along with the Human Subjects Research Statement must be in the student's file in the Graduate College Degree Certification Office. Check the UA Human Subjects website for the latest requirements.

Research involving any live vertebrate animals must be approved by the Institutional Animal Care and Use Committee (IACUC). The Animal Research Protocol Review form must be completed by the student/research advisor and submitted to the protocol office for review and approval. Contact University Animal Care for the latest requirements.

Useful University of Arizona Websites

Graduate College Degree Certification Forms and Requirements for Doctoral Degrees

<http://grad.arizona.edu/>

Cancer Biology Graduate Interdisciplinary Program

<http://www.azcc.arizona.edu/academics/cbio>

CBIO DOCTORAL PROGRAM

Orientation

Each new student in the program is assigned to the **Student Advisor**. This Student Advisor discusses any academic background deficiencies with the student and recommends suitable coursework to remove the deficiency. A departmental graduate program orientation and a "meet the faculty" gathering occurs in the beginning of the semester.

Curriculum and Supervision

Program Course Info

The **Student Advisor** helps the first year student plan his/her program with an emphasis on the first year's courses. Sample programs of coursework are listed in Appendix I. In subsequent years, the student's **Major Advisor and Advisory Committee** tailor the coursework to fit specific needs and objectives. The faculty encourages the student to take advanced courses in cancer biology, biochemistry, chemistry, molecular and cell biology and to diversify his/her program with courses in genetics, microbiology, anatomy, pathology, philosophy of science or mathematics.

Full-Time Enrollment of Graduate Students

All full-time students are expected to enroll for a combination of course work and research and dissertation study that totals 12 units of credit for the Fall and Spring semester.

- Students who have not completed their comprehensive examination should enroll in CBIO900 (Research, 1-9 units).
- After completion of the comprehensive examination, students may enroll in CBIO 920 (Dissertation). Although a maximum of 18 units of 920 may be *claimed* for credit on a student's Course Program, the student may *enroll* for as many units as needed to complete his/her dissertation.

Courses

In some cases it may be possible that these requirements are met either by transfer of graduate credits from another institution or by previous completion of an equivalent course.

Required Courses

CBIO 551 Molecular Mechanisms of Carcinogenesis
CBIO 555 Cancer Therapeutics
CBIO 561 Clinical Cancer Biology Experience
CBIO 589 Cancer Genetics
CBIO 595C Cancer Biology Colloquium, each Fall
CBIO 596H Cancer Biology Seminar Series, 2 semesters required
CBIO 681 Intro to Research (Lab Rotation), 2 semesters required
CBIO 900 Research
CBIO 920 Dissertation
EPID576A Biostatistics
MCB 695e Science, Society and Ethics

Waiver of Core Courses

A Petition Form (available through the Graduate College website) must be completed to have a core course waived. The student must meet with the instructor or coordinator of the course he/she would like to waive. The student must show proof of an acceptable grade (A or B) in a comparable course. The course

instructor/coordinator must sign the Petition. The signature of the Chairperson of the Program constitutes final approval of the Petition.

Transfer of Courses

Transfer of graduate level coursework is permitted by the Program and the Graduate College contingent upon a transcript of a completed degree on file in the Graduate College from an accredited college. Twelve units of transfer credit of a grade B or better from a non-completed graduate degree program is permitted.

The Research Advisor and Advisory Committee will help the student plan an educational program in which coursework is completed as quickly as possible. Because of individual interests or conflicts in scheduling, some formal coursework may extend into the third year of graduate study.

Seminars

Seminars are an important component of the Graduate Program. The Cancer Biology Seminar Series is a weekly seminar series is sponsored by the Graduate Program. All students are required to attend.

Cancer Biology Seminar Series CBIO596h (Mondays, 9-10 AM, Room 2951, Arizona Cancer Center). These seminars are presented by faculty from within the University or those who come from outside the University as guests of participating faculty. These seminars are presented by experienced scientists and consist of an update of recent research in the speaker's laboratory. Two semesters for credit are required.

Student seminar or presentations. Students in the Graduate Program have the opportunity to practice presentation skills to the faculty through the required Cancer Biology Colloquium (CBIO 595c) and at least once a year either through a Faculty/Student Science Fair, Arizona Cancer Center Science fair or during a Faculty/Student research retreat.

