

CANCER, DEVELOPMENTAL AND REGENERATIVE BIOLOGY – M.S., PH.D.

Co-program directors

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The School of Medicine offers basic sciences curricula leading to the Master of Science and Doctor of Philosophy degrees. The core curriculum provides a broad background in molecular biology, cell biology, and biochemistry. Advanced courses allow each student to fully develop an area of interest.

Research strengths of the program include: cancer biology (prostate, breast, thyroid, ovarian, cervical, pancreatic, and leukemia), molecular mechanisms controlling normal development and regeneration, stem cell-based cardiovascular repair, oxidative stress in mechanism of anticancer agents, stem cell delivery of gene therapy for regenerative medicine, neuronal injury and axonal regeneration, transcriptional regulation, normal and malignant immune cell development and function, nanoparticles for therapeutic applications, cellular and molecular mechanisms of cardiovascular diseases and aging, plasticity and interconnection between normal and cancer stem cells, miRNA regulation in ovarian cancer and early development, epigenomic/transcriptomic reprogramming and longevity, calcium signaling during lung development, developmental programming of health and disease, stem cell reprogramming, and genome editing.

The thesis or research Master of Science degree provides training for individuals who will become technicians involved in biomedical research in universities or in the biotechnology industry. The non-thesis Master of Science degree provides content appropriate for secondary teachers seeking advanced training in areas such as molecular biology, cancer biology, developmental biology, and regenerative medicine; and for students seeking admission to a professional school, such as medicine or dentistry.

The Doctor of Philosophy degree is designed to prepare students for careers in independent research and teaching in a university, clinical, or biotechnology environment. Doctoral degree students are expected to develop creativity and independence in addition to technical skills.

Program learning outcomes

By the end of this program, the graduate should be able to:

1. Demonstrate a broad knowledge of the biomedical sciences;
2. Demonstrate subject mastery in cancer, developmental, or regenerative biology;
3. Interpret the current literature in the field;
4. Design hypothesis-driven studies to address key questions in the field;
5. Make original contributions to the body of biomedical knowledge;
6. Demonstrate the principles of scientific and professional ethics;
7. Write effective scientific publications and grant proposals.*

*This outcome is not applicable to M.S. degree students.

M.S. requirements

A minimum of 45 units is required for the M.S. degree, as detailed in the table below. Two options, a research track and a coursework track, are available. Students must maintain a G.P.A. of at least 3.0. Students must adhere to all University and program policies as published in the *Student Handbook*, University CATALOG, or *Student Guide*. Policies and requirements are subject to change.

Basic science core

IBGS 501	Biomedical Communication and Integrity	2
IBGS 502	Biomedical Information and Statistics	2
IBGS 511	Cellular Mechanisms and Integrated Systems I	6
IBGS 512	Cellular Mechanisms and Integrated Systems II	6
IBGS 522	Cellular Mechanisms and Integrated Systems II Journal Club	2
IBGS 523	Cellular Mechanisms and Integrated Systems III Journal Club	2

Seminars (all required)

IBGS 604	Introduction to Integrative Biology Presentation Seminar	1
IBGS 605	Integrative Biology Presentation Seminar	1

Religion

REL_ ____	Graduate-level religion course (RELE, RELR, or RELT)	3
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Program specific courses **12**

Choose from the following:

ANAT 507	Stem Cell Biology and Medicine	
ANAT 544	Human Embryology Lecture	
BCHM 544	Advanced Topics in Biochemistry	
BCHM 605	Seminar in Stem Cells and Cancer or BCHM 61(Cancer Journal Club)	
CDRB 555	Biology of Cancer	

Degree completion options **8**

Coursework track:

Electives (8 units)		
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Research track:

BCHM 697	Research	
IBGS 698	Thesis (1-3 units)	
Elective (0-2 units)		

Total Units **45**

Available Electives

ANAT 548	Introductory Flow Cytometry	1
BCHM 530	Biochemical Basis of Human Disease SM	2
IBGS 525	Translational Research Training	2
MDCJ 520	Basis of Medical Genetics	2
MDCJ 560	Basis of Medical Genetics	2
MICR 515	Introduction to Bioinformatics and Genomics	2
MICR 530	Immunology	4
MICR 537	Selected Topics in Molecular Biology	1-3
PHSL 541	Cell and Molecular Biology	4
PHSL 587	Physiology of Reproduction	2

¹ Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.

