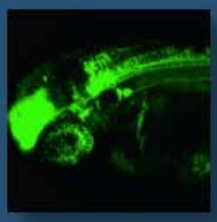
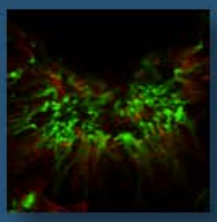
University of Pittsburgh

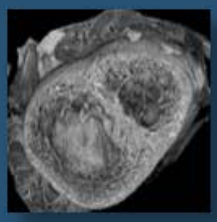
ISB INTEGRATIVE SYSTEMS BIOLOGY



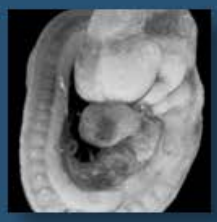
Lhx1a transgenic zebrafish



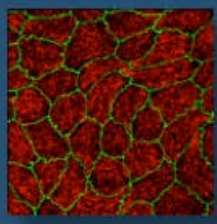
zebrafish otic vesicle cilia



congenital heart defect



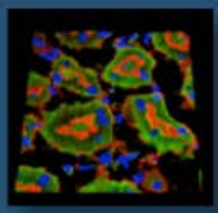
mouse embryo



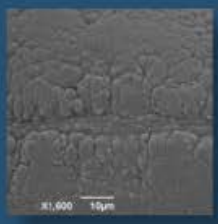
tight junctions



neural tube



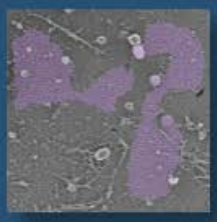
ARH in kidney



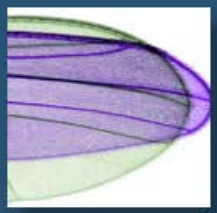
embryonic ectoderm



neural tube defect



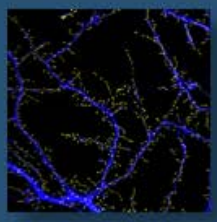
Clathrin-coated patches



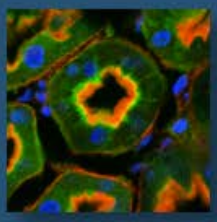
Drosophila wing



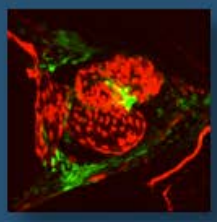
Fes SH2-kinase



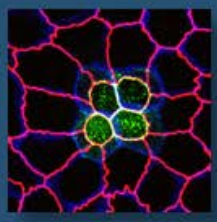
hippocampal neuron



EHD1 in kidney



zebrafish heart



Shroom - MDCK cells

I. INTRODUCTION

Integrative Systems Biology (ISB)

The ***Integrative Systems Biology*** **(ISB)** graduate program provides an exciting, innovative and vigorous academic environment for training highly motivated biomedical students and preparing them for a systems biology research career in academic institutions and industry. The ISB faculty pursues diverse and complementary research programs addressing contemporary scientific problems across biology and medicine. The ISB program is at the cutting edge of biomedical research areas including, but not limited to, developmental and reproductive biology, molecular and cell biology, stem cell biology, cellular and organ physiology, microbial pathogenesis and regenerative medicine. A systems biology / big data approach is used to investigate the development and function of living systems. These processes can be investigated using advanced quantitative and computational approaches for large scale, high-end imaging analysis that can be applied to various "omics" analyses—genomics, transcriptomics, metabolomics, and proteomics. The program will provide the requisite foundation for interrogating the mechanisms of human disease that can translate into contemporary clinical practice. State-of-the-art experimental approaches are employed, including whole organism drug discovery, stem cell therapy, and next generation sequencing that supports genomics and personalized medicine. The ISB program brings together faculty in basic and translational sciences, including researchers from multiple departments in the University of Pittsburgh School of Medicine, the Department of Biological Sciences in the University of Pittsburgh Dietrich School of Art and Sciences, the Department of Biological Sciences, Carnegie Mellon University as well as the Magee-Womens Research Institute, and the Rangos Research Center, Children's Hospital of Pittsburgh. ISB is an innovative program in graduate education that aims to train highly motivated students as self-reliant scholars in an environment where they have ready access to the breadth of approaches and sub-disciplines that constitute this diverse field through an inter-school program that rapidly immerses students into a research environment, and mentors them to become independent and creative scientists. The rapidly changing landscape of modern biomedical sciences dictates the necessity for incorporating formal training in systems, computational and quantitative approaches for the handling and processing of large datasets as an essential part of biomedical graduate education. Such training will provide the necessary qualifications for the next generation of leaders in the biological and biomedical research enterprise.

A. Cardinal aspects of the ISB Program include:

- ISB faculty members are deeply committed to graduate and postgraduate education. They engage ISB students in core research efforts within their labs.
- Students are encouraged to select a mentor and a secondary co-mentor with complementary expertise, such as basic science, translational science and computational/systems biology.
- Frontal didactic teaching is reinforced by informal small group discussions with faculty.
- Information is provided through theoretical experimental design, disease deconvolution and reconstruction.
- An option for early fulfillment of the comprehensive examination requirement is available for students who publish a first-author paper in a peer reviewed scientific journal during the first year of the thesis project in the laboratory; requires a presentation of the paper and approval of the steering committee.

- With team teaching, courses are designed around cohesive themes that facilitate students' understanding of the material through gradual conceptual progression and skill building.
- Externship experiences allow students to broaden training in diverse research disciplines, such as personalized medicine, clinical or translational research, drug discovery, computational modeling, and tissue engineering. Offered at the late stage of thesis research, externships include the opportunity to spend up to 6 months in a different laboratory at an academic or industry setting.