Cancer Biology student meetings On a regular basis, students have the opportunity to practice their presentation skills, prepare for comprehensive exam and share advances in their research before the Cancer Biology students. Faculty are not present for this meeting. The Graduate Representative coordinates this seminar.

Laboratory Rotations

Each first year student must participate in at least three research laboratory rotations (**CBIO 681**), which can be taken in regular academic semesters and, if necessary, completed during the summer. The objective of the required laboratory research rotations is the introduction of the graduate student to research and familiarization with the scope and nature of the faculty's research endeavors. The research laboratory rotation constitutes a major part of the first year graduate curriculum. Performance criteria to be used by the laboratory director will include assessment of the student's initial familiarity with the research, the development of library and literature skills, ability to apply the scientific method, the development of laboratory skills, attitude toward the research project, and a final written report prepared by the student. The reports of laboratory rotations are also included in the **First Year Annual Report** submitted by the student to the Student Progress Committee. Laboratory rotations are **limited** in length to one regular academic semester or summer session and are scheduled on an individual basis with faculty members. The Program **recommends** that students limit laboratory rotations to seven weeks. Students are expected to devote a minimum of 20 hours per week to the laboratory project.

Occasionally a student is admitted and has already selected a laboratory to pursue their research interests. The student is still required to complete two lab rotations and should discuss options with the Director of the Program. These rotations can be used to learn a technique for use in their dissertation project or to teach a technique in the selected laboratory.

Research Advisor and Advisory Committee

Prior to the selection of a Research Advisor, the student must become familiar with the research interests of the faculty. This may be initiated early in the fall semester as the student meets individually with the participating faculty whose research is of particular or potential interest. A faculty student advisor is available to counsel the student. Additional familiarity is gained through the laboratory research rotations which occur during the first two semesters.

After these preliminary interviews and research laboratory experiences, the student decides with whom he/she would like to do his/her dissertation research. The student must communicate their **selection of a research advisor** to the Student Progress Committee **by the end of the 1st year**.

At the time of research advisor selection, or shortly thereafter, an advisory committee is formed. The advisory committee consists of three members from the program faculty and two from the minor field and is chaired by the research advisor. The research advisor discusses membership of the advisory committee with the student and recommends the composition of the advisory committee to the Student Progress Committee (via the First Annual Report, CBIO forms in handbook). The Student Progress Committee may modify the advisory committee membership. Faculty members of the advisory committee are selected on the basis of their ability to provide useful advice about the research problem, to assist in selection of appropriate coursework, and to help guide the student to successful completion of degree requirements.

The advisory committee will meet with the student at least once each calendar year to review progress in coursework and research. A report of the supervising committee meeting recommendation will be completed by the research advisor (CBIO forms in handbook). The student will be responsible for giving a private dissertation proposal which will consist of a private seminar to the advisory committee which will outline the background, preliminary data and goals of the proposed dissertation topic. The advisory committee will focus on the objectives of the proposed dissertation as well as limiting the scope.

Student Evaluation

Criteria

On behalf of the program faculty, the Student Progress Committee evaluates each student on the basis of accomplishments in formal courses and performance in other areas of the program. For example, emphasis is placed upon performance in research laboratory rotations. In subsequent years the student's development as a research scientist becomes of major importance. It is therefore necessary for each student to perform well in formal courses, in seminars, and in the research laboratory. Failure to meet performance criteria in any of these areas is grounds for dismissal from the Program.

Grades in Core Courses

All students must receive a grade of "B" or better in all core courses. A student who receives a grade of "C" or less in a core course must repeat that course. A student may petition to have this repeat requirement waived; a waiver can be granted only with the written approval of the course instructor and the Student Progress Committee. **A grade of "C" or less in a core course constitutes grounds for dismissal from the Graduate Program.**

Annual Reports

Each student is required to submit an Annual Report to the Student Progress Committee before the end of the Spring Semester. The Annual Report Form consists of an updated CV. First year students have a special form.

Prior to June 1 the Student Progress Committee decides if each first year student should be sponsored for the following year based on laboratory rotation reports, core grades and academic behavior. Second year students are evaluated for advancement to candidacy at the time of their preliminary examination. If performance is substandard, the Student Progress Committee may recommend a probationary period, withdraw program sponsorship or seek dismissal. The Student Progress Committee will evaluate overall student performance in the program to date.

