MD Anderson UTHealth Houston
Graduate School of Biomedical Sciences

2024-2025 Academic Catalog

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About Us

In 1963, the 58th Session of the Texas Legislature authorized the Board of Regents of The University of Texas System to establish a Graduate School of Biomedical Sciences (GSBS) at UTHealth Houston. The creation of the GSBS, with the approval of the Texas Commission of Higher Education, included the following general charge:

"The GSBS will conduct graduate programs at the masters and doctoral levels and postdoctoral programs in the sciences and related academic areas pertinent to medical education and research."

The GSBS is an important academic bridge between UTHealth Houston components and the UT MD Anderson Cancer Center. The GSBS is linked to the intellectual resources of the thousands of faculty associated with MD Anderson Cancer Center and UTHealth Houston Schools of Medicine, Dentistry, Public Health, Nursing, and Biomedical Informatics.

From its beginning, the GSBS adopted an interdisciplinary approach to biomedical sciences education in contrast to more traditional departmentalized models focused on particular disciplines. The graduate programs offer areas of concentration at the leading edge of education in the biomedical sciences. As a result, the GSBS has attracted large numbers of outstanding faculty and students. The GSBS faculty has grown to over 600 members, and currently there are about 400 degree-seeking students. Students frequently conduct their research in newly developing interdisciplinary or multidisciplinary areas in basic and translational research.

The challenge to health sciences universities in the 21st century is to integrate the academic and clinical aspects of biomedical research in order to understand and prevent illness, promote health, and restore normal function. The GSBS is in a unique position to meet that challenge by capitalizing on its distinguished faculty and its contemporary approach to graduate biomedical education.

The GSBS is an integral and essential part of the academic activities not only of UTHealth Houston but also of MD Anderson Cancer Center. Together, MD Anderson and UTHealth Houston provide the supporting academic framework for the GSBS. The Texas Education Code stipulates that MD Anderson and UTHealth "...jointly prescribe courses and jointly conduct graduate programs at the masters and doctoral levels." It is self-evident that graduate education in biomedical research is a key ingredient in the development of increased institutional excellence and is essential to the maintenance of national research excellence. Similarly, the GSBS is absolutely dependent upon UTHealth Houston and MD Anderson because courses are taught by faculty members drawn from the two parent institutions, and because of the need for financial and administrative support. Thus, the relationship between UTHealth Houston and MD Anderson is fundamental and symbiotic.

Message from the Dean

Message from the Dean

Welcome to **The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences (GSBS)**. Our Graduate School has a rich history of providing an innovative and collaborative academic environment that gives students access to basic and clinical translational scientific programs to turn discovery into life-saving solutions. The GSBS is a testament to the collaborative strength of two major institutions in the Texas Medical Center (TMC), **MD Anderson Cancer Center** and **UTHealth Houston,** both members of The University of Texas System. In addition, our students have access to graduate courses offered at nearby TMC institutions.

In this catalog, you will find information about our curriculum, research programs, academic activities, and essential policies and procedures of our graduate school. We encourage you to explore our website (https://gsbs.uth.edu/), where you will find additional information to help you develop your strategy for completing your MS or PhD degrees at our institution.

These are extraordinary times for training in the biomedical sciences. Today's advancements in technology and the wealth of information offer unprecedented prospects for training and discoveries with the potential to significantly enhance human health. We are excited to collaborate with you to provide the essential competencies required to support the use of medicine and health technologies over the following decades. Our goal is to equip you with the skills and knowledge necessary to realize your career aspirations and contribute meaningfully to the future of healthcare.

Alejandro Aballay, PhD
Dean

Mission Statement

The mission of The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences (GSBS) is to maintain an innovative and diverse environment that provides an unprecedented breadth of opportunities for outstanding graduate students to train with leading biomedical scientists at The University of Texas MD Anderson Cancer Center and The University of Texas Health Science Center at Houston (UTHealth Houston).

The combined strengths of these institutions provide students with access to basic and translational scientific programs that are at the cutting edge of the fight to treat all major diseases. The curriculum is designed to provide students with a rigorous exposure to critical thinking strategies, area-specific scientific skills, and career development

initiatives. This curriculum, together with an emphasis on research training and scientific productivity, is designed to position our students for an outstanding and successful career in the biomedical sciences.

The educational objectives are achieved through programs leading to the Doctor of Philosophy (PhD) and Master of Science (MS) degrees. These academic activities are carried out in research laboratories and classrooms under the guidance of GSBS faculty members from the schools of UTHealth Houston and MD Anderson. As a comprehensive health science university, UTHealth Houston's mission is to educate health science professionals, discover and translate advances in the biomedical and social sciences, and model the best practices in clinical care and public health. UTHealth Houston pursues this mission in order to advance the quality of human life by enhancing the diagnosis, treatment, and prevention of disease and injury, as well as promoting individual health and community well-being. MD Anderson Cancer Center's mission is to eliminate cancer in Texas, the nation, and the world through outstanding programs that integrate patient care, research and prevention, and through education for our undergraduate and graduate students, trainees, professionals, employees, and the public. The Community Outreach program and other GSBS faculty and student public service activities are aimed at educating the public about the biomedical sciences, as well as promoting an interest in careers in science, particularly among elementary and secondary school students.

Vision Statement

To create a collaborative and innovative academic environment that inspires and lays the foundation for new generations of biomedical scientists to realize their potential, commit to success and make discoveries that have major impact on treatment of diseases worldwide.

Accreditation

University Accreditation

The University of Texas MD Anderson Cancer Center is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award baccalaureate, masters, and doctorate degrees. The University of Texas MD Anderson Cancer Center also may offer credentials such as certificates and diplomas at approved degree levels. Questions about the accreditation of The University of Texas MD Anderson Cancer Center may be directed in writing to the Southern Association of Colleges and Schools Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097, by calling (404) 679-4500, or by using information available on SACSCOC's website (https://www.sacscoc.org).

The University of Texas Health Science Center at Houston (UTHealth Houston) is accredited by the Southern Association of Colleges and Schools Commission on Colleges to award baccalaureate, masters, doctoral, and professional degrees. Degree-granting institutions also may offer credentials such as certificates and diplomas at approved degree levels. Questions about the accreditation of The University of Texas Health Science Center at Houston may be directed in writing to the Southern Association of Colleges and Schools Commission on Colleges 1866 Southern Lane, Decatur, Georgia 30033-4097 by calling (404) 679-4500, or by using information available on SACSCOC's website (https://www.sacscoc.org/).

Programmatic Accreditation

The Genetic Counseling program is accredited by the Accreditation Council for Genetic Counseling, located at:

1660 International Drive, Suite 600
McLean, VA, 22102
Telephone: (703) 506-7667; Fax: (703) 506-3266
Accreditation Council for Genetic Counseling Website (https://www.gceducation.org/)

The Medical Physics Program is accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc., located at:
1631 Prince Street
Arlington, VA 22314
Telephone: (571) 298-1239; Fax: (571) 298-1301
Commission on Accreditation of Medical Physics Education Programs, Inc. Website (https://www.campep.org/)

School Administration and Faculty

Administration

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The Faculty

Faculty at the GSBS are drawn from several UTHealth Houston academic units (Medical, Dentistry, Biomedical Informatics and Public Health), and from MD Anderson.

The research interests of the faculty span the entire range of the biomedical sciences. Individual faculty profiles are available on the GSBS website (http://gsbs.uth.edu/directory/?ptype=faculty).

Tuition and Fees

Tuition

Tuition and fees are subject to change and become effective on the date enacted. The Texas Legislature does not set the specific amount for any particular student fee. Student fees are authorized by state statute; the specific fee amounts and the determination to increase fees are made by the university administration and The University of Texas System Board of Regents.

Under Texas law, UTHealth Houston may charge a resident doctoral student who has in excess of 100 semester credit hours the non-resident tuition rate.

Tuition for Fall and Spring Semesters

For 2024-2025, Resident tuition is $248 per semester credit hour; Non-resident tuition is $658 per semester credit hour.

To maintain full-time student status, a student must register for at least 9 credit hours of GSBS coursework in both consecutive Fall and Spring semesters.

Tuition for Summer Sessions

For 2024-2025, Resident tuition is $248 per semester credit hour; Non-resident tuition is $658 per semester credit hour. If students register for additional courses during the second summer term, tuition and fees will be automatically adjusted.

To maintain full-time student status, a student must register for at least 6 credit hours of GSBS coursework in the Summer semester.

Fees and Charges

Please refer to the Bursar's Office website for the current Tuition and Fees Schedules here (https://www.uth.edu/bursars/student-resources/tuition-fees/).

Fees and Charges

- Audit Course Fee $25.00/course
- Graduation Fee[1] $150.00
- Student Health Insurance[2] $3,438.00
- Information Technology Access Fee (Semester) $42.00
- Medical Evacuation/Repatriation (Annual - international students only) $96.00
- Medical Liability Insurance (Annual - genetic counseling students only) $14.50
- Medical Liability Insurance (Annual - MD/PhD students only) $25.00

[1] A graduation fee of $150 payable at registration for the final academic term is required of all students. This fee does not include regalia rental.

[2] Health insurance is required of all UTHealth Houston students. If students have a health insurance policy (including the insurance provided to GSBS Graduate Research Assistants), GSBS encourages students to submit proof of comparable insurance to Auxiliary Enterprises prior to the start of the semester. Details on the insurance plan are available through the Auxiliary Enterprises Office.

Financial Support

PhD and MD/PhD Students

Students are supported by a graduate research assistantship (GRA) which includes

- A stipend of $36,000 per annum;
- Payment of the student's GSBS tuition and required fees; and
- Health insurance

MS in Biomedical Sciences

It is the expectation of the GSBS that students be supported by a GRA after officially affiliating with an advisor. The GRA includes:

- A stipend of $28,000-36,000 per annum;
- Payment of the student's GSBS tuition and required fees; and
- Health insurance

MS in Biomedical Sciences students may waive the GRA and may pursue outside employment. If a student is employed in the laboratory in which the student is also performing MS thesis work, experiments performed and data generated in the normal work associated with that employment may not be included in the MS thesis.

Specialized MS in Medical Physics

GSBS assistantships normally are not awarded to students although support for a GRA may be available from individual faculty members or from the program. GRA support may include one or any combination of the following:

- A stipend of $18,000-36,000 per annum;
- Payment of the student's GSBS tuition and required fees; and
- Health insurance

Specialized MS in Genetic Counseling

GSBS assistantships normally are not awarded although financial aid may be available. For more information, see Other Financial Support section below.

Graduate Research Assistantships (GRA)

Graduate Research Assistantships awarded to GSBS students are intended to assist in meeting educational and living costs so that students devote full time to their studies. It is the expectation of the GSBS that PhD, MD/PhD, and MS in Biomedical Sciences students holding a GRA will not undertake outside activities, including employment of any kind. An exception to this policy will be made for internships that can be justified as contributing to the student's training. All internships (paid or unpaid) must be approved by the GSBS Dean's office.

Funding of the GRA is contingent upon continued enrollment, maintaining good academic standing, and satisfactory progress towards degree completion.

No PhD, MD/PhD, or MS in Biomedical Sciences student may hold more than one training position at a time. That is, students who hold the GRA training position during their tenure as graduate students, may not hold other training positions (e.g., post-doctoral fellow) concurrently with the GRA position.

External Fellowships and Combined Awards

Students who are awarded an approved, competitive, external Fellowship are eligible, at their advisor's discretion, to be supplemented up to 130% of the standard GSBS GRA stipend level. To qualify, the fellowship must be made explicitly under the student's name and must contain stipend support.

Other Financial Support

All degree students may be eligible for the many endowed scholarships and fellowships that are administered by the Dean's Office. The scholarships and fellowships are awarded on a competitive basis by the GSBS Student Scholarship Committee using criteria specific to each award. Factors taken into consideration include the student's academic performance, research progress, and faculty recommendations. Applications are solicited from students twice a year using a common application. The GSBS also provides travel awards to help students defray the costs of attending scientific meetings. Further information

may be obtained from the GSBS website or the GSBS Office of Academic Affairs.

The GSBS maintains a list of active institutional training grants and can assist students in preparing applications for external fellowships and awards.

In addition to the types of financial aid mentioned above, other sources of support are available through UTHealth Houston's Office of Student Financial Services (http://www.uth.edu/sfs/).

Contact Us

The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences

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6767 Bertner Avenue
S3.8344 Mitchell BSRB
Houston, TX 77030

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Graduate School
PO Box 20334
Houston, TX 77225-0334

UTHealth Houston Campus Address:
GSBS, S3.8344 BSRB

MD Anderson Campus Address:
BSRB Unit 1011

Phone: 713-500-9850
Fax: 713-790-1529
E-mail: Talk2GSBS@uth.tmc.edu

Admission

Admissions Statement

The mission of The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences (GSBS) is to maintain an innovative and diverse environment that provides an unprecedented breadth of opportunities for outstanding graduate students to train with leading biomedical scientists at The University of Texas MD Anderson Cancer Center and UTHealth Houston. To this end, all applicants to the GSBS are evaluated based on a holistic process.

GSBS Structure and Degree Programs

Recognizing that contemporary biomedical research often involves interdisciplinary approaches, the faculty has developed its educational programs to make its vast resources available to students with minimal constraints. Major emphasis is placed on studies leading to the PhD degree, but all PhD students may elect to complete an MS degree prior to starting dissertation studies. Students with specific interests in acquiring technical and specific professional skills may be admitted to courses of study for the MS degree. The GSBS also offers two certificate programs. In addition, persons who wish to take courses and/or conduct research, but not as part of a formal degree program, may be admitted as non-degree students. Degree, certificate and non-degree programs offered at the GSBS are described in the following sections.

Applicants for the MS and PhD Degree Programs

Applicants must have a bachelor's degree from an accredited institution or its equivalent. A solid background in the basic sciences is recommended. An MS degree is not required for admission into the PhD program.

Applicants are expected to have a grade point average of at least 3.0 on a scale of 4.0 on undergraduate and graduate level coursework.

Applicants are not required to take the Graduate Record Exam (GRE).

A student admitted to the GSBS MS degree program may not matriculate into a GSBS PhD degree program prior to the completion of the requirements for the MS degree. An exception to this policy may be granted with approval from the Dean.

Applicants may submit only one application per year for a particular degree program. If an application is rejected, the applicant may reapply to that degree program after one calendar year. For reapplication, the applicant is expected to complete a new application for admission and supply any additional materials to update their application.

Factors Considered in Admissions Decisions

The GSBS Admissions Committee may consider a range of factors including:

- Previous research experience and accomplishments, including participation in science activities, enrollment in laboratory and research-based courses, and involvement in research projects, presentations of research findings and publications;
- Expressed commitment to a career in the biomedical sciences;
- Undergraduate grade point average;
- Performance in undergraduate courses in the biological and physical sciences and mathematics;
- Trends in academic performance;
- Degree of difficulty of undergraduate academic program;
- Previous graduate-level study, including course grades, grade point average, and degree of difficulty;
- Honors and awards for academic achievement;
- Success in overcoming socio-economic and educational disadvantages;
- Multilingual proficiency and performance on the Test of English as a Foreign Language (TOEFL) for International applicants;
- Non-academic responsibilities, such as employment and family responsibilities; and
- Involvement in community activities.

Application Procedures

Applications must be submitted electronically through the online application system, Embark. A link to the online application form can be found in the Admissions section of the GSBS website.

All components of the application must be submitted electronically. Please note that there is no need to submit official transcripts or test

scores as part of the preliminary application process. This information will be self-reported by the applicant. Copies of transcripts and test scores are to be uploaded into the application system.

- **Online application form.**
- **Grade Point Average** – GPAs must be converted to a 4.0 scale.
- **Unofficial transcripts** – An unofficial copy of the transcript from each college and university attended is required.
- **TOEFL scores** (International applicants) – The applicant should upload a copy of the ETS score report.
- **Application fee** – A $50 application fee is required. Fee waivers are available by request.
- **CV/Resume** – A CV or resume is required and should include academic honors, scientific publications and presentations, awards received in college, employment history, internships, summer research programs, education history, etc.
- **Personal statement** – The personal statement should be one page in length and should be a discussion of the applicant's motivation and rationale for pursuing a graduate degree. The statement should specifically address objectives in seeking advanced education, professional goals, areas of study in which the applicant wishes to specialize, reasons for seeking admission to GSBS, and how the applicant's professional goals may be met in the GSBS.
- **Research statement** – Students must describe their research background and experience relevant to their application to the GSBS. In this one-page statement, students should provide a detailed description of at least one independent research project, including a hypothesis, aims of the project, description of data generated, conclusions drawn from this data and the significance of this work. Prospective MS students without research experience should explain other work experiences that make the student a suitable candidate for graduate school. The research statement is required for PhD applicants and applicants to the MS program in Biomedical Sciences.
- **Optional Essay** – A brief statement detailing the ability to recover quickly during difficulty. This is one important characteristic that can contribute to success in graduate school. Resilience can be activated and strengthened through many situations in life, for example, by overcoming financial hardship to pursue education or by leading an organization to a major goal. Applicants may provide an optional essay to share their personal story of resilience. Since this essay is optional, the information shared will only be used to learn more about the applicant and provide the committee with more insight to the applicant's personal journey towards graduate school.
- **Three letters of recommendation** – Three letters of recommendation are required to be submitted via the online system by persons well qualified to evaluate the applicant's scholastic performance, scientific ability, research interests and motivation, and personal attributes such as character; contact information for these reference writers must also be provided. If the applicant is currently enrolled in, or has completed, a graduate program, one of the recommendations should be from the applicant's academic advisor or mentor.

Admitted applicants with degrees from foreign institutions must submit a transcript evaluation indicating the degree is equivalent to a U.S. baccalaureate degree prior to matriculation. Only a general evaluation is required.

Admissions interviews may be requested by the GSBS Admissions Committee. Interviews conducted by GSBS faculty are a required step to be admitted to the PhD program. Final admission requires receipt of official transcript, Educational Testing Service (ETS) score report documents (if required), and is contingent upon a satisfactory completion of the criminal background check.

Applications to the accredited programs in Genetic Counseling and Medical Physics are reviewed by program-level admissions committees who make recommendations to the Dean regarding admission.

Special Information for Foreign and Non-English-Speaking Applicants

Applicants who are not U.S. citizens or permanent residents, and who have not obtained a bachelors or master's degree from a U.S. school will submit the same application materials described above. However, all foreign nationals whose native language is not English, and who have not attended an English-speaking university, must take the Test of English as a Foreign Language (TOEFL) which is administered by the Educational Testing Service and used as a measure of the applicant's proficiency in English at the time of application.

All international students admitted to the GSBS who do not have a degree from an English-speaking institution will be required to take a diagnostic English language skills test administered in the GSBS before the start of Fall semester classes. The test will evaluate the student's ability in the areas of listening and speaking, reading and writing, and grammar and vocabulary. Admitted students whose English skills are thought to require help for successful performance in the GSBS will be asked to take an English language skills course during the first year at the GSBS.

Application Deadline

Complete applications, containing all application materials, must be submitted by a specific deadline, which is posted on the GSBS website in the Admissions section.

Enrollment of Graduate Students from Affiliated Institutions

Through reciprocal agreements, students at other components of The University of Texas System, as well as graduate students from Rice University, Baylor College of Medicine, Texas Woman's University, the University of Houston, Texas A&M Health Science Center-Institute of Biosciences and Technology, and the Gulf Coast Consortium may take graduate courses for credit at the GSBS, subject to the approval of the instructor. In addition, GSBS students may take courses for credit at any of the above institutions. The mechanisms for payment of tuition and registration fees vary according to the individual institution. Consult with the UTHealth Houston Office of the Registrar for specific details.

Non-Degree Students

Qualified individuals who hold a bachelor's degree in science, who have a demonstrated interest in a career in research, and who wish to take courses at the graduate level without enrolling in an MS or PhD degree program may be admitted to the GSBS as non-degree students. Application to be a non-degree student requires:

- **Online application form**.
- **Personal statement** – A one-page statement that explains the applicant's motivation for pursuing enrollment as a non-degree seeking student, including a proposed course of study.
- **Unofficial transcript(s)** – from each college and university attended.
- **Application fee** - A $50 application fee is required. Fee waivers are available by request.