B. Faculty research interests can be broadly divided into four major areas:
(http://www.isb.pitt.edu/faculty_pages/faculty_interests/faculty_research_interests.html)

1. **Cell, Development, and Molecular Biology:** Research in this area centers on basic molecular mechanisms underlying intracellular trafficking and organelle biogenesis, cytoskeletal organization, cell polarity, regulation of channels and transporters, cilia biology, signal transduction, cell cycle control in injury and wound healing, early embryonic patterning, organogenesis, and the transition from gamete to embryonic, and fetal development to the adult reproductive organism. Projects in this area utilize in vitro cell systems, as well as animal models, and human patient data and specimens in order to bring together diverse aspects of cell and developmental biology and gain insight into processes underlying human diseases.

2. **Quantitative Biology.** Research in this area focuses on developing quantitative approaches studying and predicting biological mechanisms of function and intervention methods at multiple scales. Research topics include cell and systems modeling, quantitative systems pharmacology, personalized medicine, big data analysis and synthetic biology. Projects will combine experimental and computational/quantitative components and will be at the interface between life sciences, computer sciences, physical sciences and engineering.

3. **Translational Medicine:** Areas of translational research are diverse, and include a wide range of research topics. Examples include genetic etiology of disease, molecular mechanisms involved in disease, molecular aspects of disease physiology, stem cell biology, regenerative medicine and chemical biology and drug design.

4. **Genes and Evolution:** This area focuses on the evolution of developmental patterning and the ancestral relationships driving speciation and the diversity of adaption, and their role in development and disease. These approaches include exploration of the origin and evolution of embryonic development, modification of developmental processes underlying emergence of new form and function, and the role of developmental plasticity in evolution. Systems approach with analysis of large scale sequencing data, and the integration of interactome and gene regulatory network analysis are pursued to elucidate the molecular mechanisms that contribute to evolutionary processes.

For a more detailed description of individual faculty research, please visit the ISB graduate program website: www.isb.pitt.edu

II. DOCTOR OF PHILOSOPHY DEGREE

A. ADMISSION

All interested students apply for admission directly to the ISB program. The deadline for receipt of applications is January 1 for admission to the subsequent fall term. However, early applications are encouraged, and offers may be extended to suitably qualified candidates before the application deadline.

Students seeking a Ph.D. degree are encouraged to apply, the program does not directly admit students for an M.S. degree.

Minimum requirements for admission include a baccalaureate degree in a natural or physical science or engineering program, scores from the general Graduate Record Examination (GRE) test and three letters of recommendation. Candidates must possess a minimum grade point average of 3.0 (on a scale of 4) or its equivalent from an accredited institution. Details about the application process can be found at http://www.isb.pitt.edu/apply/apply.html.

Prior research experience is highly desirable and letters of recommendation from faculty familiar with the applicant's research accomplishments are particularly valuable to the evaluation process.

Selected applicants will be invited for an interview at the University of Pittsburgh. Funds to cover travel expenses are available. In certain circumstances, the Graduate Studies Admissions Committee may choose to conduct a telephone interview with the prospective candidate.

Foreign applicants with undergraduate degrees from countries other than Canada, Australia, the United Kingdom and New Zealand are required to take the Test of English as a Foreign Language (TOEFL) and provide official score reports from both the spoken (TSE) and written (TWE) parts of the examination.

B. FINANCIAL AID

Financial support with remission of tuition and fees is available to all graduate students in the program for the duration of their studies. Students may be supported from the following sources:

1. Dean's Fellowships. All students are supported through the Dean's office during the first year of study. Support consists of tuition remission and a stipend for the first year of graduate study.

2. Research grants to individual faculty members. Students involved in thesis research are frequently supported from research grants to their major advisor. It is the policy of the Program that the amount provided by faculty members for student support will be such that the total stipend received by the student from all departmental or medical school student support funds shall be neither greater nor lesser than the stipend level designated by the Integrative Systems Biology Graduate Program. Student stipend support by faculty research grants will begin at the conclusion of the Dean's Fellowship

support.

3. Training Grants. A limited number of students involved in thesis research may be supported by training grants in specific programs. Students whose major advisor is a member of the training faculty of such grants are eligible to compete for such funds.

4. Foundation and Government Fellowships. Qualified second-year students are strongly encouraged to apply for these prestigious and highly competitive awards.

All Ph.D. degree candidate students are expected to receive their stipend and tuition remission each year regardless of the sources of support. If the amount of the stipend a student receives from any source is less than current rate at the University of Pittsburgh, the sponsor of the student is expected to make up the difference.

The University will provide individual health insurance under the graduate student plan. An option to purchase family coverage is available at a cost, which is the difference between family coverage and individual coverage.

As part of the Program's intention to provide the greatest opportunity to develop scholarship and research skills, stipends are intended to support full-time commitment on the part of the student to successfully complete his/her graduate training in a reasonable period of time.

C. DEGREE REQUIREMENTS

C.1. Requirements for a Ph.D.

The ISB Program is comprised of formal course work and original research, which is designed to allow attainment of a Ph.D. in 4-6 years. The University requires students seeking the Ph.D. degree to engage in a minimum of one term of full-time doctoral study, which excludes any other employment, except as approved by their departments. The Ph.D. degree work must be completed within a period of 10 years from the student’s initial registration for graduate study. If the student has received credit for a master’s degree appropriate to the field of study, then all requirements for the Ph.D. degree must be completed within eight years.