Forms for the Cancer Biology reports are available on the Cancer Biology webpage (<http://www.azcc.arizona.edu/academics/cbio/>)

Qualifying Examination

Satisfactory completion of the first two year's work constitutes passage of the **Qualifying Examination** (see Graduate Catalog). The student has attained grades of no less than B in major courses and **maintains a grade point average of at least 3.0**. Part of the evaluation includes the submission and approval of an **Annual Report** outlining his/her activities during that year. The Report will list courses taken and grades received, published abstracts and papers, seminars and report presentations and honors. The Annual Report must be approved by the Student Progress Committee before the year's work is considered complete.

Advancement to Candidacy

Advancement to candidacy requires satisfactory completion of the **Comprehensive Examination**. As required courses are completed, usually at the end of the second academic year, the comprehensive examination may be scheduled. The completion of required courses is recommended but is not required to take the comprehensive exam. **The Comprehensive Examination must be completed by the end of the third academic year**. The comprehensive examination is considered the single major test of whether or not the student is suitable doctorate material.

Comprehensive Examination

Students wishing to take the Comprehensive (preliminary) Examination within a given semester shall, with the approval of their Advisory Committee, inform the Chairperson of the Program and the Graduate College at least three weeks before the scheduled date of the Examination. (See "Doctoral Candidates: A Handbook for Completing the Steps to Your Degree"). The Graduate College requires the completion of the Doctoral Plan of Study prior to scheduling the Comprehensive Exam. A proposed course program must be submitted to the Chairperson of the program for approval. The comprehensive examination consists of two parts: The Outside Research Proposal and the Oral Examination

Research Proposal

The first part is a research proposal in an area of Cancer Biology. The topic selected for the research proposal must be approved in advance by the Advisory Committee. The research proposal must be an original work and not a reflection of a research project currently being investigated in the dissertation director's laboratory. The proposal is prepared in the form of a National Institutes of Health grant proposal (see Guidelines for the Preparation of Research Proposals and <http://grants.nih.gov/grants/oer.htm>). **(Copies of previous student**

research proposals are available for viewing in the Cancer Biology Program office.) The research proposal must detail items 1-4 of the NIH guidelines; information concerning a proposed budget, etc. is not required. It must be submitted to the Advisory Committee at least three weeks before the oral examination. Within one week after receiving a copy of the Proposal from the student, members of the Advisory Committee inform the student of problems of clarity or definition with the research proposal. No preliminary judgments as to the defensibility of the proposal are made at that time.

Oral Examination

An oral examination is conducted by the Advisory Committee serving as an examining committee. The first hour is devoted to a defense of the **Research Proposal**. The remaining time consists of a broad examination covering any aspect of Cancer Biology and/or the chosen minor field of study.

The exam must last a minimum of 2 hours but cannot exceed 3 hours. It is common for the student to give a 5-10 minute overview of the research proposal using audio-visual materials. A laptop computer and LCD projector are available for the exam. (Reserve in advance though the CBIO office.) Previous students have had at least one practice oral exam with other graduate students and postdocs about two weeks before the scheduled exam. This can be helpful in identifying your strengths and weaknesses. Students often need practice using the board to effectively illustrate answers to the questions posed.

A student may attempt the preliminary examination a maximum of two times. A second attempt at the oral examination must be scheduled within six months following the first oral examination and no earlier than four months. Failure in both attempts results in automatic dismissal from the Ph.D. program. Upon successful completion of the comprehensive examination, the Results of the Oral Comprehensive Examination for Doctoral Candidacy are forwarded to the Graduate College. After completion of formal courses and during the pursuit of the dissertation research, the candidate is expected to continue to participate actively in the departmental seminar program and student activities.

Dissertation

At the time of advancement to candidacy, planning of the research program begins in meetings with the Advisory Committee. The Committee reviews the goals and experimental approaches as summarized by the candidate, particularly in relation to the objectives set out in the dissertation proposal, and helps formulate and approve any changes or new plans deemed appropriate. At this time it may become necessary to increase the frequency of Advisory Committee meetings. The candidate is expected to fulfill specific goals recommended by the Committee. A report of the suggested goals is recorded by the research advisor at the time of the advisory committee meetings (See CBIO forms in handbook).

An outline of the dissertation content and style must be approved by the Advisory committee before it is written. In both of these formats the details of the mechanics of the writing must follow the Graduate College rules (see **Student's Manual for Theses and Dissertations**, <http://grad.arizona.edu/academics/degree-certification/diss-theses/manuals>).