- **CV or Resume** – Include academic honors, awards received in college, employment history, internships, summer research programs, education history, etc.
- **Three letters of recommendation** – Three letters of recommendation are required to be submitted via the online system by persons well-qualified to evaluate the applicant's scholastic performance, scientific ability, research interests and motivation, and personal attributes such as character; contact information must also be provided.
- **Deadline** – The deadline to apply as a non-degree student is two months prior to the start of the semester.

Students admitted as non-degree seeking students must submit official transcripts, immunization records and have a background check performed prior to enrollment. Instructions regarding these and other pre-enrollment requirements will be sent by email once admitted.

A non-degree student will be admitted for one year. No commitment to eventual admission to a degree program is implied by admission as a non-degree student. Re-admission for additional periods of study as a non-degree student will be considered by the Dean, and is dependent in part on the student maintaining at least a 3.0/4.0 grade point average in GSBS courses. Application for re-admission requires a written statement by the applicant reviewing past performance and future goals.

Employees

Employees of institutions within the Texas Medical Center may, with consent of the instructor and the employee's supervisor and with permission of the Dean, register for GSBS courses each semester. Registration forms for this purpose and information regarding tuition and fee costs are available from the UTHealth Houston Office of the Registrar. Employees must submit an official transcript from their undergraduate institution verifying that they have earned a bachelor's degree or the equivalent prior to enrollment.

Guidelines for Employees Who Wish to Pursue a GSBS Degree

Any employee of an institution in the Texas Medical Center may, with consent of the instructor and the employee's supervisor and with permission of the Dean, register for GSBS non-research courses. If the employee is eventually admitted to the GSBS, courses taken while an employee will appear on the student's transcript and may be used to meet GSBS degree requirements, with the approval of the student's Advisory Committee and the Academic Standards Committee.

Academic Standards, Policies, and Procedures

Following is a summary of general GSBS regulations. Complete and specific regulations and requirements are included in the GSBS Policies and Procedures (https://gsbs.uth.edu/academics/policies-and-procedures/) pages available on the GSBS website, developed under the auspices of the Academic Standards Committee. The provisions that apply to a particular student are those in the GSBS Catalog and the UTHealth Houston General Information Catalog in effect at the time the student is admitted to a GSBS degree program.

Degree Requirements

The general requirements for the PhD and MS degrees are described in the Programs of Study (p. 10) section of this catalog. The specific requirements for the degrees and the time limits for meeting the requirements are presented on the individual degree and degree program pages.

Unless there is an embargo in effect, all research papers, theses, and dissertations authored by degree candidates are available to interested members of the general public upon request.

Registration

Full-time students must be registered for each term (Fall, Spring, Summer) of the academic year unless approved for an official leave of absence. Students who are not registered for a term or on an approved leave of absence are considered to have withdrawn from school. Once having withdrawn, a student who wishes to continue formal studies must apply and be readmitted to the GSBS. A student must be enrolled through the semester in which he or she completes all requirements for graduation.

Transfer Credit

No record of courses taken at other institutions prior to admission to the GSBS will appear on a student's GSBS transcript. However, with approval from the Academic Standards Committee and the GSBS Office of Academic Affairs, students who entered the GSBS may transfer credit from previous graduate work taken at another accredited institution provided the credit was not earned toward a completed degree or certificate program. Transfer credits cannot exceed in number those earned in GSBS coursework toward any degree. For the program of work that a student submits in the petition for admission to candidacy for the MS degree, a maximum of two courses taken elsewhere may be included and counted toward the credit hour minimum for the degree. Particular courses taken at the graduate level at another institution, if approved by the GSBS Office of Academic Affairs, may be considered as meeting individual degree requirements.

Grading System

Graduate students must be assigned letter grades (A*, B, C, F*) for completion of formal courses listed in the GSBS Catalog. For computation of the GPA: *A = 4, B = 3, C = 2, and F = 0*.

A grade received in an approved course taken at another institution will be recorded as submitted by the institution but will not be calculated in the GSBS GPA unless the course is cross-listed as a GSBS course.

Literature Surveys, *Special Project: Research*, Seminars, *The Ethical Dimensions of the Biomedical Sciences, Tutorials,* and other research courses listed in the GSBS Catalog are assigned grades of *Pass (P)* or *Fail (F)*. In addition, other courses may be graded as pass/fail with permission from the GSBS curriculum committee. A grade of *P* will not be included in the computation of a student's GPA.

For *Special Project: Course*, the instructor may assign either a letter grade (*A, B, C, F*) or a *Pass/Fail* grade. However, the grading system must be the same for all students in the course. A letter grade will be included in the computation of a student's GPA; a grade of *P* will not.

Thesis for Master of Science and Dissertation for Doctor of Philosophy will be listed as *Pass* (indicating sufficient progress) or *Fail*.

A grade of *Incomplete* (*I*) may be issued by the Course Director whenever a student is unable to complete all course requirements by the end of the semester due to unavoidable circumstances. The grade of *Incomplete* cannot be given for poor performance or for the purpose of avoiding

the issuance of a regular grade to a student who has performed poorly. Before the end of the following semester, the student must turn in the required work for a regular grade or else the *Incomplete* will be replaced with a grade of F. In instances where unavoidable circumstances prevent the student from completing the work in the following semester, the student may apply for an extension of the *Incomplete* until the next time the course is offered. Such extensions must be approved by both the Course Director and the GSBS Office of Academic Affairs.

The symbol *WP* is given when a student with satisfactory course performance withdraws from a course within the first nine weeks of class with the consent of the instructor. A *WP*, by itself, will not prevent the student from withdrawing from GSBS in good standing. The symbol *WF* is given if the student has displayed unsatisfactory course performance up to the date of withdrawal. A *WF* grade is equivalent to an *F* in the calculation of the GPA. There will be no withdrawal after the last day of the ninth week of class.

A failing grade in any GSBS course is grounds for dismissal from the GSBS. The student may request that the Dean allow him or her to retake the course the next time it is offered (usually within one year) rather than being subject to dismissal. If the request is granted, the student must earn a grade of *A* or *B* in that course; a grade of *C* when the course is retaken will result automatically in dismissal. During the interim, the student will be on academic probation. If the student passes the course, the *F* will remain on the transcript, but only the new grade will be calculated in the student's GPA.

Students may retake a GSBS course, in which case both the new and previous grades will appear on the transcript, but only the second grade will be calculated in the GPA. Students whose GPA is less than 3.0 can only retake courses in which they received a C or below in an effort to raise their GPA to 3.0 or above.

Grade Grievance Procedure

In attempting to resolve any student grievance regarding grades or evaluations, it is the obligation of the student first to make a good faith effort to resolve the matter with the faculty member involved. Individual faculty members retain primary responsibility for assigning grades and evaluations. The faculty member's judgment is final unless compelling evidence suggests discrimination, differential treatment, or a mistake. If the evidence warrants an appeal, the student must submit a request in writing with supporting evidence to the Dean. The determination of the Dean is final.

Probation

Causes – Any student that does not meet the academic standards of GSBS may be placed on academic probation by the Dean. Any of the following actions or conditions can cause the student to be placed on academic probation, including but not limited to:

- Failure of any course; A failing grade in any GSBS course taken while a student is enrolled at GSBS is grounds for dismissal from the GSBS. The student may request that the Dean allow him or her to retake the course the next time it is offered (usually within one year) rather than being subject to dismissal. If the request is granted, the student must earn a grade of A or B in that course; a grade of C when the course is retaken will result automatically in dismissal. During the interim, the student will be on academic probation. If the student passes the course, the F will remain on the transcript, but only the new grade will be calculated in the student's GPA.
- Failure to maintain a GSBS cumulative grade point average of 3.0 or better; The GPA must be raised to a 3.0 or better within one year. A student who receives a grade of C in a course may choose to retake the course to raise his/her GPA. In this case, only the second grade would be used in the GPA calculation, but the original (C) grade will remain on the student's transcript.
- Failure of the student to meet with their Advisory Committee within a six-month period
- Failure to meet the particular requirements for the MS or PhD degree in the time periods specified by the GSBS
- Failure to make satisfactory progress toward the degree or perform academically in a satisfactory manner, as determined by the student's Advisory Committee
- Release of the student by the Research Advisor due to the student's unsatisfactory progress toward the degree

Procedures – The Dean may place a student on academic probation for any of the reasons given above or other academic-related deficiencies on a case-by-case basis. Written notification will be provided to the student, his or her Advisor or Advisory Committee, and Program Director (if applicable). Within one month of notification, the student, in consultation with the Advisor or Advisory Committee and Program Committee (if appropriate), will submit to the Academic Standards Committee a proposed course of action to resolve the student's academic difficulties. The Academic Standards Committee will review the proposal, approve it, or suggest modifications and forward its recommendations to the Dean. The Dean will make the final decision on the student's proposal and inform the student of the conditions to be met. The student will remain on probation until otherwise notified by the GSBS Office of Academic Affairs.

Students who are released by their Research Advisor for unsatisfactory progress toward the degree may be placed on probation after review by the Academic Standards Committee of the specific reasons for the release. In conducting this review, the committee has the option to receive input from the student, advisor, and/or other GSBS faculty members. The student must consult with the GSBS Office of Academic Affairs to identify a new advisor and begin a six-week trial period within one month of the release. For students on probation, the plan for degree completion and selection of a new Research Advisor must be approved by the GSBS Academic Standards Committee prior to the student's formal affiliation with the Advisor.

Consequences – Any student on probation will not be allowed to stand for the MS final oral thesis examination, petition for the PhD candidacy examination (except when probation is due to failure to submit a petition), or stand for the defense of the PhD dissertation. Students on probation are not eligible to receive GSBS Scholarships, Fellowships or Travel Awards. Also, students will not be able to serve as officers in GSBS student organizations or members of GSBS standing committees, or participate in internships.

More severe actions, up to and including dismissal, may be considered by the Academic Standards Committee for a student's failure to make satisfactory progress toward the degree.

Dismissal

Causes – The following list describes the most common conditions or circumstances in which the Dean may dismiss a student from the GSBS, which includes but is not limited to:

- If the student fails any course
- If the student fails to identify a research advisor within the allotted period for the degree program
- If the student's academic deficiencies are not resolved within the time period specified in policy or by the Dean
- A student displays substantial deficiencies in his or her ability to perform effectively in a laboratory, or other research or training environment (as determined by one or more GSBS faculty members)
- After release by the research advisor, a student is unable to identify a new research advisor and provide a satisfactory plan for degree completion
- After voluntarily seeking new mentorship, a student is unable to identify a new research advisor and provide a satisfactory plan for degree completion
- If the student fails the PhD candidacy examination

Procedures – The GSBS Academic Standards Committee will consider any questions concerning a student's academic progress in which dismissal is a possible outcome and will make the decision concerning the dismissal of the student. If the student wishes to appeal the decision of the Academic Standards Committee, he or she may appeal to the Dean, who will consider the evidence and the decision of the GSBS Academic Standards Committee and render a decision on the appeal. The Dean's decision is final.

Policy for Readmission of Students Dismissed for Unsatisfactory Progress

Any student who withdraws from GSBS or is dismissed because of unsatisfactory progress must wait one year before applying for readmission. Upon re-application, students are evaluated by the GSBS Admissions Committee on a case-by-case basis. Those who appear to have the potential to complete the degree program successfully are recommended for admission to the Dean. The Dean makes the final decision concerning readmission.

Student Conduct and Discipline

Students are responsible for knowledge of and compliance with University policies concerning student conduct and discipline as set forth in UTHealth Houston Handbook of Operating Procedures (HOOP) Policy 186, Student Conduct and Discipline (https://www.uth.edu/hoop/186-appendix-a.htm).

The GSBS Code of Conduct pledge must be signed by all students in GSBS degree programs when they first enroll and when they petition for MS or PhD candidacy.

Leaves of Absence, Time Away from Duties, and Withdrawals

The GSBS allows students to request an official Leave of Absence (LOA) for up to one year. During an official LOA, the student cannot be paid by the advisor or the GSBS, but may work at outside employment. Students may request an official LOA from the GSBS Office of Academic Affairs. Students must specify a date when they will return from LOA. If they do not return by that date and they have not been granted an extension of the LOA, they will be considered to have withdrawn from the GSBS. Students funded by GSBS are funded for the specified term for continuous enrollment. If a student takes a LOA during the time funded by GSBS, no guarantee can be made that the GSBS-funded time lost during the LOA can be "re-captured" once the student returns to their studies.

Students may return prior to their approved LOA return date. Students returning from LOA do not need to re-apply for admission, but they must notify the GSBS Office of Academic Affairs that they are returning at least 30 days prior to the start date of the semester in which they wish to re-enroll. Extensions of the official LOA period may be requested through the GSBS Office of Academic Affairs for a maximum of up to one additional year and must have the approval of the Dean. Requests for extensions must be submitted at least 30 days before the end of the initial leave period.

In cases where a student on leave of absence has separated from the thesis/dissertation advisor, the student must identify a faculty member who is willing to serve as the new thesis/dissertation advisor prior to the student's re-enrollment in the GSBS. The new advisor and a plan for completing the thesis/dissertation must also be approved by the GSBS Academic Standards Committee.

In cases where a student is returning from a leave of absence that was initiated after, or coincident with, being placed on academic probation, the student must submit a plan for remedying the academic issue and completing the degree program at least 60 days prior to returning to the GSBS. This plan must be approved by the Academic Standards Committee before the student may enroll again.

An official LOA request petition must be filled out by the student and turned into the Office of Academic Affairs. As a part of this form, numerous signatures are required from various offices around the Texas Medical Center, indicating that the appropriate institutional individuals and offices approve the request for a LOA with non-registered status.

Note that any student who fails to register for any semester and who has not been granted an official leave of absence or been approved as a non-registered candidate for a degree will be considered to have withdrawn from GSBS. Once having withdrawn, a student who wishes to continue formal studies must apply and be readmitted to GSBS.

Time Away from the Lab

Students receive their stipends as employees from one of the GSBS parent institutions, each of which has its own employment policies and procedures with which the student must comply. UTHealth Houston and MD Anderson Cancer Center each has its own policies on several issues, such as the amount of time graduate students are permitted to be away from their lab or workplace for purposes such as sick leave, vacation, family-related leave, etc. The GSBS policy on time away from the lab is deferred to the policy of the institution at which the student is employed. When a student joins the lab/group of a faculty member, the student should apprise him/herself of these policies. In all cases, however, the student should remember that they are employed by the advisor, and the advisor sets the standards for work ethic and policies of the lab, including attendance standards and expectations. The student and advisor should always explicitly discuss the advisor's expectations before they make a mutual commitment. In all cases, it is the student's responsibility to request time away from the lab (or expected lab activities; in advance, when possible) and to keep the advisor, or the advisor's designee, informed in a timely manner of any unanticipated absences, e.g., for illness, family emergencies, etc.

Students with Disabilities and Attendance Requirements

UTHealth Houston is committed to providing reasonable accommodation to all members of the University community and to individuals who access services or programs of the University who have or had an impairment that substantially limits a major life activity. Reasonable accommodation may be provided to an individual with a disability to enable the individual to participate in University academic programs, services, and activities, so long as it does not create undue hardship or fundamentally alter the essential elements of a program or position.

Students seeking disability-related accommodation must contact University Relations & Equal Opportunity (UREO) to initiate the accommodation process. Accommodation requests are considered on a case-by-case basis considering the student's individual limitations, accommodation needs, and the operational realities of the university. If the requestor is determined to be a qualified individual, the requestor, the designated Section 504 Coordinator and applicable faculty will engage in an interactive process facilitated by UREO to determine if it is possible to grant reasonable accommodation.

Accommodations are not retroactive, and require advance notice to implement. To allow adequate time to evaluate the required documentation, engage in the interactive process, and make arrangements for any accommodation to be provided, requestors are strongly urged to contact UREO as soon as possible.

The school is not required to grant accommodations that constitute a fundamental alteration of the program or course. Specifically, the school does not have to modify a requirement, including attendance, that is essential to the educational purpose or objective of a program or class. Decisions regarding essential requirements of a course or program will be made by a group of people who are trained, knowledgeable, and experienced in the area through a careful, thoughtful, and rational review of the academic program and its requirements. Decision-makers will consider a series of alternatives for the essential requirements, as well as whether the essential requirement(s) in question can be modified for a specific student with a disability.

For additional information on the disability accommodation process, please see HOOP Policy 101, Disability and Pregnancy Accommodation (https://www.uth.edu/hoop/policy.htm?id=1448050).

A list of UTHealth Houston 504 Coordinator's by school can be found here (https://www.uth.edu/hoop/section-504-coordinators.htm).

Programs of Study

Degrees

- Biomedical Sciences (MS) (p. 10)
- Biomedical Sciences (PhD) (p. 12)
- Genetic Counseling (Specialized MS) (p. 16)
- Medical Physics (Specialized MS) (p. 17)

Dual Degree Program

- PhD/MD Program (p. 18)

Graduate Certificates

- Biomedical Sciences for Cancer Research Grant Administration and Management (Certificate) (p. 18)
- Medical Physics (Certificate) (p. 19)

Non-Degree Students

- Non-Degree Study (p. 19)

Biomedical Sciences (MS)

Students enrolled in MS degree programs are provided the opportunity to gain mastery of the scientific background of their discipline and their specific research problem. Such mastery is acquired from didactic instruction and individual study of the scientific literature.

The MS degree is an important component of the GSBS educational program. Although many students currently bypass the MS portion of the PhD program, the school continues to recognize the value of studies for the MS degree for some PhD students, as well as for students seeking graduate training available through individualized or specialized MS programs.

General Course Requirements

Students are required to complete a minimum of 36 credit hours of coursework to obtain the degree of the Master of Science (MS) in Biomedical Sciences. Students in a MS degree program who have completed graduate courses in the general area of biomedical sciences at another institution that were not used to earn a degree or certificate may request that the credit hours earned elsewhere be used toward the GSBS degree requirement. Approval of these requests are at the discretion of the Dean. The student must have received at least a B (if the course awards letter grades of A, B, C or F) or P (if the course was graded pass/fail) in the course to be awarded GSBS credit hours. The grades from courses taken at other institutions will not be used in the calculation of the cumulative grade point average.

Seminar Presentation Skills Training Course Requirement

MS students in Biomedical Sciences are required to register and pass the Seminar Presentation Skills Training course (GS21 1221 Seminar Presentation Skills Training) every semester they are enrolled in the degree program. The aim of this course is to

1. expose MS students to a broad range of current research topics in biomedical sciences and related fields,
2. give the students a place to practice presentations, provide positive feedback and exchange ideas among their peers, and
3. strengthen the MS community by creating a space where all MS students can come together to hear a research presentation from senior MS trainees and be able to network with other students in the program.

Students enrolled in the Genetic Counseling and Medical Physics specialized MS programs are not required to register for this course.

Ethics Course Requirement

All MS students (including those completing an MS in a specialized area) are required to pass an ethics course (either GS21 1051 Ethical Dimensions Biomedical Sciences or GS21 1181 Biomedical Ethics for the

Genetic Counselor). The aims of these courses are to provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives. These courses, and two online ethics modules, "Data Acquisition and Management" and "Responsible Authorship and Publication," must be completed before the student petitions for candidacy.

Petition to Candidacy for the MS Degree

A petition to candidacy for the Master of Science degree must be submitted to the Academic Standards Committee for approval. The petition consists of the program of work, the specific aims of the proposed research, the Student Acknowledgment and Pledge to adhere to the Student Code of Conduct in addition to other GSBS rules. It also requires the approval for the Advisory Committee Chair, Program Director, Dean of the Office of Academic Affairs, and the Academic Standards Committee. The program of work should indicate the courses that will be used to satisfy remaining curriculum requirements for the MS, which may include courses taken, in progress, and/or planned. Students must be admitted to candidacy before receiving credit for the first semester of *Thesis*. The petition should be submitted within one year of matriculation into the MS program. If an extension is requested, written justification must be provided to the Academic Standards Committee for its approval.

Defense of the MS Thesis

During the final semester of *Thesis*, the student must submit for approval by the Dean a form to request the defense of the MS thesis. This form, along with a one-page abstract of the research, an electronic version of the thesis for submission to anti-plagiarism software, and a PDF of the thesis for format verification must be submitted to the GSBS Office of Academic Affairs at least 14 days before the scheduled thesis defense. The Office of Academic Affairs will check to be certain that all courses included in the program of work have been completed. If all is in order, an announcement of the thesis defense will be posted in the weekly GSBS newsletter. If the program of work has not been completed, the student and the Advisory Committee will be notified and the thesis defense will not be permitted until the required courses have been completed.