A minimum total of 72 credits are required to satisfy the Ph.D. requirement. Of these, 32 credits must come from approved courses and lab rotations, not including Dissertation Research.

C.2. Requirements for a Masters Degree.

Students are not directly admitted to the ISB graduate program to attain a M.S. degree. In certain cases, however, it may be necessary that a student in the Ph.D. program be transferred to a terminal M.S. degree program. Students pursuing a M.S. degree in ISB will be required to complete the same course work as described for the Ph.D. program during the first two years and to prepare and successfully defend a Masters Thesis as agreed upon by the dissertation advisor and the program directors.

D. COURSES

All students are required to complete a minimum of 72 credits to satisfy the Ph.D. requirement, out of which a minimum of 32 credits must be formal coursework. The curriculum of the ISB program consists of two introductory courses to programming and statistics, a set of four core courses (the Approaches courses), the Ethics core course, two elective courses, Rotations, Seminars, and Journal Club. The introductory courses can be waived for students that possess the necessary skills with the approval of the directors.

Required Core courses:

Programming	MSCBIO 2025	3 credits
Biostatistics	BIOST 2041	3 credits
Systems Biology I	ISB 2020	3 credits
Systems Biology II	ISB 2035	3 credits
Grant Writing	INTBP 3240	2 credit
Scientific Ethics and Responsible Conduct of Research	INTBP 2290	1 credit
Beside to Bench	ISB 2070	2 credit
ISB Conference	ISB 2060	1 credit
Laboratory Rotation	ISB 2000	3 credits

Most core courses are graded by the A-F system (letter grade) and few by Pass/Fail. A grade of B or better is required for passing a core course. For more about grade requirements, please see the corresponding section.

A written report of each Laboratory Rotation will be required as part of this course. This report is to be graded by the project advisor. If an incomplete ("I") grade is given by a faculty member to a student in this course, a memo must be prepared by the faculty member and sent to the graduate student advisor and the student, stipulating what measures must be taken and the time frame within which the student is to make up the grade.

Elective Courses:

A total of at least two elective courses must be taken in the second year, including at least one biological and one quantitative elective. Any graduate level course in the University of Pittsburgh or Carnegie Mellon University can be counted towards the elective requirement with approval of the Directors. A letter grade of B- or better is considered a passing grade for elective courses.

Overview of the Path towards Obtaining an Advanced Degree

First Year – Fall

• Programming	3 credits
• Biostatistics	3 credits
• Beside to Bench	2 credit
• ISB Conference	1 credit
• Laboratory Rotation	3 credits
First Year – Spring	
• Systems Biology I	3 credits
• Systems Biology II	3 credits
• Beside to Bench	2 credit
• ISB Conference	1 credit
• Directed Study	1-4 credits
First Year – Summer	
• Directed Study	2 credit
• Professional Skills & Ethics	1 credit
End of First Year: Evaluation and promotion to the second year based on grades in courses and reports from Laboratory Rotations and the Advisor.	
Second Year	
• Two electives	
• Directed Study	1-9 credits
• Comprehensive Examination. Prepare written proposal on the thesis project and defend it by oral examination before thesis committee.	
• Choose thesis committee	
• Advancement to candidacy for the Ph.D.	
• Beside to Bench	
• Grant Writing Course	
• ISB Conference	
Subsequent Years	
• Foundations of Career Development Planning	
• Beside to Bench	
• ISB Conference	
• Full time thesis research	
• Write and defend thesis	
• Graduation!	

Laboratory Rotation:

Laboratory research is the major component of any biomedical Ph.D. program. The ISB supervises the process of research rotations during the first year. Students are expected to complete three research rotations by the end of the first semester. Students can chose to either start their rotations in the July or August rotations. At the end of each rotation, the student is required to complete a written report that is prepared according to the rotation report students will obtain at the beginning of each rotation. When the written report is complete, the rotation mentor will review the performance of the student and assign a letter grade for the rotation. Failure to maintain satisfactory laboratory performance will result in dismissal from the program. It is expected that the three rotations will be performed in different laboratories of members of the ISB training faculty. This will provide the student with an adequate opportunity to identify an area of research interest and to establish a relationship with a potential

dissertation advisor. It is possible for students to take a fourth rotation if necessary. Requests to modify the rotation requirements must be made, in writing, to the Graduate Program Director. Students are responsible for submitting a copy of the rotation report to the Rotation Advisor by the date indicated below. Students and Rotation Advisors are asked to discuss the rotation as well as the report and complete an evaluation form. The completed evaluation form (with all signatures) should be submitted to Shari Murphy at sas101@pitt.edu. The laboratory rotation schedule for academic year 2017-18 is listed below:

Rotation Schedule

Rotation Begins	Rotation Ends & Report Due	Evaluation Form Due
August 27, 2018	September 28, 2018	October 5, 2018
October 1, 2018	November 2, 2018	November 9, 2018
November 5, 2018	December 11, 2018	December 14, 2018

Progress evaluation:

An evaluation at the end of the first year assesses student progress, and consists of the Steering Committee reviewing student transcripts, rotation reports, and any additional information. Subsequently, a comprehensive exam is taken during the second year. Upon successful completion of the comprehensive exam, students will propose a doctoral committee and present a dissertation proposal as promptly as possible. An annual review of all ISB students will be conducted by the Steering Committee. If a significant deficiency is identified, the student will receive an unsatisfactory rating and may be placed on probation. Specific recommendations within a designated time frame will be given. Failure to remedy the unsatisfactory areas with the defined time period may result in dismissal from the program. A decision of dismissal shall be made by a majority vote of the Steering Committee.