When the dissertation is written, the candidate submits a copy to each member of the Supervisory Committee **at least three weeks prior** to the final examination. After the Committee members have reviewed the dissertation and they approve with minor revisions, the student will have the Committee members sign the "Announcement of Final Examination" which needs to be submitted to the Graduate College per the guidelines on the Graduate College website. Upon receipt of the Announcement of Final Examination by the

Graduate College, the announcements of the upcoming final examination will be sent to the entire faculty of the Program in Cancer Biology.

Final Examination

Formal oral defense of the dissertation research constitutes the final examination. This consists of a public seminar by the candidate immediately followed by discussion of the material by the audience, including members of the Advisory Committee. The Advisory Committee will examine the candidate further in a closed door session.

Copies of final approved dissertations are available to review for context and style. These copies are kept in the Cancer Biology office.

Scientific Meetings

As part of the educational process, students in training will be encouraged to attend national scientific meetings as travel support permits. Priority for travel support will be given to students presenting communications at the American Association for Cancer Research, American Society for Developmental and Cell Biology, Gordon Conferences and related meetings. Students should discuss participation in meetings and travel support with their Research Advisors.

Limitation on Time to Fulfill Degree Requirements:

The Ph.D. degree with a major in Cancer Biology usually requires approximately five years of education beyond the baccalaureate degree. As the success of laboratory experiments or the time required for their completion cannot be predicted accurately, up to six years may be required for completion of degree requirements, which include an original and significant scientific contribution. Students will rarely be allowed to continue in the Program beyond six years. The Thesis must be completed within **7 years** of date of entry in the Program. The Cancer Biology time limit is **less** than the Graduate College limit of ten years.

Requirements for Minor Degree

Minor programs for Cancer Biology majors may include the following disciplines: Biochemistry, Cancer Biology, Microbiology and Immunology, Molecular Biology, Physiology and Pharmacology/Toxicology. Other options must be approved individually by the Advisory Committee and Chairperson of the Program.

Minor in Cancer Biology

A minimum of 9 units is required for a Minor in Cancer Biology.

Ph.D. in Cancer Biology, **Sample Course Schedule**

Note: Degree requirements are 36 units in the major, 9 units in the minor (not included below) and 18 units of dissertation. At least one half of the units must be in graded courses. Students are encouraged to take 12 units per semester until completion of the comprehensive exam.

YEAR 1 FALL	UNITS	YEAR 1 SPRING	UNITS
Cancer Genetics CBIO589	3	Molecular Mechanisms of Carcinogenesis CBIO 551	3
Oncogenes and Signal Transduction CBIO595A	1	Basic Human Pathology CBIO515	4
CBIO Seminar Series CBIO596h	1	CBIO Seminar Series CBIO596h	1
		Cancer Biology: Focus on Breast Cancer CBIO595G	1
Laboratory Rotation CBIO681	2	Laboratory Rotation CBIO681	2
Electives	4	Science, Society and Ethics	1
CBIO595c CBIO Colloquium	1	Electives	1
Total units	12	Total units	12
YEAR 2 FALL		YEAR 2 SPRING	
CBIO595c CBIO Colloquium	1	Cancer Biology: Focus on Breast Cancer CBIO595G	1
EPID 576A Biostatistics	3	Cancer Therapeutics CBIO555	3
Tumor Immunology CBIO 562	3	Drug Disposition and Metabolism CBIO550	2
Oncogenes and Signal Transduction CBIO595A	1	Clinical Experience CBIO 561	2
Electives	4	Electives	4
Total units	12	Total units	12
YEAR 3 FALL		YEAR 3 SPRING	
Oncogenes and Signal Transduction CBIO595A	1	Cancer Biology: Focus on Breast Cancer CBIO595G	1
CBIO595c CBIO Colloquium	1		
Research CBIO900	1	Research CBIO900	2
Dissertation CBIO920	3	Dissertation CBIO920	3
Total units	6	Total units	6
YEAR 4 FALL		YEAR 4 SPRING	
CBIO595c CBIO Colloquium	1		
Oncogenes and Signal Transduction CBIO595A	1	Cancer Biology: Focus on Breast Cancer CBIO595G	1
Dissertation CBIO920	5	Dissertation CBIO920	6
Total units	6	Total units	6
		TOTAL MAJOR UNITS	36
MINOR UNITS	9	MINIMUM DISSERTATION UNITS	18

SAMPLE MEDICAL STUDENT TRACK

Note: Medical Science courses can be used for units toward the minor if the units are graded. (BIOC 801, MICR 801, MCB 801). The proposed schedule is an example only.