Completion of the MS Requirements

The MS degree will not be issued until the student has successfully completed the following requirements:

- oral defense of the thesis
- approval of the thesis by the Advisory Committee
- submission of the unbound thesis to the GSBS Office of Academic Affairs for the Dean's signature
- receipt of all grades
- submission of completed exit forms to the Office of Academic Affairs

The MS degree will be awarded on the last day of the semester in which all requirements are completed. The student must be registered for *Thesis* in the final semester in which requirements are met.

All requirements for the MS degree must be completed within three years of matriculation into the MS program. Students that wish to register for classes beyond the three-year limit may only do so with the express, written permission of the Dean. Students admitted to the GSBS for the purpose of obtaining an MS degree and who wish to complete a PhD must reapply for admission to the PhD degree program and be selected, at the recommendation of the Admissions Committee, by the Dean. Matriculation to the PhD program is contingent upon completion of all MS requirements prior to enrolling in the PhD program.

Operating within this general framework for the MS degree in Biomedical Sciences are the individualized MS degree option and two specialized programs, Genetic Counseling and Medical Physics. All degrees awarded will be termed Masters of Science in Biomedical Sciences.

Individualized MS Degree: Biomedical Sciences

Qualified students may be admitted to the GSBS to pursue an MS degree in Biomedical Sciences or, with approval of the Program Director, in a Program area. With the advice and consent of the Advisory Committee and approval by the Dean, the student will construct a plan of study, including didactic coursework and a thesis topic appropriate to his or her particular interests. The degree can be completed in two years of full-time study, although students are permitted three years for completion of degree requirements.

Curriculum

The MS program of work must include at least:

- one credit hour of GS21 1051 Ethical Dimensions Biomedical Sciences,
- two online Ethics modules,
- six credit hours of GS00 1520 Research in Biomedical Science (P/F),
- six credit hours of GS00 1910 Thesis for Master of Science,
- twelve credit hours of didactic courses, graded A/F,
- one credit hour of GS21 1221 Seminar Presentation Skills Training for each semester in which the student is enrolled in the degree program – (Students in the Genetic Counseling and Medical Physics specialized programs are exempt from this requirement)
- up to eleven credit hours of additional coursework to achieve a cumulative of 36 total credit hours.

The majority (over 50%) of the 12 credit hours of graded coursework and the 36 total credit hours, plus the majority of any additional coursework required by the Academic Standards Committee or the student's Advisory Committee, must be taken in residence at the GSBS.

MS Thesis

Laboratory studies provide opportunities to gain technical facility with the methods required for investigation. In view of the wide range of fields of knowledge in which the MS degree is awarded, it is not feasible to set specific requirements for this degree.

The preparation of the MS thesis should provide the student with an:

- in depth understanding of the field of study,
- experience in formulating a research problem within the framework of contemporary knowledge,
- ability to present the rationale for the technical approach to be taken in solving the problem,
- ability to present valid and reproducible results obtained by the application of methodology appropriate to the problem,
- and capability to formulate a coherent analysis of the results and the conclusions drawn from this analysis.

The acquisition of technical expertise should be the major objective of students at the MS degree level, and the MS thesis should demonstrate the student's mastery of the knowledge and technology required for the solution of the research problem. While studies at the MS level may place less emphasis than those at the PhD level on the scope and magnitude of the intellectual contribution, the MS thesis should demonstrate the student's creativity and critical thinking in the solution of a scientific problem. The thesis should be an original document written by the student.

Biomedical Sciences (PhD)

The PhD degree program is designed to offer students the opportunity to complete didactic and laboratory studies through which they may gain the expertise to conduct independent and creative research that contributes new knowledge in an area of the biomedical sciences.

Programs

Faculty members have established formal programs of study to provide students with a structured curriculum within an area of research or a department. The Programs, approved by the Texas Higher Education Coordinating Board, provide students with a recommended series of courses appropriate for the area, collective advice on research training from the faculty members of the program, and an opportunity for interaction between students and faculty who have similar research interests.

PhD students are required to affiliate with a Program by the end of their first year of study.

The curricular recommendations developed within the Programs provide sufficient flexibility to permit students to develop an individualized program of study within the Program's framework. The current organized PhD Programs of study are as follows:

- Cancer Biology
- Genetics and Epigenetics
- Immunology
- Medical Physics
- Microbiology and Infectious Diseases
- Molecular and Translational Biology
- Neuroscience
- Quantitative Sciences
- Therapeutics and Pharmacology

Further information about PhD Programs and the faculty affiliated with them is available on the GSBS website (http://gsbs.uth.edu/programs/).

Curriculum

Successful students in this degree program will develop the necessary skills to conduct novel research at a professional level, learn the theoretical background for their particular area of study, and become familiar with the issues of biomedical ethics that interface with their chosen fields of study. To this end, the faculty have developed a challenging seven-step curriculum that gives the student the opportunity to attain the skills necessary to pursue a career in biomedical research. The seven steps of the curriculum include:

1. *Tutorial laboratory experiences:* This experience is primarily designed to offer a student the opportunity to select an area of research for the student's research dissertation and a mentor to guide this research. This phase of the curriculum occupies approximately one-half of the student's day for the first two semesters of study. During this time, the student must develop competence in research in three different tutorial laboratories.
2. *Breadth in the biomedical sciences:* Each student is required to develop a broad awareness of several different areas in the biomedical sciences. Most first-year PhD students are required to take GS21 1017 Foundations of Biomedical Research to satisfy the breadth requirement. The remaining PhD students take Program-specified courses to address breadth of knowledge.
3. *Depth in the biomedical sciences:* Students are required to join a GSBS Program and demonstrate knowledge in the Program area by meeting Program-specific course requirements.
4. *Appreciation of the ethical issues in biomedical research:* Each student is required to demonstrate knowledge in biomedical ethics by passing GS21 1051 Ethical Dimensions Biomedical Sciences. The course will provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives.
5. *Scientific writing ability:* Each student is required to demonstrate knowledge in scientific writing either by passing GS21 1152 Scientific Writing or by passing an approved scientific writing course.
6. *Capability to formulate a significant research problem and to design a rigorous scientific plan to address it:* Through completion of the course curriculum, each student is given the opportunity to develop the skills needed to identify a significant research problem in their chosen area of research concentration and to write a research proposal aimed at rigorously investigating the problem. The attainment of this skill is demonstrated by the passing of a candidacy examination, which evaluates the ability of a student to produce a written research proposal and to defend this proposal in an oral examination. The examination also tests the student's depth of knowledge of the pertinent scientific background.
7. *Ability to perform research that significantly contributes to the scientific body of knowledge:* The student performs research and publishes it in a peer-reviewed journal. The student also writes a dissertation under the guidance of an Advisory Committee. Students must demonstrate competence in the formulation and performance of original research. After completing the research and writing the dissertation, the student must present a public seminar of the research findings and successfully defend the dissertation.

The seven steps in the curriculum of the PhD program described above represent the general GSBS academic requirements. Additional course work included in a student's program of study is selected by the student and a faculty Advisory Committee. The program of study should be selected to provide the student with educational experiences appropriate to the scientific disciplines with which the dissertation research is concerned.

General Requirements

The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences requires a minimum of 72 credit hours to obtain the degree of Doctor of Philosophy (PhD). Students specializing in Medical Physics must complete a minimum of 82 semester credit hours due to the extensive course requirements of that area of concentration. Students are required to register as full-time

students each term, for a minimum total of 24 credit hours earned each year. The average time to completion of the PhD degree is 5.2 years. On average, PhD students complete 135 credit hours by the completion of their degree requirements. The 72 credit-hour minimum includes:

Code	Title	Hours
GS21 1051	Ethical Dimensions Biomedical Sciences	1
GS00 1514	Tutorial Research Experience (P/F only) [1]	6
GS21 1017	Foundations of Biomedical Research [2]	7
GS21 1152	Scientific Writing [3]	2
GS00 1520 & GS00 1920	Research in Biomedical Science (P/F) and Dissertation for Doctor of Philosophy (a minimum of one year of registration for research, which includes these courses)	

1 each instance of the Tutorial Research Experience class is 2 hours, but students are required to complete the class a total of three times with three different faculty mentors

2 or required Program-specific courses

3 or another approved scientific writing course, any required Program-specific coursework

Any exceptions to this minimum credit-hour requirement must be approved by the Dean upon recommendation by the Academic Standards Committee. The majority of these 72 credit hours (i.e., over 50%), plus the majority of any additional coursework required by the Academic Standards Committee or the student's Advisory Committee, must be taken in residence at the GSBS, at other UT schools, or at an institution with which a consortium arrangement exists (i.e., Rice University, the University of Houston, Baylor College of Medicine, Texas A&M Health Science Center-Institute of Biosciences and Technology, and the Gulf Coast Consortium).

Tutorial Laboratory Requirements

PhD students must complete, with a grade of “Pass”, three different tutorial laboratory rotations under the supervision of three different GSBS faculty members.

The tutorials are each worth two credit hours (10 weeks per tutorial, 20 hours per week, or other arrangements resulting in a total of 200 hours in the laboratory) and are normally taken during the first two semesters. The tutorial laboratory experience serves the dual role of introducing the incoming student to a variety of research environments and allowing the student the opportunity to select an advisor to supervise future dissertation research.

One tutorial requirement may be waived at the discretion of the GSBS Office of Academic Affairs if:

- The student has an MS degree from another institution, provided the MS degree involved laboratory research and the preparation of a thesis; or
- The student has had laboratory research experience judged to be equivalent to a tutorial rotation; or
- The student has authored peer-reviewed publications in the biomedical sciences.

Waiver of more than one tutorial requirement will not be permitted except in extraordinary circumstances. Students wishing a tutorial waiver must submit a written request for waiver to the GSBS Office of Academic Affairs. Tutorial waivers will be considered only for students who have identified the laboratory in which they will remain for their dissertation research. Therefore, the request must also be supported by the student's proposed advisor.

PhD Students who have, prior to their enrollment in the degree program, carried out research under the employment of a GSBS faculty member, may do one required tutorial rotation under the supervision of that faculty member. In such instances the two remaining rotations must both be completed under the supervision of other GSBS faculty members. Such students will not be eligible for a third rotation waiver.

Students who previously completed an MS thesis under a GSBS faculty member may be permitted to waive the third rotation with approval of the GSBS Office of Academic Affairs after successfully completing a rotation with their MS advisor and successfully completing one rotation under the supervision of another GSBS faculty member.

Advisory Committee

Upon the completion of the tutorial rotations, the student identifies a research Advisor. The student, with the assistance of the Advisor, proposes an Advisory Committee and submits the proposal to the Academic Standards Committee for its approval. Upon approval by the Academic Standards Committee and the Dean, the Advisory Committee members are notified of their appointment. The student must meet with the Advisory Committee at least every 6 months to keep them apprised of progress toward the degree. As the student’s research progresses, a change in focus may necessitate a change in committee membership. This change must be approved by the Academic Standards Committee.

Breadth Requirement

Most PhD students are required to pass GS21 1017 Foundations of Biomedical Research. This course provides incoming graduate students with a broad overview of modern biomedical sciences, spanning historical perspectives to cutting-edge approaches. The course combines traditional didactic lectures and interactive critical thinking and problem solving exercises to provide students with a strong background in fundamental graduate-level biological topics including genetics, molecular and cellular biology, biochemistry, physiology, developmental biology and biostatistics. The remaining PhD students are required to pass Program-specific courses that are approved by the GSBS Curriculum Committee to meet this requirement.

The breadth requirement must be met before the student petitions to take the PhD candidacy examination. The goals of this requirement are to:

- Provide students with a breadth of knowledge in relevant areas of biomedical sciences,
- Enhance their critical thinking and communication skills,
- Facilitate creative collaboration between biomedical scientists trained in depth in different disciplines.

A description of the Core Course is posted on the GSBS website and is available in the GSBS Office of Academic Affairs. A listing of Program-specified breadth courses is also posted on the GSBS website and available in the GSBS Office of Academic Affairs.

Recognition of Previous Graduate Course Work to Substitute for GSBS Required Courses

Students may petition to substitute previous graduate coursework taken at another institution for any course requirement by providing documentation that the course is equivalent to the required GSBS course. Such requests must be approved by the GSBS Office of Academic Affairs.

Undergraduate-level courses are unacceptable as substitutes for GSBS courses.

Ethics Course Requirement

All students are required to pass GS21 1051 Ethical Dimensions Biomedical Sciences prior to petitioning for candidacy. The aim of the course is to provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives. The course explores issues such as the commitment to truth and its breakdown; the ethics of authorship; experimentation with human and animal subjects; management of scientific data; mentor and trainee responsibilities; collaborative research peer review; conflicts of interest; biosafety and biosecurity; and the relationships of scientists to industry, society at large, and future generations. In addition, two online modules, "Data Acquisition and Management" and "Responsible Authorship and Publication" must also be successfully completed by all students.

Scientific Writing Requirement

All PhD students are required to pass GS21 1152 Scientific Writing or another approved scientific writing course, prior to petitioning for candidacy.

MS Degree Bypass

Students will be considered for a bypass of the MS degree only after satisfactory completion of the PhD candidacy examination. A recommendation from the GSBS Examination Committee that the student should be permitted to bypass the MS degree will be reviewed by the GSBS Academic Standards Committee.

Completion of the Master of Science degree is recommended for students:

- With little experience in laboratory research;
- Who have not written research papers or literature reviews;
- Who would benefit from the opportunity to pursue a research project under close supervision;
- Who need significant improvement in written and oral communication; or
- Who have not determined which biomedical problem(s) they intend to pursue independently.

The PhD Candidacy Examination: Its Purpose

The purpose of the candidacy examination is to test the breadth and depth of knowledge in the biomedical sciences. The examination is meant to be an evaluation of the student's ability to construct a hypothesis, to design the means by which to test it, and to critically analyze obtained results. The oral candidacy examination gives the student the opportunity to demonstrate:

- An understanding of the research area in which he or she is being tested;
- The ability to formulate a research problem and to comprehend its significance;
- The ability to design appropriate experimental approaches to solve the problem.

A student's performance will be regarded as satisfactory only if the student:

- Demonstrates an adequate knowledge of the field and the research specialty in which he or she is being tested;
- Identifies a significant research problem, the solution of which will make a substantial contribution to our existing knowledge;
- Makes sound judgments in formulating a rigorous experimental design and can interpret critically the results anticipated;
- Demonstrates that the experimental design and methods proposed are appropriate to solving the problem.

Petition for the PhD Candidacy Examination

Students are required to petition for PhD candidacy by the end of the second year following matriculation.

Before submitting the petition for the candidacy exam, the student must have eliminated all deficiencies identified by the student's Advisory Committee and completed the tutorials, scientific writing and ethics requirements, and either the Core Course or Program-specific required courses to meet the breadth requirement.

PhD students must pass a candidacy exam in the format required by the student's Program. Program exam requirements and guidelines are posted on the GSBS website.

PhD Candidacy Examination

All PhD students must prepare and defend a written research proposal as part of their candidacy examination. The candidacy examination tests breadth and depth of the student's understanding of a defined research area. The examination includes both written and oral components.

The candidacy examination must take place before the end of the first semester of the third year following matriculation and after the petition is approved by the Academic Standards Committee. Completion of PhD candidacy and either the bypass (or completion) of the MS degree must be achieved by the end of the third year of enrollment. PhD students who fail to do so will be placed on academic probation and their progress will be reviewed by the GSBS Academic Standards Committee to determine if further action is needed.

It is the student's responsibility to select the date, time, and place of the examination. If a member of the GSBS Examining Committee is unable to attend the examination, a substitute who meets the same criteria (e.g., outside the student's major interest) should be added. The new member must be approved by the GSBS Office of Academic Affairs.

Results of the PhD Candidacy Examination

The Chair of the GSBS Examining Committee is responsible for submitting the results of the examination to the GSBS Office of Academic Affairs for review by the GSBS Academic Standards Committee. The results of the examination will be one of the following (students are recommended to candidacy by the Academic Standards Committee and admitted to candidacy by the Dean only after review and approval of the examination results):

- **Student passes unconditionally**. The GSBS Examining Committee, where appropriate, also may recommend that a student who receives an unconditional pass may bypass the MS degree.
- **Student passes conditionally, with the conditions clearly stated, i.e., the exact nature of the deficiency/ies along with a suggested mechanism to repair the deficiency/ies**. The Examining Committee may choose to formulate the final mechanism for removing the deficiency/ies, or the Examining Committee may at its discretion assign this responsibility to the student's Advisory Committee. Conditions must be

fulfilled within one year of the exam date. The Chair of the Examining Committee must write a letter of certification to the Office of Academic Affairs when the student has resolved the conditional pass. The Chair of the Examining Committee must serve as a member of the Advisory Committee, at least until the conditional pass has been resolved. Requests for an extension of the one-year deadline, with justification by the Advisory Committee, must be submitted to the Academic Standards Committee for its approval. In all cases, conditions must be fulfilled before the student requests the defense of the PhD dissertation.

- **Student is to be re-examined at some future date before the Examining Committee will render a decision**. Results of the first exam (where it was determined that the student would be re-examined) must be submitted to the GSBS Office of Academic Affairs immediately following the exam. Specifically, in a memo to the student and the Academic Standards Committee, the Chair of the Examining Committee should describe areas that need improvement, areas of strength, conditions for re-exam and a deadline for the re-exam (maximum one year after original exam). The Exam Committee for the re-evaluation must be composed of the same faculty members that conducted the first exam. Upon re-examination, the Committee may only elect to Unconditionally Pass or Fail the student. Students may be re-examined only once. The Chair of the Examining Committee must separately communicate to the Office of Academic Affairs the result of the re-exam. If the student fails to successfully complete the re-examination prior to the deadline determined by the Examining Committee (not to exceed one year from the first examination), the Academic Standards Committee will dismiss the student from the PhD program.
- **Student fails**. Failure of the examination means the Examining Committee has determined the student has not demonstrated the requisite potential to complete the PhD program, and the Academic Standards Committee will dismiss the student from the PhD program. The Academic Standards Committee may, at its discretion, determine that the student will be permitted to continue towards a terminal MS degree. Subsequent to dismissal, the student may re-apply to the School after one year; the application will be considered in competition with other applications pending at the time.

Registration for PhD Dissertation

After being admitted to candidacy for the PhD degree, the student is permitted to register for GS00 1920 Dissertation for Doctor of Philosophy. The student must register for at least one semester of Dissertation before becoming eligible for the PhD dissertation defense. The student must be registered for Dissertation in the final semester in which requirements are completed.

Expectations for the PhD Dissertation

The following are expectations for the PhD dissertation, established by the GSBS Faculty. They are based on the Council of Graduate Schools' publication, *Requirements for the PhD: A Policy Statement* (Washington: Council of Graduate Schools in the United States, 1979 – used with permission of the CGS).

Nature and Purpose

The doctoral dissertation is the final and most important component of the series of academic experiences, which culminate in the awarding of the PhD degree. Four major functions are fulfilled by the dissertation experience:

- It is a work of original research or scholarship which makes a contribution to existing knowledge;
- It is an educational experience which demonstrates the candidate's mastery of research methods and tools of the specialized field;
- It demonstrates the student's ability to address a major intellectual problem and arrive at a successful conclusion; and
- It demonstrates that the student possesses the potential to function as an independent researcher.

In view of the wide range of fields of knowledge in which the PhD degree is awarded, it is not feasible to set specific requirements and standards for this degree. Nevertheless, there is a general -- and usually explicitly stated -- agreement among American universities that the doctoral dissertation should be a distinct contribution to knowledge, and of sufficient value to warrant its publication in a reputable journal, or as a book or monograph.

Relationship with MS Thesis

GSBS students may utilize a MS degree project as the basis of the hypotheses to be tested by the doctoral research. The PhD dissertation must not include data that are part of the MS thesis. Data from the MS thesis may be included in the dissertation as part of the Introduction or as an appendix. In all cases, data from the MS thesis must be identified clearly as originating from the previous work. Furthermore, the PhD dissertation must have a title that is distinct from the MS thesis.