Grades:

University policy dictates that the student must have a cumulative grade point average (QPA) of at least 3.0 for graduation. This grade is computed on the basis of course credits only, and students are graded on an A to F basis in required and elective courses. The Program requires that the student obtain a minimum of a B grade in all required courses, B- or better in all elective courses and maintain a QPA of 3.0. Only A through F grades are employed for the QPA computation. If a student has failed to maintain the minimum grade requirement, the Steering Committee must decide whether to dismiss the student from the ISB program or allow the student to retake any required course for which a grade less than a B was received, as well as restore a minimum QPA of 3.0; such students will be on probation.

E. FACULTY ADVISOR

During the first term in residence, each student is expected to interview the Program faculty members regarding possible research areas for their dissertation. In the second term, the student will choose a mentor(s) (and possible co-mentor) who will give assistance on the decision about the subject of the dissertation research program and who will remain in close consultation with the student about various aspects of the research as it unfolds. The student must submit to the Director of the Program written notification of the choice of a faculty mentor(s)/co-mentor. Students enrolled in the ISB Program may select a thesis advisor only from among the ISB Program faculty. Current ISB Program faculty and their research interests

are listed on the ISB web site.

F. RESEARCH CREDITS

Students enrolled in the M.S. program will register for ISB 2500 for their research accreditation. Students enrolled in the Ph.D. program will register for ISB 3500 for their research accreditation. Laboratory research is the major component of any biomedical Ph.D. program. Failure to maintain satisfactory laboratory performance may result in the student being placed on probation. Failure to remedy the problems in laboratory research may result in dismissal from the program by a vote of the ISB Steering Committee.

G. COMPREHENSIVE EXAMINATION AND ADMISSION TO CANDIDACY

1. Introduction: The Comprehensive Examination will be administered after the student has completed or is near completion of their second-tier course work, has decided on the general area of his/her thesis research and has chosen a mentor. The student will be required to submit a written proposal in the format of a research grant (see description below). The oral defense will typically take place within approximately 3 weeks of submission of the written proposal. **The exam will take place AFTER the spring semester of the students second year. Ideally, the exam should be successfully completed by the middle of June of the second year, and if additional time is warranted, with approval, no later than the end of July of the second year.**

NIH instructions describing R01 format (https://grants.nih.gov/grants/funding/r01.htm) and page limit should be followed except as amended by ISB Program guidelines. **The proposal should be clearly, logically and carefully written in proper English.** The student will submit the proposal to the ISB Administrator, who will distribute it to the Examination Committee. The Examination Committee is composed of the thesis doctoral committee (see below: H. DOCTORAL COMMITTEE). It is the responsibility of the student and thesis advisor to create this committee and designate a chair. This committee will be assembled ideally by beginning of the Spring semester of the second year. The committee shall read the proposal and by vote determine if the written proposal is acceptable or unacceptable. Submission of acceptable proposals will allow passage into the oral examination that will test the student's understanding of both the contents of the research proposal and the basic concepts underlying said contents. The student is graded on a pass/fail structure. A simple majority vote of the panel decides the outcome. In the event of a failure of the written or oral exam, the student shall be given one opportunity to retake each part of the examination. A second failure or either the written or oral portion shall result in the dismissal of the student from the program or recommendation that the student transfers to the M.S. degree program for the completion of his/her training.

2. Format of the Comprehensive Examination: The Comprehensive Examination is based on the student's thesis research area. A letter will be sent to the student by January 31 of their second year, notifying him/her and the members of their committee of the due date for the written proposal.

The examination will require that the student submit and defend a proposal in the format of a research grant with the following guidelines rigorously adhered to:

a. The proposal is expected to be conceptually well-founded and adequately documented. **The student is responsible for preparing an original research proposal. Dissertation**

advisors <u>ARE</u> allowed to help develop and edit the Specific Aims, but the Research Plan must be prepared by the student, and can be edited by fellow students or post-docs. The thesis advisor cannot see the Research Plan until it has been submitted to the program. Attribution to published and unpublished sources must be comprehensive. The written research plan must be **original to the student**, although the project may have been previously outlined in the advisor's grant. The proposal should not be verbatim or slightly modified version of any published or unpublished papers the student may have written with the advisor or anyone else. The proposal is to be well organized, written in a coherent, grammatically correct style, and should describe ***original*** and ***innovative*** experiments that will accomplish the stated aims and objectives of the research. The written proposal should not consist of just a collection of experiments, but include well-defined hypotheses and rationale as well as the significance of the proposed experiments.

b. The written research proposal will adhere to the following page guidelines:

(i) Title Page
(ii) Specific Aims – limit 1 page
(iii) Significance/Background and Innovation
(iv) Approach - (This includes sections on preliminary data, research plan, and methods)

Sections iii and iv can be no longer than 12 pages, total.