YEAR 1 FALL	UNITS	YEAR 1 SPRING	UNITS
<i>Basic Medical School Curriculum</i>		<i>Basic Medical School Curriculum</i>	
Molecular and Cellular Biology MCB801	4	Human Neuroscience ANAT 805	6
Human Gross Anat. ANAT 801	8	Human Physiology PSIO 801	8
Microscopy Anatomy ANAT 802	5	Medical Biochemistry BIOC801	5
Human Neuroscience ANAT 805	3	Prep. Clinical Medicine MED801	10
Prep. Clinical Medicine MED801	10	Soc. & Behav. Sci MED 805	6
Soc. & Behav. Sci MED 805	6		
Total	36	Total	35

Year 1 Summer: Laboratory Rotation
CBIO681 2

YEAR 2 FALL	UNITS	YEAR 2 SPRING	UNITS
<i>Basic Medical School Curriculum</i>		<i>Basic Medical School Curriculum</i>	
Micro & Immunology MICR801	6	Pharmacology PHCL801	6
General and Systemic Pathology PATH 801	10	General and Systemic Pathology PATH 801	10
PSM MED801	10	PSM MED801	10
SBS MED805	6	SBS MED805	6
Total	32	Total	32

Year 1 Summer: Laboratory Rotation
CBIO681 2

YEAR 3 FALL	UNITS	YEAR 3 SPRING	UNITS
<i>Basic Medical School Curriculum</i>		<i>Basic Medical School Curriculum</i>	
Concepts in Genetic Analysis BIOC545	3	Molecular Biology MCB511	3
Laboratory Rotation CBIO681	2	Laboratory Rotation CBIO681	2
CBIO Seminar 596h	1	CBIO Seminar 596h	1
Immunopathology MICR695	1	Computer Analysis & Seq MCB516	3
Total		Total	

Graduate College Requirements

A significant portion of the process for obtaining a graduate degree involves the proper handling of University-mandated paperwork and requirements. The departmental requirements and the graduate college requirements are not necessarily one and the same. Both entities must be satisfied to obtain a graduate degree. Graduate College requirements, such as the timely submission of accurate forms and adherence to deadlines, are rigid and generally not subject to appeal. The Graduate College changes its requirements occasionally so be advised that the requirements presented here to be used as guidelines. Therefore, if the student has any doubts or questions concerning the material in this section, the wisest course is to contact the Graduate College directly.

This section presents a brief listing of the basic requirements mandated by the Graduate College, a summary of the forms required and a timetable for Doctoral degrees.

1. Qualifying written examinations are not given by the Cancer Biology program. Successful completion of the first two year's courses and research rotations constitutes passing the Qualifying Exams.
2. All requirements must be completed within 7 years of starting program.
3. At least 36 units of work (excluding the dissertation units earned) must be in the major field. Courses in the Cancer Biology program are listed under the prefix to the course numbers: CBIO. These courses can be listed under one prefix or cross-listed under two or three different headings. *All dissertation units should be registered under CBIO.*
4. One or two supporting minors are required. A minor within the major program ("Cancer Biology ") is permitted with the approval of the Graduate College.
5. At least half of the student's total credits must have letter grades assigned (i.e., A, B, C, etc.).
6. The student must maintain a 3.0 average. Probation will result if a student's GPA falls below this minimum. A student on probation will receive a letter from the program outlining what must be done to resume good standing. A student can be dismissed if he/she does not improve his/her GPA in the specified period required by the department. The student's GPA must be 3.0 overall to receive the doctoral degree.
7. It is the responsibility of the student to identify a dissertation advisor by the end of the first year in the doctoral program. The dissertation advisor will provide mentoring and stipend support for the student. Those students not able to identify a mentor in the first year may be asked to leave the program. The major professor must be a tenure track faculty member in the Program or a co-director from the program. In the event that the research project is not carried out in the laboratory of a member of the Program Faculty, the co-director must be Program Faculty. The student must communicate his/her choice of dissertation advisor in writing to the office of the Chairperson of the Cancer Biology Program, **contingent upon approval.**
8. The student, in consultation with the dissertation advisor, should select the Advisory Committee no later than the end of the fourth semester. This committee must consist of at least 3 faculty members from the Cancer Biology GIDP and 2 from the minor program. The specifics of the committee member selections are best discussed with the major advisor. The doctoral student must communicate committee selections in

writing to the office of the Chairperson of the Graduate Program in Cancer Biology using the "Selection of Advisory Committee Form".

