

**PhD GUIDELINES**  
**Cancer Biology Graduate Program**  
**(Updated September 2023)**

**I. Goals of Graduate Training in Cancer Biology**

**A. Overview**

Our major basic scientific challenge in cancer research is to determine the underlying biological bases for malignancy and the clinical challenge is to apply this basic research to the treatment of human cancers. To meet these challenges, training programs are needed that specialize in the biology and clinical treatment of cancer while, at the same time, expose students to many disciplines (including biochemistry, pathology, molecular biology, therapeutics, immunology, epidemiology, pharmacology and chemistry), and to state-of-the-art research methods.

The Cancer Biology Graduate Program at Wayne State University School of Medicine and the Barbara Ann Karmanos Cancer Institute is committed to providing an outstanding training experience in the rapidly evolving field of cancer research leading to the PhD in Cancer Biology. The guiding philosophy of our training program is to teach students to think critically, through an immersion in an educational curriculum that emphasizes hypothesis-based research in a multidisciplinary setting, training in effective communication, and exposure to cutting-edge technologies. The training program emphasizes clinical cancer care and translational research and provides extensive opportunities for oral presentation and scientific writing. Specialized training in fellowship writing, bioinformatics, metabolomics, etc., as relevant to the dissertation research, is encouraged. The prevailing goal of our training program is to develop scientists with strong foundational training and perspectives in Cancer Biology, and outstanding capacities for critical thinking, effective communication and networking skills needed for professional success in the coming decades. Reflecting our emphasis on reducing cancer disparities, an additional goal of our training program is to encourage workforce diversity by educating trainees from diverse backgrounds.

To complete the PhD in Cancer Biology, students must successfully defend their dissertation research and complete a publishable research project under the guidance of a faculty mentor.

**B. Research**

Outside of the required coursework and written and oral comprehensive exams, the bulk of PhD study involves independent laboratory or population-based research leading to results of publishable caliber. The Cancer Biology Graduate Program offers a variety of research experiences in the broad field of Cancer Biology that range from basic laboratory research to translational research and population-based cancer research. Research opportunities are available in many contemporary areas of Cancer Biology including cancer therapeutics, metastasis, tumor microenvironment, breast cancer biology, carcinogenesis, cancer genetics and epigenetics, cancer epidemiology, and cancer immunology. Dissertation research mentors are selected based on students' research interests and the research rotation experiences (see below). There are numerous ways students can become familiar with faculty research for identifying potential dissertation mentors, including web site summaries, faculty seminars, one-on-one meetings, and the research rotations (see below). Each student must complete three laboratory research rotations during the first year of study, after which he/she chooses a dissertation mentor. Since scientific research is open-ended, the amount of time required for completion of a defensible dissertation leading to the PhD cannot be predicted, although typically the PhD degree in Cancer Biology is conferred within 4 to 5 years. A written dissertation and a final oral defense of the dissertation research to the Dissertation Committee are requirements for conferring the PhD degree in Cancer Biology. There is a requirement for a minimum of one first author publication and one co-authored publication based on the dissertation research for the PhD degree in Cancer Biology.

## **II. Role of the Director, the Graduate Officer and Steering Committee**

The Cancer Biology Director is charged with providing the oversight of all aspects of the Cancer Biology Graduate Program and setting the overall priorities. The Graduate Officer in consultation with the Director will act as an academic advisor for the student until the dissertation advisor has been selected at the end of the first year of PhD study. The student should consult with the Graduate Officer before selecting courses.

Together with the Director and Graduate Officer, the Cancer Biology Graduate Program Steering Committee oversees student progress in the program. Approval by the Steering Committee will be required for the following:

- Acceptance of credit for prior off-campus academic activity
- Selection of rotation advisors
- Selection of dissertation advisor/mentor
- Plan of Work
- Doctoral Committee composition

In addition, the Steering Committee regularly monitors the academic and research progress of students in the doctoral program, decides final operational changes relating to curriculum, admissions, etc., based on recommendations of the appropriate subcommittee (e.g., Curriculum, Admissions). Finally, the Steering Committee of the Cancer Biology Graduate Program serves as the advisory committee for the T32 CA009531 Training Grant in the Biology of Cancer.