(v) Literature Cited - Must include complete citation with all authors, year, title, journal, volume, inclusive pages. References should be limited to relevant and current sources, published or unpublished, that are pertinent to the proposed research.

c. The proposal is single spaced, with 0.5 inch margins on all sides. The type font should be Arial, size 11 and line spacing should have no more than 6 lines of text within a vertical line.

d. The research proposal must be converted to a PDF (Acrobat) format for electronic submission. The file should be named as: student's last name_year.pdf

3. Administration:

a. The student shall have one to two weeks after the Spring semester (as detailed in the letter) to submit the completed proposal. The Program Directors will meet with the student(s) to discuss these guidelines, answer questions, and to clarify the extent to which the student's thesis advisor, faculty, post-docs and students may be used as a resource. Upon completion, the proposal will be submitted electronically to the ISB Administrator by the due date. Examination proposals submitted after the deadline must be accompanied by a letter from the student that states the reasons for late submission and a justification for acceptance of the proposal. The Program Directors will review all cases of late submission and inform the student within 2 working days whether the examination proposal has been approved for submission. Rejection of the proposal will be counted as a failing grade on the written examination.

b. Each committee shall consist of the student's graduate thesis faculty members. It will be the responsibility of the committee chairperson to poll the members as to the acceptability of the written proposal (preferably within two weeks of submission to the committee). If the

committee finds the written proposal unacceptable, the chairperson shall immediately notify the student to review the reasons why the proposal was deemed unacceptable and provide written feedback from the committee as to how the student can improve the proposal. The Program Administrator will also be notified by the committee chair. An unacceptable written proposal shall constitute failure of the written part of the comprehensive exam. Based on the provided critiques, the student must submit a revised version of the proposal by email to the committee and the Program Administrator within three weeks.

c. In the case of an unacceptable written proposal, the committee and the ISB Program Director will evaluate the resubmission and will determine if the proposal is acceptable for passage into the oral exam. Failure at this stage will result in the dismissal of the student from the program or recommendation that the student transfer to the M.S. degree program for the completion of his/her training.

4. Oral Examination Process:

a. Presuming an acceptable written proposal, the oral examination for each student will be scheduled as soon as feasible, based upon the above defined deadlines.

b. At the beginning of an oral examination, and in the absence of the student, the Chair will briefly address the committee, communicating the ground rules for the examination.

c. The oral examination will be held in a closed session, with only the student and the committee in attendance. **The advisor is not allowed to be present at the oral exam.** The student will begin the examination with an oral presentation (not to exceed 15 minutes) of the research proposal. The research proposal and presentation shall be the sole documents available to the student during the oral examination.

d. It will be the Exam panel's task to evaluate the student's understanding of both the content of the research proposal and the basic concepts underlying them. While it is not expected that the students will know every answer, a general understand of their field, the experiments they propose, and the ability to think on their feet are good metrics to test them on.

e. At the end of the oral examination, the Exam panel will vote in private to pass/fail the student. A simple majority shall prevail; ABSTENTIONS WILL NOT BE PERMITTED. There shall be no conditional pass/fail decision. After the panel vote, the panel chair will immediately notify the student of the decision and evaluation of performance. A critique written by the Exam panel chairperson, evaluating the exam performance and the pass/fail decision, shall be submitted to the Director of the graduate program, the student and the student's advisor. Students and their thesis advisors shall be formally notified of the exam outcome by a letter from the graduate program.

f. Students failing the oral exam will be given one more opportunity to retake the exam. The committee will provide reasons for failure to the student and the advisor in the meeting following the exam. The student, the committee, and the advisor will decide on another convenient time to hold the oral (likely within three weeks). A second failure shall result in the dismissal of the student from the program or recommendation that the student transfer to the M.S. degree program for the completion of his/her training.

g. A "pass" shall be warranted when the following conditions are met: (i) the written proposal is considered acceptable as presented, and (ii) the student has performed knowledgeably in the oral defense of the proposal.

H. DOCTORAL COMMITTEE

Before admission to candidacy for the Ph.D. degree, the student proposes for approval a committee of five persons to serve as the Doctoral Committee. The primary responsibility of the Doctoral Committee shall be to advise the student in the effective analysis of a research problem and to approve a body of original research of sufficient quality to form the basis for the Ph.D. dissertation.

Directly after the student has passed the Comprehensive Examination the student will hold the first Doctoral Committee meeting, generally as one combined meeting. The majority of the Doctoral Committee shall consist of members of the University Graduate Faculty. The committee shall consist of at least five members, including the major advisor(s), and a minimum of three ISB program faculty members, and one external member. The student and advisor will designate the chair of the Doctoral Committee, which shall not be the advisor. The student is also responsible for submitting names of the approved Doctoral Committee to the Director of the Graduate Program and to the appropriate administrative official in the School of Medicine.

At the first meeting the Committee should approve a student's proposal for doctoral research. After the first meeting, it is suggested that the Thesis Committee meets semi-annually to review the student's research progress, but the Thesis Committee shall meet no less than once per year. After each meeting, the student must forward a brief progress report with accompanying thesis advisor evaluation to the graduate coordinator for the ISB Graduate Program. A simple majority of the Doctoral Committee determines actions of the committee.

I. DISSERTATION AND FINAL ORAL EXAMINATION

The student's dissertation must provide evidence of original scholarly research of sufficient quality to be published in a leading scientific journal. Laboratory work for which a student receives wages is not eligible for any part of the dissertation research. The Doctoral Committee will meet at the time the student's research is ostensibly complete and will authorize the student to begin writing the thesis. The style and format of the thesis must conform to the standards set forth by the Graduate Council of the University. The thesis advisor and one or more members of the Doctoral Committee will read preliminary drafts of the thesis and will approve the final copy for submission to the Doctoral Committee.

The final copy will be submitted to the Doctoral Committee as noted below. The thesis defense will consist of a public seminar on the subject of the dissertation followed by a closed examination by the Doctoral Committee. Approval of the Thesis will be granted if there is no more than one dissenting vote by full members of the Doctoral Committee exclusive of the major advisor. The degree will be granted by the School of Medicine.