9. A dissertation consisting of at least two semesters of full-time work is required. Registration for 18 units of dissertation credit (920) is required. A dissertation may be done in absentia with the prior approval of the dissertation committee and the Executive Council of the Interdisciplinary Program in Cancer Biology.

10. The Ph.D. requires the equivalent of at least 6 semesters of full-time graduate study. There are two residency requirements: one is a requirement on the time spent at the University of Arizona, the other is a requirement on total units earned at the University of Arizona.

Time Requirement:

The student must spend two regular semesters of full-time academic work in the major field in actual residence at the University of Arizona. Any semester that a student is registered for at least 6 units of graduate course work or research will be counted toward meeting the residency requirement (provided that the student's full-time is devoted to the graduate work).

Unit Total Requirement

Thirty units of graduate credit must be completed at the University of Arizona.

A Doctoral Plan of Study must be submitted to the Chairperson for approval. All course work should be listed including on-going and projected courses to total at least 36 units in the major and 9 units in the minor field of study. Eighteen units of dissertation (920) are listed separately. This form must be signed by the minor advisor and the Program Chairperson. The student should be advised that the Doctoral Plan of Study represents a contract between the student and the department for fulfilling the doctoral requirements.

Successful completion of Comprehensive (Preliminary) Exams is required to be advanced to Candidacy for the Ph.D. These are taken after essentially all (at least 80%) course work is complete, usually the fall at the start of the third year in the doctoral program in Cancer Biology. The preliminary exam consists of two parts, the written research proposal and oral defense of the proposal. If the doctoral student fails the Comprehensive Exam, the student may repeat it once with the approval of the Student Progress Committee and the Graduate College. For scheduling the oral exam the student should meet with faculty on his/her Thesis Advisory Committee. The student MUST submit to the Graduate College an "Application for Preliminary Oral Examination" form at least three weeks before the proposed date. The oral and written exams must be taken within two semesters of each other. The student must petition for an extension of this limit if a longer period elapses. The Degree Certification office can be contacted for advice on this petition. If an oral examination is scheduled during the summer, the student needs to be enrolled in at least one unit of graduate study (Supplemental Registration CBIO930).

13. Advancement to Candidacy: After the program background requirements are completed, after passing the preliminary exam and demonstrating ability to do original research (as stipulated in the Graduate Catalog), the doctoral student is advanced to candidacy by the program. The student must file a Doctoral Advancement to Candidacy form no later than six months before his/her intended completion (award) date. The Graduate College requires that doctoral students submit the original and three copies along with a copy of their unofficial transcripts. The exact title of the dissertation must be entered on this form.

14. No later than 7 business days before the proposed Final Examination (dissertation defense), the student should complete the "Announcement of Final Examination" form and file it with the Graduate College. The scheduled Final Examination should occur at least three weeks before the desired award date. Three award dates are published for each academic year. The student should pick up the list of deadlines for these dates from the Graduate College about six months before he/she intends to finish the dissertation.

15. All graduate students on a graduate research assistantship who wish to defend during the Fall or Spring semester need to be registered for at least 6 units. If a final defense takes place during the Summer Session I or II, the student needs to enroll for one unit.

16. Dissertations are now filed electronically through the Graduate College. Consult the Graduate College Degree Certification website for the latest requirements for dissertation submission.