## **III. Financial Support**

All students accepted into the program are provided financial assistance. Students receiving assistantships are permitted to take no more than ten credits per semester. Financial support for our PhD training program in Cancer Biology is derived from university graduate research assistantships and fellowships, NIH training grants (T32 CA009531), faculty grants, and individual NIH graduate (F30/F31) fellowships. Assistance with the development and submission of individual F30/F31 graduate fellowships is provided through the Cancer Biology Graduate Program.

Students are covered by a health insurance policy that is partially paid by Wayne State University. Spouses and children of students are also eligible for coverage. The health insurance policy provides coverage for hospital, surgical, consultant and incidental fees.

Funding from various sources is available to attend and present at national/international scientific meetings, and to attend scientific workshops (see below).

## **IV. Curriculum**

An integral part of the Cancer Biology Graduate Program curriculum is the Wayne State University School of Medicine Interdisciplinary Biomedical Sciences (IBS) curriculum that takes a broad-based approach to graduate education in biomedical research. The interdisciplinary focus is accomplished through the combined efforts of the graduate faculty in the School of Medicine. The core curriculum requires several IBS courses during the first year. The training program of each cancer biology student

will be tailored to his/her specific interests and research requirements. As warranted, previous educational experiences will be recognized, permitting the student to progress as rapidly as possible toward the PhD degree. Since the program requires a broad understanding of cancer biology, a core curriculum beyond that of the IBS courses is required. A total of 30 credits from the following are required for graduation. [See Section XVII for Course Descriptions]

***Required Core Courses and Research***

IBS7015 Interdisciplinary Molecular and Cellular Biology	6 credits
2 IBS Biomedical Electives	2 credits each
CB7130 Clinical Aspects of Cancer Biology	1 credit
CB7210 Fundamentals of Cancer Biology	3 credits
CB7600 Applied Cancer Biostatistics	2 credits
CB7700 Recent Developments in Cancer Biology	6 credits (Journal Club)
CB7710 Individual Study in Cancer Biology	3 credits (Research Rotations)
CB7800 Rigor and Reproducibility in Cancer Biology	1 credit
CB7890 Seminar Series	6 credits
CB8920 Principles of Translational and Clinical Cancer Research	1 credit

In addition to the required courses, a number of advanced cancer biology courses are offered from which students can choose up to 15 credit hours. At least 8 of these credits must be from CB elective courses. This gives a total of 45 coursework credits. A number of other courses are available to allow students to specialize in a specific research discipline.

***Elective Courses (up to 13 credit hours)***

CB7220 Molecular Biology of Cancer Development	3 credits
CB7240 Principles of Cancer Therapy	2 credits
CB7300 Special Topics in Cancer Biology	1-3 credits
CB7410 Cancer Immunology and Immunotherapy	3 credits
CB7430 Cancer Epidemiology	2 credits
CB7460 Mechanisms of Neoplasia-Signaling	3 credits
CB7300 Special Topics in Cancer Biology	1 credit
CB8910 Applied Cancer Omics and Data Analysis	1 credit

During the second year of PhD study, students must submit a “Plan of Work” that documents the academic curriculum leading to the PhD. It is expected that the majority of the course work will be completed during the first and second years of PhD study. A written comprehensive qualifying exam is administered in the late spring of the first year of study, based loosely on an individual F30/F31 predoctoral fellowship application. This is followed during the second year by an oral comprehensive exam of the proposed dissertation research based on a written research prospectus. PhD candidacy is conferred upon successful completion of the oral comprehensive exam. During the summer of the first year of study, a month-long clinical rotation is required (CB 7130) during which graduate students “round” with oncologists treating cancer patients in the Karmanos Cancer Hospital. First year PhD students are also required to read the book “The Emperor of All Maladies: A Biography of Cancer” by Siddhartha Mukherjee during the summer of the first year of PhD study. The third and subsequent years are primarily devoted to dissertation research. Forty-five credits of general research, including 30 credits of dissertation research during consecutive semesters (see below) will complete the Graduate School requirements for the PhD degree.