All graduate students must be on active status (i.e., must have been registered for a minimum of three credits during a twelve month period) and must register for at least one credit during the term in which they are graduated. Students who complete all the degree requirements in one term but are graduated in the next may petition the dean for a waiver of

this requirement. A student who is on inactive status must be re-admitted and registered for three credits in order to be graduated.

The following procedures and requirements have been stipulated by the School of Medicine. These requirements must be met before the last day of the term in which the student has applied for graduation.

1. At least one month prior to the defense:

   Student will make arrangements with his/her graduate program for final defense. The information will be relayed to the Office of Graduate Studies in letter form stating student's name, graduate program, degree sought, title of dissertation, date, time and place of the thesis defense. This information will then be forwarded by this office to the University for publication (must be received within the stipulated time frame for this publication). The announcement will also be sent to the Graduate Faculty Members of the School of Medicine.

   Each member of the student's Doctoral Committee (identified on Nomination of the Doctoral Thesis Defense and Final Examination Committee, form PITT-1976) will be given a draft of the thesis **two weeks** before the final defense. One copy of the draft thesis is deposited at the Graduate Studies Office.

2. After the thesis defense, the following should be brought to the Graduate Studies Office (as one package):

   ETD Approval Form (with original signatures)

   Dissertation Defense Report and Dissertation Approval Report Milestone Forms

   Survey of Earned Doctorates completion certificate

   Processing Receipt from University Cashier (G-7 Thackery Hall) for payment of dissertation binding/microfilming fees.

   Three (3) additional copies of the Title Page

   Three (3) additional copies of the Abstract (350 word maximum double-spaced) initialed in the upper right hand corner by the student's advisor

   UMI/ProQuest Form

   A letter from the Program Director giving official notice that the candidate has fulfilled all the academic requirements (change of status and grade cards should accompany this letter).

   Please also note that students are required to submit an electronic version of the thesis using the ETD submission process as required by University Policy.

J. TEACHING REQUIREMENT

The ISB program allows a non-mandatory, optional teaching experience by acting as teaching fellows in a medical school course. Students in years 2, 3 and 4 of the program have the option to act as teaching assistants. If you wish to act as a teaching assistant, please contact the Program Director.

III. MASTER OF SCIENCE DEGREE

The Program does not formally accept students for the Master's degree. This degree is available to students who do not complete the Ph.D. program.

A. Financial Aid

All full-time students enrolled in the M.S. Program are eligible for waiver of tuition. Once a student has joined the laboratory of his/her thesis advisor, the student is supported by the research grant of the thesis advisor at a level equivalent to the stipend received by students in the Ph.D. degree program.

B. Faculty Advisor

Selection of the faculty advisor is as described for the Ph.D. degree program.

C. Thesis Committee

The Thesis Committee for an individual student shall consist of his or her thesis supervisor and at least two other members, one of whom may be chosen from outside the Program faculty. The proposed composition of the student's thesis committee, together with the title and one page abstract of the proposed thesis research, must be submitted by the major advisor to the Student Evaluations Committee within six months after the choice of a major advisor, as described for the Doctoral Committee.

The student's Thesis Committee must meet with the student at least twice a year, at which time the student must submit a progress report and the committee discusses his/her research project and general progress. The student's Thesis Committee, through the major advisor, must forward a copy of the progress report with accompanying evaluation to the Student Evaluations Committee and to the Director of the Graduate Program following each six-month meeting. A simple majority of the Student Evaluations Committee determines actions of the committee. The student's progress is presented annually to the Program faculty by the Student Evaluations Committee

D. Degree Requirements

a. The student must successfully complete the first-year core curriculum and receive a B or better in all required courses and laboratory rotations.

b. There are no additional advanced topic courses required beyond the core curriculum.

c. The student must complete a one-year research project leading to an M.S. thesis. The thesis must be defended before a thesis committee.

A total of 24 credits meets University requirements for the M.S. degree. The University

mandates that the M.S. degree work must be completed within a period of 5 years of full-time enrollment. Award of the M.S. degree for work that has extended beyond the 5-year limit requires special permission of the Graduate Council of the University.

E. Grades

A final QPA of 3.0 is needed to obtain the M.S. degree.

F. Comprehensive Examination and Preliminary Evaluation

The Preliminary Evaluation for Ph.D. students serves as the Comprehensive Examination for M.S. students.

Following satisfactory completion of the required course work and satisfactory performance on the comprehensive examination, the student shall proceed to complete the research requirement for the M.S. degree. If, however, the student has failed to maintain a QPA of 3.0 in required course work, or if the performance on the comprehensive examination has been unsatisfactory, the ISB Steering Committee shall decide, by majority vote, whether the student shall be given an opportunity to remedy the deficiency or be dismissed from the Program.

G. Thesis and Final Oral Examination

The scope of the research project should be carefully planned to ensure completion within a reasonable period of time (as close to the two-term minimum as possible).

M.S. candidates must be registered as full-time students during the execution of thesis research. Thus, those individuals who complete the course requirements on a part-time basis shall be required to matriculate as full-time students for completion of the degree. During this research period the Program encourages and expects from the M.S. candidate the same vigorous full-time commitment to the successful completion of the graduate training as it does of Ph.D. candidates.

The student's thesis must provide new knowledge and evidence of original scholarly research of sufficient quality to be published in a leading scientific journal. The Thesis Committee will meet at the time the student's research is ostensibly complete and will authorize the student to begin writing the thesis. The committee shall consist of three members of which at least one may be from outside the ISB Program faculty. The composition of the thesis committee and the nature of the research must be approved by the Student Evaluations Committee as outlined for Ph.D. candidates. The responsibilities of the Master's Thesis Committee are essentially the same as described for the Doctoral Committee.