Ph.D. Timetable

Year I	
Complete required first year core coursework	Maintain 3.0 GPA and no less than a "B" grade
Participate in laboratory rotations and identify a dissertation advisor.	Notify student Progress Committee using the first Progress Report .
Choose Research Advisory Committee	In consultation with the Research Advisor, choose the Committee by 2nd year.
Year II	
Complete required second year core coursework	Maintain 3.0 GPA and no less than a "B" grade
Select an Advisory Committee	Submit form to the Chairperson of the Student Progress Committee in the Cancer Biology Program before scheduling Oral Preliminary Exam. Committee Form.
Original Research Proposal	In the 4th semester of course work the student should begin planning and reading for the original research proposal.
Doctoral Course Program	At approximately 1.5 years into the program (after completing at least 12 units) the student should list both on-going and projected courses to total at least 45 units in the major field and at least 9 units in the minor field. Dissertation units (920) are listed separately (18 units) bringing the total to at least 72 units. This form must be submitted to the Student Progress Committee for approval prior to the preliminary examination.
Written Research Proposal	Must be approved in advance by the Advisory Committee.
Application for Preliminary Oral Examination	This form needs to be submitted no later than three weeks prior to the exam and should be scheduled no later than 1 month after written exams. These last at least 2 but no longer than 3 hours. At this time the student must submit the Written Research Proposal to the Advisory Committee.
Year III	Pass Comprehensive Exam no later than end of third year
Year IV-V	
Doctoral Application to Candidacy	Available on-line. Submit to Graduate College after the successful completion of the Oral Preliminary Exam but no later than 6 months before proposed completion date.
Deadline Sheet	Available on-line.
Student Manual for Theses and Dissertations	Available on-line.
Announcement of Final Examination	Available on-line. Submit form to the Graduate College no later than 3 weeks before proposed exam date.
Final Dissertation Draft	Submit to the Program Office as soon as draft is approved by the dissertation committee (after final defense) for check.
Microfilm Form	Submit along with final copies of dissertation.
Pay fees for doctoral degree candidacy, dissertation processing, and microfilming	No later than the day before the final copies of the dissertation are submitted to the Graduate College.

Guidelines for Research Proposal Preparation

- a. The proposition must be distinct from research proposals which are active in the laboratory in which the student proposes to do his/her dissertation. In fact, the faculty encourages the student to explore Cancer Biology areas distant from his/her research interests.
- b. The proposal should be prepared in the form of the NIH research grant application. NIH grant application packets should be examined for guidance. The following sections should be included: Abstract, Significance, Rationale, Specific Aims, Research Plan. The Research Plan should include experimental methodology, examples of the type(s) of data expected, the statistical tests to be applied, and how the data would be interpreted. Clarity and logic are of utmost importance.
- c. An extensive bibliography is not required, but references to the most pertinent citations should be included.
- d. The total written presentation, proposition plus experiments to be defended, should be a maximum of 25 single spaced typewritten pages. Secondary details should be left to the oral defense.
- e. Suitable propositions may address a variety of topics. For example, the student may propose a re-interpretation of literature data, or a crucial experiment to test a theory or hypothesis, or a new theoretical approach to a problem, or the design of a new piece of equipment. The limit to suitability is the student's imagination and approval of the advisory committee. The topic and scope of the research proposal must be approved by the supervisory committee prior to writing the proposal.
- f. The faculty strongly emphasizes that the responsibility for the quality of the proposition, be it originality, approach, or significance, rests completely with the student. The student selects the area, prepares the written proposition, submits it to the faculty, and defends it at the oral. The proposal must be approved by the student's advisory committee. At the time of the oral defense, the committee judges the acceptability of the proposition by the extent to which the student demonstrates scientific maturity, originality, and ability to explain and defend his/her position.
- g. The general format is:
 - I. Title page
 - II. Abstract
 - III. Research Plan (10 pages total)
 - A. Hypothesis/Specific Aims (1 page)
 - B. Background and Significance (2-3 PAGES)
 - C. Experimental Design (6-8 pages)
 - D. Expected outcomes and potential pitfalls
 - IV. References (include complete reference)
 - V. Appendix (Figures, Tables, flow diagrams)

Master's Degree Policy

Students are admitted to the Cancer Biology GIDP only with the express desire to obtain a PhD. In the event that this is not possible the following guidelines apply.

Students enrolled in the doctoral program who wish to obtain the MS degree in Cancer Biology are expected to complete the following requirements:

1. Contact Program Chair (copy Program Coordinator) in writing of intention/circumstances to obtain a terminal Master's degree.
2. Pass required Cancer Biology coursework with B grade or above.
3. Form a committee comprised of three faculty members, two must be Cancer Biology. Send a notice to the Program Chair with the list of your committee members.
4. Complete Graduate College Master's Plan of Study and Master's Completion of Degree Requirements forms.
5. Demonstrate scientific insight/integrative thinking (three options)
 - A. Write a critical literature review
 - B. Write a research proposal, following CBIO GIDP comprehensive exam guidelines
 - C. Write a first author manuscript

Student must orally defend one of options in #5 if student has not passed comprehensive exams.

Specific content of written portion of MS requirement for students enrolled in PhD program are established on a case-by-case basis by the student's committee.