Defense of the PhD Dissertation

At a time deemed appropriate by the Advisory Committee, the student will submit a complete draft of the dissertation to each member of the Advisory Committee, together with the form requesting to defend the PhD dissertation. The completed defense form and a one-page summary of the research must be submitted to the GSBS Office of Academic Affairs. The dissertation defense will be held no sooner than two weeks nor later than three months after the request form is received by the Office of Academic Affairs and approved by the Dean.

- Prior to the defense, students who matriculated prior to Summer 2014 must submit at least one first-authored paper related to their education and research at GSBS to a peer-reviewed journal for publication.
- Students who matriculated in Fall 2014 and thereafter must also submit at least one first-authored paper related to their education and research at GSBS to a peer-reviewed journal for publication prior to the defense, and the paper must be accepted for publication prior to graduation.
- The student's Advisory Committee must approve the quality of the journal for the required publication.
- A request for exception to these policies must be recommended by the Advisory Committee or the Academic Standards Committee and approved by the Dean.

Guidelines for the PhD Dissertation Defense

The purpose of the dissertation defense is to provide a consistent and complete evaluation of the dissertation and the student's understanding of the research, as well as the student's ability to report information to the scientific community in a well-organized and interesting form.

An announcement of the defense will be distributed by electronic mail to all GSBS students and faculty.

Guidelines for the defense are:

- The student will deliver a 45- to 60-minute public presentation on campus, including a detailed description of the background, rationale, materials and methods, results, and conclusions appropriate to the research. Following the presentation, the student will respond to questions from the audience.
- Immediately thereafter, and at a location announced at the end of the seminar, the Advisory Committee will examine the student on the dissertation. Any member of the GSBS Faculty who attends the public presentation may participate in the examination to the extent described below. Others wishing to attend must be approved by the Advisory Committee.
- The student's Advisor will serve as moderator of the examination. The student will be expected to respond to questions from those attending on any aspect of the written dissertation or the material presented at the public presentation.

After the examination, the student will meet privately with the Advisory Committee to discuss the results. Finally, the Advisory Committee will determine what recommendation to make to the Dean and the Academic Standards Committee. The Committee may conclude that the student has passed, or it may require additional research, modifications to the dissertation, and/or another defense. The results of this meeting will be communicated through the GSBS Office of Academic Affairs to the Dean and the Academic Standards Committee for their information and approval.

Within one week of the dissertation defense, any member of the GSBS Faculty who has read the student's dissertation and has attended the defense may write directly to the Dean to provide an evaluation of the student's performance. In reaching a final decision on whether to award the PhD or require further work and/or another defense, the Dean will take into consideration the recommendation of the Advisory Committee and other comments received from GSBS Faculty. In particular cases, the Dean may solicit additional evaluations of the dissertation from experts in the field either within or outside the GSBS Faculty. Should a concern be raised by a GSBS faculty member about a student's performance, the decision of the Dean will be communicated to the student and the Advisory Committee within one month of the dissertation defense.

Approval of the Dissertation

All members of the Advisory Committee are expected to sign the student's dissertation to demonstrate their approval of the document. If any member refuses to sign the dissertation, the Academic Standards Committee will consider the matter and provide a recommendation to the Dean. In deciding whether to approve the dissertation, the Dean will take into consideration the recommendations of the Advisory Committee and the Academic Standards Committee. In particular cases, the Dean may solicit additional evaluations of the dissertation from experts in the field either within or outside the GSBS Faculty.

Completion of the PhD Requirements

The PhD degree is not awarded until the student has completed the following requirements:

- Successfully defended the dissertation;
- The final dissertation, approved by the Advisory Committee, is submitted electronically to the GSBS Office of Academic Affairs for the Dean's approval;
- The first-authored paper requirement has been met, if applicable, and
- All exit forms are completed and submitted to the GSBS Office of Academic Affairs.

The student must be registered for *Dissertation* in the final semester in which requirements are met.

Students must also complete a form indicating the dissertation-related research areas to be listed on the diploma. Students may request to list none, one or two areas on the diploma. If areas are listed, the first must be the Program with which the student is affiliated. The second area must correspond to one of the other GSBS Programs approved by the Texas Higher Education Coordinating Board and must overlap with the student's dissertation research topic. Any areas listed on the diploma must be approved by the director of the corresponding Program. Any second area must also be approved by the GSBS Academic Standards Committee.

The degree will be issued as of the final day of the semester in which all degree requirements have been met. The PhD degree must be completed within seven years of first registration in GSBS. Students may continue registration in GSBS after the seven-year limit only with the express written permission of the Dean.

Genetic Counseling (Specialized MS)

The specialized Master of Science degree in Genetic Counseling is designed for individuals who seek a terminal MS degree with requisite education in genetic counseling. The program's mission is to excel in the training of versatile genetic counselors by facilitating competency-based learning, supporting personalized growth, and immersing students in the depth and breadth of genetic counseling practice. Graduating students demonstrate proficiency in genetic counseling competencies and have accrued a substantial and diverse clinical logbook cases in order to sit for the American Board of Genetic Counseling certification exam. The program's challenging curriculum provides training in medical genetics and genomics, cancer genetics, prenatal genetics, psychosocial counseling, and genetic counseling research. In addition to the aforementioned general MS requirement of 36 semester credit hours, the more stringent and specific Genetic Counseling Program requirements include the successful completion of specialized courses, clinical rotations, a Master of Science thesis, advanced rotation exam and an oral comprehensive exam totaling 45 semester credit hour for completion of the program.

The program is fully accredited by the Accreditation Council for Genetic Counseling, located at:
1660 International Drive, Suite 600
McLean, VA, 22102
Telephone: (703) 506-7667; Fax: (703) 506-3266
Accreditation Council for Genetic Counseling Website (https://www.gceducation.org/)

Curriculum

Genetic Counseling students take classes in the areas of cancer genetics, prenatal genetics, medical genetics, research methodology, ethics, and psychosocial counseling. The majority of course work is completed by the end of the first year. Clinical rotations and the completion of a Master

of Science thesis research project dominate the second year. Required course work totals 45 credit hours and includes:

Code	Title	Hours
GS11 1132	Intro to Genetic Counseling	2
GS11 1012	Cancer Genetic Counseling	2
GS11 1011	Embryology	1
GS11 1622	Topics in Medical Genetics I	2
GS11 1642	Topics in Medical Genetics II	2
GS11 1082	Psychosocial Issues in Genetic Counseling I	2
GS11 1182	Psychosocial Issues in Genetic Counseling II	2
GS21 1181	Biomedical Ethics for the Genetic Counselor	1
GS11 1142	Approaches to Genetic Counseling Rsch I	2
GS11 1152	Approaches to Genetic Counseling Rsch II	2
GS11 1031	Contemporary Issues in Genetic Counsel	1
GS11 1021	Psychosocial Practicum	1
GS00 1520	Research in Biomedical Science (P/F)	1-9
GS00 1910	Thesis for Master of Science	1-9
GS11 1173	Introductory Clinical Rotation in Genetic Counseling	3
GS11 1174	Advanced Clinical Rotation in Genetic Counseling	4

MS Thesis

Students are expected to propose and complete a clinically-oriented or laboratory research question that includes study design, data collection, data analysis, and a written manuscript. A written thesis in publication-ready format and an oral defense are required for graduation.

Clinical Rotations

Students receive cases of significant depth and breadth in the genetic counseling arena typically totaling over 200 clinical cases, well above the minimum of 50 logbook cases needed to sit for the board examination offered by the American Board of Genetic Counseling. After completing their clinical training, students should be well-prepared, flexible genetic counselors, familiar with the needs of an increasing diverse clientele.

Advanced Rotation and Oral Comprehensive Exams

Students demonstrate cumulative clinical skill acquisition at the conclusion of their Advanced Rotations via the Advanced Rotation Exam. Results of this exam may affect placement for final clinical rotations and/or show the need for remediation. Students demonstrate overall synthesis and application of genetic counseling material via an oral comprehensive examination. Students who are not able to demonstrate adequate skills will be required to complete remediation. Failure by a student to pass two attempts at the oral comprehensive exam will require the student to undertake extended remediation. Extended remediation from either exam could delay graduation; unsuccessful remediation will result in dismissal from the program.

Prerequisites

A cumulative undergraduate GPA of 3.0 or greater and coursework in biology, genetics, psychology, statistics and biochemistry are recommended. However, the Genetic Counseling Program (GCP) considers the entire application when selecting applicants to interview. Additional items that are recommended for a strong application include genetic counseling shadowing, assistantship or internship, crisis counseling, volunteering with advocacy or disability groups, tutoring, peer mentorship and research experience.

An interview with the GCP is required for admission to the program. On average, the program receives 250 applications each year and interviews approximately 54 candidates. Offers to interview are extended in February after the applications are reviewed. The Program participates in the Genetic Counseling Admissions Match through the Genetic Counselor Educators Association (formerly known as the Association of Genetic Counseling Program Directors) and National Matching Services. Match results are typically released in mid April.

Further information concerning the prerequisites or academic requirements for this program may be obtained by writing to:

Claire N. Singletary, MS, CGC
Department of Pediatrics
McGovern Medical School at UTHealth Houston
P.O. Box 20708
Houston, Texas 77225
Claire.N.Singletary@uth.tmc.edu or gsbs.gcpinfo@uth.tmc.edu

Medical Physics (Specialized MS)

The Specialized Master of Science degree in Medical Physics prepares students for a clinically-oriented career as a medical physicist in a healthcare environment, a clinical support research laboratory or a clinical support industry. A graduate of the program would also be prepared for entry into a PhD program in medical physics or into a clinical medical physics residency program. The program curriculum educates the student in the areas of radiation oncology physics, diagnostic imaging physics, and medical health physics related to both ionizing and non-ionizing radiation. The area of radiation oncology physics emphasizes radiotherapy; the area of diagnostic imaging physics includes both diagnostic radiology and nuclear medicine; and the area of medical health physics includes protection from ionizing and non-ionizing radiation. The program requirements entail coursework and thesis research that total 43semester credit hours for completion.

The MS Program in Medical Physics is accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc., located at:

1631 Prince Street
Arlington, VA 22314
Telephone: (571) 298-1239; Fax: (571) 298-1301
Commission on Accreditation of Medical Physics Education Programs, Inc. Website (https://www.campep.org/)

Coursework

The students in this program must complete 42 hours of required courses:

Code	Title	Hours
GS02 1052	Imaging Science	2
GS02 1072	Statistics for Medical Physicists	2
GS02 1103	Intro to Med Physics II: Med Imaging	3
GS02 1093	Intro Medical Physics I:Basic Intraction	3
GS02 1113	Intro to Med Physics III: Therapy	3
GS02 1193	Intro Med Physics IV:Physics Nuclear Med	3
GS02 1213	Therapy Medical Physics II	3

GS02 1223	Diagnostic Medical Physics II	3
GS02 1202	Electronics for Med Physics	2
GS02 1053	Radtn Detectn, Instrumntn, & Data Analys	3
GS02 1063	Fundamental Anatomy, Physiology, and Biology for Medical Physics I	3
GS02 1073	Fundamental Anatomy, Physiology, and Biology for Medical Physics	3
GS02 1133	Intro to Radiation Protection	3
GS02 1731	Medical Physics Seminar	1
GS21 1051	Ethical Dimensions Biomedical Sciences	1
GS00 1910	Thesis for Master of Science	1-9
The students in this program must complete a minimum of one credit hour of electives. The available electives include:		
GS02 1021	Supervised Clinical Experience in Radiation Therapy Physics	1
	Various Medical Physics Special Project Courses	
	Other electives from the GSBS, Rice University, or the University of Houston	

MS Thesis

A thesis of a quality sufficient for the work to be publishable in a refereed journal is required. The student is admitted to candidacy upon approval by the Program and the GSBS Academic Standards Committee of the planned program of coursework, the abstract of the proposed research, and a list of proposed members of the Advisory Committee. The student must be admitted to candidacy before receiving credit for the first semester of *Thesis*. The student must register for *Thesis* credit for at least one semester. The MS thesis is considered complete when the final thesis has been approved by all members of the student's Advisory Committee and after the student has presented a public seminar and passed an oral examination on the thesis by the members of the Advisory Committee and other interested faculty. The student is expected to submit at least one manuscript based on the thesis work to an appropriate peer-reviewed scholarly journal.

Prerequisites

A bachelor's degree in physics or in another basic science or in engineering with the equivalent of a minor in physics is required. The physics background may be demonstrated by completion of upper-level courses in atomic and nuclear physics, electromagnetism, quantum mechanics, classical mechanics, and thermodynamics. Additional requirements are calculus and differential equations. A year of chemistry and a semester of biology are highly desirable. Applicants are expected to have a grade point average of at least 3.0 on a scale of 4.0 on all undergraduate and graduate level work taken previously, particularly in the prerequisite areas.

The GRE is not required. Foreign nationals whose native language is not English and who have not attended an English-speaking university must take the Test of English as a Foreign Language (TOEFL).

Further information may be obtained by writing to:

Rebecca M. Howell, PhD
Director, Graduate Program in Medical Physics
The University of Texas MD Anderson Cancer Center
Department of Radiation Physics
8060 El Rio Street, Unit 605
Houston, Texas 77054
rhowell@mdanderson.org

PhD/MD Program

McGovern Medical School at UTHealth Houston and The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences participate in a dual degree program leading to both MD and PhD degrees. This program is sponsored and supported by UTHealth Houston and MD Anderson Cancer Center and provides a stipend, tuition and fees, and health insurance support during MD and PhD training. Extensive basic and translational research opportunities and participation of more than 500 faculty members from both institutions provide a unique environment and resources for training combined-degree students. The MD/PhD program training structure is also unique and is organized to train physician-scientists. Students complete the first three years of medical school training prior to starting their dissertation research. Thus, the students enter the GSBS with a comprehensive understanding of human disease that can inform and direct their dissertation research. Requirements of both degrees are typically completed in seven years. The program is administered by an MD/PhD Committee, which is comprised of faculty at both institutions.

Students must meet the admissions requirements of the GSBS and McGovern Medical School to qualify for admission to the MD/PhD program. The program is restricted in size and provides stipend support for exceptional MD/PhD candidates. For information, visit the GSBS website.

Application for admission to the MD/PhD Program may be made by submitting an application online through the American Medical College Application Service (AMCAS) and a mandatory secondary online application which may be found on the GSBS website. Three letters of recommendation (two general letters and an additional letter from a research mentor) are also required and should be submitted through AMCAS. The deadline is November 1st.

Students affiliating with a dissertation advisor and PhD program at the GSBS must be in good academic standing at McGovern Medical School and have the approval of the MD/PhD Program Director.

Completion of the MD/PhD Program and receipt of either the MD or PhD is contingent upon completion of all requirements for both degrees. A student entering this program may not receive the PhD degree without completion of the MD degree and likewise may not receive the MD degree without completion of the PhD degree.

Biomedical Sciences for Cancer Research Grant Administration and Management (Certificate)

This Graduate Certificate Program in Biomedical Sciences for Cancer Research Grant Administration and Management is intended for students who are interested in or currently pursuing a career in Biomedical Science Research Administration, and for working professionals with aspirations of working as a research administrator in a biomedical research institution. A total of 12 semester credit hours are required for completion of the Graduate Certificate Program.

The curriculum is based upon the Research Administrators Certification Council (RACC) “Body of Knowledge” and will assist students learning about Research Administration and prepare them to take the national Certified Research Administration® licensing exam. Elements of

the curriculum include understanding the environment and context within which biomedical research administration is conducted, fiscal management, regulatory compliance, sponsored program administration, grant proposal and budget development and an emphasis on pre- and post-award management.

Coursework

The Certificate requires a minimum of 12 semester credit hours of formal GSBS credit as follows:

Code	Title	Hours
GS21 1723	Cancer Research Administration and Management, Pre-Award	3
GS21 1733	Cancer Research Administration and Management, Post-Award	3
GS21 1743	Cancer Research Administration and Management, Lab/Practicum	3
Select at least one of the following:		3
GS21 1613	Translational Cancer Research	
GS21 1232	Translational Sciences: Bedside to Bench and Back	
GS04 1235	Basic and Translational Cancer Biology	
Total Hours		**12**

Prerequisites

The certificate may be awarded to students enrolled in formal GSBS degree programs (i.e., MS or PhD) or to students admitted for non-degree study. Permission of the instructor is required in order to enroll in the Cancer Research Administration and Management courses.

Further information may be obtained by writing to:

Robert C. Bast, Jr., MD
The University of Texas MD Anderson Cancer Center
Department of Experimental Therapeutics
rbast@mdanderson.org

Medical Physics (Certificate)

The Graduate Certificate Program in Medical Physics provides medical physics education to students who already have earned doctorates in physics or a related discipline and who wish to retrain as medical physicists. A total of 30 semester credit hours are required for completion of the Graduate Certificate Program in Medical Physics.

In order to become a practicing medical physicist who is recognized by the American College of Radiology (ACR) as a Qualified Medical Physicist, one must become certified by the American Board of Radiology (ABR). Board certification is also necessary in order to become a Licensed Medical Physicist in the State of Texas. The ABR requires that those whom it examines for certification have completed a residency program that is accredited by the Commission on the Accreditation of Medical Physics Education Programs (CAMPEP). In order to enter such a residency, one must have graduated from a CAMPEP-accredited graduate program. CAMPEP has recognized that PhDs who wish to retrain need not take the gamut of graduate education, some of which is common to all subjects, and thus accredits certificate programs, such as this one, which teach only the core topics of medical physics in a well-defined curriculum.

The Graduate Certificate Program in Medical Physics is accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc., located at
1631 Prince Street
Arlington, VA 22314
Telephone: 517.298.1239 Fax: 571.298.1301
CAMPEP Website (http://www.campep.org)

Information for applicants is available on the GSBS website. Further information may be obtained by writing to:

Rebecca M. Howell, PhD
Director, Graduate Program in Medical Physics
The University of Texas MD Anderson Cancer Center
Department of Radiation Physics
8060 El Rio Street, Unit 605
Houston, Texas 77054
rhowell@mdanderson.org

Coursework

Students must complete 30 semester credit hours of required courses:

Code	Title	Hours
GS02 1093	Intro Medical Physics I:Basic Intraction	3
GS02 1103	Intro to Med Physics II: Med Imaging	3
GS02 1113	Intro to Med Physics III: Therapy	3
GS02 1193	Intro Med Physics IV:Physics Nuclear Med	3
GS02 1213	Therapy Medical Physics II	3
GS02 1223	Diagnostic Medical Physics II	3
GS02 1053	Radtn Detectn, Instrumntn, & Data Analys	3
GS02 1063	Fundamental Anatomy, Physiology, and Biology for Medical Physics I	3
GS02 1073	Fundamental Anatomy, Physiology, and Biology for Medical Physics	3
GS02 1133	Intro to Radiation Protection	3

Prerequisites

- A doctoral degree (typically a PhD or a DSc) in physics or a closely related scientific or engineering discipline, and
- A present or past pre-doctoral or post-doctoral research experience related to medical physics at The University of Texas MD Anderson Cancer Center or The University of Texas Health Science Center at Houston, which are the parent institutions of The University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences.

Non-Degree Study

Non-Degree Students

Qualified individuals who hold a bachelor's degree in science, have a demonstrated interest in a career in research, and wish to take courses at the graduate level without enrolling in an MS or PhD degree program may be admitted to the GSBS as non-degree students. No commitment to eventual admission to a degree program is implied by admission as a non-degree student. Non-degree students will pay regular (per credit) tuition and will receive transcripts indicating the appropriate grades and credit for work completed. Non-degree students will not be eligible for GSBS-based or sponsored financial aid, but may be eligible for other

types of financial aid from UTHealth Houston. Further information about non-degree study is included in the section on admission.

Course Descriptions

Course descriptions in school catalogs and the Course Search (https://catalog.uth.edu/course-search/)are correct at the time of publication. See myUTH (https://uthidp.uth.edu/nidp/saml2/sso/?id=Campus-Affiliate-LOA2-DUO&sid=0&option=credential&sid=0) for more recent course information and to register for courses.