The style and format of the thesis must conform to the standards set forth by the Graduate Council of the University. The faculty advisor and one or more members of the Thesis Committee will read preliminary drafts of the thesis and will approve the final draft for submission to the Thesis Committee for final approval.

The final copy will be submitted to the Thesis Committee at least two weeks prior to the date of the thesis defense. The thesis defense must take place at least two weeks before the degree is to be conferred. The thesis defense shall consist of an oral presentation of the thesis

by the student, followed by the student's response to questions from the floor. This thesis defense, or final examination, is open to the public and will be conducted by the Thesis Committee. Following approval of the thesis, the M.S. degree will be granted by the School of Medicine.

All graduate students must be on active status (i.e., must have been registered for a minimum of three credits during a twelve month period) and must register for at least one credit during the term in which they are graduated. Students who complete all the degree requirements in one term but are graduated in the next may petition the Dean for a waiver of this requirement. A student who is on inactive status must be readmitted and registered for three credits in order to be graduated.

The following procedures and requirements have been stipulated by the School of Medicine. These requirements must be met before the last day of the term in which the student has applied for graduation.

1. At least one month prior to the defense:

   Student will make arrangements with his/her graduate program for final defense. The information will be relayed to the Office of Graduate Studies in letter form stating student's name, graduate program, degree sought, title of dissertation, date, time and place.

   Each member of the student's Thesis Examining Committee will be given a draft copy of the thesis to prepare for final defense. One copy of the draft thesis is deposited at the Graduate Studies Office.

2. After the thesis defense the following should be brought to the Graduate Studies Office (as one package).

   ETD Approval Form (with original signatures)

   Thesis Defense Report and Dissertation Approval Report Milestone Forms

   Dissertation Defense and Dissertation Approval Milestone Forms

   Processing Receipt from University Cashier (G-7 Thackery Hall) for payment of dissertation binding/microfilming fees.

   Three (3) additional copies of the Title Page

   Three (3) additional copies of the Abstract (350 word maximum double-spaced) initialed in the upper right hand corner by the student's advisor

   Please also note that students are required to submit an electronic version of the thesis using the ETD submission process as required by University Policy.

IV. REGISTRATION PROCEDURE

During registration for each succeeding term of each student will confer with his or her advisor about curriculum choices. Note that the Director of the Program will attempt to maintain an annotated course list to assist students and advisors in decisions about specific course offerings as they relate to a particular student's curriculum. After students transfer into ISB, they will send their Enrollment Form to the program coordinator, who will lift the hold from their account, and they will then be able to log in and self-register for the semester. Each candidate for graduation must file an official application for a graduation card in the Graduate Studies Office early in the term in which he/she expects to graduate.

V.STUDENT ORGANIZATION

Graduate students within the Medical School have a Biomedical Graduate Student Association (BGSA) with elected officers. The organization holds meetings to discuss academic matters as well as other items of interest to the students and the graduate program.

VI.COURSE DESCRIPTIONS

Laboratory Research Rotation **ISB 2000**

Students are required to perform three distinct five-week laboratory rotations in the summer/fall term of the first year. These rotations provide students with an opportunity to perform experimental research in three different scientific areas, while experiencing diverse laboratory environments and practices. They also facilitate selection of the dissertation laboratory and advisor. Students select the laboratory rotations based on their research interests and in consultation with their academic advisor.

Introduction to Bioinformatics Programming in Python **MSCBIO 2025**

The course will introduce students to a variety of computational tools for solving common problems in biological research. Students will be taught the Python programming language through hands on exercises and assignments. Students will acquire knowledge and programming skills that will increase their productivity as researchers.

Introduction to Statistical Methods I **BIOST 2041**

The overall purpose of this course is to introduce students to basic probability and one and two sample procedures (point and interval estimation and hypothesis testing) for the Normal and Binomial distributions. Basic one and two sample nonparametric tests are also presented. This broad goal includes use of statistical software to analyze data sets and answer research questions; recognition of situations when these procedures are and are not appropriate; and intuitive understanding of the rationale used in creating the statistical procedures presented.

Systems Biology I **ISB 2020**

This course will introduce the students to genomic data and basic analytical principles pertaining them. The students will learn about high-throughput sequencing methods and applications, genomic variation, transcriptomics and epigenomic data. At the end of the course, the students will be able to analyze efficiently these type of datasets using existing algorithms or algorithms they will develop.

Systems Biology II **ISB 2035**

This course will introduce students to the use of model organisms and cell systems as research models. General and specific imaging approaches and imaging tools used to study these models will be covered. Model systems to be discussed include mouse, zebrafish, cell

culture, yeast and C. elegans. Emphasis will be placed on the strengths that specialized techniques of each organism provide to the biomedical research community.

Grant Writing **INTBP 3240**
All scientific writing all has the same goal, i.e, the writer wishes to present their ideas and data such that the reader can evaluate the validity of the results and conclusions based on the facts presented. Whether as part of an abstract, review, scientific article or grant application, the reader should be able to easily follow the methods used to generate the data as well as the logic used to draw the reported conclusions. With this in mind, the course will focus on a) honing the precision with which we write to avoid confusing the reader such that they cannot grasp critical aspects we are attempting to convey; b) increasing the clarity with which we present our scientific ideas to avoid confusing the reader; and c) maintaining the objectivity with which our ideas are presented. Thus, we anticipate this course will be of interest to anyone interested in furthering their grant writing skills as a prelude to their future careers.