CBIO Program Forms

FIRST YEAR REPORT: Cancer Biology Graduate Interdisciplinary Program

(Student to complete and submit to Student Progress Committee)

NAME _____ DATE _____

A: COURSEWORK:
Course number and name Grade

B: LABORATORY ROTATIONS:
Rotation 1 (CBIO 681) (List Advisor, dates and description of studies).

Rotation 2 (CBIO 681) (List Advisor, dates and description of studies).

Rotation 3 (CBIO 681) (List Advisor, dates and description of studies).

Use back of form if more than three rotations were completed

IF YOU DID NOT COMPLETE AT LEAST TWO LABORATORY ROTATIONS, PRESENT JUSTIFICATION BELOW:
(attach an additional page if necessary)

SELECTED RESEARCH ADVISOR:

Student Signature (Date)

APPROVAL OF THE PROGRESS COMMITTEE:
(Date)

Important Instructions: The student is responsible for bringing the appropriate forms to his/her committee meetings.

RESEARCH LABORATORY ROTATION EVALUATION FORM

CANCER BIOLOGY GRADUATE INTERDISCIPLINARY PROGRAM

(Student to complete and submit to Program Coordinator after each rotation)

STUDENT:

LABORATORY DIRECTOR

DATE

PROJECT:

PERFORMANCE: (To be completed by Laboratory Director):

Initial familiarity with project:

Library and literature skills:

Use of scientific method and laboratory skills:

Attitude toward project:

OTHER COMMENTS/RECOMMENDATIONS: GRADE (A, B, C) _____

(Faculty/Laboratory Director Signature)

(Date)

(Student Signature)

(Date)

Important Instructions: The student is responsible for bringing the appropriate forms to his/her committee meetings.

SELECTION OF ADVISORY COMMITTEE

PROGRAM IN CANCER BIOLOGY

(Student to complete and submit to Program)

STUDENT _____

DATE _____

RESEARCH ADVISOR _____

STUDENT'S MINOR: _____

RECOMMENDED MEMBERSHIP OR ADVISORY COMMITTEE

MAJOR FIELD (AT LEAST TWO)

MINOR FIELD (AT LEAST TWO)

SIGNATURE OF STUDENT _____

SIGNATURE OF RESEARCH ADVISOR _____

RECOMMENDATION OF STUDENT PROGRESS COMMITTEE: _____ DATE _____

Important Instructions: The student is responsible for bringing the appropriate forms to his/her committee meetings.

The major advisor on the student's committee is responsible for the completion of this form and its return to the Chair of the Student Progress Committee or to the Cancer Biology Administrative Office.

Report of Student Supervisory Committee Meeting

Cancer Biology Graduate Interdisciplinary Program

STUDENT _____

DATE OF MEETING: _____

Summary and/or Recommendations: (to be filled out by major professor)

We have reviewed the student's annual Summary Progress Report and the summary of academic progress.

_____	_____
_____	_____
_____	_____

Dissertation Director/Advisor

Important Instructions: The student is responsible for bringing the appropriate forms to his/her committee meetings.

The major advisor on the student's committee is responsible for the completion of this form and its return to the Chair of the Student Progress Committee or to the Cancer Biology Administrative Office.

Sample of a Dissertation Outline

The dissertation outline must be approved by your advisory committee regarding content and style. In addition the mechanics of the writing, it must conform to Graduate College guidelines (available in the Graduate College). This example is taken from a recent dissertation with the specific examples in parentheses. Dissertations are approximately 120 - 200 pages in length, containing 20-30 figures.

Title of Dissertation (DNA replication in *Drosophila* embryos: proteins at the fork.)

Abstract

Chapter 1. Introduction (An overview of DNA replication and its regulation.)

Sections of specific information, for example:

(Replication Fork Enzymes)

(Modulation of DNA polymerase)

(Cell cycle Control)

(Cell cycle regulation during *Drosophila* embryogenesis)

(Specific Aims of this work)

Chapter 2. Experimental Methods and Materials

(Enzyme Purifications)

(Enzyme Assays)

(Other Procedures)

Chapter 3. Purification of Characterization of DNA polymerase

Introduction

Results

Discussion

Chapter 4. DNA polymerase associated proteins in early embryos

Introduction

Results

Discussion

Chapter 5. Characterization of DNA polymerase associated kinase

Introduction

Results

Discussion

Chapter 6. Summary - Regulation of DNA replication at the replication on fork.

References