Service learning requirement

This requirement may be met by taking IBGS 525 Translational Research Training or a religion course designated as a service learning course.

For more information about this requirement and a list of religion courses that fulfill it, see section on academic service learning (<http://llucatalog.llu.edu/about-university/academic-policies-information/degree-completion-requirements/>) in this CATALOG.

Noncourse requirements

Coursework track: a comprehensive written examination over the graduate coursework in lieu of preparing a thesis.

Research track: pass an oral examination given by their graduate guidance committee after the thesis has been completed.

Normal time to complete the program

Two (2) years— based on full-time enrollment; part time permitted

Comparison

See the comparison (<http://llucatalog.llu.edu/medicine/cancer-dev-and-regen-biology/comparison/>) of the M.S. and Ph.D. degree programs.

Ph.D. requirements

For the Ph.D. degree, students must complete a minimum of 61 units— as detailed in the table below—and must maintain a G.P.A. of at least 3.0. Students must adhere to all University and program policies as published in the *Student Handbook*, University CATALOG, or *Student Guide*. Policies and requirements are subject to change.

Basic science core

IBGS 501	Biomedical Communication and Integrity	2
IBGS 502	Biomedical Information and Statistics	2
IBGS 503	Biomedical Grant Writing	2
IBGS 511	Cellular Mechanisms and Integrated Systems I	6
IBGS 512	Cellular Mechanisms and Integrated Systems II	6
IBGS 522	Cellular Mechanisms and Integrated Systems II Journal Club	2
IBGS 523	Cellular Mechanisms and Integrated Systems III Journal Club	2

Seminars (all required)

IBGS 604	Introduction to Integrative Biology Presentation Seminar	1
IBGS 605	Integrative Biology Presentation Seminar (1)	2
IBGS 607	Integrated Biomedical Graduate Studies Seminar ¹	1

Religion

RELE 5__	Must be numbered 500 or above	3
RELR 5__	Must be numbered 500 or above	3
RELT 5__	Must be numbered 500 or above	3

Program specific courses **6**

Emphasis: Developmental/regenerative biology

ANAT 507	Stem Cell Biology and Medicine
ANAT 544	Human Embryology Lecture

Emphasis: Cancer biology

BCHM 544	Advanced Topics in Biochemistry
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BCHM 605 Seminar in Stem Cells and Cancer
or BCHM 610 Cancer Journal Club

CDRB 555 Biology of Cancer

Electives: **6-12**

Choose from the following and other courses as approved by advisor:

BCHM 530	Biochemical Basis of Human Disease SM
CDRB 550	Clinical Exposure in Oncology
IBGS 525	Translational Research Training
IBGS 537A	Special Topics in Biomedical Sciences
MDCJ 560	Basis of Medical Genetics
MICR 515	Introduction to Bioinformatics and Genomics
MICR 530	Immunology
NSBB 506	Fundamentals of Electrophysiology
PHSL 541	Cell and Molecular Biology
PHSL 587	Physiology of Reproduction

Research and dissertation

BCHM 697	Research (1-10)	12
IBGS 696	Research Rotations (1)	2
IBGS 699	Dissertation (1-5)	1-5

Total Units **61**

¹ Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.

Service learning requirement

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For more information about this requirement and a list of religion courses that fulfill it, see section on academic service learning (<http://llucatalog.llu.edu/about-university/academic-policies-information/degree-completion-requirements/>) in this CATALOG.

Noncourse requirements

- Pass written and oral comprehensive examinations in order to advance to candidacy.
- Successfully defend the dissertation before their guidance committee prior to being awarded the Ph.D. degree.

Normal time to complete the program

Four (4) years — full-time enrollment; part time permitted

Comparison

See the comparison (<http://llucatalog.llu.edu/medicine/cancer-dev-and-regen-biology/comparison/>) of the M.S. and Ph.D. degree programs.