## ***Dissertation Research***

CB7996 Research	1-15 credits
CB9991 Doctoral Candidate Status 1	7.5 credits
CB9992 Doctoral Candidate Status 2	7.5 credits
CB9993 Doctoral Candidate Status 3	7.5 credits
CB9994 Doctoral Candidate Status 4	7.5 credits

Conferring of the Doctor of Philosophy degree in Cancer Biology requires at least ninety credits.

In addition to traditional classroom learning, there are many additional educational opportunities available to our students including seminars by nationally/internationally renowned scientists both within and outside the cancer center, special non-credit courses, fellowship and grant writing, and research workshops.

### **V. Rotations**

#### **A. Definition**

Research rotations (CB 7710) are research projects carried out by first-year students under the supervision of a full-time Cancer Biology graduate faculty member. A rotation has defined objectives that can be accomplished within the allocated time span.

#### **B. Objectives**

Research rotations are expected to achieve two major objectives:

1. The student will gain valuable training and experience in laboratory or population science research techniques and approaches.
2. The student will be provided an experience by which to choose a specific faculty member to direct her/his doctoral dissertation research.

The value of productive research rotations cannot be over emphasized since optimal pairing between students and mentors is essential to successful PhD study.

#### **C. Number and Duration of Rotations**

Graduate students will complete three rotations within the first year of the graduate program. Each rotation will consist of no less than 8 weeks per rotation. Typically, this includes 2 rotations in the fall semester, followed by one 8 week rotation in the winter semester. The student is expected to spend a minimum of 15-20 hours per week performing research. Students who choose to enter the program in the summer term prior to matriculation have an opportunity to complete a 10-week rotation before classes begin. During the summer term, the student is expected to expend full time (~40 hours per week) effort on the rotation project.

#### **D. Selection of Rotation Advisor**

During the week prior to the beginning of the fall semester, an orientation will take place for incoming students. At this time, students will also be introduced to the rotation expectations and a list of potential rotation mentors will be provided. Students are expected to meet one-on-one with potential rotation mentors during the first two weeks of the fall semester. By the end of the 2<sup>nd</sup> week of the fall semester, students should identify their mentor for the first rotation for the fall semester.

During the fall semester, students should take the opportunity to meet with faculty members who might

serve as rotation mentors for the 2<sup>nd</sup> (fall) and 3<sup>rd</sup> (winter) rotations.

All rotations must be approved by the Cancer Biology Director in consultation with the Steering Committee.

### **E. Final Report**

At the end of the rotation (within two weeks of completion), a written evaluation the student's progress (see "Rotation Appraisal" on the Cancer Biology web page under "Resources") is submitted by the student to the Cancer Biology Graduate Program Office. The final report should be approved by the rotation mentor (indicated by a signature and date). The purpose of the appraisal and final report is to provide the Steering Committee a means of monitoring student progress during the laboratory rotations.

### **F. Academic Credit**

The student will register for one credit of CB7710 (Individual Studies) for each rotation. The faculty advisor will be responsible for assigning a satisfactory/unsatisfactory grade associated with the rotation.

## **VI. Seminars and Conferences**

There are a multitude of cancer-related seminars throughout the university and cancer center. The Karmanos Cancer Institute Cancer Research Seminar Series offers a monthly seminar by nationally/internationally recognized leaders in Cancer Biology. In connection with these seminars, students will regularly meet outside speakers. At least one student-hosted seminar is planned each academic year. Seminars are considered an integral part of the educational experience leading to the PhD degree so attendance is expected. Seminars are posted on the Cancer Biology Graduate Program web site and will be advertised by email.

In addition to formal seminars by outside speakers, students are provided special training opportunities ranging from career guidance to research workshops. Students will be notified electronically of these opportunities. Students are expected to attend and present their research at national and international conferences, with matching support provided by the Cancer Biology Graduate Program for one conference each year. Additional travel support for students is provided by the Graduate School. Consideration for travel funding from the Cancer Biology Program is dependent upon attendance of at least 80% of Karmanos Cancer Institute Research Seminars.