B

- Biochemistry (GS03) (p. 23)
- Biostatistics, Bioinformatics, and Systems Biology (GS01) (p. 20)

C

- Cellular, Molecular, and Developmental Biology (GS04) (p. 24)

H

- Human Genetics (GS11) (p. 27)

I

- Immunology (GS06) (p. 26)

M

- Medical Physics (GS02) (p. 21)
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N

- Neurosciences (GS14) (p. 30)

O

- Other Course Offerings (GS21) (p. 32)

P

- Pharmacology/Toxicology (GS13) (p. 29)
- Physiology and Pathology (GS12) (p. 29)

Biostatistics, Bioinformatics, and Systems Biology (GS01)

Course descriptions in school catalogs and the Course Search (https://catalog.uth.edu/course-search/)are correct at the time of publication. See myUTH (https://uthidp.uth.edu/nidp/saml2/sso/?id=Campus-Affiliate-LOA2-DUO&sid=0&option=credential&sid=0) for more recent course information and to register for courses.

GS01 1023 Survival Analysis (3 Credits)
Prerequisite: Introduction to Biostatistics and Clinical Trials (GS01 1033), or permission of instructor. Survival data are commonly encountered in scientific investigations, especially in clinical trials and epidemiologic studies. In this course, commonly used statistical methods for the analysis of failure-time data will be discussed. One of the primary topics is the estimation of survival function based on censored data, which include parametric failure-time models, and nonparametric Kaplan-Meier estimates of the survival distribution. Estimation of the cumulative hazard function and the context of hypothesis testing for survival data will be covered. These tests include the log rank test, generalized log-rank tests, and some non-ranked based test statistics. Regression analysis for censored survival data is the most applicable to clinical trials and applied work. The Cox proportional hazard mode, additive risk model, other alternative modeling techniques, and new theoretical and methodological advances in survival analysis will be discussed. Letter Graded

GS01 1031 Quantitative Sciences Student Seminar Series (1 Credit)
Prerequisite: Permission of instructor; general genetics and statistics recommended. This series is held bi-weekly for students to present their research project in front of their peers and program faculty. The focus of the session is for the students to practice presenting their project to a varied audience of peers and mentors. Attendees should be prepared to ask questions of the speaker and to provide constructive criticism. This is a required course for all QS Program students and participation is mandatory. All QS students must register for this course every semester unless the student has a direct course conflict. QS-affiliated students are expected to give a minimum of two talks; one pre-candidacy and one post-candidacy, and secondary ARC students are expected to give a minimum of one talk. Pass/Fail

GS01 1033 Introduction to Biostatistics and Clinical Trials (3 Credits)
Prerequisite: Calculus and linear algebra. This course is a one-semester overview of statistical concepts most often used in the design and analysis of biomedical studies. It provides an introduction to the analysis of biomedical and epidemiological data. The focus is on non-model-based solutions to one sample and two sample problems. The course also includes an overview of statistical genetics and bioinformatics concepts. Because this course is primarily for statistics majors, the applied methods will be related to theory wherever practical. Students will be given the opportunity to gain experience in the general approach to data analysis and in the application of appropriate statistical methods. Emphasis will be on the similarity between various forms of analysis and reporting results in terms of measures of effect or association. Emphasis will also be given to identifying statistical assumptions and performing analyses to verify these assumptions. Because effective communication is essential to effective collaboration, students will have the opportunity to gain experience in presenting results for statistically naive readers. Letter Graded

GS01 1143 Introduction to Bioinformatics (3 Credits)
Prerequisite: None. This course is intended to be an introduction to concepts and methods in bioinformatics with a focus on analyzing data merging from high throughput experimental pipelines such as next-gen sequencing. Students will be exposed to algorithms and software tools involved in various aspects of data processing and biological interpretation. Though some prior programming experience is highly recommended, it is not a requirement. Letter Graded

GS01 1233 GLM & Categorical Data Analysis (3 Credits)
Prerequisite: STAT 519, STAT 615, or STAT 410 (Rice courses) or permission of instructor. This course is devoted to the theory and methodology of categorical data analysis with an introduction to Generalized Linear Models. There will be analyses of real data sets using R. The course is cross-listed at Rice University (STAT 545). The venue of the course will be at Rice University. Letter Graded

GS01 1273 Modern Nonparametrics (3 Credits)
Prerequisites: Mathematical Statistics (GS01 1083 or equivalent) and Linear Regression or permission of instructor. This course seeks to introduce students to the many developments in modern nonparametrics, including resampling methods, nonparametric and semiparametric regression models that have occurred over the last several decades. Topics include the bootstrap, jackknife, cross-validation, permutation tests, classification tree, random forests, nonparametric smoothing and regression, spline regression, and functional data analysis. While the course will focus on applications, time will be devoted to derivations and theoretical justifications of methods. The statistical software R will be used for the homework exercises. Letter Graded

GS01 1283 Foundations of Statistical Inference II (3 Credits)
Prerequisite: Rice STAT 532. This is the second semester course in a two-semester sequence in mathematical statistics. The course topics include random variables, distributions, small and large sample theorems of decision theory and Bayesian methods, hypothesis testing, point estimation, and confidence intervals; topics such as exponential families, univariate and multivariate linear models, and nonparametric inference will also be discussed. This course is cross-listed at Rice (STAT 533). The venue of the course will be at Rice University. Letter Graded

GS01 1813 Topics in Clinical Trials (3 Credits)
This course will provide an overview of methods for the design and analysis of clinical trials. Topics will include fundamental principles and commonly used designs for phases I, II and III trials. Advanced topics will include flaws with many conventional methods, hybrid designs, dealing with multiple outcomes, bias correction, precision medicine, and Bayesian methods. This course is cross-listed at Rice University as STAT 630. Letter Graded

Medical Physics (GS02)

Course descriptions in school catalogs and the Course Search (https://catalog.uth.edu/course-search/)are correct at the time of publication. See myUTH (https://uthidp.uth.edu/nidp/saml2/sso/?id=Campus-Affiliate-LOA2-DUO&sid=0&option=credential&sid=0) for more recent course information and to register for courses.

GS02 1011 Rad Induced Late Effects & Survivorship (1 Credit)
Prerequisite: Medical Physics Program or consent of instructor. Students will meet weekly to present and discuss a contemporary publication on the subject of late effects, cancer survivorship, and dosimetry following medical radiation exposures. Publications may include scientific articles, books, reports, review papers, etc. The late effects of interest to the participants of this course are radiation-induced second cancers, infertility, organ dysfunction, cardiovascular effects, lung damage, pregnancy and neonatal outcomes, cognitive deficit, auditory impairment, dental abnormalities, diabetes, other chronic disease, and other long-term radiogenic effects and public health concerns. Medical radiation exposures include those related to radiotherapy and diagnostic imaging. Radiation dosimetry, late effects, and survivorship publications will be based on radiological measurements, analytic calculations, Monte Carlo calculations, predictive risk models, epidemiological data, and any related studies. The presentation outline comprises 25 minutes of prepared slides and 25 minutes of discussion. Each student will be required to present at least once during the semester and will be expected to actively participate in the discussion period. A minimum of 80% attendance is required for a passing grade. Students and faculty will not present their own work. This course is intended for Medical Physics students but is open to students from other programs with instructor consent. Pass/Fail

GS02 1012 Physics of Positron Emission Tomography (2 Credits)
Prerequisites: Radiation Detection, Instrumentation, and Data Analysis (GS02 1053) and Introduction to Medical Physics II: Medical Imaging (GS02 1093) or Introduction to Medical Physics IV: The Physics of Nuclear Medicine (GS02 1193). This course will focus on advanced Positron Emission Tomography (PET) physical principles, image formation and processing, and image correction techniques, as well as lay the foundations for understanding tracer kinetic modeling. Students will have the opportunity to obtain hands on experience with PET imaging and data analysis. The use of PET imaging in various medical and research applications will be presented. Letter Graded

GS02 1021 Supervised Clinical Experience in Radiation Therapy Physics (1 Credit)
Prerequisites: Introduction to Medical Physics I Basic Interactions (GS02 1093) and Introduction to Medical Physics III: Therapy (GS02 1113). The Supervised Clinical Experience in Radiation Therapy Physics course is an elective course intended for students to be exposed to the practical working environment of a radiation oncology clinic. The time commitment for this elective is 4 hours a week with no didactic portion. Students will have 2 options: (1) a general supervised clinical experience whereby the student will rotate one morning every week with each site-specific physicist from the Department of Radiation Physics at MD Anderson Cancer Center, or (2) a student/mentor-led experience that focuses on one specific treatment procedure. Students pursuing the second option will submit a proposal to be approved by the course director before the start of the course (to ensure that it is consistent in effort and scope to the general experience) and a report of their experiences at the end of the course. Pass/Fail

GS02 1031 Supervised Clinical Experience in Imaging Physics (1 Credit)
Prerequisites: GS02 1093: Intro to Medical Physics I: Basic Interactions; GS02 1103: Intro to Medical Physics II: Medical Imaging; GS02 1113: Intro to Medical Physics III: Therapy; GS02 1194: Intro to Medical Physics IV: The Physics of Nuclear Medicine and Consent of Instructor. This course provides graduate students with a high-level understanding of clinical imaging physics operations through hands-on experience and clinical observation. Each week will focus on a different aspect of imaging physics focusing on clinical operations and observation. The course will culminate in an oral exam similar to the ABR part III exam. The course intends to target senior Medical Physics students who are nearing completion of their course work. Pass/Fail

GS02 1032 Principles Magentic Resonance Imaging (2 Credits)
Prerequisite: Introduction to Medical Physics II (GS02 1103) or consent of instructor. The goal of this course is to provide a comprehensive understanding of the physics involved in magnetic resonance imaging (MRI), and prepare the students to carry out research or practice medical physics in this area. The topics include basic spin physics, contrast mechanisms, hardware, data acquisition, image reconstruction, and artifact recognition. Emphasis will be placed on practical issues encountered in research and clinical applications. Letter Graded

GS02 1052 Imaging Science (2 Credits)
Prerequisites: Calculus, Linear Algebra. This course provides a concise and coherent review of some commonly-encountered topics in applied mathematics, with a particular emphasis on their applications and relevance to medical imaging. The course covers and is equally divided into two major sections: 1. Optimization methods and algorithms, 2. Fourier and wavelet transforms. Letter Graded

GS02 1053 Radtn Detectn, Instrumntn, & Data Analys (3 Credits)
Prerequisites: Introduction to Medical Physics I (GS02 1093) or equivalent, and permission of instructor. This course encompasses a study of the characteristics and applications of charged particle, photon, and neutron detectors. Modular analog and digital electronics required for signal processing and data recording will be used. Techniques of data analysis and error propagation of counting statistics will be introduced. The course will include two lectures and one laboratory exercise weekly. The applications of radiation detectors in radiotherapy, health physics, nuclear medicine, and radiobiology will be emphasized. Letter Graded

GS02 1063 Fundamental Anatomy, Physiology, and Biology for Medical Physics I (3 Credits)
Prerequisite: Introduction to Medical Physics III: Therapy (GS02 1113). This is Part I of a two-part course that covers the fundamental biological principles that are essential for medical physicists, presenting them in an integrated progression from the molecular level to the organismal level. This course may also be of interest for graduate students of biophysics, radiation biology, and biomedical engineering. Beginning with a review of basic biochemistry, the course proceeds through molecular biology then cellular biology and physiology. Applications of these principles to radiation biology are covered, then the course moves to cell-cell and cell-matrix interactions, tumor growth and development, and radiation carcinogenesis. The course concludes with the language of anatomy. Letter Graded

GS02 1072 Statistics for Medical Physicists (2 Credits)
Prerequisites: Calculus, Linear Algebra. This course is a one-semester overview of statistical concepts in biomedical and imaging studies. The material is intended to provide an introduction to applied methods of biostatistics that are prevalent in an engineering curriculum but are now increasingly encountered in medical physics literature and various areas of medical physics research, including non-model-based solutions to one sample and two sample problems. Students will gain experience in general understanding of the underlying statistical principles, the general approach to data analysis and interpretation of appropriate statistical methods. Letter Graded

GS02 1073 Fundamental Anatomy, Physiology, and Biology for Medical Physics (3 Credits)
Prerequisites: Introduction to Medical Physics III (GS02 1113), Fundamental Anatomy, Physiology, and Biology for Medical Physics I (GS02 1063). This is Part II of a two-part course that covers the fundamental biological principles that are essential for medical physicists, presenting them in an integrated progression from the molecular level to the organismal level. This course may also be of interest for graduate students of biophysics, radiation biology, and biomedical engineering. Part II builds on the concepts from Part I of the course, and focuses on systems biology, including anatomy, physiology, and oncology, with special focus on the use of radiotherapy to treat cancer. This course has a unique focus on radiologic anatomy, and students will learn to identify normal anatomic structure in medical images acquired using radiography, computed tomography, and magnetic resonance imaging. Molecular and functional imaging and cancer biology are also introduced in this course. Letter Graded

GS02 1093 Intro Medical Physics I:Basic Intraction (3 Credits)
Prerequisite: None. This semester covers the basic interactions of ionizing radiation important in medicine. Topics include production of radiation, photo, charged particle, and neutron interactions, cavity theory, radiation interactions with solids. Letter Graded

GS02 1103 Intro to Med Physics II: Med Imaging (3 Credits)
Prerequisite: Introduction to Medical Physics II (GS02 1103) or consent of instructor. This course includes the production of x-rays, x-ray interactions, radiography, fluoroscopy, mammography, computed tomography (CT), and picture archiving and communication systems (PACS). It covers the basic principles of diagnostic x-ray and CT imaging physics, the fundamental characteristics of each imaging modality, the major components of imaging chain systems, the principles of image formation and reconstruction, the attributes used to assess the performance and image quality of an imaging system, radiation dosimetry, and clinical applications in diagnostic x-ray and CT imaging. Letter Graded

GS02 1113 Intro to Med Physics III: Therapy (3 Credits)
Prerequisite: Introduction to Medical Physics I (GS02 1093). The physics of treatment modalities to include external beam radiotherapy, brachytherapy, and internal emitters will be discussed. The necessary therapy equipment will be described with methods of calibration, dose specification, and dose prescription. The effects of machine geometry and patient anatomy on dose calculations will be discussed. Machine calibration and quality assurance procedures are emphasized. Letter Graded

GS02 1132 Proton Therapy Physics (2 Credits)
Course Description The proton therapy physics course will provide students knowledge about proton beam dose deposition in different media, radiobiology of proton beams, clinical proton beam generation and delivery, commissioning proton therapy delivery systems, quality assurance, simulation and treatment planning for proton therapy, uncertainties in proton beam therapy, clinical indications for proton therapy, image guidance for proton therapy, treatment delivery and clinical outcome. In addition to lectures, practical hands-on sessions will be held for dosimetric measurements, beam calibration, quality assurance checks and treatment planning for different disease sites. Letter Graded

GS02 1133 Intro to Radiation Protection (3 Credits)
Prerequisite: Radiation Detection, Instrumentation, and Data Analysis (GS02 1053) or permission of instructor. The science of radiation protection including terminology, biological effects, shielding dose limits, and dose measurement will be studied. The role of state and federal enforcement agencies will be discussed. The application of radiation protective concepts in a medical environment will include room design, isotope handling, instrumentation calibration, and room surveys. Letter Graded

GS02 1193 Intro Med Physics IV:Physics Nuclear Med (3 Credits)
Prerequisites: Introduction to Medical Physics I (GS02 1093); Radiation Detection, Instrumentation, and Data Analysis (GS02 1053) [may be concurrent]; and Consent of Instructor. This course introduces graduate students to the basic science and instrumentation of nuclear medicine and magnetic resonance imaging. It presents scientific principles underlying quantitative radionuclide organ imaging methods for dosimetry and treatment planning. Letter Graded

GS02 1202 Electronics for Med Physics (2 Credits)
Prerequisite: Undergraduate electronics course covering basics of analog and digital circuits, or permission of instructor. This course emphasizes the analog and digital electronics associated with scientific instrumentation, particularly as related to medical physics. Topics include analog DC and AC circuits and circuit analysis, transformers, and basic semiconductor devices such as diodes, transistors, and operational amplifiers; electrical safety; the use of filters and voltage regulators; digital logic; digital circuits, and the interface between analog and digital domains; and an overview of the electrical characteristics of systems that are used in the practice of medical physics. Letter Graded

GS02 1213 Therapy Medical Physics II (3 Credits)
Prerequisites: GS02 1113: Introduction to Medical Physics III: Therapy. This course will cover concepts and applications in "modern" radiation therapy physics. It will start with an introduction to model based planning with CT and followed with rigorous treatment of convolution based-algorithms, Monte-Carlo, and deterministic algorithms. This will include further discussion of heterogeneity corrections and limitations in commercially implemented algorithms utilized in treatment planning systems. This will be followed by discussion on modern radiation therapy planning and delivery approaches in IMRT, VMAT, stereotactic, and image-guided RT principles. Proton radiation therapy will be covered in detail. The final section of the class will cover advanced RT topics including MR in RT, patient specific QA, artificial intelligence/automation applications, biological based treatment planning, and FLASH. Letter Graded

GS02 1223 Diagnostic Medical Physics II (3 Credits)
Prerequisite: Working knowledge of calculus up through partial differential equations as well as Fourier Series and Fourier Transform at the level covered in GS02 1052: Imaging Science. This course provides graduate students with a foundation in the fundamental physics, principles of image formation,a nd reconstruction, instrumentation, safety, and quality assurance of ultrasound and magnetic resonance imaging. Letter Graded

GS02 1731 Medical Physics Seminar (1 Credit)
Prerequisite: None. In the fall term, students present talks on selected topics in general medical physics, therapy, and medical imaging. The objectives are to acquaint students with a wide range of medical physics topics and to develop public speaking skills. In the Spring term, students will learn the fundamentals of Medical Physics leadership, professionalism, and ethics. The objectives are to familiarize the students with several professional and ethical concerns within the field, develop an understanding of how to create a robust Radiation Oncology safety culture and quality assurance program, and provide them with lectures from subject area experts on each topic. Pass/Fail

Biochemistry (GS03)

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GS03 1011 Emerging Fields in Biochemistry and Molecular Biology: RNA Biology (1 Credit)
Prerequisite: None. The goal of this mini-course is to learn cutting-edge RNA biology within a historical context. This course will focus on recent research in RNA biology: differential RNA processing and stability (splicing, polyadenylation, and turnover), the functional significance of various classes of non-coding RNAs (microRNAs, lncRNAs, cRNAs, ceRNAs, eRNAs, etc.), the CRISPR/Cas9 system, and RNA epitranscriptomics (RNA methylation and terminal uridylation). Class lectures and discussions will be predominantly student-led with assistance of topic area experts. Overall, there will be 12 class meetings (two meetings per week) at 1.25 hours each. Letter Graded

GS03 1023 Current Methods in Biochemistry and Cell Biology (3 Credits)
Prerequisites: Foundations of Biomedical Research (GS21 1017) or two semesters of undergraduate biochemistry. The goal of this course is to instruct students in cutting edge methodologies that relate to both structural and molecular biology. The class will consist of 43 1-hour lectures held on Monday, Wednesday, and Friday. Individual lecturers are chosen from multiple GSBS Graduate Programs based on their expertise in the relevant technologies. The lectures will provide a sound foundation in the principles, appropriate applications, and limitations of a repertoire of techniques ranging from qRT-PCR to metabolomic profiling to basic recombinant protein expression and analysis. The course is designed to act synergistically with techniques covered in the Core Course. Letter Graded

GS03 1111 Scientific Writing for Grant Proposals (1 Credit)
Prerequisite: Foundations of Biomedical Research (GS21 1017). The goal of this mini-course will be to learn how to write an effective grant proposal. There will be formal lectures on the components of an NIH grant followed by writing workshops. The course will also include a mock study section with peer review of the written proposals. This course fulfills the GSBS writing requirement. Letter Graded

GS03 1711 Seminars in Biochem/Molecular Biology (1 Credit)
Prerequisite: General knowledge of biochemistry. This course will consist of formal seminars given by staff and visiting scientists in the broad disciplines of biochemistry and molecular biology. Pass/Fail

Cellular, Molecular, and Developmental Biology (GS04)