ISB Conference **ISB 2060**
This course will present an opportunity for students to become familiar talking about critical aspects of being a researcher that they deem important including but not limited to, current scientific literature, biological, biostatical, or computational principles, laboratory techniques, and research-in-progress (RIP) reports. Each week, two students will lead 30 minute discussions either on their own primary research, or on topics of their choosing. For each presenter, time is allocated for questions and discussion of the relevant conclusions to allow development of presentation skills.

Bedside to Bench **ISB 2070**
This course introduces graduate students to biomedical research in a comprehensive format integrating organ system biology and clinical medicine with critical developments in the basic science research literature. Course topics include renal-electrolyte, cardiology, cancer, pulmonology, infectious disease, endocrinology, neurology, rheumatology and immunology, hepatology and liver disease, gastroenterology, geriatrics and hematology/oncology. Course work includes an overview of each biomedical field, clinical tours, discussions with leading physicians on the current challenges in patient care, and analysis of the basic science literature in a journal club forum.

Directed Study **ISB 2080**
A laboratory course providing the student an opportunity to carry out a laboratory project under the direction of a member of the Program prior to admission to candidacy for the Ph.D.

M.S. Thesis Research **ISB 2090**
Laboratory projects to fulfill the requirements for the Masters of Science degree.

Ph.D. Dissertation **ISB 3090**
After advancement to candidacy for the Ph.D. degree, students enroll in this course to pursue original experimental laboratory research, the results of which will provide the substance of their doctoral dissertation. A minimum of 40 credits of this course are required for the Ph.D. degree in the School of Medicine.

VII. Policy and Procedures for Changing Advisors

Students may request a change of advisor at any time, but all changes must be approved by the new advisor(s), the program Directors, and the Associate Dean for Graduate

Studies. The responsibility for the entire process of managing a potential advisor change (including all of the steps described below) lies solely with the student. While students may seek advice from any member of the faculty, neither individual faculty members nor any program committees are responsible for assisting in this process.
Students who are considering an advisor change should:

1. Inform their current advisor and the Directors that they are considering an advisor change.

2. Identify possible new advisors and contact them to determine if they are potentially willing and able to advise the student.

3. Meet with potential new advisors.

4a. Request approval by the Directors of an advisor change if they obtain an advising offer from a new advisor and wish to accept it.

--or--

4b. Inform their current advisor and the Directors if they decide to remain with the current advisor.

While students are considering or exploring an advisor change, they are expected to continue with their class and research work as usual. Advisors are not permitted to terminate the advising relationship with a student based on the student's considering an advisor change or to otherwise penalize a student for considering such a change.

The entire procedure above should ordinarily be completed within two to three weeks, and it is the student's responsibility to identify and obtain the agreement of new advisors, if they are interested in changing advisors. The Directors will respond to any request for approval of advisor change within one week of its receipt.

VIII. Conduct, Honor, and Integrity Policies and Procedures

Guidelines on Academic Integrity

These guidelines contain a set of principles that shall be applicable to each of the academic units throughout the University. A student desiring information about the program's specific procedures and makeup of its academic integrity hearing board may obtain a copy of the procedures and other necessary information from the SOM Graduate Office. Additional information or guidance may be obtained from the Offices of the Provosts. It is also available at the following web address:
http://www.pitt.edu/~provost/ai1.html

Guidelines for Ethical Practice in Research

Guidelines for Ethical Practice in Research can be found at the following web address:
http://www.pitt.edu/~provost/ethresearch.html

Research Integrity Policy

These guidelines cover policies for reporting research findings and data collection, to name a few. Policies for Research Integrity can be found at the following web address:

http://www.bc.pitt.edu/policies/policy/11/11-01-01.html

IX. STRUCTURE OF THE GRADUATE PROGRAM FACULTY

A. DIRECTOR OF GRADUATE PROGRAM

The Director of the ISB Program administers the program, appoints all committees, calls meetings, advises the students, and is responsible for monitoring their progress.

B. ASSOCIATE DIRECTORS OF GRADUATE PROGRAM

The Associate Directors of the ISB Program assists the Director as requested by the Director in the administration of the ISB program. Special emphasis is placed on (a) education committee and (b) recruitment and admissions. The Vice Directors are elected by a majority vote of the Steering Committee and serve for a five-year term.

C. EXECUTIVE COMMITTEE STRUCTURE

The Executive Committee is the standing committee of the Program. The Executive Committee is composed of faculty from the Graduate Program who are appointed for a five-year term by the Director. The Executive Committee is composed of the Director, Executive Director, Associate Directors and three members at-large from the ISB program. It is recommended that the committee have at least one member from each of the three main thematic areas. The Executive Committee is responsible for developing policies and procedures for the ISB graduate program, for administering selection of graduate faculty, for supervision of various committee activities and for making final decisions in cases where students are placed on probation or dismissed from the program.

D. Administration - 2014-present

EXECUTIVE DIRECTOR
Dr. Cecilia Lo

PROGRAM DIRECTOR
Dr. Neil Hukriede

ASSOCIATE DIRECTORS
Dr. Takis Benos (Curriculum)
Dr. Gary Thomas (Admissions)

EXECUTIVE COMMITTEE
Dr. Cecilia Lo
Dr. Neil Hukriede
Dr. Takis Benos
Dr. Gary Thomas
Dr. Adrien Lee
Dr. Ivet Bahar
Dr. Yoel Sadovsky
Dr. Alexander Sorkin

Program Administrator
Ms. Shari Murphy