An annual Cancer Biology Graduate Research Symposium organized by the graduate students is held in the winter/spring at which students will have opportunities to present their research in posters and oral presentations. Highlights of the annual symposium include a keynote address by a distinguished alumnus of the Cancer Biology Program and announcement of the recipient of the "Leonard N. Simons Award for Exemplary Research and Scholarly Achievement" to a Cancer Biology PhD student who has distinguished him-/herself through scholarship and leadership among his/her student peers. In 2023, the Mary Lou Zieve Award for Professional Development was also added which provides a senior Cancer Biology student support for specialized training that would directly impact his/her research. Participation in the research symposium is mandatory for all Cancer Biology students beginning with their 1<sup>st</sup> year of PhD study.

In addition, students are required to attend and participate in the student Journal Club (CB7700) and Cancer Biology Seminar (CB7890).

Attendance at PhD student defenses in Cancer Biology is also mandatory.

## **VII. Academic Requirements**

All students are required to maintain at least an earned "B" grade point average (3.0 GPA) in the Cancer Biology graduate curriculum. If a student's GPA falls below 3.0, that student cannot be supported by a Graduate Assistantship and is placed on academic probation for the next semester. Failure to raise the GPA to the minimum 3.0 level will be the grounds for dismissal from the Cancer Biology Graduate Program. A grade lower than "B" in any of the core curriculum courses will also be grounds for dismissal from the program.

## **VIII. Written Preliminary Examination**

A written preliminary examination will be administered at the end of the winter semester of the first year of the program. This examination involves development of a research proposal based on research papers submitted by Cancer Biology faculty members. Examinations are graded by up to 3 Cancer Biology faculty members who are expected to meet with the student to discuss the proposals and how they could be improved. Passage requires sign-off by the three faculty reviewers. Students must pass the written comprehensive examination prior to taking the oral comprehensive examination and progressing to PhD candidacy.

## **IX. Selection of Dissertation Advisor**

The Cancer Biology Program offers dissertation research opportunities in many areas of Cancer Biology, spanning from basic research to translational research and population-based research. At the end of the first year of PhD study, the student will choose a dissertation research project and a mentor under whom to study. Final approval of the dissertation mentor will be by the Cancer Biology Steering Committee.

Upon committing to a particular mentor, realistic goals should be set by the student and mentor for performing a research project that can be completed within 3-4 years. A signed Mentor/Student Agreement must be signed by mentors and students and returned to the Cancer Biology Program office. Copies of the Mentor/Student Agreement can be found on the Cancer Biology web site.

## **X. Plan of Work**

The doctoral student must complete the University's Plan of Work form before 45 credit hours of research have accrued. This document should be prepared with the assistance of the Graduate Officer and the PhD Dissertation Advisor. An example of a Plan of Work is under "Resources" on the Cancer Biology Graduate Program web site. The Plan of Work requires the signed approval of the student's Dissertation Advisor and the Cancer Biology Graduate Program Graduate Officer.

## **XI. Selection of a Doctoral Committee**

During the first semester after approval of the Dissertation Advisor, the student, together with the Dissertation Advisor, should select a Doctoral Committee. The committee shall consist of at least four members of the Graduate Faculty. The committee members must include the student's Advisor and two other members of the Cancer Biology faculty with primary, joint or secondary appointments in the Department of Oncology, and one member with a primary appointment in a department other than

Oncology. For CB faculty advisors with Graduate Faculty status in a department other than Oncology, a Doctoral Committee co-chair with a Graduate Faculty appointment in Cancer Biology/Oncology must be appointed. The Doctoral Committee must be approved by the Cancer Biology Graduate Program Steering Committee. The Steering Committee reserves the right to require faculty additions to the Doctoral Committee.

The purpose of the Doctoral Committee is to guide the student's progress. The Doctoral Committee is also charged with administering both the oral examination required for progression to PhD candidacy (see below), as well as the Doctoral Dissertation Defense.

Additions or deletions from the original Doctoral Committee must be approved by the Steering Committee and the Graduate School. The student must meet with his/her Doctoral Committee at least twice each year. The student will be responsible for organizing the committee meetings. A Committee Report Form (this form can be found on the web site under "Resources") must be completed summarizing the recommendations of the Dissertation Committee, signed by all committee members and submitted to the Cancer Biology Graduate Program office within one week following the committee meeting.