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GS04 1011 Workshop for Experimental Training in Mouse Cancer Biology (1 Credit)
Prerequisite: Prospective students must be on an approved existing mouse animal protocol and have consent of instructor (approval code needed for registration). The laboratory mouse is widely used in cancer biology research. This lecture and laboratory-based workshop is designed to provide students with a basic working knowledge of using and handling laboratory mice in the setting of cancer biology research. Topics covered include basic research regulations and guidelines for rodents, including mice. Mouse husbandry, genetics, colony management as well as basic mouse handling, restraint, injection, surgery, euthanasia, necropsy and tissue biopsy will be covered in both lecture and laboratory settings. At the end of the workshop, students, even those with no prior experience working with laboratory mice, will be able to properly handle and restrain mice, perform injections, become familiar with surgery, euthanasia, post-mortem tissue collection and processing as well as tissue biopsy. While this workshop is intended primarily for students in the Cancer Biology Program, other GSBS students are encouraged to apply as the laboratory mouse is also an important tool in a wide variety of biomedical research settings. Pass/Fail

GS04 1051 Fluorescence and Electron Microscopy: Imaging Cells and Molecules (1 Credit)
Prerequisites: General knowledge of microbiology and biochemistry and consent of instructor. Fluorescence and electron microscopes permit the examination of cellular features at high magnification. This laboratory-based course is designed to provide the theory, fundamental operating principles, specimen preparation techniques of fluorescence microscopy, transmission electron microscopy, and cryo-electron microscopy. At the end of the course, students with no prior experience will be able to prepare specimens, operate the instruments, and collect and interpret data. In addition, students will also learn how to write part of manuscripts. While this course is intended for students in the Microbiology and Infectious Diseases Program, other GSBS students are encouraged to enroll as these advanced microscopic techniques are broadly used. Pass/Fail

GS04 1073 Developmental Biology (3 Credits)
Prerequisite: Permission of instructor. Developmental Biology is one of the fundamental modern biological disciplines. This course provides an in-depth examination of the basic cellular, molecular, and genetic mechanisms by which a fertilized zygote transforms into an organism with fully differentiated and functioning tissues and organs. Topics covered will include cell-to-cell communication, embryo patterning, tissue morphogenesis, cell differentiation, progenitor cells, advantages and disadvantages of classical and genetic model organisms for analyzing development, postembryonic development and regeneration, and the profound implications of developmental biology for medicine. The course is divided into hands-on lab modules, utilizing primary model organisms to examine the basic principles of development biology and will discuss current debates and recent findings that have yet to be simplified for textbook presentation. Letter Graded

GS04 1081 Stem Cells in Biomedicine (1 Credit)
Prerequisite: Permission of instructor. A stem cell is a cell from the embryo, fetus, or any adult organ, that has the ability to reproduce itself for long periods of time, and at a given signal, give rise to many specialized cell types in the body. Apart from embryonic stem cells, adult stem cells maintain this capability throughout the life of an organism. In recent years, scientific advances have suggested that stem cells could be of great potential use in the treatment of a variety of diseases. The objective of this graduate school course is to provide the students with information about stem cell origin, their role in early development, their isolation and therapeutic promises for the future. The course will also offer students a great opportunity to take part in recent and ground breaking advances in stem cell biology. All in all, the material presented is intended to evoke more interest in the field of stem cell biology, both for the student, the layman, as well as for the bench scientist. Ultimately, the long term goal is to encourage future research in finding alternative therapeutic modalities in stem cell-related diseases, such as cancer, Parkinson's, diabetes, atherosclerosis, congenital diseases, and Alzheimer's disease. This course is taught by a group of high profile scientists with a broad expertise in stem cell biology, biochemistry, clinical applications, and ethics. Letter Graded

GS04 1093 The Biology of Cancer Metastasis (3 Credits)
Prerequisite: Consent of instructor. This is a didactic introductory-level course entirely dedicated to the study of the cellular biological processes that underpin cancer metastasis. This course will cover basic, translational, and clinical knowledge, with specific emphases on the metastatic cascade: seed and soil hypothesis, organ-specific metastasis, cell cycle and metastasis, multiple therapies for various metastatic cancers, and will address the process of taking basic research to the clinic ("bench-to-bedside") for major metastatic human cancers. This is a prerequisite course for Cancer Biology Program students in the Cancer Discovery track. Letter Graded

GS04 1103 Principles of Therapeutics (3 Credits)
Prerequisite: Undergraduate-level biochemistry and biology. This course establishes a foundation of therapeutic principles from understanding disease pathophysiology to the whole pipeline of drug discovery and moving a drug from laboratory to regulatory filing and clinical implementation. This course includes didactic lectures from >35 experts including 1/3 basic research faculty, 1/3 clinical faculty and 1/3 pharma/biotech industry veterans. It starts with discussions on disease processes, through therapy development, then to clinical translation. The course is grouped into a series of general topics. The first topic includes disease mechanisms in microbial, viral, fungal, neurodegenerative, and malignant settings in order to better understand the nature of the problems. The second topic focuses on the development of lead molecules and drug design, including x-ray crystallography, molecular modeling, hit identification, lead optimization, and pharmacokinetic/pharmacodynamics studies. The third topic puts emphasis on drug screening methodologies, including high-throughput/content technologies and molecular imaging as well as in vitro and in vivo preclinical model systems. The fourth topic covers different therapeutic modalities and improved drug delivery systems. It also describes the latest development of immunotherapy, cell therapy, gene therapy, and stem cell transplantation. The fifth topic focuses on the identification of novel molecular targeting strategies and efforts toward individualization of therapy with state-of-the-art-omics technologies and biomarker development. The final topic group focuses on translating therapeutic strategies to the clinic, including the phases of preclinical studies, clinical trial design and execution, and regulatory considerations. Letter Graded

GS04 1213 Mechanisms Cancer Therapeutics (3 Credits)
Prerequisite: Basic understanding of biochemistry and cell biology. This course will establish a foundation of the principles of cancer therapy, including pharmacologic rationales, consideration of biological targets, and mechanism-based approaches to combinations. A major emphasis will be placed on agents that damage DNA, and the response of tumor cells to such insults. In depth presentations will consider all classes of chemotherapeutic agents, their metabolism, and mechanisms of action, and the resistance mechanisms of tumor cells. Mechanistic rationales for other therapeutic modalities used for cancer treatment such as radiotherapy, gene therapy, and immunotherapy will also be covered. Students will have the opportunity to learn to identify novel therapeutic targets, and the procedures used to develop new agents for clinical evaluation. Letter Graded

GS04 1235 Basic and Translational Cancer Biology (5 Credits)
Prerequisite: None. This Cancer Biology Core course aims to consolidate essential knowledge of human cancer biology, providing insights into disease development, multifaceted molecular signatures, diagnostics, and therapeutics. It will utilize seminal articles in the field of cancer biology, primary research publications, and incorporate the expertise of GSBS faculty to convey foundational information and the latest advancements in basic, translational, and clinical cancer research. Auditing this is permitted with Course Directors' approval. Letter Graded

GS04 1253 Principles in Genetics and Epigenetics (3 Credits)
Prerequisite: GS21 1017/18: Foundations of Biomedical Research (GSBS Core course) or equivalent. (Please contact one of the course directors to confirm prior equivalents). The Principles in Genetics and Epigenetics (PIGE) class is designed for students who have a major interest in the aspects of experimental and human genetics and epigenetics as they relate to human disease, including Mendelian disorders, complex diseases and cancer. Students are required to have completed the core course (or equivalent). This class will provide in-depth instruction in four areas: 1) Experimental genetics, 2) Human genetics, 3) Epigenetics, 4) Applied bioinformatics. The class will be held two times a week for one and a half hours. Students are expected to actively participate in the course by initiating discussions, asking questions, and providing constructive comments, as well as completing weekly homework assignments based on the material covered in the lectures of the preceding week. Students will be evaluated by attendance, participation, bioinformatics workshop participation and completion of assigned exercises, and overall performance on the assigned homework. As a foundational course, this course is designed to introduce students to the basic principles in genetics and epigenetics and prepare the student to generate novel hypothesis-driven projects as part of their own research in the areas of genetics and epigenetics inside and outside of G&E laboratories. The course emphasizes active learning through a combination of didactic lectures, selected application lectures and a bioinformatics workshop. Auditing this course is permitted with Course Directors' approval. Letter Graded

GS04 1263 Cancer Epidemiology (3 Credits)
Prerequisite: GS21 1017: Foundations of Biomedical Research or Consent of Instructor. This primarily introductory-level course reviews the causes of cancer and the epidemiology of cancer by anatomical site. The course will introduce seminal studies and current issues in cancer epidemiology and will cover basic concepts pertinent to cancer epidemiology research including biology, pathology, statistics, classic and novel risk factors, prevention, and genetics. Selected publications from epidemiologic literature provide an opportunity for student-faculty discussion. This course is cross-listed at UTHealth Houston School of Public Health (PH 2745). Pass/Fail

GS04 1751 Design and Delivery of Advanced Research Seminar (1 Credit)
Prerequisite: None. This course has two major objectives. The first objective is to familiarize students with current research in regulatory biology, with particular emphasis on molecular mechanisms of cell regulation and signaling. The second objective is to teach students how to give outstanding research seminars. Weekly 90-minute meetings involve alternate faculty and student presentations on current problems in regulatory biology. Faculty presentations introduce each topic and provide a broad and critical overview of approaches used to tackle research problems. Student presentations cover recent articles from leading journals on the same topic. Students are instructed in the preparation of slides/overheads, seminar organization and techniques of oral presentation and are given detailed feedback by faculty and fellow students following their presentations. Three to four topics are covered each year and the topics discussed vary annually. Students can, and often do, register for the course multiple times during their graduate careers. Pass/Fail

GS04 1792 Pragmatic Bioinformatics for Bench Scientists (2 Credits)
Prerequiste: None. Bioinformatics is becoming essential in the genomic era. Witnessing both the power and the complexity of bioinformatics, bench scientists, despite providing most of the biological insights, often feel left out as simply data generators, and frustrated when collaborating with data analyzers. This course, taught by bench scientists who have published on specific bioinformatics topics, aims to empower bench scientists with valid statistical and computational methods to be able to explore data and communicate with computational scientists. It is pragmatic because it covers as-needed theoretical background and teaches usable, instead of efficient, programming in the format of a dry-lab protocol that generates publication-quality figures. It consists of 9 modules covering basic coding, principles, RNA, DNA, protein, images, network analysis, and freeware. Letter Graded

GS04 1811 G & E Scientific Writing (1 Credit)
Prerequisites: Permission of instructor and student must be at least in their second year to take this course. This course is designed for second-year students who have already chosen their thesis lab. Students will be taught how to write scientific papers. The goal of this class will be for each student to write a review of the literature of their field of research for submission and publication. This course satisfies the GSBS Scientific Writing requirement. Pass/Fail

GS04 1813 History of Biology and Cancer Science (3 Credits)
Prerequisite: None. This course is designed to have students experience the history of biology and cancer science as it evolved. Seminal papers in the last 100 years will be reviewed in a chronological fashion to have students appreciate seminal discoveries that advanced our fundamental understanding of human biology and the disease called cancer. Through this journey, students will be able to experience how techniques and tools to study biology evolved and how such knowledge was applied to understand and unravel new information about cancer. The course will highlight how such fundamental biology helped translate science and help generate drugs to combat cancer. Pass/Fail

GS04 1821 G&E Scientific Presentations (1 Credit)
Prerequisites: GS21 1017: Foundations of Biomedical Research and student must be at least in their second year to take this course. The G&E Scientific Presentation class is designed for second year students who have chosen their thesis lab and are preparing for their candidacy exam. The students will use their thesis project as a template to develop a 20-minute scientific presentation. All aspects of the presentation will be covered including title and introduction slides, organizing your data into a story, model slides and conclusions and answering questions. In addition to the 20-minute presentation, students will also give two 90-second elevator talks, one to a scientific group and one to a non-scientists group. Students will also present a 10-minute chalk talk based on the research plan that is based on the data from their 20-minute talk. This course is designed to prepare the student for the oral defense portion of their candidacy exam and to prepare the student to present their work in both short and long format platform presentations. Pass/Fail

Immunology (GS06)

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GS06 1013 Fundamental Immunology (3 Credits)
Prerequisites: Undergraduate-level Biology and Biochemistry courses plus a basic knowledge of cellular and molecular biology. The objectives of the course are to cover a broad overview of the principles of immunology by the pioneers in the field. Extensive introductory classes are offered by experts in their respected areas. The content of lectures provides students with basic understanding of different functions of the immune systems, two major types of immune responses, the immune cell types mediating immune response, the immune responses to foreign entities and related basic concepts of immunology to clinical settings. Letter Graded Letter Graded

GS06 1103 Emerging Concepts in Immunology (3 Credits)
Prerequisites: GS06 1013: Fundamental Immunology or Consent of Instructor. The chief objective of this course is to teach students about recent discoveries and techniques used in the field of immunology. Students will critically evaluate and present publications from top-tier journals under the guidance of leading experts in the selected fields. Topic areas include basic, translational, and clinical studies in antigen processing, lymphokines, complement, tumor microenvironment, T and B lymphocytes, vaccines and adjuvants, immunotherapy, CAR T cells, and monoclonal antibodies. The course generally runs for 10 weeks with two meetings per week for 2 hours each session. Auditing this course is permitted with Instructor's consent. Letter Graded

GS06 1132 Application of Tumor Immunology in the Clinical Setting (2 Credits)
Prerequisites: Previous immunology course such as Fundamental Immunology (GS06 1013) or Permission of instructor prior to enrollment.This course builds upon basic immunology to provide a foundation for tumor immunology as it is applied in the clinical setting. Graduate students, postdoctoral fellows, and medical residents/fellows who participate in this course will gain an understanding of immune surveillance, tumor markers, human tumor immune responses, novel cancer immunotherapeutics, and regulatory process and clinical trial design for cancer immunotherapeutics. Letter Graded

GS06 1611 Advanced Topics in Immunology (1 Credit)
Prerequisite: Fundamental Immunology (GS06 1013) and Foundations of Biomedical Research (GS21 1017) or permission of instructor. This course is an analysis of current topics in immunology. Weekly oral presentations of an assigned topic will be made by participating students. Course emphasis is on the development of communication skills and analysis of current research areas. Pass/Fail

Microbiology and Infectious Diseases (GS07)

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GS07 1015 Microbial Genetics and Physiology (5 Credits)
Prerequisites: GS21 1017: Foundations of Biomedical Research or Permission of Instructor. The objective of this course is to provide our second-semester, first-year students with a broad knowledge of prokaryotic and eukaryotic microbial biology. Topics covered include genetics, gene expression, signal transduction, and stress responses, cell biology, pathogenesis, host responses, and antimicrobial therapy. The course is divided into 15 one-week units composed of at least two faculty-led lectures and two roundtable discussions of the primary literature. Letter grades are based on participation (25%), writing exercises focused on the papers discussed in class (50%), and a weekly problem set (25%). Letter Graded

GS07 1092 Topics in Microbiology and Infectious Diseases (2 Credits)
Prerequisites: Previous coursework in molecular microbiology or permission of instructor. This course provides cutting-edge information on selected topics in Microbiology and Infectious Diseases and develops the student's ability to critically review research and develop a research program. The course primarily consists of student presentations and discussion of recent scientific articles. The list of articles for each session will be provided in advance. Students will also be required to develop and write a full NIH-style grant proposal. This course satisfies the GSBS Scientific Writing requirement. Letter Graded

GS07 1731 Seminar in Infectious Diseases (1 Credit)
Prerequisite: Coursework or work experience in microbiology. A small group discussion course examining the biologic and clinical basis of infectious diseases. Students will attend and analyze infectious disease grand rounds presentations, tour a clinical microbiology laboratory, participate in group discussions with infectious disease physicians, and critically analyze clinically-related articles in the general areas of microbial pathogenesis, host-parasite interactions, diagnosis, therapy and prevention. Pass/Fail

GS07 1741 Literature Survey in Microbiology and Infectious Diseases (1 Credit)
Prerequisite: None. This is a required course for all MID Program students except for those in their final thesis/dissertation writing semester. Students will present and critically evaluate recent journal articles. The specific articles will be chosen by the presenter from the literature in the fields of microbiology and infectious diseases. Students will be evaluated on their presentation and participation in discussions. Pass/Fail

GS07 1751 Micro & Moleculr Genetics Seminar Series (1 Credit)
Prerequisite: None. This is a required course for all MID Program students except for those in their final thesis/dissertation writing semester. Attendance of at least 75% of the seminars is required for a passing grade. Students will attend the weekly departmental seminars series in the Department of Microbiology and Molecular Genetics. Pass/Fail

Human Genetics (GS11)

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GS11 1011 Embryology (1 Credit)
Prerequisite: 1st year Genetic Counseling students. This course provides an introduction to normal human embryologic development of the major body systems. The presented topics will create a foundation on which students can receive information on abnormal development relevant to genetic disease. In addition, students are expected to consider how these concepts can be communicated to a patient in a clear, concise manner. This course is coordinated by two board certified genetic counselors with lectures from the McGovern Medical School faculty. Letter Graded

GS11 1012 Cancer Genetic Counseling (2 Credits)
Prerequisite: None. This course is taught by the faculty and staff of UT MD Anderson Cancer Center and includes lectures by experts in basic science cancer research, clinical oncology, pathology and cancer genetic counseling. Some of the topics covered include overview of cancer biology and clinical oncology, hereditary colon cancer syndromes, hereditary breast cancer syndromes, rare cancer syndromes, management of high risk patients, collecting a cancer-focused family history, hereditary cancer risk assessment models and tools, and psycho social aspects of cancer risk assessment and counseling. Students will expand and refine the knowledge and skills learned in this course during their clinical cancer genetics rotation. Letter Graded

GS11 1013 Genetics & Human Disease (3 Credits)
Prerequisites: Consent of Instructor; General knowledge in genetics and statistics is recommended. This course introduces principles and methods of human genetic analysis with special reference to the contribution of genes to our burden of disease. Although molecular, biochemical and morphogenic processes controlled by genes will be briefly surveyed, the aim is to describe the analytical processes whereby genetic mechanisms are inferred and genes located on chromosomes. Letter Graded

GS11 1021 Psychosocial Practicum (1 Credit)
Enrollment required of all Genetic Counseling MS students. Open only to Genetic Counseling MS students. This is a two-year course focusing on psychosocial issues in genetic counseling comprised of various units focusing on psychosocial issues in genetic counseling. Topics surrounding cultural competency are also included. Students will have the opportunity to participate in various in-class activities, discussions and role-plays. Role-plays allow students to consider different counseling techniques, to learn how personal biases may affect the counseling session, and to practice how to employ empathy, advanced empathy, confrontation, active listening, reflecting, etc. This course is coordinated by two board certified prenatal genetic counselors and is facilitated by the Genetic Counseling Program faculty. Letter Graded

GS11 1031 Contemporary Issues in Genetic Counsel (1 Credit)
Prerequisites: GS11 1182: Psychosocial Issues in Genetics and II; GS21 1181: Biomedical Ethics for the Genetic Counselor. This course provides a platform for exploration of the complex ethical and moral issues that arise in genetic counseling. The format varies weekly and includes presenting and discussing advanced psychosocial topics, debating ethical case scenarios, and participating in seminars for continued professional development. Genetic counseling students in their second year are eligible for this course. Letter Graded

GS11 1082 Psychosocial Issues in Genetic Counseling I (2 Credits)
Prerequisite: None. Psychosocial aspects of genetic counseling combine didactic lectures and role-play to teach psychosocial issues associated with genetic disease. Topics include: basic counseling skills, interviewing skills, giving a family a diagnosis, breaking difficult news, disabilities, multicultural issues, and counseling for chronic disease. This course is taught by the program directors. Letter Graded

GS11 1092 Genetic Epidemiology of Chronic Disease (2 Credits)
Prerequisite: None. This course will expose students to the evidence and logic involved in inferring the contribution of genetic mechanisms to those diseases of public health importance. Emphasis will be on developing a framework for assessing the impact of genes on common disease, but will not include detailed methodological developments or statistical techniques. The format will be a weekly two-hour session in which a single disease will be examined. In this way students will be exposed to a broad spectrum of diseases and see both the uniqueness and the similarities of the problems inherent to each. Letter Graded

GS11 1103 Evolution of DNA and Protein Sequence (3 Credits)
Prerequisites: Calculus, Statistics, and Consent of Instructor. This course will provide basic principles for understanding factors that govern the evolution of DNA and protein sequences. Students will be provided with the opportunity to learn about the formation and evolution of multigene families and other evolutionary phenomena. They will also be introduced to statistical methods and computer programs for analyzing DNA and protein sequence data. There will be computer demonstrations of some topics. The application of these principles and methods to genome-wide epidemiology will be discussed. Letter Graded