## ***XII. Individual Development Plans***

All Wayne State graduate students are required to prepare Individual Development Plans (IDPs). This requirement stems in part from federal agency mandates, and is designed to provide students with a concrete mechanism by which to examine and plan career choices and to monitor progression toward these goals during their graduate training. IDPs should be prepared by students during fall of the first year upon consultation with the Graduate Officer, Program Director and dissertation mentors. They are to be submitted to the Graduate School, and must be updated annually. For further information, including worksheet, template, and submission forms, please visit the following web site: <http://gradschool.wayne.edu/policies/idp.php>. A copy of the IDP should be provided to the Cancer Biology Graduate Program office.

## ***XIII. Oral Qualifying Examination and Dissertation Proposal***

After successful completion of the written preliminary examination, the student will prepare a written "Dissertation Prospectus" outlining the proposed dissertation research. The outline should be organized similar to the Research Plan of a F31 fellowship application to the National Institutes of Health. The research proposal will be the basis of the oral qualifying examination. Students are expected to develop their research proposals into individual predoctoral fellowships for submission to the Department of Defense, Komen Foundation, National Science Foundation, and NIH. Fellowship applications are expected to be submitted during year 3 of PhD study.

The Doctoral Committee will administer the oral examination. Oral examinations are generally administered between January and May during the second year of PhD study. Satisfactory performance will be determined by having no more than one dissenting vote on passing. In the event of a failure, the Committee may recommend to the Graduate Program Steering Committee and the Office of Graduate Studies either (i) that a second examination be taken within 12 months, but no sooner than one academic semester after the first examination, or (ii) dismissal of the student from the program. After successful completion of the oral qualifying examination and incorporation of any modifications requested by the Doctoral Committee, the written research proposal along with a summary as indicated on the Graduate School Dissertation Outline Form will be submitted to the Graduate School for

approval.

#### ***XIV. Steps to Achievement of Doctoral Candidacy***

The student achieves PhD Candidacy status after completing the following requirements:

- A. Satisfactory completion of two years of study in the Cancer Biology Graduate Program, in which most if not all of the core curriculum will have been completed.
- B. Satisfactory completion of the written comprehensive examination.
- C. Filing and approval of the Plan of Work with the Graduate School.
- D. Passing of the oral qualifying examination.
- E. Filing and approval of the Research Prospectus, and Candidacy forms with the Graduate School.

Students are expected to achieve Doctoral candidacy by June of their second year in the program and no later than the end of the summer semester of their second year.

#### ***XV. Progress Toward the PhD Degree***

By June 1 of the third academic year of PhD study, all Cancer Biology students are expected to provide (a) a one-page summary that includes the research progress toward each of their specific aims from the prospectus and (b) a copy of their CV. These documents will be reviewed by the Cancer Biology Graduate Program Steering Committee to evaluate progress toward the PhD. If progress toward the PhD is considered inadequate, the student will meet with the Cancer Biology Program Director and/or the Cancer Biology Steering Committee. Inadequate progress toward the PhD is grounds for redirection toward a Master's degree track and/or dismissal from the Cancer Biology PhD program.

#### ***XVI. Steps to Completion and Awarding of PhD Degree***

Students have a seven-year time limit to complete all requirements for the PhD degree. Upon completion of the doctoral research, there are specific steps that must be taken to graduate with the PhD degree in Cancer Biology.

- A. Student prepares dissertation.
- B. Student files "Application for Degree" no later than the last day of registration for the term in which he/she expects to graduate.
- C. Students planning to defend their PhDs must first solicit approval from the Cancer Biology Steering Committee and the Program Director to defend their PhD prior to soliciting approval from the PhD Dissertation Committee. At least two weeks prior to the date of the upcoming final dissertation committee meeting, a ~1 page summary which outlines the student's research accomplishments in relation to each of the proposed aims, a summary of publications, awards, etc. on which awarding the PhD will be based should be submitted to the Cancer Biology Program office. The report should be accompanied by an "Application to Defend the PhD in Cancer Biology" form from the Cancer Biology website. The Cancer Biology Graduate Program Steering Committee will review, approve or disapprove the progress report, and advise the Cancer Biology Program Director of the decision.



- D. Upon approval from Cancer Biology Program Director, the student meets with the Doctoral Committee and receives Committee approval for the dissertation defense.
- E. The student submits the dissertation to the Graduate School approval of dissertation format.
- F. Student arranges date/time/place of final oral defense and informs the Graduate School two weeks in advance. Advertising the PhD defense is coordinated with the Cancer Biology Graduate Program office.
- G. The student completes Final Report document. The Final Report document must be signed by all PhD Dissertation Committee members, the Cancer Biology Graduate Director, and the Graduate Officer indicating that the dissertation has passed the plagiarism check.
- H. The student uploads the document to the ETD web site and submits to the Graduate School the signed Final Report document with a copy of the defense flyer at least 2 weeks prior to the date of defense.
- I. A public lecture is announced and advertised, after which the student presents a public lecture and participates in a closed-door defense of the dissertation with the Doctoral Committee.
- J. The Final Report form and the Graduate Examiner's Report form with all signatures and marks are returned to the Graduate School within 48 hours of the defense. To communicate to the Graduate School that revisions to the dissertation were requested at the defense, the box on the defense form indicating that "Revisions to Dissertation Required" should be marked.
- K. Once the dissertation corrections have been completed to the satisfaction of the Dissertation Committee, committee members should sign the front page of the dissertation indicating that the student has made the revisions satisfactorily. The student should upload the final document with the signed front page by the deadline date for the semester in which he/she wishes to graduate.

In addition to the dissertation requirement, all students receiving a PhD in Cancer Biology are expected to publish a minimum of 2 research publications (exclusive of review articles) in ISI indexed journals (i.e., cited on PubMed), at least one for which the student is first author.

## ***XVII. Cancer Biology Course Descriptions***

***CB7130 - Clinical Aspects of Cancer Biology (1 Credit):*** Cancer Biology PhD students accompany clinicians during rounds in hospital and outpatient clinics, as well as attend clinical conferences and related sessions.

***CB7210 - Fundamentals of Cancer Biology (3 credits):*** This team-taught course is intended to introduce the students to the basic principles of neoplastic development, progression and therapy. The lectures are organized into three thematic blocks including cancer development and pathology, mechanisms of cancer development and progression, and principles of cancer prevention and therapy. **Prerequisites:** **IBS 7015**. This course is offered every year in the winter semester.

***CB7220 - Molecular Biology of Cancer Development (3 credits):*** This team-taught course is intended to educate students on the genetics and molecular basis of normal cell transformation into malignant cancer cells. Molecular mechanisms that are fundamental to the regulation of cell growth, development, and differentiation will be discussed. The students are expected to present and participate in discussions of one or more key recent papers that are relevant to the lectures. **Prerequisites:** **IBS7015 and CB7210**. Students with a strong background in biology/molecular biology

are encouraged to enroll. This course is offered in the fall semester of odd years.

**CB7240 - Principles of Cancer Therapy (2 Credits):** This is a team-taught course designed to expand significantly upon the principles of cancer therapy taught in CB7210. Concepts relating to tumor biology and the biochemistry and pharmacology of both classic and targeted agents are covered. **Prerequisites: IBS7015 and CB7210.** This course is offered in the winter term of even years.

**CB7300 - Special Topics in Cancer Biology (1 -3 Credits):** This course is designed to provide students exposure to emerging themes and technologies in the cancer field as well as to cancer related topics that are not covered in detail in other courses. Special Topics courses may be team-taught or taught by individual faculty, and will be offered as a minicourse or full course. This course will be offered in the fall and winter semesters. **Prerequisite: IBS7015.**

**CB7410 - Cancer Immunology and Immunotherapy (3 Credits):** The purpose of this course is to introduce students to concepts and methodologies in cancer immunology and immunotherapy as well cutting-edge developments in the academia and the industry in this rapidly progressing field. Upon the completion of the course, the students will become familiar with how the immune system recognizes limits and eradicates cancer, how cancer immunity is influenced by host genetics and environmental factors, how cancer immunotherapies are predicted, performed and monitored in the era of precision medicine and artificial intelligence, and what are the future developments anticipated for cancer immunotherapy. The curriculum is updated every time when the course is offered. Each week consists of a 1.5-hour lecture and a 1.5-hour discussion. Offered Every Other Winter. **Prerequisite: IBS 7090 with a minimum grade of C or equivalent and consent of coordinators. Restriction(s): Enrollment is limited to students with a major in Cancer Biology. Equivalent: IM 7410 (for students of other IBS majors).**