GS11 1113 Introduction to Statistical Genetics and Bioinformatics (3 Credits)
Prerequisite: Permission of instructor. This course is designed as an introduction to statistical genetics/computational biology, and serves as the entry point to several courses in this area. It reviews the key statistical concepts and methods relevant to statistical genetics, discusses various topics that have significant statistical component in genetics, particularly in population and quantitative genetics. Topics include estimation of gene frequencies, segregation analysis, test of genetic linkage, genetics of quantitative characters, inheritance of complex characters, forensic science and paternity testing, phylogeny and data mining. This course is cross-listed at School of Public Health (PH 1986L). The venue will be at School of Public Health. Letter Graded

GS11 1123 Population Genetics (3 Credits)
Prerequisite: Permission of instructor. This course will discuss the principles of population genetics and their applications to human populations as well as statistical methods for analyzing genetic samples of individuals from one or more populations. Topics to be covered include random mating, linkage, inbreeding, natural selection, maintenance of polymorphic and deleterious genes, molecular evolution, quantitative genetics and a modern population genetics approach known as coalescent theory, the cornerstone for analyzing DNA sequence samples from populations. Topics may vary from year to year with the background of the students. Studies at the molecular level will be emphasized. This course is cross-listed at School of Public Health (PH 1984L). The venue will be at School of Public Health. Letter Graded

GS11 1132 Intro to Genetic Counseling (2 Credits)
Prerequisite: Permission of instructor; course is intended for students admitted to the specialized Master of Science program in Genetic Counseling. In this course, students learn the foundation of the genetic counseling profession, including the history of the profession, intake and pedigree skills, ethnic carrier screening, and basic prenatal, pediatric, and cancer genetic counseling concepts. Material is delivered in small group presentation and discussion format, as well as via lecture and practice-based role-play. Multiple genetic counseling faculty contribute to this course. Students in the first semester of the genetic counseling program are eligible for this course. Letter Graded

GS11 1142 Approaches to Genetic Counseling Rsch I (2 Credits)
Prerequisite: Introduction to Genetic Counseling (GS11 1132). This course provides an introduction to basic concepts in epidemiology, statistics and research instruction on how to use STATA to perform univariable statistical analysis. Students will also receive instruction on concepts in human research and rationale for IRB reviews. Group discussions during this course will help students polish their research questions and methodology. Genetic counseling students in their first year of study are eligible for this course. Letter Graded

GS11 1152 Approaches to Genetic Counseling Rsch II (2 Credits)
Prerequisite: Approaches to Genetic Counseling Research I (GS11 1142). This course provides an introduction to advanced concepts in epidemiology and statistics and instruction on how to use STATA to perform advanced multivariable statistical analysis. Genetic counseling students in their second year of study who have passed Approaches to Genetic Counseling Research I (GS11 1142) are eligible for this course. Letter Graded

GS11 1172 Prenatal Genetic Counseling (2 Credits)
Open only to Genetic Counseling MS students. This course provides an in depth review of current topics in prenatal genetic counseling, including screening and diagnostic testing, ultrasound findings, and teratogens. Students are expected to gain an appreciation for more complex prenatal issues that impact prenatal practice and to work on critical thinking skills. This course is coordinated by two board certified prenatal genetic counselors with lectures by the Genetic Counseling Program faculty. Letter Graded

GS11 1173 Introductory Clinical Rotation in Genetic Counseling (3 Credits)
Prerequisite: Introduction to Genetic Counseling (GS11 1132). This course provides genetic counseling students with the opportunity to become familiar with each clinical setting, including clinical operations, patient population, and other members of the health care team. Students learn how to obtain general and specialty-focused family, pregnancy, and medical histories. They also provide the evaluation and assessment of cases including medical record and literature review. Differential diagnoses are discussed and students observe counseling sessions as well as some diagnostic and medical procedures. As the semester progresses, students begin assuming some of the roles of the genetic counselor during the session, focusing on accurate risk assessment and patient education, and progressing to conducting an entire session. Genetic counseling students in their first year are eligible for this course. Pass/Fail

GS11 1174 Advanced Clinical Rotation in Genetic Counseling (4 Credits)
Prerequisite: GS11 1173: Introductory Clinical Rotation - Genetic Counseling. This course provides genetic counseling students with the opportunity to provide the majority of the genetic counseling during sessions, focusing on refining their clinical counseling skills and further developing their psychosocial counseling skills. Students are encouraged to tackle even the most complex cases coupled with appropriate supervisor support. At the conclusion of the advanced rotations, students will be expected to be fully trained genetic counselors. Genetic counseling students in their second year are eligible for this course. Pass/Fail

GS11 1182 Psychosocial Issues in Genetic Counseling II (2 Credits)
Prerequisite: GS11 1082: Psychosocial Issues in Genetic Counseling I. This course builds upon the baseline psychosocial issues in genetic counseling taught in the fall semester and is comprised of various units focusing on psychosocial issues in genetic counseling such as cultural competency, mental illness, grief and end of life are included. Students will have the opportunity to participate in various in-class activities, discussions and role-plays. This course is coordinated by the program directors and is facilitated by the Genetic Counseling Program faculty. Enrollment required of all Genetic Counseling M.S. students. Open only to Genetic Counseling M.S. students. Letter Graded

GS11 1622 Topics in Medical Genetics I (2 Credits)
Prerequisite: None, however, Genetics and Human Disease (GS11 1013) may be taken concurrently. The first-semester course focuses on the fundamentals of Medical Genetics. It combines didactic lectures and discussions. The human genetics faculty teach this "state of the art" course. Letter Graded

GS11 1642 Topics in Medical Genetics II (2 Credits)
Prerequisites: GS11 1622: Topics in Medical Genetics I and Consent of Instructor. The second-semester course focuses on individual topics related to the practice of Medical Genetics. Topics include: biochemical conditions, molecular genetics and cytogenetics, evaluation of organ systems with emphasis on genetic pathogenesis of malformations and dysmorphology. This course is a combination of didactic lectures and discussions. The lecturers are experts in their respective fields. Letter Graded

GS11 1711 Sem in Genetics & Population Biology (1 Credit)
Prerequisite: Second year graduate standing or higher. Presentation and analysis of individual topics of research. This class is a series of seminars on a variety of topics in genetics presented by faculty from the School of Public Health and other institutions in the Texas Medical Center, as well as a number of visiting speakers. Pass/Fail

Physiology and Pathology (GS12)

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GS12 1011 BCB Seminar Series (1 Credit)
Prerequisite: None. This class is a forum in which students, postdoctoral fellows and occasionally faculty present their ongoing research to facilitate discussion, learning and scientific interactions. Areas of research that are discussed include both fundamental and translational cell biology and biochemistry, touching on topics in cancer, muscle and kidney physiology, neuroscience, protein structure/function, as well as cardiovascular and circadian physiology. All students will be expected to attend lectures and participate in discussions. Post-candidacy students will be expected to present a 45-minute seminar describing their thesis research. Auditing this course is permitted with course directors' consent. Pass/Fail

GS12 1164 Human Pathobiology (4 Credits)
Prerequisite: None. This course is designed to provide a comprehensive introduction to human health and disease at the molecular, cellular, tissue and system levels for each human organ system. Lectures will highlight the key elements routinely covered in medical school: histology, anatomy, physiology and pathophysiology courses with an emphasis on the understanding of the mechanisms of cell injury and death, inflammation and repair, immunopathology, vascular disturbances and carcinogenesis. The course will include two two-hour lectures each week, review of slides will be included in each lecture. Students will have opportunities to examine histological and pathological specimens (using scanned slides), be introduced to human anatomy and physiology and spend time integrating knowledge into clinical scenarios. This is a required course for all students in the Clinical and Translational Oncology Track of the Cancer Biology Program. Letter Graded

GS12 1262 Cellular Basis Cardiac Function (2 Credits)
Prerequisite: None. This course will provide a comprehensive review of mechanisms of energy transfer in a highly specialized organ. Letter Graded

GS12 1442 Principles of Experimental Mouse Pathology (2 Credits)
Prerequisite: None. This course conveys the fundamental knowledge needed to perform valid and interpretable research using mouse models. This course will feature lectures covering basic concepts of mouse biology, developmental biology, and genetics (including basics of genetically engineered mice, inbred backgrounds and nomenclature); animal study design; mouse models of cancer; toxicology; ante mortem and post mortem pathological characterizations (including background strain lesions). The course will feature a diverse group of instructors with a strong background on the subjects presented. Letter Graded

Pharmacology and Toxicology (GS13)

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GS13 1011 Computer Aided Drug Design (1 Credit)
Prerequisites: None, but a basic knowledge of chemistry (2D chemical structures, amino acids, etc.) is recommended. This course gives introductory knowledge of computer-aided drug design, including both cheminformatics and bioinformatics. All drug discovery stages will be discussed with emphasis on the application of computational approaches in the pipeline, consisting target identification and validation, hit and lead discovery and optimization, and ADME/Toxicity studies. The objectives of this course are to introduce the participants to different computational methods for drug discovery and development. After finishing this course, the students are expected to be familiar with modern cheminformatics and bioinformatics approaches, including QSAR, pharmacophore modeling, molecular docking, virtual screening, ADME/Toxicity predictions, sequence alignment, homology modeling, and protein structure prediction. Letter Graded

GS13 1024 Molecular Basis of Cell Signaling (4 Credits)
Prerequisite: Background in biochemistry and cell biology; Permission of the instructor. This course provides a detailed exploration of the molecular basis of cell signaling with emphasis on recent developments, structure-function, and quantitation. The course will include both the regulation of second messenger systems (GPCRs, G proteins, cAMP, IP3 and lipid), ion channels, growth factor-regulated tyrosine kinases, small G proteins (ras, GEFs, Gaps), kinase/phosphatase pathways, steroid hormones/ transcription, and the modeling of these systems. Letter Graded

GS13 1111 Case Studies in Drug Development (1 Credit)
Prerequisite: None. This course will be an intensive 2-week Foundations of Cancer Therapeutics (FCT) Crash Course that surveys key elements in the process of discovering, developing and commercializing cancer therapeutics. A major component of the crash course is the Merck drug discovery material for TIPS T32 trainee course plus live lectures from drug discovery experts. It will introduce students to the basic principles of drug discovery and development, including how such research is conceived, conducted, evaluated, explained to patients, and applied to patient care. Students will then apply these principles to analyze and discuss specific and current drug discovery and development projects at both UT Health and pharmaceutical companies. These cases will each have associated questions to be explored so students may learn to identify optimal patient targets for new drugs while ensuring the safety of their subjects. Each discussion will include issues of science, ethics, conflict of interest, and intellectual property. Pass/Fail

Neurosciences (GS14)

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GS14 1021 Current Topics in Neurobiology of Disease (1 Credit)
Prerequisite: None. This course is an integrated approach to neurological diseases, which includes background information as well as the diagnosis, treatment, and biological mechanisms of the diseases under study. This course will provide students with a broad understanding and appreciation for invasive (e.g., electrocorticography (ECoG), stereo-electroencephalography (sEEG), local field potential (LFP), deep brain stimulation (DBS) and non-invasive (surface EEG, transcranial magnetic stimulation, transcranial current stimulation) recording and stimulation modalities as they relate to brain mapping, neurological/psychiatric diseases and disorders (e.g., stroke, epilepsy, depression, PTSD) as well as the augmentation and/or restoration of certain functions. Importantly, a discussion of ethical implications as well as the future of these emerging technologies will be threaded throughout and specifically addressed. Lectures will be given by leading experts in the field from UTHealth Houston, Rice University, and Baylor College of Medicine. This course is open to graduate students, medical students, residents, and postdoctoral fellows. Pass/Fail

GS14 1024 Systems Neuroscience (4 Credits)
Prerequisite: Consent of Instructor. This course cover the key concepts in systems neuroscience that allow students to understand how individual neurons and circuits process information and modulate behavior. The central idea behind this course is to illuminate the connection between physiology and function. In order to do this, we will concentrate on several key brain systems, and for each of these systems, we will interrogate how the structure and physiology of distinct brain circuits account for their function. The aim is to understand fundamental principles, not to survey the entire brain. We chose several different systems that are qualitatively different to illustrate the basic principles of systems neuroscience. The course will provide students with fundamental knowledge about the function, connectivity, and plasticity of neuronal circuits. We will do this by exploring how selected brain systems form perceptions of the external world, execute movements, make decisions, represent space, and form memories. In addition, we will examine how stress, fear, and reward are encoded and regulated, how the brain controls internal metabolic needs such as food intake, energy expenditure, temperature regulation and sleep, and how pain sensation is initiated peripherally and perceived centrally. We will emphasize unifying principles, including how the brain processes information, how different cell types contribute to the function of circuits, and how the brain is modified during learning and experience. An integral part of the course is a neuroanatomy lab that will relate the functional view presented during the lectures with the anatomical structures in which these functions are implemented. The course will also include article presentations in which each student has the opportunity to present a scientific paper related to the course material, discuss the findings, and ask questions. Letter Graded

GS14 1051 Sem in The Neurobiol of Lrng & Memry (1 Credit)
Prerequisite: None. This course has two major objectives. The first is to familiarize students with current research in learning and memory with particular emphasis on the cellular and molecular mechanisms. The second goal is to teach students how to give outstanding research seminars. Weekly 90-minute meetings involve alternate faculty and student presentations on current problems in the neurobiology of learning and memory. Faculty and student presentations cover recent articles from leading journals on the same topic. Students are instructed in the preparation of PowerPoint presentations, seminar organization, and techniques of oral presentation and are given feedback by faculty and fellow student following their presentations. Students can register for this course multiple times during their graduate career. Pass/Fail

GS14 1071 Translational Neuroscience (1 Credit)
Prerequisite: None. This course is a multidisciplinary course that focuses on understanding neurological diseases from both basic and clinical approaches. We will examine several brain disorders including neurodegenerative diseases and psychiatric-behavioral disorders. During each session, a basic and a clinical expert in one of the selected disorders will partner to introduce the general concepts of the neuropathology, clinical signs, diagnosis, therapeutic strategies, and current research directions of the specific disorder. The main goal of the course is to understand the important interdisciplinary role of basic and clinical research. These research efforts have a common mission: To improve the quality of life of patients suffering from these disorders. Highlighting the interconnection between basic and clinical research will help provide dual feedback to translate the results from bench to bedside. In most of the cases, a PhD faculty will partner with an MD faculty to explain both sides of the most current research. Only by combining knowledge will we be able to advance our efforts in the prevention, diagnosis and treatment of these neurological disorders. Auditing this course is permitted with course director's consent. Pass/Fail

GS14 1131 Neurobiology of Mental Health Disorders (1 Credit)
Prerequisite: None. This course will cover the current understanding of the biological basis of mental health disorders, including schizophrenia, bipolar disorder, depression, post-traumatic stress disorder, and substance use disorders. The course will include discussions on challenges that are unique to mental health disorders, and how knowledge of biological underpinnings can be translated to clinical treatments. The presentations will be led by researchers with expertise in the specific disorder and will focus on recent publications on the topic, to facilitate an interactive discussion with students. Upon successful completion of this course, students will understand the current knowledge of the biological basis of psychiatric disorders, including underlying molecular, cellular, and systems mechanisms. Students will appreciate how challenges unique to mental health disorders are being approached, what challenges remain, and future directions. Auditing this course is permitted with course instructor's consent. Pass/Fail

GS14 1141 Neuroimmunology (1 Credit)
Prerequisite: None. This course combines knowledge from the fields of Neuroscience and Immunology. The course covers not only the studies of the nervous system/immune system, but also the immune responses to certain neurological diseases, including Alzheimer's Disease, Multiple Sclerosis, Ischemic/Hemorrhagic Stroke, BBB disorders, etc. Specific immune cells will be discussed including the activation pathways of neutrophils, microglia, T/B cells upon pathogenic stimuli to the nervous system. The objectives of the course are to help students better understand the interactions of the nervous system and the immune system. Specifically, upon successful completion of this course, students will be able to better understand the roles of various immune cell types in the pathology of neuroinflammatory diseases, the molecular pathways that regulate the activation of immune cells and mobilization of inflammatory mediators. Auditing this course is permitted by course directors' consent. Pass/Fail

GS14 1151 Cancer Neuroscience (1 Credit)
Prerequisite: None. This is the first program to integrate neuroscience and cancer biology to spur a wave of innovation in cancer research and treatments. By building on nearly a decade of collaborative research and discussions among our faculty, this course aims to explore the interface between cancer biology and neuroscience and the impact of the nervous system on tumor development, tumor progression, and patient outcomes. Classes will cover several emerging areas, including the neural regulation of cancer initiation and growth, neuro-immune interactions, neural plasticity in the tumor microenvironment, translating research from bench to bedside, and quality of life issues. The course will bring together leading experts from across the fields of neuroscience, cancer biology, and immunology, as well as oncologists, surgeons, neurologists, integrative medicine and palliative care specialists, patients, and patient advocates to facilitate discussion of exciting new concepts and developments in this emerging field. The course will feature classes devoted to fundamental and translational research as well as workshops and panel discussions that include the following topics: neural regulation of cancer, glial cell regulation of cancer, cancer neuro-immunology, CNS and PNS malignancies, neurological sequelae of cancer therapies, quality of life, neural health, and rehabilitation. Auditing this course is permitted with course directors' consent. Pass/Fail

GS14 1173 Cognitive Neuroscience (3 Credits)
Prerequisite: Permission of the instructor. This course is an introductory graduate-level overview of cognitive neuroscience. The course will cover basics in history, neuroanatomy, methods of cognitive neuroscience, sensation and perception, control of action, learning and memory, emotion, language, attention, drugs and cognition, impulsivity, cognitive control, social cognition, and neurobiology of disease. The intent is to provide students with fundamental knowledge of how the brain relates to cognitive functions and how this may help in understanding and treatment of human diseases that affect the central nervous system. Letter Graded

GS14 1183 Biology of Neurological Diseases (3 Credits)
Prerequisite: None. This course will focus on the etiologies underlying major neural diseases. Led by GSBS faculty with related expertise, the course will review representative neural diseases and discuss seminal research papers in the respective fields, with emphasis on the current understanding of these diseases at molecular, cellular, and system levels. By completing this course, students should grasp the knowledge of fundamental biology of major neural diseases, appreciate the common and distinctive mechanisms underlying these diseases, learn the existing hypotheses and experimental paradigms as well as outstanding questions and main challenges in the field, and hone the ability to develop novel strategies for scientific and translational discoveries for this unique group of diseases. Auditing this course is permitted with course director's consent. Letter Graded

GS14 1213 Visual Neuroscience (3 Credits)
Prerequisites: GS14 1214: Molecular and Cellular Neuroscience and Consent of Instructor. This is an advanced elective course aimed at students in the neurosciences. The course will introduce the students to the core concepts of the anatomy, physiology and function of the visual system, with an emphasis on retinal circuitry. The retina is arguably the most valuable model to study the CNS. Its accessibility and organization makes it a convenient research tool with which to link anatomy and functionality, and study processes and diseases similar to those in the brain and spinal cord. The course will guide students to understand how image-forming and non-image forming functions of the retina are accomplished. Normal and dysregulated molecular events underlying developmental and physiological control of retinal function will also be covered. The course will alternate lectures and student presentations of significant articles in the field. Active involvement of the students in class is expected. Letter Graded

GS14 1214 Molecular and Cellular Neuroscience (4 Credits)
Prerequisite: None. This course is a graduate-level treatment of molecular and cellular neuroscience. It is designed for first-year graduate students and will introduce basic concepts of molecular, electrical and chemical signaling in individual neurons, synapses, and local neuronal circuits. Topics covered include the functional properties of membranes, receptors, and channels, intracellular signaling cascades, synaptic transmission, short- and long-term forms of synaptic plasticity, and information processing in neuronal dendrites and local circuits. Letter Graded

GS14 1223 Neurocircuits and Behavior (3 Credits)
Prerequisites: Molecular and Cellular Neuroscience (GS14 1214), Systems Neuroscience (GS14 1014) and consent of instructor. This is an advanced course aimed at students interested in the general field of Systems Neuroscience. The course will introduce new technological advances, as well as their application to examine the functional role of specific neural circuits in vivo. This course will employ a combination of introductory lectures and extensive in-class discussions of primary literature. In addition, students will be introduced to the manuscript peer review process by selecting manuscripts from a preprint server and identifying their conceptual and technical strengths and weaknesses. Letter Graded