**CB7430 - Cancer Epidemiology (2 credits):** This course will serve to introduce students to the general concepts and methods used in cancer epidemiology research. The course is intended to educate students on important measures of cancer burden in the United States and worldwide, as well as the major causes of human cancer. As part of the course curriculum, students will be required to review and provide critical appraisal of selected literature in innovative areas of cancer epidemiology research. **Prerequisites: None. However, FPH 7240 "Introduction to Epidemiology" is strongly recommended by the instructor.** This course is offered in the winter semester of odd years.

**CB7460 - Mechanisms of Neoplasia Signaling (3 Credits):** This course is intended to educate students about the cellular regulatory signal-transduction-networks that are often activated inappropriately in malignant cells. The course will focus on the major principles of cancer cell biology including survival, apoptosis, adhesion, and cell cycle deregulation. The lectures and discussions of the current discoveries and observations in the field of cancer research will be conducted by expert cancer researchers, and are aimed at enhancing analytical and critical thinking skills of students and researchers from diverse backgrounds including cancer biology. **Prerequisites: IBS7015 and CB7210.** Students with a strong background in biology/molecular biology are encouraged to enroll. This course is offered in the fall semester of even years.

**CB7600 - Applied Cancer Biostatistics (2 Credits):** Students are introduced to the concepts and applications of statistical methods and data analysis. Students will have hands-on experience in statistical thinking, analyzing, and interpreting through the interactive teaching modules. The course provides an opportunity for students to understand statistical analyses in the Cancer Biology literature, as well as provide guidance for planning and analyzing their own research studies. This course is offered in the fall semester of even years.

**CB7700 - Recent Developments in Cancer Biology (1 credit):** This course is organized in a journal club format and is designed to develop proficiency in critically evaluating original scientific literature, to develop oral and written communication skills, to broaden knowledge of current cancer research, and to provide insight into different research strategies. Each student is expected to participate in class discussions. This course is restricted to students in the Cancer Biology Graduate Program. It is offered each year during the fall and winter semesters and is **mandatory for students in years 1-4.**

**CB7710 - Individual Studies in Cancer Biology:** Cancer Biology graduate students pursue experimental research under the guidance of selected faculty. This is the research rotation through which first year students select their PhD dissertation mentor.

**CB7800 - Rigor and Reproducibility in Cancer Biology (1 Credit):** The objective of this course is to provide students with the ability to understand and learn how to conduct rigorous and reproducible cancer research. These include experimental design, data interpretation, publishing, animal and human research, and other topics relevant for the conduct of responsible research in Cancer Biology.

**CB7890 - Seminars in Cancer Biology (1 Credit):** This course provides Cancer Biology students with the opportunities to present their dissertation research to their peers. This class not only provides the students with the opportunity to develop their oral presenting skills, but also gives the students a chance to critically evaluate their peers. **This course is mandatory for all students in all years in the Cancer Biology program** and is offered every fall and winter semester.

**CB8910- Applied Cancer Omics and Data Analysis (1 Credit):** This course is designed to instruct students who have a general background in molecular biology in the understanding and practical application of contemporary “omics” technologies within the context of cancer research. The course will emphasize the use of publicly available cancer “omics” datasets and associated bioinformatics tools for data mining. Students will develop skills by utilizing data repositories and analysis methods in a project geared toward their research interests. No coding or programming experience is required.

**CB8920- Principles Translational and Clinical Cancer Research (1 credit):** The goal of this course is for the students to understand the fundamentals of translational and clinical cancer research with an emphasis on identifying clinically meaningful research goals and application of laboratory-based research into clinical trials. The students will attend a series of lectures from clinical oncology faculty members. Students will work with clinical mentors to develop translational research projects or correlative end points for a clinical trial concept. Students are expected to present a brief proposal of the project at the end of the course, which will be evaluated by the course director.