GS14 1611 Current Topics in Neuroscience (1 Credit)
Prerequisite: None. This course will give an overview of the wide range of research being carried out in the GSBS Neuroscience Graduate Program, and is open to all first year graduate students. Through presentations and discussions with a different NSGP faculty member each week, students will gain an appreciation for some of the big ideas and unsolved questions in Neuroscience research, and become familiar with the experimental and theoretical approaches being used to tackle those questions. Anyone with a strong interest in Neuroscience research is encouraged to take this class. There are no exams or reading assignments, but students are expected to attend all presentations and to actively participate in class discussions. Pass/Fail

GS14 1612 Biostatistics for Life Scientists (2 Credits)
Prerequisite: Permission of instructor. This is an entry-to-intermediate-level course aimed at scientists in the life sciences. During the first half of the semester, the course will introduce students to the basic concepts and statistical tests that are routinely encountered in analyzing scientific data in designed experiments, as opposed to the analysis of clinical or epidemiological type data. Following an introduction to probability, students will learn what statistical tests are appropriate and how to run them. Emphasis is on intelligent usage rather than mathematical formality. Standard tests such as t, z, chi squared, ANOVA and regression analyses will be learned, as well as how power analyses and calculating sample size is performed. During the second half of the semester, advanced topics in life sciences, including Poisson distributions, clustering methods and multidimensional analyses will be included. Another goal of this course will be to build familiarity with the basic R toolkit for statistical analysis and graphics. Letter Graded

Other Course Offerings (GS21)

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GS21 1014 Design and Management of Clinical Trials (4 Credits)
Prerequisite: Consent of instructor. This course will include 21 hours of lecture. The lectures will teach the basic research concepts and principles that underlie the design and actual day-to-day conduct of clinical trials using examples primarily from cancer trials. Topics include the nature of disease and its impact on research protocol design, appropriate statistics to use, and medical terminology frequently encountered in clinical research; methods to monitor human subjects' response to treatment, monitoring of clinical research laboratories; rules and regulations (including (including the Office of Human Research Protections, the Federal Drug Administration, and the state), and ethical concerns related to clinical trials. Three practicums, 24 hours each, will be available to students. Each student must complete two. The practicums include: (1) Topics in Regulatory and Ethical Concepts in Human Subjects Research within the Office of Protocol/Institutional Review Board (IRB) Office. Students will work in conjunction with the Office of Protocol Research/IRB Office staff at MD Anderson Cancer Center to study the operational processes utilized by this office to allow for application of informed consent process and compliance with regulatory guidelines. Students will be given a primer in the ethical evolution and application of human subjects research. Students will apply these principles and regulations to experiences, helping to ensure their comprehensive understanding by following the scientific and ethical review processes of a research protocol involving human subjects from conception to termination by following a protocol from scientific review to IRB review process. (2) Topics in Compliance and Auditing of Responsible Conduct of Research within the Office of Research Education and Regulatory Management. Students will receive advanced instruction in the principle areas of monitoring and auditing clinical trials to ensure compliance with Responsible Conduct of Research as defined by the US Public Health Service that specifically apply to clinical trials and human research. Students will conduct a project within this office where they will follow an investigational new drug (IND) application. (3) Topics in Data Management in Cancer Clinical Trials within the Phase I Program. Students will be taught methods of collecting and interpreting data in clinical trials, and the requirements and methods to insure data security and patient confidentiality. Students will learn how to supervise/coordinate the actual data collection and monitoring aspects of clinical trials. Students will participate as a member of a clinical trials project team under the direction of the course director and directors/coordinators of ongoing studies at MD Anderson. Pass/Fail

GS21 1017 Foundations of Biomedical Research (7 Credits)
Prerequisite: Consent of Instructor. This course is for first-year GSBS students only (others by permission of instructor). It provides incoming graduate students with a broad overview of modern biomedical sciences, spanning historical perspectives to cutting-edge approaches. The course combines traditional didactic lectures and interactive critical thinking and problem-solving exercises to provide students with a strong background in fundamental graduate-level topics including genetics, molecular and cellular biology, biochemistry, physiology, developmental biology, and biostatistics. This is the GSBS Core Course which fulfills the GSBS breadth requirement. Letter Graded

GS21 1018 Foundations of Biomedical Research for Quantitative Students (7 Credits)
Prerequisite: Consent of Instructor. Enrollment in this course is limited to GSBS first-year and second-year students who will pursue the quantitative degree track. This course will provide incoming graduate students with a broad overview of modern biomedical sciences, spanning historical perspectives to cutting edge approaches. The course combines traditional didactic lectures and interactive critical thinking and problem solving exercises to provide students with a strong background in fundamental graduate-level topics including genetics, molecular and cellular biology, biochemistry, physiology, developmental biology and biostatistics. This is the GSBS Core Course which will be graded pass/fail and together with Introduction to Biostatistics and Bioinformatics (GS01 1033) fulfills the GSBS breadth requirement for quantitative-track students. Pass/Fail

GS21 1051 Ethical Dimensions Biomedical Sciences (1 Credit)
Prerequisite: None. This course is a systematic overview of the ethical concepts and traditions that are the foundation of biomedical science. The aim of the course is to provide students of the biomedical sciences with a framework to recognize, examine, and resolve ethical issues that may arise in their professional lives. These concepts will be examined through facilitated small group discussions of cases and exercises that involve ethical issues in the responsible conduct of biomedical research. Students will prepare to participate in these small group discussions by completing required reading assignments. Pass/Fail

GS21 1111 Statistical Genetics Journal Club (1 Credit)
Prerequisite: Recommended concurrent graduate course in statistics and genetics. The aim of the journal club is to facilitate students' awareness of the field of statistical genetics. Topics include the following: methods for mapping genes, analyzing genome-wide association studies, the design and analysis of sequencing studies, gene-gene and gene-environment interactions, and statistical methods for emerging and high throughput data types. Particular emphasis is given to presentation skills, critical reading of articles, and asking questions. A strong interest in gaining practical experience in statistical and computational genetics is more important than specific background, although some graduate study in statistics or genetics will be helpful. Pass/Fail

GS21 1112 Bio-behavioral Research Methods in Cancer Prevention and Addiction (2 Credits)
Prerequisite: None. Bio-behavioral research methods in cancer prevention and addiction addresses the growing demand for multi-disciplinary research in disease prevention. Going beyond traditional behavioral research, the bio-behavioral approach investigates the biological mechanisms underlying risk-related behaviors such as tobacco use, unhealthy diet, sedentary lifestyle, chronic stress, and social isolation and aims at understanding their role in determining cancer risk. The primary objective of this survey course will be to provide students with a greater understanding of the basic mechanisms involved in the complex interplay of genetic, neurobiological, psychological, and environmental factors in the initiation of smoking, dietary practices, exercise habits, and other healthful behaviors as well as the methodological approaches used in cancer prevention research. Other objectives include developing students' appreciation of how different disciplines can contribute to cancer prevention as well as their awareness of the promise and potential pitfalls of multidisciplinary approaches. Topics include: (1) risk modeling; (2) bio-behavioral basis of nicotine dependence; (3) neurophysiological mechanisms of addiction; (4) psychophysiological response to exercise; (5) genetics of risk-taking behaviors; (6) psychological influences on immune function, subsequent cancer risk, and risk reduction techniques; (7) genetic determinants of behavior; and (8) psychophysiological, cognitive, and motivational mechanisms underlying persuasion in response to cancer prevention messages. Emerging areas of future research will be identified and discussed. Pass/Fail

GS21 1142 Writing Scientific Research Articles for Publication (2 Credits)
Prerequisite: Permission of instructor. This course presents the fundamentals of writing scientific research articles for publication and includes the basic structure of the research article, writing strategies, and ethical issues. Participants will improve scientific hypothesis-driven writing skills through discussion, readings, and numerous graded writings assignments; and they will go through the writing process, including revisions, of producing a draft of a scientific article. Pass/Fail

GS21 1152 Scientific Writing (2 Credits)
Prerequisite: 2nd year/pre-candidacy students. The objectives of the course are to teach critical thinking and the fundamentals of proposal writing that will help students write candidacy exam proposals, grants, papers, meeting abstracts, and theses/dissertations. Students will develop a research plan and write a 6-page grant proposal. Students will also learn to edit and critique their fellow students' proposals, which will help prepare the students for writing and editing their candidacy exam. Weekly meetings will consist of lectures from faculty/experts addressing how to compose grant proposal sections. In addition, students will meet weekly with faculty in small groups to critique/discuss research assignments during which students will be given feedback on their proposal content/style by faculty and fellow students. This course fulfills the GSBS Scientific Writing requirement and is limited to the first 20 registrants. Pass/Fail

GS21 1171 NIH Fellowship Proposal Development (1 Credit)
Prerequisite: Scientific Writing (GS21 1152), Scientific Writing for Grant Proposals (GS03 1111), Topics in Microbiology and Infectious Diseases (GS07 1092) or an equivalent course. This course is designed for students who intend to submit an NIH fellowship application (F30,or F31) at the end of the course. Participants will learn about the components of a fellowship application, how to develop an effective training plan and the peer review process. By the end of the course, participants will have developed a complete draft of their application. Participants are expected to have completed the GSBS Scientific Writing course, or equivalent, as the Research Strategy and Specific Aims sections will not be covered. Pass/Fail

GS21 1181 Biomedical Ethics for the Genetic Counselor (1 Credit)
Prerequisite: Open only to Genetic Counseling MS students. This course provides a foundation for navigating biomedical ethics topics likely to be encountered during genetic counseling training and practice, including issues relevant to clinical, research and industry based genetic counselors. The course is case based and primarily student led. This course will be coordinated and primarily facilitated by the course directors. Genetic counseling faculty and outside guest speakers will also participate on occasion. Enrollment required of all Genetic Counseling MS students. Pass/Fail

GS21 1191 Effective Career Planning (1 Credit)
Prerequisite: None. This interactive and discussion-based course teaches career planning through a lens of personal and professional leadership. We explore modern leadership concepts and apply them to career planning to best equip course participants with the information, resources, confidence, and self-awareness necessary to find success in career inside and beyond academia. Course activities include self-assessment exercises, career and leadership related discussions, informational interviewing/networking, and other activities to increase students' leadership skills. The course culminates with a "Leadership Development Plan" presentation where each student presents their career vision and their short- and long-term career goals. This course is open to all GSBS students, but highly recommended for post-candidacy PhD students and MS students in their final year of study. Pass/Fail

GS21 1221 Seminar Presentation Skills Training (1 Credit)
Prerequisites: MS students in the Biomedical Sciences program only. Consent of instructor. Students who register for this course are required to attend official seminars and submit a brief report for each of the talks they attend (10 seminars must be attended during the Fall/Spring and 6 seminars must be attended during Summer). Seminars are considered to be official if they are hosted by any biomedical science department at the Texas Medical Center or Rice University and presented by 1) a faculty member from any university/college or 2) a scientist holding a doctoral degree who is applying for an open faculty position. This course will meet on the first Friday of each month (3:00 pm - 4:00 pm) except in January where the meeting will be on the second Friday (3:00 pm - 4:00 pm). There are four meetings in the Fall, five meetings in the Spring and three meetings in the Summer. During each of these meetings, two second- and third-year MS students will present their research work to their peers. Each presentation will be moderated by another second- or third-year MS student. First year MS students are only required to attend and participate in the discussion, but are not required to present nor moderate. After each of these meetings, all MS students are expected to submit a peer feedback form to give an insight of what they thought about the talks. The goal of this course is to (1) expose MS students to a broad range of current research topics in biomedical sciences and related fields, (2) give them a chance to learn how to present their research and results to their peers, (3) give them a place to practice presentations, provide feedback, and exchange ideas among their peer MS students, (4) and strengthen our MS community by creating a space where all MS students can come together to hear a research presentation from senior MS trainees, and be able to network with other students in the program. This is a required course for MS students in the Biomedical Sciences program. Pass/Fail

GS21 1232 Translational Sciences: Bedside to Bench and Back (2 Credits)
Prerequisite: None. This is an integrated, multidisciplinary course designed to provide students the necessary tools to devise, fund, implement, and publish exemplary research involving patients or materials obtained from a human source. Students participating in this course will gain an understanding of the depth, complexity, and limitations of integrating laboratory and clinical research into investigations of human disease. After completion of the course, students will understand the importance of translational research: using laboratory findings to benefit human patients (bench to bedside) and investigating clinical observations in the laboratory (bedside to bench). This course is distinct from Human Protocol Research (GS211132); this course focuses on the interrelationship between laboratory-based and clinical research. A culture that fosters translational research of the highest quality requires laboratory and clinical investigators appreciate the scientific complexity of patient-oriented translational research. Letter Graded

GS21 1301 Clinical Perspectives for a Basic Scientist (1 Credit)
Prerequisite: None. Impacting clinical practice is a major driver for research in the academic setting and even more so in industry. Understanding of clinical questions/needs is key in order to find the right research focus, or to identify a suitable clinical counterpart to perform research that will translate into clinical practice. In this newly created nanocourse, emphasis is on clinical aspects in cancer, and how research in general can accelerate and contribute to answer clinical questions in this field. Therefore, many of our speakers are clinicians or have a strong clinical background, e.g., in pathology, surgery, therapy modalities, or clinical trials. The students will hear firsthand what the urgent clinical questions/challenges are and participants will have the opportunity to discuss these themes with the clinicians. Additionally, we want to highlight clinical aspects in cancer prevention and survivorship to expose students to research opportunities existing in these fields. The nanocourse lectures will close with the testimony of a cancer survivor. At the end of this nanocourse, students will have gained insight into different clinical specialties and their research questions. Auditing this course is permitted with course directors' consent. Pass/Fail

GS21 1341 Nano course in Lymphatics in Health and Disease (1 Credit)
Prerequisite: None. This nanocourse will familiarize students with the "other" circulatory system, the lymphatics. This system works to promote fluid homeostasis, immune cell trafficking, cellular waste cleanup, metastasis, and plays important roles in disease states such as Alzheimer's, lymphedema, and hypertension. The goal is to enable budding and established researchers to suitably incorporate lymphatics into research proposals that will answer questions important to relevant pathologies. Objectives are to be able to recount the basics of lymphatics anatomy and biology, to be able to describe imaging and bench methods for visualizing lymphatics and to recognize pathological conditions for which lymphatic roles should be investigated. Pass/Fail

GS21 1351 Nano course in Cardio-oncology (1 Credit)
Prerequisite: None. Cardio-oncology is a medical subspecialty concerned with the diagnosis and treatment of cardiovascular diseases (CVDs) and organ failure mediated by macro- and micro-circulatory defects in cancer patients. The goal of cardio-oncology is for cancer patients to receive maximum and uninterrupted treatment for cancer while protecting them from cardiovascular complications mediated by the treatment. For this, we must understand both pathophysiology of CVDs and mechanisms of anti-cancer treatments. The course is designed to provide an overview of the cardiovascular system in both normal and pathological states, of various cancer treatments, and the way (and how) cancer treatments affect the cardiovascular system and other organ functions. There will be 15 lectures, each 1 hour long. Students will be evaluated based on their class participation, attendance, and a review paper on subjects suggested by the lecturers. Class size will be 4-20 inclusive of the students who audit the course. There is no required textbook (materials and literature will be electronically provided). Letter Graded

GS21 1361 Introduction to Circadian Biology (1 Credit)
Prerequisite: None. This is a nanocourse aimed at students who would like to familiarize themselves with the concept of circadian timing. The course will introduce the students to the anatomical, biochemical, and molecular bases of circadian clocks, with an emphasis on the mammalian circadian system. The course will bring an understanding of how circadian rhythms are a fundamental property of living begins. Events underlying dysregulated clock function and subsequent impact on health will also be covered. The course will alternate lectures and student presentations of significant articles in the field. Active involvement of the students in class is expected. Letter Graded

GS21 1611 Topics in Molecular Medicine (1 Credit)
Prerequisite: MD/PhD students only; permission of instructor. The seminar will use selected topics in molecular medicine as a vehicle to introduce students to basic ideas of biomedical research, to the skills involved in evaluating the research literature and presenting data, and to the interplay between the research laboratory and the problems of clinical medicine. Students will be expected to conduct literature reviews, make oral presentations of research papers, and participate in the discussions of each topic. The course is offered in the Fall, Spring, and Summer semester, and MD/PhD students are required to register for the course throughout their tenure in the Program except during the third and fourth years of Medical School when schedules for clinical rotations conflict with the weekly seminar. Pass/Fail

GS21 1613 Translational Cancer Research (3 Credits)
Prerequisite: GS04 1063: Cancer Biology (preferred). This course will provide a primer for translational cancer research and will review concisely the current understanding of human cancer biology that is driving interest in targeted therapy and personalized management for prevention, detection and treatment of cancer. Techniques used to characterize human cancers at a cellular and molecular level will be described. Concepts, examples and alternative strategies to achieve individualized targeted therapy will be presented. Processes for developing drugs and biomarkers will be reviewed. Translation from bench to bedside and back will be outlined for surgical oncology, radiation oncology, medical oncology and cancer imaging. Challenges for translation in cancer prevention will be considered. Infrastructure required for translational research will be reviewed, including tissue banks, biopsies, interventional radiology, molecular pathology, molecular imaging, bioinformatics, biostatistics, novel trial design and interactive databases. Objectives and paths for training and career development will be outlined as well as the sociology of team science. Interactions between Academe, Pharma, the NCI, FDA and Foundations will be explored. Finally, the course will analyze barriers to more rapid translation of cancer research to the clinic and community. This course consists of a two hour lecture and one hour seminar, weekly. Letter Graded

GS21 1622 Topics in Cancer Prevention (2 Credits)
Prerequisite: None. Given the projected shortage in 2020 of medical oncologists to care for cancer patients and survivors, the need for cancer prevention and control is urgent. Research and discovery of new and improved strategies for preventing cancer will be discussed, as well as the application of proven cancer prevention strategies in the clinic and community, and the ethical implications surrounding all of these efforts in cancer prevention and control. The objectives of this course are to provide students in the basic, behavioral, and population sciences with a strong foundation in conceptual models used for cancer prevention research and practice, the principal approaches used in promising areas of research, and new challenges and opportunities for future cancer prevention and control activities. The course will be taught by a team of MD Anderson faculty from various basic science, population science, and clinical disciplines. Pass/Fail

GS21 1723 Cancer Research Administration and Management, Pre-Award (3 Credits)
Prerequisite: Permission of instructor; must be enrolled/admitted to the CRAM certificate program. This course is intended for students pursuing a career in Cancer Research Administration and for working professionals with aspirations of working as a research administrator in a research institution specializing in oncology, or the like. This course provides an overview and introduction to the broad field of research administration and management. Elements of the curriculum include understanding the environment and context within which research administration is conducted, fiscal management, regulatory compliance, sponsored program administration, grant proposal and budget development and a specific emphasis on pre-award management. This course is designed to benefit students who are preparing to sit for the National Certified Administrator® Licensing Exam. Letter Graded

GS21 1733 Cancer Research Administration and Management, Post-Award (3 Credits)
Prerequisites: GS21 1723: CRAM, Pre-Award, and Permission of instructor, must be enrolled/admitted to the CRAM certificate program. This course is intended for students pursuing a career in Cancer Research Administration and for working professionals with aspirations of working as a research administrator in a research institution specializing in oncology, or the like. This course provides an overview of the post-award components of effective and compliant research administration. Elements of the curriculum include the principles of post-award research administration, fiscal management, regulatory compliance, and leadership with a specific emphasis on post-award management. This course is designed to benefit students who are preparing to sit for the National Certified Research Administrator® Licensing Exam. Letter Graded

GS21 1743 Cancer Research Administration and Management, Lab/Practicum (3 Credits)
Prerequisite: Permission of Instructor. This course is intended for students pursuing a career in Cancer Research Administration and for working professionals with aspirations of working as a research administrator in a research institution specializing in oncology, or the like. The Lab/Practicum requires independent completion of a project related to research administration with Central Office and mentor involvement. This course is designed to benefit students who are preparing to sit for the National Certified Research Administrator® Licensing exam. Letter Graded

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